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FORUM

INCREASING THE USE OF THE SUN: A POTENTIAL ROLE FOR THE ENERGY UTILITIES*

Dale D. Goble†

I. INTRODUCTION

The OPEC oil embargo and the quadrupling of petroleum prices in 1973 altered the global balance of power and raised questions about the stability of Western industrial economies which traditionally have been dependent upon an abundance of cheap energy. Unfortunately, the significance of this new reality has been largely ignored. After a temporary decline, the rates of energy consumption have increased and now exceed their preembargo levels.¹ Politically, however, the events of 1973 continue to be felt. They are the impetus for the current debate on national energy policy.

If the implications of the new economic and political order have been largely lost on the general public, the current debate has done little to illuminate the basic issues. Energy policy is fraught with intricate and pervasive relationships. The technical language, computer models, and economic projections that characterize the debate obscure as much as they reveal. In addition, there is little agreement among the debaters on even the premises from which to discuss the issues:

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1. In 1973 the total domestic energy consumption from all sources was 74.551 quads (10^{15} Btu). After dropping to 70,557 quads in 1975, consumption has risen steadily. For the first half of 1977, consumption totaled 38.299 quads. However, throughout this period, the percentage of imported oil used in domestic consumption increased from 19.48% to 25.82%. MONTHLY ENERGY REV., Sept. 1977, at 2. Petroleum imports currently comprise about half of the domestic petroleum consumption. COM. AMERICA, Aug. 26, 1977, at 3. The result on the domestic economy, balance of trade, and the value of the dollar has been staggering.

[t]he simplest substantive question, such as whether to build a big power station, can lead to an infinite regress of questions: why a power station? why a big one? why more electricity? why electricity? why more? Nor is there consensus on the subject matter of energy policy. To some, it is simply a set of severable technical and economic issues; to others, a web of sociopolitical and ethical questions that are inseparable from subordinate technical and economic issues. Statements about energy policy that seem self-evident to some analysts—"we need more energy," "one must either grow or decay," "nuclear power is cheap and safe," "nuclear power is expensive and dangerous," "life in a nuclear-armed crowd would be intolerable"—seem vacuous, nonsensical, tendentious, contingent, or false to others. Such basic disagreements cannot be resolved on scientific grounds. No wonder energy policy makes citizens protest, experts despair, politicians duck, and governments fall.²

The result of this disagreement on first principles has been a hazy, unfocused debate. The crucial role of energy insures that any decision on energy policy will have a fundamental impact upon this country's entire social structure, from economics and environment to health and housing. Therefore, the issue is far more than the promotion of one type of energy; it is the choice of a future among inconsistent alternatives.³

This article is only indirectly a contribution to the current energy debate. Instead of evaluating in detail the relative merits of nuclear, coal, and solar energy, the article analyzes one alternative for inducing a more rapid conversion to the use of solar energy. The option examined will have special importance if the United States turns away from its current dependence on fossil and nuclear fuels. Moreover, the issues addressed have a vitality that transcends any particular resolution of the more fundamental policy choices. Even the proponents of nuclear electricity concede that "over the long run, the sun will emerge as an increasingly attractive source" of energy.⁴

2. Lovins, *Cost-Risk-Benefit Assessments in Energy Policy*, 45 GEO. WASH. L. REV. 911, 911-12 (1977) [hereinafter cited as Lovins].

3. A recent review of a previous energy crisis concluded:

The first energy crisis, which has much to do with the crisis we now face, was a crisis of deforestation. The adoption of coal changed the economic history of Britain, then the rest of Europe and finally the world. It led to the Industrial Revolution . . . The substitution of coal for wood between 1550 and 1700 led to new methods of manufacturing, to the expansion of existing industries and the exploitation of untapped natural resources.

Nef, *An Early Energy Crisis and Its Consequences*, SCIENTIFIC AM., Nov. 1977, at 140.

4. Bos, *Solar Realities*, ELECTRIC POWER RESEARCH INST. J., Feb. 1976, at 7-8 [hereinafter

II. OPTIONS FOR ENCOURAGING USE OF SOLAR ENERGY

Choice among methods of encouraging the use of solar energy is inextricably intertwined with the broader issues of national energy policy.⁵ While fossil and nuclear fuel costs will continue to rise until solar energy is economically competitive, inaction until that time is likely to result in substantial social and economic disruption. The effects of the present escalation of fuel prices are already significant and can only increase. Encouraging extensive utilization of solar energy systems now may eliminate the impact of a sudden shift in energy sources.

The transition to the use of nondepletable resources can best be achieved by employing a number of economic and social incentives. To date this issue has been approached through measures designed only to alter the relative costs of solar and traditional energy resources. Two divergent methods of achieving this goal have dominated the discussion. On one hand, a reduction in the real cost of solar energy systems by use of governmental programs such as tax incentives,⁶ low-interest loans,⁷ or other subsidies has been proposed. Alternatively, some commentators have recommended increasing the cost of conven-

cited as Bos]. Cf. Simpson, *The Real Issue With Nuclear Power*, PUB. UTIL. FORT., April 22, 1976, at 21-22 ("[I]n the long term, [new energy resources and conservation] may well be the two most important factors in the energy equation."); DIVISION OF SOLAR ENERGY, ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION, *SOLAR ENERGY IN AMERICA'S FUTURE: A PRELIMINARY ASSESSMENT 73* (DSE-115/1 1977) [hereinafter cited as STANFORD STUDY] ("[E]ven if nuclear power becomes technically successful, economically attractive, and accepted by society . . . solar energy will be needed for supplying a significant fraction of the nation's total energy requirements in the future.")

5. Legal analysts have focused on the legal and institutional barriers that might hinder the use of solar energy. One commentator, for example, has enumerated seven broad areas of potential impediments, including concerns of the utilities of the effect of the use of solar energy upon load factors and profitability, financing procedures, union jurisdictional questions, zoning limitations, and the lack of a right of access to direct sunlight. Robbins, *Law and Solar Energy Systems: Legal Impediments and Inducements to Solar Energy Systems*, 18 SOLAR ENERGY 371, 372-73 (1976). See also Hirshberg & Schoen, *Barriers to Widespread Utilization of Residential Solar Energy: The Prospects for Solar Energy in the U.S. Housing Industries*, 5 POL'Y SCI'S 453 (1974) [hereinafter cited as Hirshberg]. This viewpoint unfortunately tends to obscure the fact that the legal problems frequently are reducible to economic considerations. The difficulty with current legal and institutional structures is not that they are incapable of providing answers to potential problems, but that the answers provided adversely affect the economics of solar energy. See generally Comment, *Solar Rights: Guaranteeing a Place in the Sun*, 57 OR. L. REV. 94 (1977). The problem, therefore, is more accurately viewed as determining the best method for realigning the legal structure to achieve the desired social results.

6. Altering the tax structure to achieve social goals is a traditional method for achieving economic results where direct governmental intervention is considered inappropriate. To date approximately 25 states have enacted some form of tax incentive for solar energy systems. See, e.g., ARIZ. REV. STAT. § 42-1312.01, as amended by Act of June 1, 1978, ch. 112, 1978 Ariz. Legis. Serv. 443 (1978) (ten-year property tax exemption for difference between the cost of the solar energy system and a traditional energy system).

7. Presently only Montana has a program of low-cost loans. MONT. REV. CODES ANN. § 84-7406 (Supp. 1975). A similar proposal was rejected by California voters in the 1976 general election. See 1976 Cal. Legis. Serv. ch. 264 (West).

tional energy supplies by allowing them to rise to their market levels through deregulation⁸ or by pricing them at their replacement costs.⁹

There is, however, a third option. The energy utilities can be encouraged or required to provide an incentive program designed to promote the use of solar energy.¹⁰ While specific incentives vary, the concept is essentially to treat the installation of individual, dispersed solar energy systems as comparable to the expansion of a utility's traditional energy-supply capacity. Rather than constructing new central generating facilities, the utility would encourage its customers to install private solar energy systems. The resulting reduction in the customer's energy requirements would then be available for other uses or users.¹¹

Such an incentive program could assume a number of forms. The simplest incentive, both to develop and to administer, would be a reduced, promotional rate for the auxiliary energy required by the owner of the system. A second alternative would be for the utility to provide a cash incentive for the installation of a suitable system. The least traditional method of promoting the use of solar energy would be a program of utility financing or utility installation of the systems. Under this approach, either the individual homeowner would make the necessary arrangements, with the utility financing the system's cost, or the utility would act as a general contractor and finance the price of the system that it had installed.¹²

8. For the effects of decontrolling petroleum and natural gas prices on the economic competitiveness of solar energy systems; see generally Ben-David, Schulze, Balcomb, Katson, Noll, Roach, & Thayer, *Near Term Prospects for Solar Energy: An Economic Analysis*, 17 NAT. RESOURCES J. 169 (1977) [hereinafter cited as Ben-David].

9. See National Energy Policy (Fact Sheet), 13 WEEKLY COMP. PRES. DOC. 573 (Apr. 20, 1977).

10. This option has attracted only limited comment. See generally E. DAVIS, PROJECT SAGE PHASE I REPORT (1973), reprinted in 1A *Energy Research and Development and Small Business: Hearings Before the Senate Select Comm. On Small Business*, 94th Cong., 1st Sess. 1161 (1976) [hereinafter cited as E. Davis]; S. FELDMAN & B. ANDERSON, THE PUBLIC UTILITY AND SOLAR ENERGY INTERFACE: AN ASSESSMENT OF POLICY OPTIONS (NTIS DSE/2523-2 1976); OFFICE OF SYNFUELS, SOLAR, & GEOTHERMAL ENERGY, FEDERAL ENERGY ADMINISTRATION, ENERGY RATE INITIATIVE 78-82 (NTIS PB-265 607 1977); Freeman, *Utility Alternatives for Solar Energy*, PUB. UTIL. FORT., Jan. 5, 1978, at 20 [hereinafter cited as Freeman]; Koger, *Regulatory Constraints on Solar Energy and Thermal Storage Installations*, PUB. UTIL. FORT., Jan. 19, 1978, at 9 [hereinafter cited as KOGER]; Lovins, *Energy Strategy: The Road Not Taken?*, FOREIGN AFF., Oct. 1976, at 65, 87-88 [hereinafter cited as Lovins, *Energy Strategy*]; Smackey, *Should Utilities Market Solar Energy?*, PUB. UTIL. FORT., Sept. 28, 1978, at 37.

11. For a similar proposal, that gas utilities treat conservation as analogous to new supplies, see Rosenberg, *Conservation Investments by Gas Utilities as a Gas Supply Option*, PUB. UTIL. FORT., Jan. 20, 1977, at 13. See also *Re Michigan Consol. Gas Co.*, 1 P.U.R.4th 229 (Mich. Pub. Serv. Comm'n 1973) (adopting such a plan); OR. REV. STAT. § 757.730, Note (1977) (to expire Jan. 1, 1982) (requiring energy suppliers to provide their customers with weatherization services).

12. Probably the most advantageous method of raising the needed capital, at least from the standpoint of energy conservation, would be to raise the utility's rates to its marginal cost, *i.e.*, the cost for the next unit of energy. See generally notes 33-38 *infra* and accompanying text. This

Each of these potential incentives could be designed to insure that the solar energy systems installed are compatible to the maximum extent with the existing utility supply. For example, the incentives could be scaled to the efficiency or load characteristics of the proposed system.

While there are other potential roles that a utility could adopt to promote solar energy,¹³ this article will focus on these three alternatives. The incentive proposals will be analyzed through an examination of the economic, technological, legal, and social issues that will probably arise. These areas in particular must be considered to insure that the proposal will be acceptable.

III. A METHODOLOGICAL NOTE

The most prevalent method presently employed to evaluate policy alternatives is some variant of cost-benefit, or systems, analysis.¹⁴ In its ideal form, this method requires the analyst to assemble and to quantify all of the benefits, risks, and costs attributable to a particular set of alternatives. The alternative which presents the best balance of costs and benefits is then selected for implementation.

Despite the superficial certainty of this method of analysis, it has a number of troublesome problems both theoretically and practically. These problems are compounded when the method is applied to an

would significantly increase the cost of the traditional energy and the utility's revenues, and produce two beneficial impacts. First, by pricing energy at the margin, consumers would be provided with direct economic signals on its relative value, which should create a strong impetus for increased conservation. Second, a "surplus" would result that would be available to finance the installation of solar energy devices.

Equitable problems arising from the sharp increase in energy costs could be ameliorated by refunding a percentage of the increase on a per household basis. This would provide a further impetus for conservation because consumers who used less than average amounts of energy would experience only minimal rate increases. The complexities inherent in marginal-cost pricing are beyond the scope of this article. See generally E. BERLIN, C. CICCHETTI, & W. GILLEN, *PERSPECTIVES ON POWER* (1974); Huntington, *The Rapid Emergence of Marginal Cost Pricing in the Regulation of Electric Utility Rate Structures*, 55 B.U.L. Rev. 689 (1975).

13. One author has recommended that "the dispersed solar system installed in the customer's residence [be treated] as utility property for ratemaking purposes." Freeman, *supra* note 10, at 22. He argues that "[o]nly a pure rate base approach results in an allocation of capital for new Btu on an equitable basis by allowing solar Btu to compete with conventional Btu at the margin." *Id.*

The use of the marginal-cost pricing/rebate system outlined in note 12 *supra* would also accomplish this result, and the method suggested here would not raise the spectre of the utilities "owning the sun." See Rosapepe, *Utilities Eclipse Sun, POLITICKS & OTHER HUMAN INTERESTS*, Oct. 25, 1977, at 8; *Utilities and Solar Energy: Will They Own the Sun?*, PEOPLE & ENERGY, Oct. 1976, at 2. See generally notes 129-146 *infra* and accompanying text.

14. For general introductory overviews of the method, see E. MISHAN, *COST-BENEFIT ANALYSIS* (1971); Prest & Turvey, *Cost-Benefit Analysis: A Survey*, 75 ECON. J. 683 (1965) [hereinafter cited as Prest].

analysis of such significantly dissimilar alternatives as solar and conventional energy resources.

It is beyond the scope of this article to present a detailed critique of the theory or practice of the cost-benefit method,¹⁵ or to detail the elements that should be considered in developing an analytic method more appropriate for energy policy.¹⁶ Nevertheless, it is important to outline the more significant limitations on the appropriateness of the procedure. These limitations serve to highlight common areas of difficulty in the analysis of energy issues.

The primary operational tool of cost-benefit analysis is the reduction of the various items to a common denominator, generally quantified in monetary terms. As one such analysis argued, "[W]ithout an initial quantification statement, selecting among . . . alternatives with the objective of maximizing net social welfare is impossible."¹⁷ It is this reliance upon quantification that introduces the most significant difficulties.

First, despite the appeal to quantification and the apparent mathematical certainty of the procedure, most policy issues contain an irreducible quantum of nonobjectivity—at least if the decision-maker is concerned with the *quality* of life rather than merely with increasing the *quantity* of some commodity.¹⁸ This inherent element of subjectiv-

15. For general critical reviews, see Green, *The Risk-Benefit Calculus in Safety Determinations*, 43 GEO. WASH. L. REV. 791 (1975) [hereinafter cited as Green]; Lovins, note 2 *supra*; Tribe, *Policy Science: Analysis or Ideology?* 2 PHILOSOPHY PUB. AFF. 66 (1972) [hereinafter cited as Tribe].

