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SERI/TR-62-255

June 1979

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Regulated Utilities and Solar Energy

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SERI

Solar Energy Research Institute
A Division of Midwest Research Institute

1536 Cole Boulevard
Golden, Colorado 80401

Operated for the
U.S. Department of Energy
under Contract No. EG-77-C-01-4042

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Printed in the United States of America
Available from:
National Technical Information Service
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161
Price:
Microfiche $3.00
Printed Copy $5.25

NOTICE

SERI/TR-62-255
UC CATEGORY: UC-59, 62

REGULATED UTILITIES AND SOLAR ENERGY: A LEGAL-ECONOMIC ANALYSIS OF THE MAJOR ISSUES AFFECTING THE SOLAR COMMERCIALIZATION EFFORT

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JUNE 1979

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FOREWORD

This Legal Reconnaissance Paper on Regulated Utilities and Solar Energy was prepared by the Solar Energy Research Institute (SERI) to fulfill, in part, SERI's solar information dissemination function. This paper is part of the Market Development Branch Law Program, which in turn is a part of the overall program of the Technology Commercialization Division.

This is the third of five Legal Reconnaissance Papers sponsored by the SERI Law Program. The other four address (1) legal issues surrounding the commercialization of OTEC, (2) legal issues pertaining to the commercialization of WECS, (3) municipal bonds as a method of accelerating public and municipal interest in solar energy, and (4) legal issues raised by the commercialization of solar heating and cooling (SHAC) devices. These five studies are meant to broadly survey the legal questions that are raised by either a specific solar technology (i.e., OTEC, SHAC, and WECS) or a potential barrier or incentive to the general commercialization of solar technologies (i.e., utilities and municipal bonds). It is hoped that these reconnaissance papers will be springboards for further, more detailed studies of some aspect of the general topic covered.

The research for this paper was funded primarily by the Solar Energy Research Institute, as part of its Visiting Law Professor and Summer Law Intern Programs. Much of the initial research for Sections 2.0 and 3.0 of the paper, which deal with (1) ownership by regulated utilities of decentralized solar devices, and (2) solar-powered utility competition with existing, regulated fossil-fuel-powered utilities, was conducted under the auspices of the Colorado Energy Research Institute, Golden, Colorado. Sections II and III of the paper have also been published separately, by the Denver Law Journal (in 56 Denver L.J. 31 [1979]), and by the Colorado Energy Research Institute in a CERI report entitled "Public Policy Questions Posed by the Rise of a Solar Energy Industry in Colorado" (1979). Section 4.0 of the paper, which deals with the role of utility rate structures as potential barriers to solar commercialization, is to be published separately by the Solar Energy Research Institute, as an article in the Solar Law Reporter (in Volume 1, #2 [1979]), and as one research product of the SERI Law Program Summer Intern Program.

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ABSTRACT

The reaction of public utilities to the additional (and competitive) sources of energy supplied by solar technologies will have a significant impact on the commercialization of solar energy. Decentralized applications of solar energy need utility-produced power to back up the energy produced by solar means. The cost and availability of this power will largely determine the acceptance of solar energy. There are three legal issues surrounding the role of utilities in the solar commercialization effort: (1) the extent to which utilities may own, sell, lease, finance, or service solar devices for utility customers; (2) the degree to which solar-powered utilities may be able to compete with existing utilities; and (3) the degree to which various utility rate structures will be allowed to penalize decentralized solar users. The impact of state constitutional and statutory provisions upon these issues is examined, along with relevant federal constitutional doctrines. Finally, the statutes of the National Energy Act, many of which specifically address the above issues, are discussed.

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SUMMARY

It is anticipated that the role of private, investor-owned and municipally owned utilities will have a significant impact on the commercialization of solar energy. Utilities play a powerful role in the future of solar energy because solar technologies tend to supplant or supplement energy furnished by utilities, and the utilities' reaction to this additional (and competitive) source of energy will affect the commercialization potential of solar technologies. Moreover, decentralized applications of solar energy need utility-produced power to back up the energy produced by solar means. The cost and availability of this utility-generated power will impact on the acceptance of solar energy. In addition, applicable provisions of the National Energy Act (e.g., The National Energy Conservation Policy Act of 1978) require most utilities to advise consumers on solar-reliant conservation measures.