16. An analytic method designed to resolve energy policy options must be an amalgam of several elements. First, alternatives should be evaluated in terms of their net energy outputs, considering the energy requirements of such constituent items as fabrication, transportation, and transmission. See, e.g., Hannon, *An Energy Standard of Value*, 410 ANNALS 139 (1973); Huettner, *Net Energy Analysis: An Economic Assessment*, 192 SCI. 101 (1976); cf. Nonnuclear Energy Research & Development Act of 1974, § 5(a)(5), 42 U.S.C. § 5904(a)(5) (1976) (requiring net energy analysis of nonnuclear energy technologies). But an evaluation in terms of net Btu's alone is insufficient and the qualitative aspects of the divergent forms of energy must also be considered. This can be most expeditiously accomplished through a combination of end-use analysis, see, e.g., 7 ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION, CHOOSING AN ELECTRIC ENERGY FUTURE FOR THE PACIFIC NORTHWEST: AN ALTERNATE SCENARIO FINAL DRAFT (1977), and the use of thermodynamic and enthalpic analysis implicit in so-called "second-law" efficiencies. See generally Metz, *Energy Conservation: Better Living Through Thermodynamics*, 188 SCI. 820 (1975); The Study Group on Technical Aspects of Efficient Energy Utilization, *The Efficient Use of Energy*, PHYSICS TODAY, Aug. 1975, at 23. For the most coherent attempt to date to consider the relevant items, see A. Lovins, Scale, Centralization, and Electrification in Energy Systems, reprinted in *Alternative Long-Range Energy Strategies: Joint Hearing Before the Senate Select Comm. on Small Business & Senate Comm. on Interior & Insular Affairs*, 94th Cong., 1st Sess. 218, 230-36 (1976) (discussion draft subject to revision).

17. S. BARRAGER, B. JUDD, & D. NORTH, THE ECONOMIC AND SOCIAL COSTS OF COAL AND NUCLEAR ELECTRIC GENERATION 40 (1976) [hereinafter cited as S. BARRAGER].

18. See Green, *supra* note 15, at 798 n.26; Schlesinger, *Systems Analysis and the Political Process*, 11 J.L. & ECON. 281, 283 n.1 (1968) [hereinafter cited as Schlesinger].

ity is present at each stage of the analysis, from the selection of the item to be maximized¹⁹ to the determination of what information is to be used in the analysis.²⁰ The attempt to quantify all of the variables selected for analysis does not avoid subjectivity, but only cloaks the unavoidable normative judgments with an unwarranted air of objectivity.

Second, this subjectivity is compounded by the method's reliance upon prices as the primary measuring device. A comparison of the current or projected prices of solar and conventional energy resources is largely a meaningless exercise. The prices of conventional energy resources are currently held substantially below world market prices by controls which effectively subsidize the consumption of fossil fuels. The amount of this subsidization is one measure of the amount by which the market undervalues solar energy.

Price controls are only the most apparent difficulty with the use of energy prices. More significant is the fact that neither the present market pricing mechanism nor conventional economic theory has developed an adequate method for valuing exhaustible natural resources.²¹

19. Theoretically at least, the cost-benefit method is goal neutral because, while it is explicitly designed to maximize net social welfare, it cannot provide the needed definition of "social welfare." This neutrality is attributable to the method's economic heritage. "The question of what is the best measure or definition of social welfare, is a political or philosophical, not an economic one. Economics as such is a science of means, not ends." I A. KAHN, *THE ECONOMICS OF REGULATION* 67 (1970) [hereinafter cited as I A. KAHN]. Unfortunately, most analysts ignore this logically prior issue and uncritically adopt the most common goal of maximizing the present value of benefits. "[T]he most common maximand where projects involve only costs and benefits expressed in money terms is the present value of benefits less costs. Other maximands are possible, however, such as capital stock at a final date." Prest, *supra* note 14, at 703. See, e.g., S. BAR-RAGER, *supra* note 17, at 40 (implicitly adopting this goal in a cost-benefit analysis of energy alternatives). The simple fact that the earth's energy resources are finite raises significant questions as to the propriety of using this definition of social welfare in analyzing energy alternatives.

20. It is tautological that any analysis can only be as useful as the underlying information allows. Energy policy, because of its comparatively recent origin as an area of social concern, is plagued by nonexistent or insubstantial data. As the current Secretary of Energy has noted,

For most of the civilian programs, very little policy-oriented research bearing on allocative decisions has been done. In some areas the problems have not even been formulated. Consequently, there is no capital of preexisting research to be milked. It may be years before adequate analyses are performed. While in no way does this suggest that analytical effort should not be pushed, it does suggest that our expectations should not be pitched too high with respect to immediate benefits.

Schlesinger, *supra* note 18, at 290-91. A similar source of bias is present in determinations of which sets of information or which projections should be employed in the analysis.

21. Both Marxian and free-market economists have consistently assumed (often only implicitly) that

[i]n actual life . . . an important factor of production, namely . . . natural resources [is] limited in quantity. Though the stock of it may go on expanding for a long time, it cannot, in view of this limitation, do so indefinitely. . . . Hence ultimately the stock of this factor must come into equilibrium and cease to expand. . . . We may conclude there necessarily exists some state, which . . . would be in equilibrium and stationary.

A. PIGOU, *THE ECONOMICS OF STATIONARY STATES* 12 (1935). Pigou concluded that "[i]n a

Both continue to treat such resources as free goods, ignoring their finite nature. How, for example, does one determine the worth of a vein of coal or a barrel of petroleum left in place for use in 3000 A.D.?²² The market's inability to resolve this dilemma has contributed to a rapid depletion of all exhaustible resources. The use of prices as the basis for quantification in cost-benefit analysis is similarly myopic.

The third major limitation on the use of cost-benefit analysis to resolve energy policy issues is also tied to the method's reliance upon quantification. Qualitative items, which inherently resist quantification, are either ignored or assigned arbitrary values.²³ Although critics of the method have focused primarily on the questionability of valuing items such as clean air or human life,²⁴ the difficulty is even more pervasive. The method is also incapable of providing justifiable quantifications for the qualitative aspects of different energy resources.²⁵ The concern of analysts has been almost exclusively with projections of the

stationary state factors of production are stocks, unchanging in amount, out of which emerges a continuing flow, also unchanging in amount, or real income." *Id.* at 19. This view of natural resources as an inexhaustible flow, despite its obvious falsity, lies at the heart of conventional economic analyses. *See, e.g.,* Solow, *The Economics of Resources or the Resources of Economics*, AM. ECON. REV., May 1974, at 1 (advancing a more complex schematic that, nonetheless, reduces to the same paradigm). *But see* Georgescu-Roegen, *Energy and Economic Myths*, 41 S. ECON. J. 347, 374 (1975) (advancing the argument that, rather than a perpetual cycle, "[t]he economic activity of any generation has some influence on that of future generations—terrestrial resources of energy and materials are irrevocably used up and the harmful effects of pollution on the environment accumulate."). *See also* Ise, *The Theory of Value as Applied to Natural Resources*, 15 AM. ECON. REV. 284 (1925).

22. As the legal philosopher John Rawls commented, "There is no need to stress the difficulties that this problem raises. It subjects any ethical theory to severe if not impossible tests." J. RAWLS, *A THEORY OF JUSTICE* 284 (1971). The problem is also beginning to attract some economic notice. *See, e.g.,* Solow, *Intergenerational Equity and Exhaustible Resources*, 41 REV. ECON. STUD. 29 (Supp. 1974).

23. An example of this process is found in a cost-benefit study which concluded that, while "[d]ata-oriented techniques are not generally applicable" to valuing such risks as plutonium diversion, values could nevertheless be assigned by "rely[ing] on expert judgment, quantified using subjective probabilities." S. BARRAGER, *supra* note 17, at 40. The study also quantified the "value" of clean air as the "sum of damages directly caused to human health and material property, and indirectly through the effects of acid rain." *Id.* at 17.

24. *See, e.g.,* Green, *supra* note 15, at 798 n.26; Mishan, *The Economics of Disamenity*, 14 NAT. RES. J. 55 (1974).

25. The "quality" of a form of energy is a measure of the variety of tasks that it can perform and is closely, though not strictly, related to the temperature of the energy source. Thus electricity, which can run motors, power electrolytic processes, and provide lighting in addition to heat, is a higher quality energy source than wood, which can provide only heat unless it is transformed through significant chemical alterations. But a thermodynamic price must be paid for the additional quality present in electrical energy. The conversion of heat to mechanical energy involved in thermal-electric generation is inherently inefficient. Three units of heat are consumed to produce one unit of electricity. STANFORD STUDY, *supra* note 4, at 10-11. By more closely matching the quality of energy required for the task to the energy employed, overall consumption of fuel stocks can be held stationary or reduced in the long run without a corresponding reduction in economic well being. As Lovins has noted, heating a house to 68°F with electricity generated by fissioning uranium at 10,000°F is "like cutting butter with a chain saw." Lovins, *Energy Strategy*, *supra* note 10, at 79.

total quantities of energy required while the qualitative aspects of the issue have drawn little comment. Furthermore, cost-benefit analysis as currently structured is incapable of recognizing or incorporating this distinction. One discussion of this procedure concluded that "no widely accepted method of assessing benefits exists."²⁶

The central role of quantification in cost-benefit analysis thus renders the method unsuitable for the issue at hand. Whatever its value in comparing the alternative means of providing the same commodity (such as coal and nuclear generation of electricity), the procedure is structurally incapable of a meaningful analysis of solar energy alternatives. While the goal of promoting greater rationality in decision-making is laudable, the use of an economic model creates an overly narrow conception of that rationality. The equation of the desire for efficiency with rational thought²⁷ involves a subtle confusion of means and ends. While efficiency may be the proper test for selecting rational means, its value in selecting goals is far less certain. The outcome is all too often, as Laurence Tribe has noted, ideology masquerading as analysis.²⁸

However, rational political decision making does require consideration of alternatives. While such consideration cannot produce the apparent mathematical certainty associated with cost-benefit analysis, it can serve to present the issues that must be resolved. The remainder of this article is given over to an analysis of the economic, technological, and legal means of implementing the proposals presented in Part II, as well as the social and political ramifications of those proposals.

IV. ECONOMIC ISSUES

A distinction must be made between the economic considerations of individual consumers and of public utilities because the position of the two groups in relation to conventional energy resources is fundamentally different.

26. Starr, Rudman, & Whipple, *Philosophical Basis for Risk Analysis*, 1 ANN. REV. ENERGY 629, 638 (1976).

27. One economist has argued that "[t]he economic principle is the fundamental principle of all rational action. . . . All rational action is therefore an act of economizing." L. VON MISES, EPISTEMOLOGICAL PROBLEMS OF ECONOMICS 148 (1960). *But cf.* F. KNIGHT, THE ECONOMIC ORGANIZATION 3 (1951) ("It is characteristic of the age in which we live to think too much in terms of economics, to see things too predominately in their economic aspect; and this is especially true of the American people. There is no more important prerequisite to clear thinking in regard to economics itself than is recognition of its limited place among human interests at large."). *See also* P. DIESING, REASON IN SOCIETY 24 (1962); Boulding, *Economics as a Moral Science*, 59 AM. ECON. REV. 1 (1969).

28. Tribe, *supra* note 5, at 66.

A. Consumer Economics

Assuming that the economic decisions of the average consumer are predicated in terms of the lowest cost,²⁹ an individual is unlikely to invest the required capital in a solar energy system until it is apparent that the investment will result in savings. Setting aside theoretical questions about energy prices, the central issue becomes the comparative costs of solar and conventional energy sources.

Solar energy is presently cost competitive with traditional energy sources for some uses and for some consumers.³⁰ As conventional energy prices continue to rise and the real capital investment for a solar energy system continues to decrease, the sun will probably become a competitive source of energy for most of this country's domestic space and water heating requirements by the year 2000. One study, for example, has concluded:

Based on comparison with conventional energy costs, solar water heating and solar space heating installed at an equivalent system cost of \$20 per square foot of collector is competitive today against electric resistance systems throughout most of the U.S. If the system cost is reduced to \$15 per square foot solar systems become competitive against oil water heating and/or oil and electric heat pump space heating in many cities. Finally, if the cost should be reduced to \$10/ft² by 1980 through a combination of technical innovations and incentives, solar hot water and heat would be economically competitive against all residential fuel types.³¹

Thus for domestic hot water and heating requirements, solar energy is presently a meaningful option.

However, the substantial initial capital investment and high interest rates can retard a rapid shift to the use of solar energy.³² This effect is compounded by the apparent belief that solar energy is only a potentially valuable future resource. Therefore, it is unlikely that increased

29. This is not necessarily a uniformly valid assumption. "Many persons perceive solar energy as ethically preferred to other energy sources. For this reason, they are willing to pay more and/or tolerate lower performance. . . . Although this choice is difficult to quantify into system cost, it is nonetheless real." STANFORD STUDY, *supra* note 4, at 32.

30. See, e.g., DIVISION OF SOLAR ENERGY, ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION, AN ECONOMIC ANALYSIS OF SOLAR WATER & SPACE HEATING (NTIS DSE-2322-2 1976) [hereinafter cited as DIVISION OF SOLAR ENERGY]; JOINT ECONOMIC COMM., 95TH Cong., 1ST Sess., THE ECONOMICS OF SOLAR HOME HEATING (Comm. Print 1977) [hereinafter cited as JOINT ECONOMIC COMM.]; Ben-David, *supra* note 8.

31. DIVISION OF SOLAR ENERGY, *supra* note 30, at iii (footnotes omitted).

32. The importance of interest rates was emphasized by the congressional study which noted that the "feasibility of solar energy can be determined almost solely by interest rates." JOINT ECONOMIC COMM., *supra* note 30, at 84.

use of solar energy will result from market incentives alone. If the substitution of solar energy for nonrenewable fuels is desirable, further incentives must be employed. One such option is to make use of the energy utilities.

B. Utility Economics

For the individual consumer, the important energy costs against which to compare solar energy are the applicable rates of the local energy utility. In practice the current legal criteria for acceptable utility rates, *i.e.*, rates that are just and reasonable,³³ result in total rates that approximate the utility's average cost of producing and transporting the energy.³⁴ Since in some areas of the country solar energy is already cost competitive, in those areas at least solar energy can now be produced for the average cost of energy from the local utility. However, for the utility the important cost is the marginal cost.³⁵ Until the late 1960's and early 1970's, both the average and marginal costs for utilities declined. At that time this trend reversed due to a number of factors including inflation, a reduction in the economies of scale, and rapidly increasing real costs for capital, construction, and fuel.³⁶ As a result marginal costs have risen dramatically, and, while they have an obvious impact on average costs, they are currently escalating more

33. See, *e.g.*, *FPC v. Hope Nat. Gas Co.*, 320 U.S. 591 (1944).

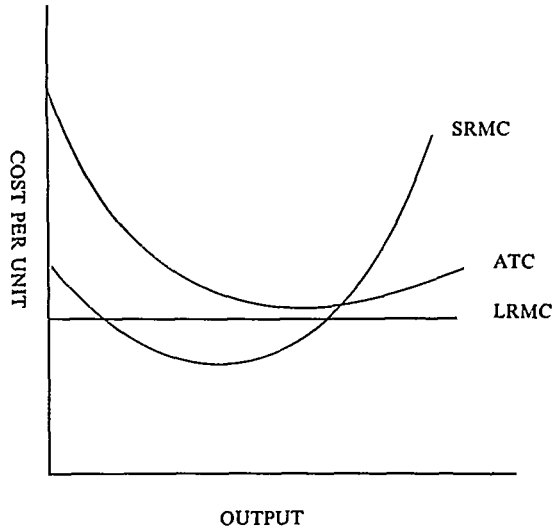
34. The traditional method of establishing rates "tends to base prices preponderantly on average historical costs." *Re Consolidated Edison Co.*, 8 P.U.R.4th 475, 480 (N.Y. Pub. Serv. Comm'n 1975). Cf. 1 A. KAHN, *supra* note 19, at 63 ("The principle benchmark for 'just and reasonable' rate levels has been the cost of production, including . . . the necessary return to capital.")