There are three legal issues surrounding this important utility role in the solar commercialization effort. First, in the near term, it is important to know whether existing utilities may own, sell, lease, finance, or service solar devices for utility customers. Second, in the long term, it is necessary to understand whether solar-powered utilities may be able to compete with existing, regulated utilities that rely on conventional (e.g., oil, gas, coal, uranium, and hydroelectric) fuels. Third, in both the near and long term, it is imperative that lawyers, legislators, utilities, and PUCs realize the extent to which various utility rate structures penalize or encourage decentralized solar applications. Underlying these three issues (especially the second) is the important question of whether a solar-reliant power system may itself become a utility subject to PUC jurisdiction and control.

State statutory and constitutional law provide tentative answers to many of these issues. Federal constitutional law is significant when considering the antitrust and equal protection implications of utility behavior toward solar facilities. The statutes of the National Energy Act specifically address many of the issues that arise from solar technologies. Regulations from the Department of Energy implementing these statutes will go even further in resolving conflict about this utility role.

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SECTION 1.0

INTRODUCTION

Increased interest in alternative energy forms has lately been stimulated by concern over the steady depletion of nonrenewable energy resources such as natural gas, oil, and coal. Solar energy, as a supplement to the nation's energy supply, is a realistic alternative energy source when one considers the mounting costs of fossil fuels, the environmental problems associated with high-sulfur coal, and the increasingly apparent safety and environmental impacts of nuclear energy. After the accident at the Three Mile Island nuclear power plant in Pennsylvania, it is expected that interest in nuclear energy will decrease, while research in solar power will increase. The use of solar energy is also consistent with this nation's concern with resource conservation and eventual energy independence. Solar energy is inexpensive, available everywhere, essentially inexhaustible, environmentally clean, and capable of reducing fossil fuel consumption [1].

Approximately 25% of the national total energy consumption consists of space heating, water heating, and air conditioning [2]. Decentralized or on-site solar technologies (those designed to be located on or near the buildings to which heat or electricity is provided) have the greatest potential in serving residential and commercial heating and cooling demands [3]. Large-scale, centralized generation of electricity by solar technologies seems promising by the 1990s [4]. Both decentralized and centralized applications of solar technologies are discussed in this section.

1.1 ON-SITE SOLAR TECHNOLOGIES

On-site solar technologies generally include both passive solar energy systems and active solar systems consisting of solar collectors and solar electric systems. Passive solar energy systems are the result of skillful architectural designs of buildings and landscaping: (1) to maximize the amount of solar energy incident upon and absorbed by a building during winter months, and (2) to maximize natural convective cooling and minimize solar heat absorbed during the summer months [5]. Passive solar designs for the maximum utilization of solar energy are achieved through orientation of the building, the location of trees, the use of awnings, overhangs, or shutters, optimum window size and location, wall thickness, and the use of movable insulation.

Active solar energy systems generally consist of (1) a solar collector exposed directly to the sun that converts sunlight into a heated fluid or gas, or, in the case of solar cells (photovoltaics), that convert light directly into electricity, (2) an energy storage system; e.g., a large water tank or underground rock bed that stores excess energy for use during periods when direct sunlight is unavailable, and (3) an energy-conversion system that converts a heated fluid or gas into mechanical energy or electricity [6]. Solar energy collectors can either be nontracking or of the type that follow the sun during the day. The costs for flat-plate collectors range between $32 and $145 per m^2 of surface area. For tracking collectors, costs can run as high as $1,800 per m^2 for two-axis tracking [7].

During periods when direct solar energy is not available, solar users can either burn fuel for energy at an on-site facility, purchase auxiliary energy service from a utility company, or store energy collected during high solar radiation periods in on-site storage devices [8]. The most common energy storage devices for thermal solar applications are hot water tanks or bins of heated rocks. Electricity-producing solar technologies use batteries for the storage of electrical energy. Current costs of low temperature (below 250°F) thermal storage facilities range from $0.50 to $5 per kilowatt-hour (kWh) of capacity of the storage unit [9]. Costs rise significantly where it is desired to store energy in a medium at higher temperatures [10].

1.2 ELECTRICITY-PRODUCING SOLAR TECHNOLOGIES

Compared to on-site solar technologies, solar and wind applications for the large-scale generation of electricity are more likely to find practical application in the long term. Sunlight can be used directly to generate electricity in two ways: (1) by heating fluids or gases to operate a heat engine [11] to turn an electric generator and (2) by using photovoltaic or solar cells; i.e., solid-state devices that use the sun's energy to produce electricity directly [12]. Wind applications for the generation of electricity make use of the wind's energy through a horizontal or vertical axis propellor to turn an electric generator.

1.2.1 Solar Thermal Power Plants

Solar thermal technologies for the generation of electricity collect concentrated solar energy and convert it to thermal energy, which in turn is transferred to a working fluid. The fluid is then used to drive a Rankine-cycle turbine or gas turbine that turns a conventional electric generator. Electric power production by solar thermal applications is thus similar to that of fossil fuel and nuclear power plants. Two designs of solar thermal generating systems are being considered: (1) the solar power tower concept and (2) energy collection through distributed receivers [13]. The solar power tower concept features a central boiler or receiver located atop a tower of specified height. The tower is surrounded by mirrors (heliostats) that track the sun throughout the day and focus sunlight on the central receiver. The distributed receiver concept uses distributed collector systems and receivers through which the heated working fluid is piped from each receiver unit to the turbine generator. This design avoids the cost of a tower but has added costs due to an extensive network of insulated piping.

A solar thermal power plant of the power tower design with a capacity of 5 megawatts (MW) [14] has been constructed for the United States Department of Energy (DOE) at Sandia Laboratories in Albuquerque, New Mexico. At Sandia, field evaluation of the array of 222 heliostats focused upon a 200 ft tower began in 1978 [15]. DOE's solar thermal program also includes the construction of a $120 million 10-MW pilot plant in the Mohave Desert near Barstow, California [16]. The pilot plant is to be built before 1981 and will require about 100 acres of land to accommodate the heliostats. It is estimated that approximately 2,000 heliostats, each with about 40 m^2 of reflective surface area, will be utilized to focus sunlight upon a 328-459 ft tower. DOE's solar thermal program plan envisions solar thermal demonstration plants ranging in capacity from 50 MW to 100 MW to be operational by 1985. Commercial plants of 100-MW to 300-MW capacity are expected to be operational after 1985 [17].

The greatest hindrance to the development of solar thermal electric generating plants is their cost. The federal program goal cost of the heliostat component of a solar thermal power plant is $70 per m^2 of mirror surface area. Designs for the heliostats to be tested at Albuquerque are estimated to cost between $500 and $750 per m^2 [18]. Using the $750 cost figure, the heliostat array for the 10-MW Barstow plant would cost $60 million or 50% of the project's total estimated cost. This figure equals $6,000 per kilowatt (kW) of plant capacity, only for the heliostats. By comparison, costs of conventional power plants range between $200 and $1,000 per kW of rated generating capacity. The cost of liquid-metal, fast-breeder, nuclear power plants are expected to be as high as $2,500 per kW [19], but this figure is still low compared with the costs of a solar thermal power plant.

1.2.2 Photovoltaic Power Plants

Photovoltaic devices, similar to the solar cells used to provide power for spacecraft, convert sunlight directly into electric energy [20]. With the absence of mechanical moving parts, photovoltaic devices can operate reliably and quietly with essentially no adverse environmental impacts. Photovoltaic devices have been used as power sources for spacecraft, remote railroad signal stations, microwave repeater stations, and agricultural applications (including an irrigation pump and fans for drying grain) [21]. A large array of photovoltaic cells would be required for a central electric-generating power source, but tracking heliostats could be used to focus sunlight upon the cells and thereby reduce the area of the arrays [22]. However, the current market for photovoltaics is essentially confined to decentralized or on-site applications [23].