35. Marginal costs are the unavoidable costs of producing the next unit of energy. They include not only the additional cash outlays directly imposed by production of additional output, but also "any enhancement of noncash costs (such as depreciation due to wear and tear of equipment) attributable to an increase in the rate of output." J. BONBRIGHT, *PRINCIPLES OF PUBLIC UTILITY RATES* 317 n.2 (1961). Marginal costs are divided into short-run marginal costs (SRMC) and long-run marginal costs (LRMC). SRMC are "marginal costs estimated under the assumption that the enhanced rate of output will be temporary and will hence be accomplished solely by an increase in the rate of utilization of the existing plant and equipment." *Id.* at 319. LRMC, on the other hand, are "marginal costs estimated under the assumption that the enhancement in the rate output will continue indefinitely and hence will be accomplished by an appropriate increase and adaption of plant capacity." *Id.* (See Figure 1 *infra*). For example, generation of additional electricity from an existing thermal plant will involve only SRMC such as additional fuel costs and increased maintenance costs. When the upper limit of the plant's capacity has been reached, however, the LRMC of the additional capacity necessary to produce the next unit of electricity is substantial since construction of a new facility is required. The analysis is further complicated by the problem of peaking capacity, which by definition is used only intermittently. SRMC are generally higher for peaking capacity because it is the least efficient and the most expensive capacity. LRMC, however, is substantially increased because it includes the full cost of maintaining capacity that is used only intermittently. See generally *id.* at 318-29. Solar energy can be used to reduce both SRMC (due to potential peak demand displacement) and LRMC (due to potential to avoid increase in capacity).

36. See *Re Detroit Edison Co.*, 3 P.U.R.4th 209, 248-50 (Mich. Pub. Serv. Comm'n 1974).

rapidly than average costs. Therefore, a prime concern of utilities is to reduce marginal costs, especially long-run marginal cost.

Figure 1



RELATIONSHIP OF VARIOUS COST FACTORS

SRMC = short-run marginal costs
 LRMC = long-run marginal costs
 ATC = average total costs

Solar energy offers the utility the possibility of reducing marginal costs. If the cost to the utility of encouraging the installation of solar energy systems is comparable to or less than the cost of producing the same amount of energy at the margin, it would be economically advantageous for the utility (and its ratepayers as a group) to provide incentives for installing such systems. This potential saving exceeds any saving to an individual who installs a system. The increased savings result from the ability of the utility either to reduce the use of its most expensive capacity or, in principle at least, to avoid the capital expenditures necessary to increase current capacity to provide the additional energy.³⁷ The problem, in economic terminology, is to redirect the

37. The potential for avoiding future additions to generating and transporting capacity (LRMC) is less certain than the ability of the utility to reduce the use of its most expensive (peaking) capacity (SRMC) because of the requirement that the utility be able to meet peak demands. The cost elements of consumer energy requirements are customer, energy, and demand charges. The customer charges, such as metering costs, are irrelevant to this consideration. The distinction between energy and demand, however, is crucial. The energy component comprises the variable costs and is levied on a ratepayer on a per unit basis for the ratepayer's consumption. The de-

value represented by the difference between average and marginal costs.

Although there have been a number of studies on the cost competitiveness of solar energy for the individual consumer, to date there has been little interest in the potential savings to utilities. This is anomalous because, as a utility representative has noted, if solar energy could improve load characteristics, "there may be an economic incentive for the utilities to stimulate solar energy use."³⁸

It is beyond the scope of this article to present a detailed cost comparison of solar and conventional energy sources. Any cost comparison necessarily involves the difficulties with valuing energy resources discussed in Part III. Additional problems arise because of the lengthy period between initial preparatory work and the completion of either coal or nuclear generating plants. The real, after-inflation costs of these plants increase significantly between order and completion dates.³⁹ Nevertheless, some general conclusions can be suggested. First, if present energy prices are accepted, the life-cycle cost of the energy produced by solar energy systems is comparable to that of nuclear- or coal-fired electricity.⁴⁰ Second, the real cost of solar energy is likely to decrease as the economies of mass production become avail-

mand component, on the other hand, represents the largely fixed costs of maintaining sufficient capacity to meet daily and seasonal peak demands. See *Re Madison Gas & Elec. Co.*, 5 P.U.R.4th 28, 33-39 (Wis. Pub. Serv. Comm'n 1974); I A. KAHN, *supra* note 19, at 95. Residential rates, despite the significant contribution of residential consumers to peak demand requirements, have traditionally been structured in declining block rates that reflect primarily the energy component. This type of rate structure imposes a penalty on the use of solar energy because the utility-furnished energy that is displaced by solar energy will be the least expensive energy purchased by the consumer. Declining block rates may also be detrimental to the utility. If solar energy use reduces base load without decreasing the daily or seasonal peak load requirements, the utility will lose the revenue for the sale of relatively profitable units of energy without a corresponding reduction in the amount of capital investment required to maintain a peak load capacity. As one study has indicated:

The real source of load factor conflict between solar systems applications and electric utilities is not unique to solar thermal applications. Rather, it is the failure of current electric rate structures to accurately relate price to cost. This conflict is not a function of solar economics or solar technology. It is primarily a matter of electric rate economics.

ENERGY POLICY PROJECT, NATIONAL CONFERENCE OF STATE LEGISLATURES, ANALYSIS OF STATE SOLAR ENERGY POLICY OPTIONS at IV-15 (1975). See also Dean & Miller, *Utilities at the Dawn of the Solar Age*, 53 N.D.L. REV. 329 (1977) [hereinafter cited as Dean].

The actual effects of widespread use of solar energy on the public utilities remains conjectural and will vary with the utility and its particular daily and seasonal peaks and with the design of the solar energy system. See, e.g., D. SPENCER, SOLAR ENERGY: A VIEW FROM AN ELECTRIC UTILITY STANDPOINT 10 (1975) (American Power Conference paper no. 104) [hereinafter cited as D. SPENCER]; Bos, *supra* note 4, at 12-13. See generally notes 45-56 *infra* and accompanying text.

38. D. SPENCER, *supra* note 37, at 11.

39. Bupp, Derian, Donsimoni, & Treitel, *The Economics of Nuclear Power*, TECH. REV., Feb. 1975, at 15 [hereinafter cited as Bupp].

40. See Appendix *infra*.

able,⁴¹ while the real cost of conventional fuels is likely to increase significantly. Thus, if solar energy systems can improve a utility's load factors, subsidizing the installation of such systems would be advantageous to the utility and to its customers. From the utility's perspective, the question should turn largely on the technological issue of whether solar energy systems reduce peak demand requirements. If so, encouraging the use of solar energy appears to be economically advantageous to the utility.

V. TECHNOLOGICAL ISSUES

The low-temperature solar energy systems required for domestic use present only minimal technological problems. A domestic hot water system, for example, requires only five components:⁴² solar insolation, a collector to capture the sunlight and convert it into heat, a medium for transporting the heat produced, a storage/exchanger system, and an auxiliary energy source. (See Figure 2.)

Simple and comparatively inexpensive systems are currently available. These systems generally employ a flatplate collector which is essentially a glass-covered box, the bottom of which is covered with a black, absorptive coating. The transport medium, frequently a water-antifreeze solution, is circulated over the black surface and is thereby heated. The collector loop is connected with the domestic water supply through a heat exchanger to insure that the solutions in the two loops do not mix.⁴³

This type of system was widely used in Florida and California before natural gas became a less expensive source of energy, and is still in use in Australia, Israel, and Japan. A study of the experience in Florida concluded that "these units provided a plentiful supply of hot water all year with little assistance" from an auxiliary heating source.⁴⁴

The requirement of a backup energy supply, however, creates potential problems. It is important to note that the difficulties which do

41. One study, for example, estimates that a cost of \$3-4 per ft² of collector surface "is feasible when manufactured in a manner similar to that of aluminum frame windows. In addition . . . module construction [promises] to reduce costs and simplify the system." E. DAVIS, *supra* note 10, at 1191.

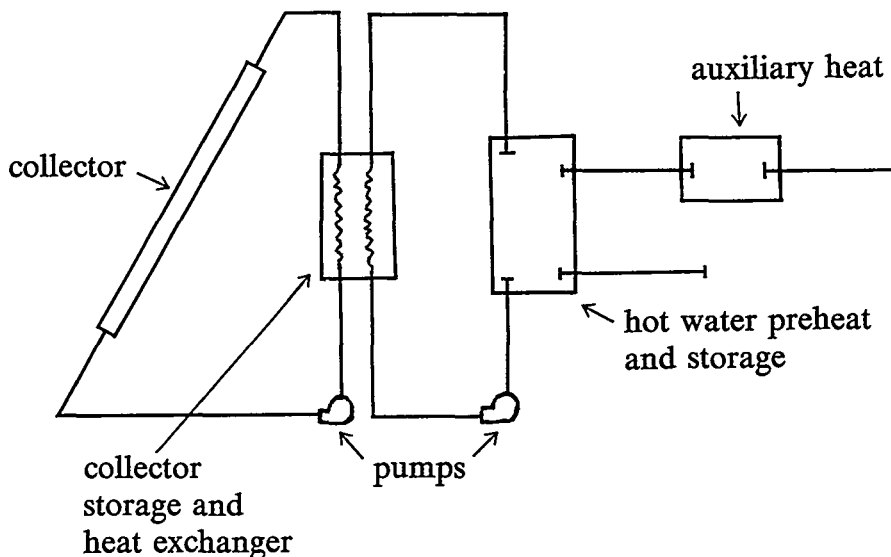
42. See generally F. DANIELS, *DIRECT USE OF THE SUN'S ENERGY* (1964); A. MEINEL & M. MEINEL, *APPLIED SOLAR ENERGY* (1976).

43. If the system is provided with a method of draining the collector during periods of low insolation and subfreezing temperatures, the two-loop design can be eliminated and the domestic water supply routed through the collector.

44. J. SCOTT, R. MELICHER, & D. SCIGLIMPAGLIA, *DEMAND ANALYSIS: SOLAR HEATING AND COOLING OF BUILDINGS 7* (1974). See also Butti & Perlin, *Solar Water Heaters in California, 1891-1930*, *COEVOLUTION Q.*, Fall 1977, at 4.

arise are not due to any problems inherent in the solar energy system. Instead, they are the result of interfacing two energy supply systems and an attempt to make the solar energy system compatible with the needs of the traditional energy supplier.

Figure 2



SCHEMATIC DIAGRAM: DOMESTIC HOT WATER

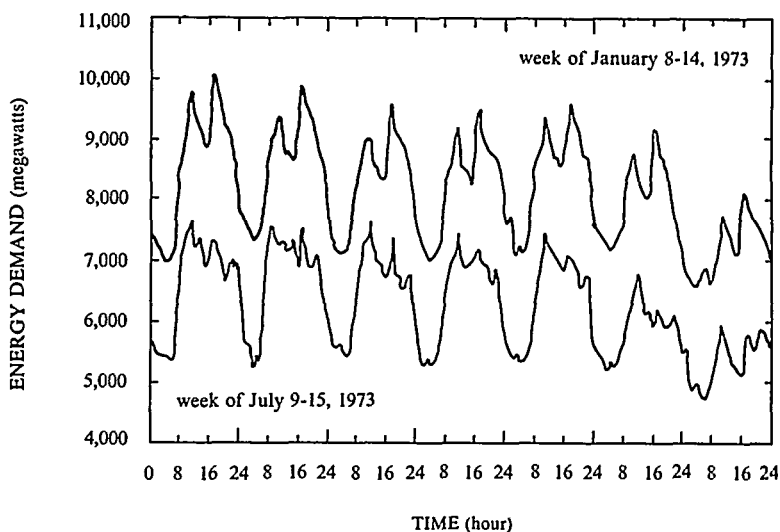
The pumps would not be required if the collector can be located lower than the storage components because the system could then use gravity to move the transport medium.

Utility spokespersons most frequently cite as the primary difficulty, and as their dominant concern, the potential disruption of the utility's load factors.⁴⁵ Load factors, the percentage of total capacity in operation at any given time, are of primary importance because they are directly related both to the rates charged to customers and to the utility's profits. While the ideal demand curve would be flat, the nor-

45. See, e.g., D. SPENCER, note 37 *supra*; Bos, note 4 *supra*. The few technical studies that are available indicate that this is a valid concern. Lorsch, in his simulation study of two Pennsylvania electric utilities found that "[t]he peak electrical demand of a solar heated home with electrical back-up is identical to, and occurs at the same time as, that of an electric resistance heated home." LORSCH, *Effect of Solar Home Heating on Electric Utilities*, in 9 SHARING THE SUN: SOLAR TECHNOLOGY IN THE SEVENTIES 97, 130 (1976) [hereinafter cited as LORSCH]. This unreduced peak demand is coupled with the fact that "[t]he annual load factor (average annual load divided by peak load) of solar heating customers is 40% to 50% lower than that of conventional, electric resistance heating customers." *Id.* Thus a solar heating customer with electric backup requires the utility to maintain the expensive peaking capacity while purchasing fewer total units of electricity. See also Koger, *supra* note 10, at 11.

mal energy demand curve for a utility is a series of peaks and valleys in both a diurnal and annual cycle.⁴⁶ The utility must maintain sufficient capacity to meet the peaks in its demand curve, even though the upper 15% of the annual demand for an average utility occurs only about 10% of the time, and the yearly maximum may last only a few hours.⁴⁷ This peaking capacity, though rarely used, must be kept in reserve and paid for through the rates that the utility charges over the entire year. The lower the load factors, the fewer the total units of energy over which the capital cost for the capacity can be spread and the higher the rates.

Figure 3



Load profile of the Hydro-Quebec system for a winter and summer week. (Source: McConnell, Beaudet, Piché, & Maille, *The Use of Off-Peak Electricity for Solar Heated Homes*, in 9 SHARING THE SUN: SOLAR TECHNOLOGY IN THE SEVENTIES 128, 130 (1976).)

Solar energy systems could potentially disrupt load factors unless properly integrated into the utility system. An extended period of low insolation might increase the peak load demand on the utility as the solar energy system's storage capacity is exhausted. However, during periods of high insolation the solar energy system would require little

46. See Figure 3. (Source: McCONNELL, BEAUDET, PICHÉ, & MAILLÉ, *The Use of Off-Peak Electricity for Solar Heated Homes*, in 9 SHARING THE SUN: SOLAR TECHNOLOGY IN THE SEVENTIES 128, 130 (1976) [hereinafter cited as McCONNELL]).

47. McCONNELL, *supra* note 46, at 130. (The figures are for Hydro-Quebec, but they are comparable with those of other utilities).

auxiliary energy. As a result, the utility would have lower valleys without a corresponding reduction in peak demand.

This potential difficulty has only recently attracted technical investigation. The initial studies⁴⁸ indicate that the effect of a substantial number of solar energy systems on the utility would be the result of several factors. The size of the system's storage capacity, the type of storage, the time period during which auxiliary energy is drawn from the utility, and the particular utility's load characteristics⁴⁹ would all influence the total impact on the utility.

The size of storage has the most obvious impact. A system with only two or three days storage capacity will present unreduced peak demands and low load factors, thus increasing costs while reducing total demand.⁵⁰ Significant expansion of storage would substantially increase the system's cost. Absent a major breakthrough in thermal storage⁵¹ or the use of seasonal storage,⁵² increasing the size of capacity

48. Feldman & Anderson, *Financial Incentives for the Adoption of Solar Energy Design: Peak Load Pricing of Back-up Systems*, 17 SOLAR ENERGY 339 (1976) [hereinafter cited as Feldman]; HUGHES, BECKMAN, & DUFFIE, *Simulation Study of Several Heating Systems with Offpeak Auxiliary*, in 4 SHARING THE SUN: SOLAR TECHNOLOGY IN THE SEVENTIES 189 (1976) [hereinafter cited as HUGHES]; LORSCH, note 45 *supra*; MCCONNELL, note 46 *supra*; MELTON, *Insolation and Temperature Statistics and Their Influence on the Design of Solar Heating Systems and the Electric Utility Interface*, in 4 SHARING THE SUN: SOLAR TECHNOLOGY IN THE SEVENTIES 172 (1976) [hereinafter cited as MELTON].