From a utility perspective, photovoltaic plants have a high energy value [24], but as with solar thermal power plant applications, photovoltaic costs are very high. Current photovoltaic costs range from $11,000 per kW to $15,000 per kW of output [25]. Electricity from currently available photovoltaic systems costs from $1.50 to $2.00 per kWh [26], compared with electricity prices from conventional electric utilities averaging between $0.02 and $0.07 per kWh for residential service.

1.2.3 Wind Power Plants

Use of the wind as a power source is not a new concept. Windmills were used extensively in Europe for milling grain. An electric power generating windmill, the Smith-Putnam machine, was located atop Grandpa's Knob in Vermont and supplied power to the Central Vermont Public Service Corporation's system intermittently from 1941 through 1945 [27]. The Smith-Putnam machine utilized a 175 ft rotor and had a generating capacity of 1.25 MW. A 0.1-MW wind turbine generator has been operational since 1975 at NASA's Plumb Brook Station at Sandusky, Ohio [28]. The Plumb Brook machine utilizes a 125 ft diameter twin-bladed single rotor mounted at the downwind end of a streamlined generator housing. The entire unit is perched atop a 100 ft tower and is mounted on bearings so that it may rotate to face the wind at all times. Power is generated when the velocity of the wind exceeds 8 miles per hour. The 100-kW rated output is achieved when the wind velocity reaches 18 miles per hour. A 0.2-MW machine similar to the Plumb Brook machine was completed early in 1978 at Clayton, New Mexico. Two machines identical to the Clayton machine are under construction at Culebra Island and Block Island, and are expected to be operational by the end of 1978 [29]. Federal contracts have been let for the construction of larger wind turbine generators having rotor diameters as large as 300 ft and with generating capacities as high as 3 MW.

Because large-scale generation of electricity by wind turbine generators is still basically in the development stage, capital costs are high. The capital cost of the 0.1-MW Plumb Brook machine was $5,500 per kW of rated capacity [30]. It is anticipated that these costs can be reduced through the federal wind energy program, which has as its goals the development and commercialization of economically viable wind energy systems [31].

1.3 THE RELATIONSHIP BETWEEN SOLAR ENERGY DEVELOPMENT AND UTILITY COMPANIES

The roles assumed by six institutional actors will have a significant impact upon the development, economic viability, and commercialization of both on-site and centralized solar technologies. These primary actors include (1) investor-owned and publicly owned (municipal) utility companies, (2) federally owned utility agencies, (3) state public utilities commissions (PUCs), (4) federal and state governments, (5) the solar industry, and (6) solar consumers.

The extent to which both investor- and publicly owned utilities are allowed to enter the solar market and own, lease, or sell on-site technologies will affect the allocation of costs between either the utilities or the solar consumers. Manufacturers of solar equipment are concerned that utility policies could foster only a chosen few of the industry while effectively eliminating other solar manufacturers from a substantial share of the market. Since investor- and publicly owned utilities enjoy a monopoly in the energy supply market, competition by solar utilities may be foreclosed. Moreover, as on-site solar technologies require conventionally fueled auxiliary systems to assure continuous service during periods of adverse weather, solar users will be concerned about the rates utilities charge for this back-up service.

Federal regulation of the solar industry may at some time govern the extent to which utilities are allowed to own, lease, or sell on-site solar devices. While federal power agencies are primarily involved with the wholesale sales of electric energy, it is conceivable that federal agencies could eventually distribute on-site solar devices or manage solar utilities that compete with existing conventional utilities. Today, state public utilities commissions regulate the entry of utilities into the energy supply market, as well as the rates charged for utility services. State utility commission policies could therefore affect a utility's ability to market on-site solar devices, a solar utility's ability to compete with existing conventional utilities, and an existing utility's right to impose discriminatory rates on those who use solar devices for heat and cooling. A state legislature could statutorily govern the roles of utilities in solar energy development and commercialization.

Three major issues thus emerge involving the relationship between solar energy development and utility companies. First, there exists the possibility that utility companies will seek to own, lease, or sell solar devices. Second, it is possible that a solar company would seek to enter the energy supply market in competition with existing regulated electric utilities. Third, it is likely that existing utilities may establish a rate structure that would penalize decentralized use of solar technologies. This paper will address all of these three important issues.

This paper will first consider the legal issues associated with public utility ownership of decentralized or on-site solar heating and cooling (SHAC) devices that may be placed on individual homes, shopping centers, apartment complexes, or may be used by other small-scale consumers of solar power. Second, it will evaluate the legal questions that may arise should a solar power company (either privately or publicly owned) compete in providing electric service with existing regulated electric utilities. Third, it will analyze the legal and economic implications that follow should existing utilities seek to impose unfavorable rates or service for decentralized or on-site solar technologies that require back-up service from the fossil-fuel utility when, because of weather conditions, solar devices are unable to function.

All three situations are considered in light of applicable federal law. Since utility law varies from state to state, and since it is impossible for a paper of this scope to analyze the relevant laws of every state, it has been necessary to limit some of the discussion to the laws and policies of one or two states. Much of the analysis that follows thus focuses on the law of Colorado and California. These two states were chosen for analysis for several reasons. Both states enjoy many days of uninterrupted sunshine, and therefore, are likely to be centers for the type of solar commercialization activities that may involve utilities. Both states, expecially California, have already witnessed direct legal responses to the emerging solar industry by existing, regulated utilities. Also, much of the legal and economic research pertaining to solar technologies has originated in the two states. Colorado is the home of the Solar Energy Research Institute, where much of the research for this paper took place. The California Energy Commission and the California Public Utility Commission have given more thought than any other agency of any other state to the potential effect of utilities on solar technologies. The laws and policies of states other than Colorado and California are presented when appropriate.

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SECTION 2.0

UTILITY OWNERSHIP OF DECENTRALIZED SHAC DEVICES

Although many of the SHAC-related issues also pertain to utility ownership of non-SHAC devices, the implications of utility ownership of non-SHAC decentralized solar technologies; e.g., small-scale wind or photovoltaic energy conversion systems, will not be addressed below. The following two legal issues, confined solely to utility ownership of non-SHAC devices, are therefore not discussed: (1) in the case of wind systems, the acquisition of an all-direction wind easement, and (2) the legal control of decentralized generating devices.

To what extent, then, may utility companies, whether investor- or publicly owned, own decentralized SHAC devices and thereby market them on a selling or leasing basis? The two decentralized nongenerating solar technologies that will be particularly affected by utility ownership policies are solar thermal space conditioning and solar thermal water heating. These two technologies generally utilize both flat-plate collectors to capture solar radiation and a working medium of water or air to store the resulting heat.

2.1 UTILITY INTEREST IN THE MARKETING OF SOLAR DEVICES

A Department of Housing and Urban Development (HUD) investigation of solar marketing and market acceptance concluded that "[u]tility policies . . . have the potential to act as barriers to the market acceptance of solar housing " [32]. Among the utilities surveyed by HUD were gas and electric companies that supplied utility service for back-up purposes to HUD solar grant homes, and provided auxiliary service to other solar buildings, but not to HUD solar homes.

Over 50% of the second category of utilities stated that they were providing either heating, ventilating, or air conditioning service to a solar-assisted building [33]. Approximately one-fourth (24%) of all utilities surveyed expressed an intention to lease SHAC devices. To the question of whether they would become involved in the servicing of solar equipment, 27% replied yes. The utilities were further asked if they foresaw some alternative utility involvement in the form of marketing, providing technical assistance or public relations advice, or monitoring solar homes. A majority of the utilities (59%) replied yes, while only 27% replied no [34]. Many utilities (45%) also believed there was a greater need for solar energy in their regions [35], while 40% viewed solar energy as a practical alternative to conventional fossil fuel [36].