49. This element will not be discussed because of the wide variation in load curves between utilities. At least two factors should be noted, however. First, for summer-peaking utilities, solar water heaters offer distinct load factor advantages. See OFFICE OF SYNFUELS, SOLAR, & GEOTHERMAL ENERGY, *supra* note 10, at 8 n.**. Second, Melton in his study of insolation and temperature statistics concluded that

those systems which do not have the capability of bringing backup electric energy into storage . . . during offpeak periods . . . will lead to an increase in electric power demand relative to electric heating systems in the Southwest. A significant penetration of such systems in the Northeast will also cause an increase in power demand, but the situation is relaxed because afternoon temperature is in the mean significantly higher on overcast days.

MELTON, *supra* note 48, at 172.

50. McConnell estimates a 40% reduction in total annual demand, with negligible reduction in peak demand. McConnell, *supra* note 46, at 132.

51. See, e.g., GREEN, OTTESON, BARTEL, & BRAMLETTE, *High Temperature Thermal Storage*, in 8 SHARING THE SUN: SOLAR TECHNOLOGY IN THE SEVENTIES 4 (1976); OFFENHARTZ, *Chemical Methods of Storing Solar Energy*, in 8 SHARING THE SUN: SOLAR TECHNOLOGY IN THE SEVENTIES 48 (1976).

52. Seasonal thermal storage

is an exciting prospect for larger buildings and communities. . . . [I]f one examines the prospect of trans-seasonal storage a new set of rules applies. Fuel savings can then be 100 percent, the back-up source can be eliminated, and the solar collector can actually be smaller than one for no storage at all. Although storage capacity must be greater, economies of scale make for relatively modest increases in storage system cost and thermal losses. . . . Energy recoveries of 70 to 80 percent may be possible after several months of storage.

SWET, *New Directions in Heat Storage for Buildings*, in 8 SHARING THE SUN: SOLAR TECHNOLOGY IN THE SEVENTIES 1, 3 (1976). See also F. HOOPER, C. ATTWATER, A. BRUNGER, R. COOK, & J. McCLENAHAN, SOLAR SPACE HEATING SYSTEMS USING ANNUAL HEAT STORAGE (NTIS

is not a satisfactory alternative.

Utility load factors are also affected by the type of storage-auxiliary interchange employed. The alternatives of separate and integrated storage each offer potential advantages.⁵³ While the separate storage method presents the best thermal characteristics,⁵⁴ the integrated storage is mechanically simpler, requires less space, and is probably less expensive.⁵⁵ Neither approach, however, would have a major impact on load factor disruption unless it is coupled with the use of primarily off-peak energy.

Load factors are most directly influenced by the timing of the solar energy system's demand for auxiliary energy. If auxiliary energy is drawn during off-peak periods, peak demands would be reduced and load factors would improve. A recent study projected a reduction of 3.8% in peak demand and an overall increase in load factors of 3%.⁵⁶ Use of off-peak energy can be accomplished through simple timing devices and can be encouraged through time-of-day pricing.⁵⁷

The ability of solar energy systems to have a beneficial impact on a utility's load factors, and thus help to reduce rates, should serve as a strong incentive to utilities to encourage the installation of suitable systems. This can be most expeditiously accomplished through the use of an incentive program.

00/2939-35 1978); BESAUT & WINN, *Cost Effective Solar Heating for Houses with Seasonal Storage of Energy*, in 4 SHARING THE SUN: SOLAR TECHNOLOGY IN THE SEVENTIES 409 (1976); Hyman, *100% Solar Space for New England*, ASHRAE J., Jan. 1976, at 66.

53. Electricity is converted to heat and stored separately, either in central or room storage units. HUGHES, note 48 *supra*. See generally DeGrasse, *Electric Storage Heating after Two Years*, PUB. UTIL. FORT., Jan. 16, 1977, at 23; Heitner & Moritz, *Commercial Thermal Energy Storage for Electric Load Leveling*, PUB. UTIL. FORT., May 11, 1978, at 24. Integrated storage systems use the same storage capacity for both solar and electrical thermal energy.

54. In line with the laws of thermodynamics, the collector efficiency is inversely related to the storage temperature. In other words, the system's efficiency is highest when the collector/storage temperature difference is greatest. Raising the storage temperature through the use of auxiliary energy thus reduces the total contribution of solar energy. See generally Asbury & Mueller, *Solar Energy and Electrical Utilities: Should They Be Interfaced?*, 195 Sci. 445 (1977). However, the loss in efficiency from integrating the two energy resources is not that significant. There is an estimated 17% increase in auxiliary energy demand with flatplate collectors, and a 10% increase with evacuated tube collectors. HUGHES, *supra* note 48, at 201.

55. HUGHES, *supra* note 48, at 190-92.

56. MCCONNELL, *supra* note 46, at 133. The precise effect on the utility varies with the time that the off-peak energy is used. McConnell discovered that restricting off-peak usage to the eight hours from 11 p.m. to 7 a.m. actually had a negative impact because the maximum demand was confined to only one-third of the day. This projection resulted in a substantial increase in the residential distribution system requirements and also increased the cost of the total (solar and backup) energy system. *Id.* at 123-33.

57. Compare Feldman, note 48 *supra*, with Koger, note 10 *supra*. See also LILCO and Sunergy to Shift Load in Solar/Off Peak Electric System, SOLAR ENGINEERING, Aug. 1976, at 24. The timing device installed in the LILCO house cost only \$30.

VI. LEGAL ISSUES

An analysis of the suitability of utility-sponsored incentive programs must consider more than the economic and technological issues. While both are vital in determining the practicality of the proposal, if such programs are to be implemented it is necessary to examine the legal problems that are likely to be encountered. The form and particulars of the incentives will largely be determined by legal rules. Failure to consider the impact of these rules is likely to impede the use of utilities as a means of increasing the utilization of solar energy. The rules which deserve careful consideration are those applicable to the regulation of the utilities and those intended to prevent restraints on competition.

A. Regulatory Law

Although the majority of energy utilities in this country are privately owned, as "natural monopolies" they have been regulated by state public utility commissions almost since their inception.⁵⁸ The regulation is pervasive, controlling rates, types of service, conditions of service, and many other areas of utility operations. A package of incentives offered by a utility will require the approval of the regulatory commission. Therefore, the legal rules applicable to the various incentives must be a crucial element in determining the feasibility of any proposed incentive.

To be legally acceptable, any incentive program must comply with two general regulatory principles. First, limitations on the utility's business activities may preclude the use of certain incentives if they are considered not to be a proper utility function. Second, the structure and scope of the program must conform with general antidiscrimination requirements. In short, any incentive program must be a legally proper function and not unreasonably discriminate between the utility's customers.

1. Propriety of a Solar Incentive Program

The most fundamental legal issue is the propriety of a utility-sponsored program of incentives designed to encourage the use of solar energy. The issue is not whether a utility can provide an incentive program, but whether the costs of the program can be included in the

58. See generally 1 A. PRIEST, PRINCIPLES OF PUBLIC UTILITY REGULATION 5-9 (1969) [hereinafter cited as 1 A. PRIEST].

determination of the utility's rates, and whether a regulatory commission can require the utility to provide an incentive program.

The elements which are sufficient to subject a business enterprise to regulation were initially outlined in *Nebbia v. New York*.⁵⁹ Based on those principles, both the courts and administrative agencies continue to distinguish between transactions of utilities that are "public" and subject to regulation, and those that are "private" and beyond regulatory supervision.

[T]he fact that a business or enterprise is, generally speaking, a public utility does not make every service performed or rendered by those owning or operating it a public service, with its consequent duties and burdens, but they may act in a private capacity as distinguished from their public capacity, and in so doing are subject to the same rules as any other private person so acting.⁶⁰

Unfortunately, the authorities provide little assistance in distinguishing the two roles.⁶¹ The characterization of a transaction is "controlled by the facts of a particular case,"⁶² which makes a precise line between "public" and "private" difficult to draw. The same practice has been treated as private in one jurisdiction and public in another.⁶³

However, the courts and commissions are in general agreement that the resolution of the issue turns upon the relation of the questioned activity to the central function of the utility, which is "to furnish the most efficient and satisfactory service at the lowest reasonable price."⁶⁴ For example, an electric utility's ice company is a nonutility function.⁶⁵

59. 291 U.S. 502 (1934). The Court held that industry is subject to regulation for the public good when it is clothed or affected with a public interest. In addition, regulation of industry in general for the public good is valid as an exercise of the police power as long as it is not arbitrary or capricious.

60. *City of Phoenix v. Kasun*, 54 Ariz. 470, 476, 97 P.2d 210, 213 (1939). See also *Associated Mechanical Contractors v. Arkansas-Louisiana Gas Co.*, 255 Ark. 424, 283 S.W.2d 123 (1955).

61. The test most frequently cited is of little assistance.

Generally, the question depends upon whether the operation has been held out as a public service, upon whether the service is in fact of a public character and whether it may be demanded on a basis of equality and without discrimination by all members of the public or obtained by permission only.

Johnson City v. Milligan Util. Dist., 38 Tenn. App. 520, 531, 276 S.W.2d 748, 753 (1954). This test does little beyond argue from the conclusion because, upon finding that an activity is a proper utility function, the antidiscrimination requirements of the test attach to the action.

62. *Id.*

63. Compare *Re Southern Cal. Gas Co.*, 35 P.U.R.3d 300 (Cal. Pub. Util. Comm'n 1960) (company ordered to cease merchandising activity) with *Liquified Petroleum Gas Ass'n v. Baltimore Gas & Elec. Co.*, 13 P.U.R.3d 519 (Md. Pub. Serv. Comm'n 1956) (merchandising activities were not subject to regulatory control).

64. *City of Greensburg v. Peoples Natural Gas Co.*, 88 P.U.R. (N.S.) 272, 276-77 (Pa. Pub. Utils. Comm'n 1950).

65. *Re Arkansas-Missouri Power Co.*, 72 P.U.R. (N.S.) 98 (Ark. Pub. Comm'n 1947).

As the questioned practice becomes more intimately related to the utility's duty to serve and as its potential impact on service increases,⁶⁶ the practice is more likely to be viewed as a proper utility function and subject to regulation. For example, the authorities disagree on whether the sale of gasoline produced in the process of extracting and purifying natural gas should be included in determining a gas utility's rates.⁶⁷ The decisions also disagree on whether the utility's sale of load-building appliances is a utility function.⁶⁸ On the other hand, the majority recognizes that promotional payments to encourage the installation of such appliances is a proper function.⁶⁹

The decisions which consider the propriety of promotional programs designed to encourage energy conservation are closely analogous to the propriety of solar energy incentives. Even before the energy crisis, the Idaho commission allowed an electric utility to finance the purchase and installation of insulation and storm windows in conjunction with an electric space heating program.⁷⁰ The commission implicitly assumed that this was a proper utility activity. Michigan, on the other hand, has expressly considered the question. In allowing the Michigan Consolidated Gas Company to initiate a home insulation program, the commission noted:

the public interest requires gas utility companies to incur costs of service and investments which conserve, as well as distribute, existing supplies of natural gas.

The commission therefore finds that efforts to promote conservation of natural gas constitute a proper utility function for a gas distribution utility. When promotion of the sale of natural gas is in the interest of gas consumers, it is held to be a utility function. Today, promotion of natural gas conservation

66. "The company has the legal right to engage in enterprises other than its utility operations, so long as there is no impairment of its service to its customers." *Re Oklahoma Natural Gas Co.*, 26 P.U.R.3d 149, 157 (Okla. Corp. Comm'n 1958).

67. *Compare Re Arkansas-Louisiana Gas Co.*, P.U.R.3d 211 (Ark. Pub. Serv. Comm'n 1961) and *Re Oklahoma Natural Gas Co.*, 26 P.U.R.3d 149 (Okla. Corp. Comm'n 1958) (excluding such sales), with *City of Detroit v. F.P.C.*, 230 F.2d 810 (D.C. Cir. 1955); *Cities Serv. Gas Co. v. F.P.C.*, 155 F.2d 694 (10th Cir.), *cert. denied*, 329 U.S. 773 (1946), and *City of Greensburg v. Peoples Natural Gas Co.*, 88 P.U.R. (N.S.) 272 (Pa. Pub. Utils. Comm'n 1950) (including such sales).

68. *Compare Re Intermountain Gas Co.*, 67 P.U.R.3d 511 (Idaho Pub. Utils. Comm'n 1967) and *Re Queens Borough Gas & Elec. Co.*, 39 P.U.R. (N.S.) 65 (N.Y. Pub. Serv. Comm'n 1941) (excluding such sales) with *Re Vallejo Elec. Light & Power Co.*, 55 P.U.R. (N.S.) 435 (Cal. Pub. Utils. Comm'n 1944) and *Re Tampa Elec. Co.*, 37 P.U.R. (N.S.) 440 (Tampa (Fla.) Util. Bd. 1940) (including such sales).

69. *E.g., Re Promotional Practices of Elec. & Gas Utils.*, 65 P.U.R.3d 405 (Conn. Pub. Utils. Comm'n 1966). For a more detailed examination of promotional payments, see notes 96-101 *infra* and accompanying text.

70. *Re Pacific Power & Light Co.*, 69 P.U.R.3d 367 (Idaho Pub. Utils. Comm'n 1967).

is equally a utility function.⁷¹

Although one commissioner has subsequently voiced doubts on the propriety of regulation in this area,⁷² the commission is currently preparing to extend the insulation program.

While these precedents are suggestive, they are insufficient in themselves. To determine the propriety of a public utility program of incentives designed to stimulate the use of solar energy, it is necessary to examine the basic legal duties of these companies. Regulation of private businesses is most frequently justified in terms of the public interest. In return for being granted a monopoly, the utility incurs a duty "to furnish adequate and safe service"⁷³ at the lowest reasonable price. In the past, increased demand for service resulted in reduced per-unit costs, and these regulatory principles required the utility to construct sufficient capacity or to contract for sufficient gas supplies to meet projected demands. The change in economic and energy-supply conditions has recently altered this traditional relationship because increased capacity is no longer automatically assumed to be in the best interest of the public.

However, if total consumption is to continue to increase, utilities must increase their available capacity. By encouraging the use of solar energy systems, a utility can effectively augment the amount of energy available from more conventional sources. Expanding capacity has always unequivocally been a proper utility function. Similarly, encouraging the use of solar energy should also be considered proper because it achieves the same effect. The method may be novel, but the result is not. In addition, the energy crisis, soaring utility costs, and environmental concerns have forced courts and commissions to reexamine traditional assumptions.

It is not our intention to belabor the obvious, but the stark reality of the situation is that our energy problems and

71. *Re Michigan Consol. Gas Co.*, 1 P.U.R.4th 229, 234 (Mich. Pub. Serv. Comm'n 1973) (citation omitted). This position has subsequently been extended to an electric utility. *Re Detroit Edison*, Case No. U-5174 (Mich. Pub. Serv. Comm'n Dec. 6, 1976).

72. This Commission has repeatedly segregated non-utility activities from those subject to regulation; the fact that a utility company conducts an activity does not make that activity subject to the Commission's jurisdiction.

It is therefore necessary for the Commission to find that insulation and/or the provision of furnace modification devices are within the scope of regulation before contemplating applying its regulatory powers to this new field of activity. Such a finding would have wide significance and represent a major reversal of existing Commission precedent and policy.

Proceedings on Staff Proposal Relating to Conservation of Natural Gas, Case No. U-5272, at 2 (Mich. Pub. Serv. Comm'n Dec. 22, 1976) (Ralls, Comm'r, concurring).

73. OR. REV. STAT. § 757.020 (1975). See also N.Y. PUB. SERV. LAW § 65 (McKinney 1955); WIS. STAT. ANN. § 196.03(1) (West 1957). See generally 1 A. PRIEST, *supra* note 58, at 226-83.

our environmental concerns are here to stay. In the face of dwindling oil supplies and spiralling costs, promotional practices which are wasteful or which only serve to fuel the energy crisis should be viewed by a regulatory agency with extreme caution.⁷⁴

Not only will solar energy provide additional energy capacity, but its use will help conserve nonrenewable resources. Therefore, although the issue is not without ambiguities, a solar incentive program should be considered a proper utility function. This characterization would allow the costs of such a program to be included in determining the rates that the utility will be permitted to charge its customers, and would allow a regulatory commission to require a utility to provide a program of incentives to encourage the use of solar energy.

2. Antidiscrimination Statutes

Any program of incentives must comply with the requirements of the state's antidiscrimination statutes, which are designed to prevent the utility from discriminating unreasonably between its customers. Antidiscrimination statutes, however, have not been interpreted to require absolute uniformity.

Discriminations are not forbidden but only unjust discriminations. It is only arbitrary discriminations that are unjust. . . . If the difference in rates is based upon a reasonable and fair difference in conditions which equitably and logically justify a different rate, it is not an unjust discrimination.⁷⁵

The problem is to determine when a particular practice becomes unreasonably discriminatory. Both courts and commissions have employed two general principles to resolve this issue. First, the classification which forms the basis of the questioned practice must be reasonable. The division of customers into different classes is initially a determination to be made by the management of the utility, and "it is a well-recognized principle . . . that considerable discretion must be afforded the management of a utility in the conduct of the utility's business."⁷⁶ The principle of managerial discretion requires that "the

74. *In re Hawaiian Elec. Co.*, 56 Haw. 260, —, 535 P.2d 1102, 1109 (1975). The trend toward requiring energy utilities to promote conservation continues. *See, e.g., Re Promotional Practices of Electric Utilities*, 8 P.U.R.4th 268 (Fla. Pub. Serv. Comm'n 1975); *Re Public Serv. Co.*, 19 P.U.R.4th 109 (N.C. Util. Comm'n 1977); *Re Montana-Dakota Util. Co.*, 21 P.U.R.4th 65 (Wyo. Pub. Serv. Comm'n 1977).

75. *Rossi v. Garton*, 88 N.J. Super. 233, 236, 211 A.2d 806, 808 (1965), quoting 12 McQUILLAN, MUNICIPAL CORPORATIONS § 34.101, at 314-15 (3d ed. 1950).

76. *Re Promotional Activities by Gas & Elec. Corps.*, 68 P.U.R.3d 82, 167 (N.Y. Pub. Serv. Comm'n 1967).

commission may not substitute its judgment for management unless there is a showing of unlawfulness, improvidence, or inefficiency."⁷⁷ Classification of customers by management will seldom be disturbed if "[a]ny matter which presents a substantial difference as a ground for distinction between customers, such as quantity used, time of use, or manner of service" is the basis of the classification.⁷⁸

In addition to allowing promotional practices to vary between reasonably determined classes, discrimination is likely to be found reasonable if the practices are indirectly beneficial to the other ratepayers. The benefit most frequently cited is an improvement in the utility's load factor. If the utility can sell more off-peak energy, the fixed costs (which are determined largely by the requirements of peak demand) can be spread over more units of energy, which in theory would reduce the per unit cost to all customers.⁷⁹ Under this analysis, every customer is benefited by increased sales. Therefore promotional practices, although frequently discriminatory, are not per se illegal.

Historically, the discretion granted to management has been such that a regulatory commission was very unlikely to substitute its judgment for that of the utility's management, if there was any reasonable basis for the classificatory scheme and if the practice would arguably benefit all of the utility's customers. While management is still allowed substantial discretion, the energy crisis and the present economic conditions confronting utilities have reduced the scope of this discretion by undercutting the indirect-benefit justification. Increased consumption no longer automatically reduces costs for all customers.⁸⁰ As

77. *Id.*

78. *Ford v. Rio Grande Valley Gas Co.*, 141 Tex. 525, 527, 174 S.W.2d 479, 480 (1943). "A classification does not have to do perfect justice under all circumstances." *Rossi v. Garton*, 88 N.J. Super. 233, 237, 211 A.2d 806, 809 (1965).

79. A public utility operation is typified by large capital investment and diminishing cost, *i.e.*, once the basic investment is made, additional load is added with relatively small incremental cost. Thus an obvious means to improve earnings and reduce cost is through growth. It is to stimulate growth that promotional practices are developed.

Re Promotional Practices of Elec. & Gas Utils., 65 P.U.R.3d 405, 412 (Conn. Pub. Utils. Comm'n 1966).

80. The wisdom of soliciting extra business [through promotional payments] in the face of cost plant location, and ecological problems is questionable. Further, the company has not convinced us that the promotion of off-peak usage does not result in an overall increase in electric consumption by consumers and in a waste of energy sources at a time when all electric utilities are faced with serious problems, including requests for additional revenues to meet construction programs designed to provide additional capacity to meet loads. While load balancing is a desirable goal to attain, we seriously doubt that the use of this incentive, in the manner offered, has materially altered the system load balancing. . . . It is our conclusion that such a program is not in the public interest, and that all promotional practices and advertising designed to, but not limited to, attract new customers, increase appliance saturation, increase customer loads, increase company loads, increase off-peak loads or encourage persons to switch from another energy source should be discontinued.

a result, public utility commissions have found, with increasing frequency, that promotional programs are not in the public interest.⁸¹ The arguments advanced for disallowing traditional promotional programs, however, provide a strong basis for permitting incentives to encourage the use of solar energy.

These two general principles are applicable to all promotional and potentially discriminatory practices. Although the following sections examine the interpretation of antidiscrimination statutes in rate and incentive payment situations, the general principles will also apply to more novel incentives.

a. *Promotional Rates*

Rate schedules can be promotional in two distinct ways. The most obvious method is by use of traditional declining block rates, which encourage increased consumption by reducing the cost per unit as the number of units consumed increases. Less obvious, but more important as a potential incentive, is the promotional variation of rates between classes of customers.

All jurisdictions have statutes prohibiting rate discrimination. However, a prohibition against charging one customer more than another "for a like and contemporaneous service under substantially similar circumstances"⁸² allows a utility significant room to vary rates between classes of customers as long as the variations are within a broad "zone of reasonableness."⁸³ This area of management discretion has frequently been cited as justification for the division of a utility's customers into classes and for the application of different rates to each class.⁸⁴ The practice has been justified where either the cost to the

Re Promotional Practices of Elec. Utils., 8 P.U.R.4th 268, 274 (Fla. Pub. Serv. Comm'n 1975).

81. [A] majority [of promotional practices] are conditioned on exclusive use of or maximum possible use of the energy furnished by the utility paying them; and by their very nature tend to add to peak loads as much or more than off-peak.

Re Promotional Practices of Pub. Utils. & Coop. Util. Ass'ns, 97 P.U.R.3d 1, 3 (Okla. Corp. Comm'n 1972). *See also In re* Hawaiian Elec. Co., 56 Haw. 260, 535 P.2d 1102 (1975); Kansas Gas & Elec. Co., 95 P.U.R.3d 247 (Kan. Corp. Comm'n 1972); Narragansett Elec. Co., 1 P.U.R.4th 60 (R.I. Pub. Util. Comm'n 1973); *Re* Wisconsin Gas Co., 99 P.U.R.3d 160 (Wis. Pub. Serv. Comm'n 1973).

82. OR. REV. STAT. § 757.310 (1975). *See also* IDAHO CODE § 61-315 (1976); ME. REV. STAT. ANN. tit. 35, § 102 (West 1965); N.Y. PUB. SERV. LAW §§ 31, 32, 35, 65 (McKinney 1955).

83. *Jager v. State*, 537 P.2d 1100, 1109 (Alaska 1975). *See also* F.P.C. v. Sierra Pac. Power Co., 350 U.S. 348 (1956); *Pittsburg v. Pennsylvania Pub. Util. Comm'n*, 168 Pa. Super. 95, 78 A.2d 35 (Super. Ct. 1951).

84. "The classification of customers, whether to encourage usage or to measure rates, is a management function which we will not disturb where not contrary to the public interest." *Watkins v. Atlantic City Elec. Co.*, 67 P.U.R.3d 483, 494 (N.J. Bd. Pub. Util. Comm'rs 1967). *See also* *Re* Pacific Gas & Elec. Co., 9 P.U.R.3d 97 (Cal. Pub. Util. Comm'n 1955); *Ford v. Rio Grande Valley Gas Co.*, 141 Tex. 525, 174 S.W.2d 479 (1943).

utility or the type of service provided are distinguishable.⁸⁵ Similarly, customers who rely on solar energy can be differentiated from other customers because of their generally reduced demand for the utility's service and the sporadic or off-peak nature of their consumption. These differences provide a reasonable basis for creating a class of solar owners with a distinct rate schedule applicable to them.

The indirect-benefit rationale has also been applied to rate-making. Lower rates for customers who improve the utility's load factor are uniformly found not to be unreasonably discriminatory.⁸⁶ This principle, frequently advanced to justify lower rates for large consumers, is also applicable to owners of solar energy systems designed to draw auxiliary energy from the utility during off-peak periods. A rate incentive for installing such systems should benefit all other ratepayers and, therefore, should be legal.⁸⁷

The determination that solar energy promotional rates are legal in principle does not insure that any particular rate will not be unduly discriminatory. This factual determination must be made in light of

85. See, e.g., *Re Montana Power Co.*, 10 P.U.R.3d 161 (Mont. B. R.R. Comm'n 1955); *Cleveland Elec. Illuminating Co. v. Ohio Pub. Util. Comm'n*, 42 Ohio St. 2d 403, 330 N.E.2d 1 (1975). Cf. *Re Idaho Power Co.*, 86 P.U.R.3d 458, 477 (Idaho Pub. Util. Comm'n 1970) (while noting that irrigation pumping was responsible for the utility's summer peak demand, the commission maintained a promotional rate due to the depressed agricultural market). But see *Re Public Serv. Co.*, P.U.R. 1929 D 342 (Colo. Pub. Util. Comm'n 1929). The rate variation can often be substantial. One utility, for example, received 35.8% of its total revenue from residential customers who consumed only 21.8% of its production. Industrial customers, on the other hand, while consuming 19.8% of the electricity sold by the utility, provided only 14.9% of the revenue. *Re Public Serv. Co.*, 9 P.U.R.4th 224, 229 (Okla. Corp. Comm'n 1975).

86. Rate differences "are not only permissible but often are desirable and even necessary to achieve reasonable efficiency and economy of operation. . . . [T]he rates must be designed to furnish the most efficient and satisfactory service at the lowest reasonable price for the greatest number of customers. . . ." *Pennsylvania Pub. Util. Comm'n v. Pennsylvania Elec. Co.*, 88 P.U.R.3d 321, 365 (Pa. Pub. Util. Comm'n 1971). See also *Re Pacific Gas & Elec. Co.*, 9 P.U.R.3d 97 (Cal. Pub. Util. Comm'n 1955); *Re Gainesville Gas Co.*, 89 P.U.R.3d 310 (Fla. Pub. Serv. Comm'n 1971).

87. While it is clear, at least in principle, that the use of off-peak electricity by the owners of solar energy systems should improve the utility's overall load factors and thus benefit all of the utility's customers, at least one commentator has argued that, absent time-of-day pricing, a reduced solar rate would result in illegal discrimination. Koger, a public utility's commissioner, argues that the effect would be "subsidization of solar heating customers by other customers of the utility through higher rates." Koger, *supra* note 10, at 11. His opinion is based upon the belief that utilities will be required to maintain a large amount of peaking capacity while selling less total electricity to the solar owner. By focusing solely on the need to maintain peaking capacity, however, he ignores the cost of the fuel necessary to operate this capacity. Lorsch found that "[t]he reduction in electric energy requirements due to the use of solar heating results in a reduction in the marginal cost of fuel used for electric generation. This cost reduction is beneficial to all customers of the utility. For example, it reduces the average fuel cost of all PECO energy generation by 0.008¢/kWh." LORSCH, *supra* note 45, at 111. (For comparison, this cost savings is over 2¢ per mBtu.) While this savings is not large, it does indicate that a solar heating customer does offer the utility some financial advantages even without drawing auxiliary energy during off-peak periods.

the conditions present in a particular case. Beyond such broad generalities as similarity of "material billing factors"⁸⁸ or general prohibitions against unduly burdening another class of customers,⁸⁹ the cases are of limited assistance.⁹⁰ Despite the apparent mathematical certainty of rate formulas, the determination is basically a policy decision for the regulatory commission in which the courts do not often interfere. The commission's expertise, the complexity of the issues, the policy-making nature of the decision, and the tradition of deference to administrative actions combine to preclude detailed judicial review.

Recently, state public utility commissions have begun to examine the traditional assumptions supporting promotional rates. A number of states have abolished the declining block rate structure in favor of flat rates with uniform per unit charges.⁹¹ One commission held that a declining block structure "is irrational in light of the energy crisis and discriminates without demonstrated justification or a rational basis against persons who use a small amount" of energy.⁹²

However, the reexamination of promotional rates is not as far reaching as might initially appear. Despite its broad language that "[p]romotional rate structures are out of date,"⁹³ Michigan has not changed industrial and commercial rates nor the disparity between the classifications. While there is some movement towards limiting the promotional aspect of rates, action to date has been restricted to removing promotional elements within classifications, leaving the promotional nature of the rate differences between classes unchanged.⁹⁴ In addition, most of the reasons given by the commissions for limiting promotional rates can be used to support a promotional solar rate. The "closely interrelated purposes [of] economic efficiency, environmental protection, and conservation"⁹⁵ would all be advanced by pro-

88. *E.g.*, *Ford v. Rio Grande Valley Gas Co.*, 141 Tex. 525, 174 S.W.2d 479 (1943); 1 A. PRIEST, *supra* note 58, at 301-02.

89. *E.g.*, *Wolf v. United Gas Pub. Serv. Co.*, 77 S.W.2d 1091 (Tex. Civ. App. 1934).

90. "I must admit that I possess no instinct by which to know the 'reasonable' from the 'unreasonable' in prices . . ." *F.P.C. v. Hope Natural Gas Co.*, 320 U.S. 591, 645 (1944) (Jackson, J., dissenting).

91. *Re Detroit Edison Co.*, 3 P.U.R.4th 209 (Mich. Pub. Serv. Comm'n 1974); *Re Consolidated Edison Co.*, 8 P.U.R.4th 475 (N.Y. Pub. Serv. Comm'n 1975); *Re Madison Gas & Elec. Co.*, 5 P.U.R.4th 28 (Wis. Pub. Serv. Comm'n 1974).

92. *Re Cut Bank Gas Co.*, 12 P.U.R.4th 106, 109 (Mont. Pub. Serv. Comm'n 1975).

93. *Re Detroit Edison Co.*, 3 P.U.R.4th 209, 249 (Mich. Pub. Serv. Comm'n 1974).

94. New York appears to be the only exception to this pattern. In constructing a rate schedule for Consolidated Edison, the Public Service Commission allocated production and transmission costs on the basis of each class's average summer peak and the noncoincident class demands. *Re Consolidated Edison Co.*, 8 P.U.R.4th 475, 482 (N.Y. Pub. Serv. Comm'n 1975). While this method continues rate disparities between classes, the rates are at least tied to a comparatively rational method for determining relative responsibility for fixed costs.

95. *Id.* at 479. Different commissions have focused on different factors. Thus Michigan,

moting the use of solar energy.