The results of the HUD investigation revealed that many utilities believed there was a greater need for and likelihood of solar energy commercialization within their regions. A significant number considered solar energy to be a practical alternative to traditional energy sources, and further suggested that they may become involved in the leasing of solar devices. Even more utilities stated that they were likely to become involved in the servicing of solar equipment, and a majority contemplated at least some form of involvement with residential applications in the development of solar energy. In short, it appears that utilities expect to play a substantial role in the development and commercialization of solar power.

2.2 ALTERNATIVE UTILITY OWNERSHIP POLICIES

If utilities seek to enter the SHAC market, what policies should be considered regarding utility ownership of SHAC devices? The four utility ownership policies most frequently advanced are: (1) utilities, being classified as regulated monopolies, are given exclusive monopoly franchises to own, sell, lease, or market SHAC systems, (2) utilities are allowed to enter the solar market, but without exclusive franchises (i.e., they may be regulated in their solar activities and will be in competition with private solar companies), (3) nonregulated utility subsidiary companies are allowed to enter the solar market but would face competition from private SHAC system suppliers, and (4) utilities are prohibited from owning, for lease or sale, SHAC systems located upon a customer's premises [37].

These four ownership policies have been implemented in connection with the operation of other regulated industries [38]. Prior to the Federal Communications Commission's (FCC) Carterfone [39] decision, telephone companies had exclusive control over the interconnection devices that were used in the telephone system—a situation reflected previously in the first option. Under this scheme, a customer was required to purchase the internal interconnection system from the local telephone company. If this ownership policy applied to solar, a customer who desired to install a SHAC device, designed to receive back-up energy from a utility company, would be required to purchase or lease the system from the utility having exclusive rights to serve that area.

Since Carterfone, the telephone industry has been doing business under a scheme like the second policy option. Telephone companies are allowed to sell terminal devices, but they no longer have an exclusive monopoly to do so. Telephone customers have the option of (1) obtaining their telephones and other terminal devices from the telephone company at a regulated rental price, or (2) purchasing this equipment from an unregulated competitive supplier. Under a similar scheme, a solar customer could lease the SHAC system from a utility at a regulated rental rate, or at his option, purchase the system from an unregulated supplier.

Policy option three is found when regulated gas and electric utilities control unregulated subsidiary companies that engage in such activities as mining, energy resource exploration, and the selling of appliances. If this third policy option were applied to the solar industry, an unregulated utility subsidiary would be in competition with other solar suppliers in the marketing of SHAC devices. The extent of direct utility involvement with SHAC system marketing through the subsidiary would be governed by the nature of PUC jurisdiction over the utility [40]. This means that, depending upon the scope and interpretation of a state's public utility law, there may be no PUC jurisdiction over a utility's marketing of SHAC devices.

The American Telephone and Telegraph Company (AT&T) is faced with the fourth ownership policy; i.e., prohibition from engaging in a certain business activity. AT&T is prohibited from engaging in unregulated business, except to a limited degree, in the sale of certain communications equipment. Following a 1956 consent decree that settled an antitrust complaint against the Bell System [41], AT&T cannot enter businesses such as data processing. For example, computer time sharing services that utilize telephone lines for connecting remote data terminals to central computers can be offered by telephone utilities not affiliated with the Bell System, but cannot be offered by Bell affiliates. Under a similar Policy, the solar industry would not be faced with competition from utilities or their unregulated subsidiaries.

2.2.1 Regulated Utility Ownership of SHAC Devices

The legal issues associated with utility ownership of SHAC systems located upon a customer's property are evaluated below under policies representing (1) a regulated monopoly situation guaranteed the utility within its service area, (2) a regulated business operation by the utility in competition with unregulated solar suppliers, and (3) utility involvement only through unregulated subsidiary companies of the utility. This discussion is followed by arguments for and against such utility participation and involvement in the solar market.