While reduced rates have traditionally been adopted to increase energy consumption, they can also be used to promote conservation. During the years in which most promotional rates were established, utilities were experiencing declining marginal costs. Therefore, increased consumption, especially of primarily off-peak energy, reduced costs to all ratepayers. This situation has now been reversed to the point that the addition of new capacity necessitates rate increases. Under these changed conditions, it is necessary to reduce the need for new capacity to attain the net customer savings which justified the original promotional rates. Conservation is a prime means of achieving this reduction. A promotional solar rate should have the same advantageous effects through conservation of conventional resources as traditional promotional rates and should be equally justifiable. It is therefore likely that reduced rates designed to encourage the use of solar energy are legal, because the owners of solar energy systems can be reasonably distinguished as a class and arguably offer load factor advantages to other ratepayers.

b. *Promotional Payments*⁹⁶

While the principle of allowing different rates to be charged to different classes of customers has been uniformly recognized and accepted, other promotional practices have met with less universal approval. Cash payments designed to induce the installation of appli-

Montana, and Ohio noted the need for conservation and the energy crisis in flattening rates. *See Re Detroit Edison Co.*, 3 P.U.R.4th 209 (Mich. Pub. Serv. Comm'n 1974); *Re Cut Bank Gas Co.*, 12 P.U.R.4th 106 (Mont. Pub. Serv. Comm'n 1975); *Re Cleveland Elec. Illuminating Co.*, 3 P.U.R.4th 259 (Ohio Pub. Util. Comm'n 1973). Wisconsin, while noting the need to conserve energy, relied primarily on an economic analysis. *See Re Madison Gas & Elec. Co.*, 5 P.U.R.4th 28 (Wis. Pub. Serv. Comm'n 1974).

96. To the extent that loan guarantees have been employed by utilities and have come under regulatory scrutiny, they have been treated as a form of promotional payment. Illinois, in its generic hearing on promotional activities, determined that

it is against the best interest of the general public . . . for any of said electric or gas utilities . . . to:

- (a) Make any loans, guarantee of loans or grants to any corporation, group, or individual for building construction; or engage, in any way, in the investment in or financing of any nonutility property. . . .

Re Promotional Practices of Elec. & Gas Utils., 69 P.U.R.3d 317, 319 (Ill. Commerce Comm'n 1967). However, the majority rule is to the contrary. Michigan Consolidated Gas Company was allowed to initiate a home insulation program that included utility financing of the cost of the installation and materials. *Re Michigan Consol. Gas Co.*, 1 P.U.R.4th 229 (Mich. Pub. Serv. Comm'n 1973). *See also Re Pacific Power & Light Co.*, 69 P.U.R.3d 367 (Idaho Pub. Utils. Comm'n 1967); *Re Detroit Edison Co.*, Case No. U-5174 (Mich. Pub. Serv. Comm'n 1976); *But see Proceedings on Staff Proposal Relating to Natural Gas Conservation*, Case No. U-5272 (Mich. Pub. Serv. Comm'n 1976) (Ralls, Comm'r, concurring).

ances, for example, have come under increasing scrutiny.⁹⁷

However, the rejection of promotional payments is a comparatively recent development. In the mid-1930's, Justice Cardoza, speaking for the Supreme Court, explicitly recognized the validity and value of such payments.

We take judicial notice of the fact that gas is in competition with other forms of fuel, such as oil and electricity. A business never stands still. It either grows or decays. Within the limits of reason, . . . development expenses to foster normal growth are legitimate charges upon income for rate purposes. . . .⁹⁸

Promotional payments are still accepted by the majority of jurisdictions in this country.⁹⁹

In general, both the reasonable-classification and the indirect-benefit rationales have been applied in approving promotional payment plans. Thus one court noted that "attempts to disallow promotional expenditures as operating expenses . . . constitute an invasion of the discretion reserved to corporate management if the expenditures are designed to produce ultimate benefits to every customer and are not excessive or unwarranted."¹⁰⁰ While a number of regulatory commissions have struck down particular programs,¹⁰¹ few have questioned the propriety of the concept.

97. See generally 1 A. PRIEST, *supra* note 58, at 308-20.

98. *West Ohio Gas Co. v. Ohio Pub. Util. Comm'n*, 294 U.S. 63, 72 (1935).

99. See, e.g., *Re Delaware Power & Light Co.*, 56 P.U.R.3d 1 (Del. Pub. Serv. Comm'n 1964); *City of Eldorado v. Arkansas Pub. Serv. Comm'n*, 235 Ark. 812, 362 S.W.2d 680 (1962); *Re Promotional Activities by Gas & Elec. Corps.*, 68 P.U.R.3d 162, 167 (N.Y. Pub. Serv. Comm'n 1967).

100. *State v. Oklahoma Gas & Elec. Co.*, 536 P.2d 887, 896 (Okla. 1975).

101. See, e.g., *Re Rate Contracts for Elec. Space Heating*, 58 P.U.R.3d 90 (Mass. Dep't Pub. Utils. 1965); *Re Duke Power Co.*, 54 P.U.R.3d 574 (N.C. Utils. Comm'n 1964); *Re Portland Gen. Elec. Co.*, 67 P.U.R.3d 417 (Or. Pub. Util. Comm'n 1967). Most of the disallowed programs violated the applicable minimum standards. The New York Commission in its generic hearings on promotional practices provided a succinct statement of these standards:

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

Re Promotional Activities by Gas & Elec. Corps., 68 P.U.R.3d 162, 170 (N.Y. Pub. Serv. Comm'n 1967). But see *Re Southwest Gas Corp.*, 61 P.U.R.3d 467, 475 (Cal. Pub. Utils. Comm'n 1965); *Re Virginia Elec. & Power Co.*, 54 P.U.R.3d 561, 566 (N.C. Utils. Comm'n 1964).

Promotional payments to encourage the use of solar energy systems should be acceptable in principle to most regulatory commissions. To comply with traditional legal standards, the program would have to be structured so that it is uniformly available to all similarly situated customers and so that its cost to the utility is reasonable. Under these conditions the use of such programs to encourage reduced, rather than increased, consumption should present few difficulties. The justification for allowing payments to increase consumption has been that increased sales reduced the per unit cost to the consumer. Present utility economics are such that the most efficient method of reducing per unit cost is to reduce consumption, especially at peak demand periods. Therefore, a promotional program designed to encourage the use of solar energy to reduce peak demand should be acceptable.

The legal rules that have been developed to regulate utilities will have an obvious impact on the structure of any incentive program. If the program does not discriminate unreasonably between the utility's customers, regulatory law will neither prevent a utility from instituting a package of incentives designed to encourage the use of solar energy systems nor prevent a regulatory commission from requiring it. If the incentives are designed to reduce the utility's requirements for future peak load capacity, the results will be advantageous to all customers.

B. Antitrust Law

Antitrust law is characterized by relatively simple concepts and extremely complex factual situations. Its general objective is the maintenance of competition;¹⁰² however, competition is not a self-defining concept. The effect of the questioned activity on competitive conditions can be determined only after specifying the particular market affected, the structure of that market, the relative concentration of the firms operating in the market, the particular company's share of the market, and the items that are in competition with the product or service.¹⁰³

The importance of the factual situation in each case and the geographical limitations on the market involved make an absolute answer to what is presently a hypothetical situation impossible. Therefore, the following discussion is intended to determine the scope of the potential

102. *See, e.g.*, *United States v. Philadelphia Nat'l Bank*, 374 U.S. 321 (1963); *Northern Pac. Ry. Co. v. United States*, 356 U.S. 1 (1958); *Standard Oil Co. v. United States*, 221 U.S. 1 (1911).

103. *See, e.g.*, *United States v. Aluminum Co. of America*, 148 F.2d 416 (2d Cir. 1945). *See generally* L. SULLIVAN, *HANDBOOK OF THE LAW OF ANTITRUST* 19-29 (1977) [hereinafter cited as L. SULLIVAN].

problems and the relevant considerations rather than to resolve the question.

Although the objective of antitrust law is the protection of competition, not all anticompetitive actions are proscribed. As the Supreme Court has stated, "[T]he history underlying the formulation of the antitrust laws led this Court to conclude . . . that Congress did not intend to prohibit all contracts . . . that might in some insignificant degree or attenuated sense restrain trade or competition."¹⁰⁴ Instead, the Court has adopted, in most situations, a "rule of reason" analysis that focuses upon the actual effects of the questioned activity upon competition.¹⁰⁵

Despite earlier doubts,¹⁰⁶ it now appears that federal antitrust laws apply to the activities of public utilities. In *Cantor v. Detroit Edison Co.*,¹⁰⁷ the defendant utility argued that it was exempt from antitrust laws under the state action exception because it was pervasively regulated by the Michigan Public Service Commission. The Court noted that "there may be cases in which the State's participation in a decision is so dominant that it would be unfair to hold a private party responsible,"¹⁰⁸ but it did not find this to be such a case. Unless the questioned activity is specifically ordered by the regulator, the utility's activities must conform to the strictures of antitrust law.

104. *United States v. Topco Assocs., Inc.*, 405 U.S. 596, 606 (1972). See also *United States Steel Corp. v. Fortner Enterprises*, 429 U.S. 610, 622 (1976) (Fortner II).

105. See, e.g., *United States v. Topco Assocs., Inc.*, 405 U.S. 596 (1972); *Appalachian Coals, Inc. v. United States* 288 U.S. 344 (1933); *Chicago Bd. of Trade v. United States*, 246 U.S. 321 (1918). See generally L. SULLIVAN, *supra* note 103, at 171-82.

106. The questions were the result of an earlier case in which the Supreme Court determined that the language and legislative history of the Sherman Act revealed an intention that the Act was "to be a prohibition of individual and not state action." *Parker v. Brown*, 317 U.S. 341, 352 (1943). Under the factual pattern in *Parker*, it appeared that at least three classes of potential defendants enjoyed some immunity from federal antitrust laws: states, state officials, and private parties which acted under the state's orders. The precise scope of the exception and the issue of its equal application to each class of defendants was unclear and has been the source of continuing litigation. See, e.g., *Goldfarb v. Virginia State Bar Ass'n*, 421 U.S. 773 (1975); *Schwegmann Bros. v. Calvert Distillers Corp.*, 341 U.S. 384 (1951). As a result, the treatment of utilities under the exception has varied widely. Compare *Gas Light Co. v. Georgia Power Co.*, 440 F.2d 1135 (5th Cir. 1971) with *Washington Gas Light Co. v. Virginia Elec. & Power Co.*, 438 F.2d 248 (4th Cir. 1971). See generally Dorman, *State Action Immunity: A Problem Under Cantor v. Detroit Edison*, 27 CASE W.L. REV. 503 (1977).

107. 428 U.S. 579 (1976).

108. *Id.* at 594-95. Cf. *Jackson v. Metropolitan Edison Co.*, 419 U.S. 345, 357 (1974) ("Approval by a state utility commission of such a request from a regulated utility, where the Commission has not put its own weight on the side of the proposed practice by ordering it, does not transmute a practice initiated by utility and approved by the Commission into 'state action.'"). Commenting on *Cantor* subsequently, the Court stated that "an exemption for the program was not essential to the State's regulation of electric utilities." *Bates v. State Bar*, 433 U.S. 350, 361 (1977). In addition, the Court noted "the lightbulb program in *Cantor* was instigated by the utility with only the acquiescence of the state regulatory commission. The State's incorporation of the program into the tariff reflected its conclusion that the utility was authorized to employ the practice if it so desired." *Id.* at 362.

A solar incentive program is in potential conflict with two major doctrines of antitrust law. First, a utility which finances or installs solar collectors for its customers may be found to have tied the sale of its traditionally furnished energy to the installation of the solar energy systems. Second, the utility might be held to have foreclosed the market (its customers) to potential solar energy system competitors. Both of these problems must be considered in structuring an incentive program.

1. Tying Arrangements

In its classic form, a tying arrangement exists when a seller with a product that a buyer wants (the "tying product") refuses to sell it unless the buyer also purchases another product or service (the "tied product").¹⁰⁹ The courts have consistently found such schemes to be an attempt by the seller to extend its power over the tying product into the market for the tied product.¹¹⁰ As such, these arrangements violate section 1 of the Sherman Act,¹¹¹ section 3 of the Clayton Act,¹¹² or both.

Judicial hostility to tying arrangements is strong. Only minimal evidence of the actual effect on competition is required. "[A]t least where certain conditions are met, arrangements of this kind are illegal in and of themselves, and no specific showing of unreasonable competitive effect is required."¹¹³ Two conditions are necessary to give rise to this presumption of illegality.

First, the seller must have sufficient economic power over the tying product to restrain appreciably the market for the tied product. This competitive restraint "results whenever the seller can exert some power over some of the buyers in the market, even if his power is not complete over them."¹¹⁴ Although the requisite power is presumed when the seller has a patent or copyright monopoly,¹¹⁵ an actual monopoly is not necessary.¹¹⁶ Actual economic power can be demonstrated by evi-

109. See generally L SULLIVAN, *supra* note 103, at 431-77.

110. See, e.g., *United States v. Loew's, Inc.*, 371 U.S. 38 (1962).

111. 15 U.S.C. § 1 (1976).

112. 15 U.S.C. § 14 (1976).

113. *Fortner Enterprises v. United States Steel Corp.*, 394 U.S. 495, 498 (1969) (Fortner I). *But see* *Continental T.V., Inc. v. GTE Sylvania, Inc.*, 433 U.S. 36 (1977) (abolishing the per se illegality rule in vertical restrictions of sale transactions: "[W]e do make clear that departure from the rule of reason standard must be based upon demonstrable economic effect rather than . . . upon formalistic line drawing." *Id.* at 58-59).

114. *Fortner I*, 394 U.S. at 503. See generally *International Salt Co. v. United States*, 332 U.S. 392, 396 (1947).

115. *United States v. Loew's, Inc.*, 371 U.S. 38 (1962); *United States v. Paramount Pictures, Inc.*, 334 U.S. 131 (1948); *International Salt Co. v. United States*, 332 U.S. 392 (1947); *International Business Mach. Corp. v. United States*, 298 U.S. 131 (1936).

116. See, e.g., *Northern Pac. Ry. v. United States*, 356 U.S. 1 (1958).

dence of the "tying product's desirability to consumers or from uniqueness of its attributes."¹¹⁷ Second, a "not insubstantial" amount of interstate commerce must be affected.¹¹⁸ The Supreme Court has stated that "normally the controlling consideration is simply whether a total amount of business, substantial enough in terms of dollar-volume so as not to be merely *de minimis*, is foreclosed to competitors by the tie."¹¹⁹ However, even if a court fails to find either of these elements, it may still find an antitrust violation. "A plaintiff can still prevail on the merits whenever he can prove, on the basis of a more thorough examination of the purposes and effects of the practices involved, that the general standards of the Sherman Act have been violated."¹²⁰

Under this analysis an utility incentive program has been held to be an illegal tying arrangement. In *Cantor v. Detroit Edison Co.*¹²¹ the defendant had instituted a light bulb exchange program with regulatory approval. Customers were charged for the electricity that they consumed but were not billed separately for the bulbs they used. The utility's rates, however, reflected the cost of the program as an operating expense. The Court did not discuss the antitrust implications in detail but assumed that the utility had illegally tied the sale of electricity to the bulb exchange program. Because all residential consumers were forced to pay for the bulbs through the rate structure,¹²² the utility's failure to realize any direct profit from the program was held to be immaterial.¹²³

Although the *Cantor* holding could arguably be avoided if the regulatory commission held hearings and issued a formal order, the scope of the state action exemption remains unclear. Therefore, a solar incentive program should be structured to avoid reliance *solely* upon the nebulous state action doctrine.

An incentive program could be formulated to avoid these difficulties. For example, it would be prudent for any utility considering an

117. *United States v. Loew's, Inc.*, 371 U.S. at 45.

118. *International Salt Co. v. United States*, 332 U.S. at 396.

119. *Fortner I*, 394 U.S. at 501.

120. *Id.* at 500.

121. 428 U.S. 579 (1976).

122. The Court, in its discussion of the defendant's program, did provide sufficient facts to establish a tying arrangement. First, the utility had a monopoly in the sale of electricity. Second, it provided 50% of the most commonly used residential bulbs which would cost almost \$6 million if sold retail. The defendant had substantial economic power over one commodity (electricity) and was using this leverage to gain a not insubstantial effect in another market (light bulbs). *Id.*

123. *Id.* at 583-84. The Court noted, however, that "[t]he purpose of the program, according to respondent's executives, is to increase consumption of electricity." *Id.* at 584. While inclusion of the costs of the bulb program as an operating expense (rather than in the ratebase) provided no direct "profit" to the company, it would enhance the company's profitability if the program achieved its stated objective.

incentive program to comply with the current contours of the state action exception. The utility could encourage the regulatory commission to hold hearings, to issue detailed findings on the proposed incentives and the regulation of energy supplies, and specifically to order the utility to initiate the program. In addition, the utility could avoid the tying issue by obtaining repayment of the costs associated with the program from participating consumers. If other suppliers of solar energy systems were not foreclosed from selling to the utility's customers, the probability of the program's validity would be substantially increased. It is, however, impossible to specify with absolute certainty the structure that should be adopted. The factual determinations required will be unique to each situation.

2. Vertical Restrictions

The most common type of vertical restriction is the franchise. "The distinguishing feature of a franchise arrangement is that customers, often the public in general, perceive an identification between franchisor and franchisee."¹²⁴ While potential alternative configurations under this type of arrangement are numerous, the most important one for a utility incentive program is the exclusive dealership plan. Under this type of plan, the franchisee is granted an exclusive right to market a product as the franchisor's authorized representative. These plans are illegal when they unduly restrain competition by foreclosing the market.¹²⁵

The case law establishes that a dominant firm may not, by committing itself to a single dealer, give that dealer dominance in its own stage of the marketing process.¹²⁶ The traditional goal of these arrangements is to reduce intrabrand competition by restricting the number of dealers handling a particular brand in a particular area. The overall competitive effect of this type of scheme is less clearly anticompetitive than tying arrangements. "The market impact of vertical restrictions is complex because of their potential for simultaneous reduction of interbrand competition and stimulation of interbrand competition."¹²⁷ This complexity recently led the Court to abandon the per se illegality

124. L. SULLIVAN, *supra* note 103, at 400.

125. *Continental T.V., Inc. v. GTE Sylvania, Inc.*, 433 U.S. 36 (1977). The rule of reason analysis rather than an illegality per se approach is used to determine the validity of these arrangements. See notes 105, 112 *supra* and accompanying text.

126. See, e.g., *United States v. Topco Assocs., Inc.*, 405 U.S. 596 (1972); *United States v. Bausch & Lomb Optical Co.*, 321 U.S. 707 (1944).

127. *Continental T.V., Inc. v. GTE Sylvania, Inc.*, 433 U.S. at 51-52.

rule and to revert to the rule of reason.¹²⁸ Vertical restraints are not restricted in principle to situations in which the effect is to limit intrabrand competition. An exclusive dealership arrangement could be used effectively to restrain competition between brands.

A utility could structure its program to avoid the traditional form of exclusive dealing plans by authorizing a single dealer to produce the systems or to install qualified systems which the utility itself did not manufacture. However, such factual differences are immaterial. The utility would still be using its substantial economic power and leverage to give its authorized representative dominance in the market for solar energy systems. This result is particularly likely in the current solar market due to its decentralized nature. Solar energy systems as commercial products are comparatively new. Most of the firms currently producing such systems or system components are small, although a number of large national or multinational firms are beginning to enter the market.¹²⁹ The economic advantages to these small companies of an exclusive dealership would be substantial in light of the market power of utilities.

The incentive package itself should be structured to encourage competition among potential suppliers and installers of the solar energy systems. This can be accomplished most easily by adopting minimum standards for the financing or installation incentives which further the utility's goal of reducing the need for additional peaking capacity. The standards should not materially aid or exclude any manufacturer of a dependable system. The individual homeowner's choice among systems should be as free as possible from the influence of the incentive program. In addition, the utility should avoid establishing an authorized dealership arrangement with a single company. If administrative efficiency requires dealer or system certification procedures, certified status should be open to all who meet the minimum standards. In short, the utility should not attempt to give any manufacturer or installer a competitive advantage.

In general, based on the above considerations, there are no legal principles which would prevent an energy utility from offering a package of solar energy incentives. While the novelty of the idea might

128. *Continental T.V., Inc. v. GTE Sylvania, Inc.*, 433 U.S. 36 (1977), *overruling*, *United States v. Arnold Schwinn & Co.*, 388 U.S. 365 (1967).

129. A list of solar manufacturers compiled in late 1976 totaled only 233 companies. See NATIONAL SOLAR HEATING & COOLING INFORMATION CENTER, SOLAR HOT WATER AND YOUR HOME 14-20 (1976). A similar list in mid 1977 included 283 companies manufacturing a solar product. See INTERNATIONAL SOLAR ENERGY SOCIETY, SURVEY OF THE EMERGING SOLAR ENERGY INDUSTRY 300-15 (1977). Neither list contained the five small Oregon companies currently manufacturing solar energy systems.

initially cause concern, its similarity to many traditional incentives should be sufficient to overcome the skepticism which often greets a different approach.

VII. SOCIAL AND POLITICAL ISSUES

The social and political effects of a utility-sponsored incentive program are the most difficult to assess. These issues are largely defined by individual perception and are grounded in ideology, economic involvement, and other idiosyncratic variables. Therefore, the following discussion can only be a primer to the more probable responses.

An increase in the use of solar energy would reduce both pollution¹³⁰ and growing national dependence on expensive imported fuel¹³¹ and would stimulate employment.¹³² Vigorous utility involvement through an incentive program would contribute to the realization of these social benefits if utility participation can increase the use of solar energy.

Although the sun's energy is "free," the substantial capital investment required to utilize it is likely to retard general and rapid acceptance.¹³³ Utility incentive programs can partially ameliorate this problem. The utility can broaden a homeowner's access to capital markets by allowing him to benefit from the lower interest rates at which the utility can frequently purchase money.¹³⁴ The utility would

130. Solar energy is the most environmentally benign energy resource. *See generally* 1 ENVIRONMENTAL & RESOURCE ASSESSMENTS BRANCH, DIVISION OF SOLAR ENERGY, ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION, SOLAR PROGRAM ASSESSMENT: ENVIRONMENTAL FACTORS—SOLAR HEATING AND COOLING OF BUILDINGS (ERDA 77-47/1 1977).

131. This would improve our current international trade imbalance. Between January and June of 1977, the United States recorded a balance of payments deficit of \$25.2 billion. During the same period, petroleum accounted for 30% of all foreign purchases, or \$22.6 billion. *COM. AMERICA*, Aug. 26, 1977, at 2-3. Reduced dependence on foreign energy would also remove a potential political weapon from the hands of suppliers and save the remaining domestic reserves for more appropriate high-temperature and noncombustion uses.

132. The public utilities are currently among the most capital intensive with an average investment of \$105,000 per employee. In comparison, all manufacturing averages \$19,500 per employee and the textile industry only \$5,000. *Energy & Jobs: Does Less Mean More?*, PEOPLE & ENERGY, June 1977, at 8. Solar energy, on the other hand, is labor intensive. Recent studies indicate that between 2.5 and 4 times as many jobs per dollar would be created by solar and conservation technologies as by nuclear technologies. *See generally Energy Conservation Act of 1976: Hearings on S. 2932 Before the Senate Comm. on Commerce*, 94th Cong., 2d Sess. 116 (1976) (statement of Fred Dubin); S. LAITNER, THE IMPACT OF SOLAR AND CONSERVATION TECHNOLOGIES UPON LABOR DEMAND (1976). In addition, the jobs would require considerably less training and would thus be more accessible to the chronically unemployed. Callion, *Solar Energy: Potential Powerhouse of Jobs*, WORKLIFE, Aug. 1976, at 2. *See generally* ENVIRONMENTALISTS FOR FULL EMPLOYMENT, JOBS & ENERGY (1977).

133. *See* Hirshberg, *supra* note 5, at 468 ("Since the construction industry is highly 'first-cost' sensitive, we expect that solar energy will have some difficulty finding early, rapid acceptance.")

134. Interest rates are crucial, especially during the initial phase of market penetration. *See* JOINT ECONOMIC COMM., *supra* note 30, at 84.

benefit as well because it "would turn over its money at least twice as quickly, thus retaining an attractive rate of return."¹³⁵

Another major reason for the current high cost of solar energy systems is the scarcity of mass-produced components. Utility participation could increase demand and thus provide the necessary incentive to the investment of capital in mass-production technologies.¹³⁶ Other economies of scale, such as mass purchasing, might also contribute to significantly reduced costs.

However, utility involvement is not without its potential disadvantages. The primary political issue is solar energy's potential decentralizing effect on society.

In place of massive hierarchical organizations, solar and wind power could create a basis for smaller economic and political units, . . . lead to a reduction in the size of urban centers and the decentralization of industry and administration, which would facilitate a greater degree of citizen self-management in all areas of life.¹³⁷

This issue has already produced some heated rhetoric. In early 1977, Southern California Gas Company petitioned the California Public Utility Commission to be allowed to test the feasibility of various solar technologies through a demonstration project.¹³⁸ Numerous public interest and consumer groups objected. One spokesperson noted dramatically, "It is unbelievable that the control of the sun, which falls on rich and poor, on all continents of the globe, should be given by a public agency to a private group interested in their own profit."¹³⁹

135. Lovins, *Energy Strategy*, *supra* note 10, at 88.

136. See generally Hirshberg, *supra* note 5, at 468. The authors cite two additional potential advantages:

[B]ecause a utility company already has a sales/distribution/service network which operates within the housing industry, the Utility Company scenario provides a way of "product fitting" solar energy systems.

Finally, because of the traditional anti-innovation bias within the industry . . . utility company sponsorship will help overcome some of the traditional "institutional-cultural biases" against solar energy which exist within the housing industry.

Id.

137. Solomon & Riesmeyer, *The Development of Alternative Energy Sources: A Legal and Policy Analysis*, 30 OKLA. L. REV. 319, 352 (1977). A decentralized energy supply system is also beneficial for national security because it is much less susceptible to acts of political sabotage and terrorism. See generally Ayres, *Policing Plutonium: The Civil Liberties Fallout*, 10 HARV. C.R.-C.L. L. REV. 369 (1975).

138. *Re* Southern Cal. Gas Co., Application No. 57032 (Cal. Pub. Util. Comm'n Jan. 21 1977).

139. *Id.*, statement of Tom Hayden, Campaign for Economic Democracy at 1 (Apr. 25, 1977). See also *Utilities and Solar Energy: Who Will Own the Sun?*, PEOPLE & ENERGY, Oct. 1976, at 2. Such rhetoric unfortunately glosses over a crucial fact. Solar energy is inexorably tied to the ownership of land. Although nondepletable on a human time scale, it is limited at any given time to available surface area. The capture and conversion of solar energy is therefore limited to

While the program in question was poorly designed and exorbitantly expensive—it would have installed only 315 solar water heating systems at a cost of approximately \$11,000,000—the objections indicated a greater concern with who would control the sun. It is debatable whether all incentive programs would provoke such responses. The Southern California Gas proposal apparently envisioned utility ownership and leasing of the systems. On the other hand, the incentive package proposed here is based on individual ownership. Nevertheless, the symbolic power of the decentralization issue should not be underestimated. . . . The issue of decentralized solar power is symbolic of a greater issue, the preservation of liberty and equity through maintaining some independence from the “big system.” It is for some an ideological credo. . . . Thus there is considerable reason to believe that the issue of decentralization of energy sources may turn out to be surprisingly vigorous and persistent.¹⁴⁰

The Southern California Gas proposal also reveals another potential problem with utility involvement. By allowing a return on capital investment, the traditional formula for determining rates provides a strong incentive for the utility to invest in the most expensive equipment available.¹⁴¹ Similar traditional problems are limited in normal rate proceedings because regulatory commissions are familiar with traditional utility expenditures. However, the novelty of solar energy would initially reduce this control. Nonetheless, this problem could be largely eliminated by an incentive program that precludes utility ownership of the systems.

An additional potential difficulty results from the conflicting loyalties that may be inherent in the program. The utilities would naturally favor expanding the market for their conventional energy product and may be unwilling to encourage intensively the use of a commodity that will reduce the need for their product. As one utility representative noted, “If we succeed in getting the public to conserve energy to the point where our revenues drop 15 to 20 percent, we may all be looking for a job.”¹⁴² This problem will be only partially alleviated if the use

persons with at least a possessory interest in land. Thus like other natural resources, solar energy is an unequally distributed commodity.

140. STANFORD STUDY, *supra* note 4, at 86.

141. Portland General Electric has recently installed two solar energy systems in Portland-area homes at a cost in excess of \$30,000 each. See also R. Noll, Public Utilities and Solar Energy Development (1976), quoted in Dean, *supra* note 37, at 351 (“a regulated utility has an incentive to invest in solar technology that is too durable, that is excessively efficient in converting sunlight to usable energy, and that requires inefficiently little maintenance.”).

142. BOOZ, ALLEN, & HAMILTON, INC., SOLAR ENERGY UTILIZATION IN FLORIDA at A(56) (1975) [hereinafter cited as BOOZ].

of solar energy improves the utility's load factor and thus its profits.

The energy utilities' position between wholesalers and consumers of energy insures that they will play a significant role in determining the rate at which this country shifts to solar energy. Utility hostility, expressed in the form of higher rates for solar users,¹⁴³ would seriously retard the utilization of solar energy by reducing the economic incentives to install solar energy systems. After interviewing public utility representatives, a study for the Florida Energy Committee concluded that "[t]heir stance can . . . be characterized as defensive, on balance."¹⁴⁴ These representatives viewed solar energy as a threat because "the only result could be a reduction in utility revenues."¹⁴⁵ These fears are not confined to Florida. Similar opinions have been expressed recently by the industry's trade group: "[I]t is clear that truly optimum solar energy utilization must consider the total requirements for meeting load demand, *i.e.*, the utility generation system as well as local solar economics."¹⁴⁶

Utility concern with load factors is eminently reasonable. To date most solar energy systems have not been designed to draw their auxiliary energy during off-peak periods. However, the technology is available to rectify this situation.¹⁴⁷ An incentive program conditioned upon the use of off-peak auxiliary power could speed both the refinement and implementation of this technology, as well as benefit the utility. Such a program would also be advantageous to the utility's ratepayers. It would improve load factors, reduce demand and the need for additional capacity, and ultimately reduce increases in utility rates.

The majority of these problems go to the form rather than the fact of utility participation. Utility ownership of the solar energy systems is likely to produce significant opposition, while an incentive program stressing ownership by the individual homeowner may be more acceptable. The central role of the energy utilities in the energy distribution network of this country is such that their opposition could delay the introduction of solar energy. Thus it is crucial that their support be sought.

143. Such rate increases have already been proposed by at least one utility. See Dean, *supra* note 37, at 342-43.

144. BOOZ, *supra* note 142, at A(52).

145. *Id.* at A(54).

146. D. SPENCER, *supra* note 37, at 10.

147. See notes 42-57 *supra* and accompanying text.

VIII. CONCLUSION

A utility incentive program designed to increase the use of solar energy is economically advantageous, technically feasible, legally permissible, and socially desirable. While there are potential problems in each of these areas, they are not insurmountable.

The question, however, remains essentially a political one. What type of society do we wish to leave to our descendents? If we are to leave them any nonrenewable energy resources, we must begin a rapid transition to the use of solar energy. This transition can be most expeditiously accomplished through the use of a number of social and economic incentives. Because of their pivotal role in the current energy distribution network, the utilities are a logical group to provide some of the necessary stimulus.

APPENDIX

COSTS OF NUCLEAR, COAL, AND SOLAR ENERGY

The formula used to project costs to utilities of new coal- or nuclear-fired generating capacity was adapted from one developed by the Federal Energy Administration:¹⁴⁸

Formula 1:

$$\text{UPE} = \frac{\text{CC}_1 \times \text{FCR}}{\text{C} \times 8.76} + \frac{\text{CC}_2 \times \text{FCR}}{8.76} - 15\% \left[\frac{\text{CC}_1 \times \text{FCR}}{\text{C} \times 8.76} + \frac{\text{CC}_2 \times \text{FCR}}{8.76} \right] + \frac{\text{HR} \times \text{F}}{10^5} + \text{O\&M}$$

where:

- UPE = cost to the utility (mills/Kwh)
- CC₁ = capital cost of the plant (\$/Kw)
- FCR = annual fixed charge rate
- C = capacity factor
- CC₂ = capital cost of transmission (\$/Kw)
- HR = heat rate
- F = fuel costs (¢/mBtu)
- O&M = operation and maintenance costs (mills/Kwh)

For uniformity, these costs were converted into costs per million British thermal units (mBtu) of delivered hot water with the following formula:

Formula 2:

148. INTERAGENCY TASK FORCE ON SOLAR ENERGY, FED. ENERGY AD., PROJECT INDEPENDENCE FINAL TASK FORCE REPORT at IV-B-1 (1974), reprinted in 1D *Energy Research and Development and Small Business: Hearings Before the Senate Select Comm. on Small Business*, 94th Cong., 1st Sess. 3993 (1975) [hereinafter cited as FINAL TASK FORCE REPORT]. The only significant alteration of the formula, which was developed to determine the *cost to consumers* is the reduction of capital investment figures by 15% to remove the utility's rate of return, thus giving the *cost to the utility*. Unless otherwise noted, the individual cost items are those employed in the FINAL TASK FORCE REPORT.

The costs are computed in terms of a hypothetical "average" 1000 MW plant. As a result, the final cost per BTN figure, while broadly valid, is unlikely to match either the actual cost or the total cost to society of any individual plant. First, the actual cost for a plant is likely to vary from the average for idiosyncratic reasons, *e.g.*, rural sites generally result in higher construction costs. Second, transmission losses are not included because of their direct relationship to transmission distances. These losses are approximately 1% per 100 miles. Third, the focus on individual plants also ignores system—or society—wide support costs. Nuclear plants, for example, require not only a large number of governmental bodies, *e.g.*, the Nuclear Regulatory Commission, Department of Energy, and state siting bodies, but are also recipients of significant governmental subsidies, *e.g.*, liability limitations, basic research operations, and proposed waste storage facilities. All electrical plants also require extensive distribution systems. For these reasons, among others, the cost figures are probably too low.

$$$/\text{mBtu} = \frac{\text{C/Kwh}}{3413} \times \frac{1}{\text{COP}} \times 10^6$$

where:

C/Kwh = cost per kilowatt hour (\$/Kwh)

1 Kwh = 3413 Btu

COP = coefficient of performance (0.9 for electric resistance water heating)

A. NUCLEAR COSTS

Cost projections for nuclear-generated electricity are beset by a number of uncertainties. These difficulties can be traced primarily to the increasing lead times required for such plants. The total time from the planning of a plant to its becoming operational has more than doubled from the six years required in 1967.¹⁴⁹ During this time the effect on capital costs of inflation alone is significant.

However, the capital costs of nuclear plants have escalated far more rapidly than inflation. A recent study, for example, concluded that the capital costs had increased \$188 per kilowatt of installed capacity during the 1970's.¹⁵⁰ Another study detected a constant 24% increase in projected costs each year between 1967 and 1974.¹⁵¹ The effect of such increases is staggering. The 1965 projections of \$130 per installed kilowatt have jumped to a range from \$1,000 to \$3,000 per kilowatt.¹⁵²

A similar trend is also apparent in the cost of fuel. The cost of uranium has risen from \$8 to \$40 per pound, and the enriched uranium

149. O'Leary, *Overview*, in ENERGY/ENVIRONMENT II 5, 7 (1977) [hereinafter cited as O'Leary]. See also Busett, *The High Cost of Nuclear Power Plants*, PUB. UTIL. FORT., Apr. 27, 1978, at 29, 34.

150. See Metz, *Nuclear Goes Broke*, NEW REPUBLIC, Feb. 25, 1978, at 23, 24 [hereinafter cited as Metz].

151. Zener, *A Comparison of the Economics of Nuclear and Solar Power*, in 5 SHARING THE SUN: SOLAR TECHNOLOGY IN THE SEVENTIES 535, 536 (1976) [hereinafter cited as Zener]. But see Lotze & Riordan, *Capital Cost Behavior: Is Nuclear Different?*, PUB. UTIL. FORT., Apr. 27, 1978, at 36, 38 [hereinafter cited as Lotze] (finding only a 10.36 increase in capital costs between 1970 and 1976).

152. Projections vary widely, seemingly in relation to the analysts pro or antinuclear bias. See, e.g., Bonneville Power Administration, Administrator's Newsletter, Mar. 1978, at 11 (reporting that a plant scheduled to begin operation in 1981 had escalated in cost from \$394 million to \$1.1 billion (\$358/Kw to \$1,000/Kw) excluding interest charges during construction which will total \$42.8 million (\$39/Kw in 1978 alone); Harding, *Sundesert: California's Fiscal Mirage*, FRIENDS EARTH, mid-Mar., 1978, at 4, 5 [hereinafter cited as Harding] (reporting California Energy Commission's estimates of \$1,451 to \$2,813 per kilowatt for plants to be completed in 1985); Metz, *supra* note 150, at 24 (\$1,250 to \$1,667 per kilowatt); O'Leary, *supra* note 149, at 7 (\$1,100 per kilowatt); Zener, *supra* note 151, at 540 (\$2,200 to \$3,100 per kilowatt for plants begun in 1976). As two pronuclear commentators have noted, "[e]stimated costs are frequently reported instead of actual costs, although estimates often understate actual costs, [especially in the case of nuclear plants]." Lotze, *supra* note 151, at 37 (emphasis added).

required to fuel the reactors has gone from \$35 to \$75 per kilogram.¹⁵³ Estimates of fuel costs in the early 1980's range from an Energy Research and Development Administration projection of 3.3 mills per kilowatt hour (90¢ per mBtu) to an industry projection of 4.1 mills (130¢ per mBtu).¹⁵⁴

Thus, the costs are:

$$CC_1 = \$1,000/Kw^{155}$$

$$FCR = 0.15$$

$$C = 0.60$$

$$CC_2 = \$535/Kw$$

$$HR = 10^4 \text{ Btu/Kwh}$$

$$F = 113¢/mBtu^{156}$$

$$O\&M = 1.6 \text{ mills/Kwh}^{157}$$

When these figures are put into Formula 1 they yield a projected cost to a utility of at least 45.2 mills per kilowatt hour. This is converted with Formula 2 into a cost of \$11.80 per mBtu.

B. COAL COSTS

Coal cost projects are plagued by similar uncertainties. The difficulties are, however, significantly less troublesome than with projections of nuclear costs. First, the lead times for coal plants are less than half of those for nuclear plants.¹⁵⁸ Thus, capital cost projections are much simpler and more accurate. Second, coal plants involve "known technologies with known, or knowable, pollution control and safety standards."¹⁵⁹ In addition, while capital costs for coal plants have escalated in recent years, they have increased at a much slower rate than those for nuclear plants.¹⁶⁰

153. Metz, *supra* note 150, at 24.

154. The ERDA estimate is in ATOMIC ENERGY COMM'N, THE NUCLEAR INDUSTRY 1974 18-20 (1974) (Wash. 1174-74). The industry figure was developed by Frank Schwoerer. It is reported in ATOMIC INDUSTRIAL FORUM, SUMMARY REPORT: FUEL CYCLE CONFERENCE '75 70-76 (1975). A 1977 report based upon the Schwoerer projections estimates the cost in 1988 to be 4.83 mills/Kwh or 150¢/mBtu. This figure would produce a total cost of \$17.60/mBtu of delivered heat. Oregon Department of Energy, Future Electricity Prices in Oregon: A Cost Based Analysis 39 (Feb. 1977) [hereinafter cited as Oregon Department of Energy].

155. See note 152 *supra*.

156. This is the figure in the FINAL TASK FORCE REPORT. See note 148 *supra*.

157. This was the cost in 1973, the latest year for which information was available. Oregon Department of Energy, *supra* note 154, at 48.

158. O'Leary, *supra* note 148, at 7 (approximately 5 years); Oregon Department of Energy, *supra* note 153, at 26 (6-8 year lead times).

159. Harding, *supra* note 152, at 4.

160. See Bupp, *supra* note 39, at 21 (nuclear capital costs increased at a rate of 238% higher than coal plants). But see Lotze, *supra* note 151 at 38 (only minimal escalation rate differences: 10.36% for nuclear and 10.21% for coal). Even assuming the comparatively negligible differences presented in the Lotze study, the differing periods required for each type of plant to become operational results in substantial cost differences. For example, thermal plants that became operational in 1975 averaged \$446/Kw for nuclear and \$366/Kw for coal. Oregon Department of

There are, unfortunately, few detailed studies of projected capital costs for coal-fired thermal plants. Those that have been completed indicate that these costs will be between \$583 and \$1300 per kilowatt of installed capacity.¹⁶¹ Similarly, there is little information upon which to base a projection of fuel costs. One study reports a 277% increase between 1970 and 1975.¹⁶² Cost projections of future coal prices are also subject to greater uncertainty than similar costs for nuclear plants. The most significant cause is the bulkiness of coal, which leads to substantial transportation charges which vary with the distance that it must be shipped.¹⁶³ For these reasons, the fuel cost estimates employed in the Final Task Force Report¹⁶⁴ have been used in this analysis.

$$\begin{aligned}
 CC_1 &= \$700/\text{Kw}^{165} \\
 \text{FCR} &= 0.15 \\
 C &= 0.80 \\
 CC_2 &= \$535/\text{Kw} \\
 \text{HR} &= 10^4 \text{ Btu} \\
 F &= 124\phi/\text{mBtu} \\
 \text{O\&M} &= 1.14 \text{ mills}/\text{Kwh}^{166}
 \end{aligned}$$

When these figures are employed in Formula 1, a projected utility cost of 34.1 mills per kilowatt hour results. Using Formula 2, a cost of \$8.90 per mBtu is derived.

C. SOLAR COSTS

Solar costs given below were computed by extrapolation from an economic analysis performed by the Energy Research and Develop-

Energy, *supra* note 154, at 32. Escalating these prices at the Lotze rates over the lead times for the respective types of plants produces a nuclear cost of \$1.456/Kw and a coal cost of \$656/Kw. In short, nuclear would cost 222% more than coal. This general conclusion is also supported by the Lotze study. Over the study period (1971-1976) total costs for nuclear plants rose 13.56% as compared to coal plants total increase of 6.77%. Lotze, *supra* note 151, at 39.

161. Harding, *supra* note 152, at 5 (reporting California Energy Commission estimate of \$1,469 to \$2,773 per kilowatt installed capacity for plants to be completed in 1985); Oregon Department of Energy, *supra* note 154, at 32 (Coal plants to be operational in 1983 estimated to cost \$583/Kw).

162. Garvin, *The Forces at Work on the Future Tempo*, PUB. UTIL. FORT., Apr. 14, 1977, at 23, 25 (an increase from 31.2¢/mBtu to 86.4¢/mBtu). See also Oregon Department of Energy, *supra* note 154 at 44.

163. In 1975 transportation charges for delivery of coal from Montana or Wyoming to a thermal plant in eastern Oregon constituted 65% of the total cost. It is estimated that transportation costs will increase more rapidly than the cost of the coal in Montana or Wyoming. By 1996 transportation will comprise 70% of the total cost of delivered coal. Oregon Department of Energy, *supra* note 154, at 47.

164. See note 148 *supra*.

165. See note 161 *supra*.

166. This was the cost in 1973, the last year for which national figures were available. Oregon Department of Energy, *supra* note 154, at 48.

ment Administration (ERDA).¹⁶⁷ The cost per million British thermal units was computed with the following formula:

Formula 3:

$$$/mBtu = \frac{TC}{(HR \times PS) \times SL}$$

where:

TC = total deferred cost (at 8.5% interest over 20 years.)

HR = heating requirements (Btu/yr)

PS = percentage of heating requirement provided by solar

SL = system life (20 yrs)

The 1975 cost of electricity in each city was used to optimize the size and cost of solar hot water systems for maximum economic competition.

	1975 cost/ft ²	collector area	% of require- ments solar	total cost*	cost/ mBtu
Atlanta, Georgia					
	\$20	99	80.7	\$3687	\$3.87
	\$15	118	87.3	\$3296	\$3.20
	\$10	148	93.9	\$2756	\$2.49
Bismark, North Dakota					
	\$20	91	76.3	\$3389	\$1.67
	\$15	119	85.9	\$3324	\$1.45
	\$10	153	92.0	\$2849	\$1.16
Boston, Massachusetts					
	\$20	144	76.7	\$5363	\$3.77
	\$15	170	85.9	\$4749	\$3.12
	\$10	255	94.1	\$4749	\$2.72
Los Angeles, California					
	\$20	110	95.4	\$4097	\$4.51
	\$15	110	95.4	\$3073	\$3.38
	\$10	127	98.0	\$2365	\$2.50
Miami, Florida					
	\$20	109	94.9	\$4060	\$8.86
	\$15	109	94.9	\$3045	\$6.64
	\$10	132	98.6	\$2458	\$5.14

*Assuming an 8.5% real interest rate.

A recent study of actual installed costs for solar energy systems in the state of Oregon found that the systems installed through 1977 averaged \$12.38 per square foot of collector surface.¹⁶⁸

167. DIVISION OF SOLAR ENERGY, ENERGY RESEARCH & DEVELOPMENT ADMINISTRATION, AN ECONOMIC ANALYSIS OF SOLAR WATER AND SPACE HEATING C-3 to C-15 (1976).

168. Solar Energy Center, University of Oregon, Oregon Solar Energy Directory (1978). There were 46 installations in the state when the directory was compiled. Cost data was available for only 36 of these. Six installations were excluded from the cost figure because they were passive systems or they employed air as the heat transfer medium. Eight additional installations were also omitted because they were either constructed with government funds (three systems) or

These costs are comparable with those presented in the description of a solar water heating system for use in the Rocky Mountain region. The economic analysis included with the description concluded that the solar costs were \$3.75/mBtu.¹⁶⁹

While it is possible to quibble with any of the particular cost items employed in this rough cost comparison of nuclear, coal, and solar energy, the broad conclusion seems unavoidable. A properly sized solar energy system is a less expensive source of additional energy for a public utility than the expansion of conventional generating capacity. This conclusion should not be surprising. A number of analysts have previously concluded that solar energy is already cost competitive in some applications with the utilities' average cost of generating electricity.¹⁷⁰ With the substantial increases in the cost of new capacity over the past few years, the conclusion that solar energy is cost competitive with the utilities' marginal costs for most applications seems reasonable.

by utilities. Governmentally-funded systems averaged \$35.67/ft²; utility constructed systems cost \$64.53/ft². One other system, which used an indoor swimming pool as the heat storage unit, was also excluded. The sample thus consisted of nineteen installations.

169. Shippee, *A Solar Hot Water Heating System*, in SHARING THE SUN: SOLAR TECHNOLOGY IN THE SEVENTIES 355, 363 (1976). The system's total cost was \$1123.20 and it included 48 ft² of collector surface.

170. See notes 29-32 *supra* and accompanying text.