2.2.1.1 Regulation by Public Utilities Law

In Colorado, the Public Utilities Law [42] provides for PUC regulation controlling (1) entry into the public service market, (2) the rates and charges for utility services, and (3) the standards and conditions of service. In addition, a Colorado constitutional provision vests all power to regulate the facilities, service, rates, and charges of every corporation, individual, or association operating within the state as a public utility in the PUC [43]. "Public Utility" is statutorily defined to include every gas corporation, electrical corporation, person, or municipality operating for the purpose of supplying the public for domestic, mechanical, or public uses and every corporation or person declared by law to be affected with a public interest [44]. The statute further provides that such public utilities are subject to the jurisdiction, control, and regulation of the PUC and to the provisions of the Public Utilities Law [45].

Under the statutory definition, an investor-owned electric or gas utility is subject to the PUC regulation in accordance with the Public Utilities Law. However, the state's jurisdictional provisions provide little indication as to whether a regulated utility supplying SHAC devices would be subject to such regulation. An argument could be made that a utility company, in supplying SHAC devices to the public, is engaging in an activity affected with a public interest and, therefore, is subject to the general jurisdiction of the PUC. Indeed, the Supreme Court of Colorado, in Western Colorado Power Co. v. Public Utilities Commission, has held that any business or activity that is affected with a public interest may be regulated under the police power of the state [46]. Should utility ownership of SHAC devices be declared to be "affected with a public interest," then such activity would be subject to the general jurisdiction of the PUC.

What legal significance attaches to utility status and PUC jurisdiction? In order for a utility to enjoy monopoly status in the ownership of SHAC devices consistent with policy one, PUC control of entry into the business of supplying SHAC systems would be required. Before a utility begins the construction of a new facility, plant, system or an extension thereto, it must first obtain from the PUC a certificate that the present or future public convenience and necessity will require such construction [47]. The installation of SHAC devices upon a customer's premises could be considered the construction of a new system or a new extension to the utility's existing system. If so, a means exists for conferring monopoly status upon a utility for its activity in supplying the public with SHAC devices, as it has been held by the Colorado Supreme Court that the purpose of the certification process is to avoid duplication of facilities and competition between utilities [48]. The certification process would be absent under policy two, as competition from other regulated entities as well as unregulated solar manufacturers, is allowed under that policy.

The Public Utilities Law requires that all charges demanded or received by any public utility for any product or commodity furnished, or any service rendered, shall be just and reasonable. The law further provides that every unjust or unreasonable charge is prohibited [49]. The rental rates charged by a utility for the leasing of SHAC devices would be subject to the statutory "reasonableness" test as administered by the PUC. Rate regulation would therefore be applicable under the first and second policy options [50].

Adequacy of solar service would seem to be governed by a Colorado statute requiring every public utility to provide adequate, just, and reasonable services as will promote the safety, health, and convenience of its patrons [51]. All utilities leasing solar devices to customers would have to abide by the principle that serving some but not all customers within a utility's service area constitutes a practice that is discriminatory and illegal [52]. In an analogous case, the Colorado PUC held that a water utility's actions in providing service to some but not all patrons located in the area covered by its certificate not only constitutes prejudice and discrimination [53], but also that the issuance of a certificate by the commission and its acceptance by a utility obligates it to furnish service to all the inhabitants of the territory covered by the certificate [54]. Therefore, any utility that receives a certificate to supply SHAC devices within its service area is under an obligation to provide solar service to those customers who make such a demand.

With respect to adequacy of service, the Colorado PUC has held that a public utility is under a duty to provide reasonably satisfactory and efficient service, and that it cannot perform negligently, carelessly, inefficiently, or in any other unsatisfactory manner [55]. Thus, any solar service furnished by a utility under the first or second policy options would be subject to the adequacy and efficiency standards of service.

Another matter needing consideration, should a utility provide SHAC devices under policies one and two, is whether the equipment used to provide solar service can be included in the rate base. The rate base of a utility is generally defined as the actual legitimate cost of plant and equipment used in providing the public service, with reasonable allowances for working capital less accumulated depreciation [56]. The amount of revenue utilities are allowed to recover from the rates they charge is proportional to the rate base. Therefore, it would be imperative that utility-owned solar devices be included into the rate base in order for the utility to provide solar service. The Supreme Court of Colorado, in an early case dealing with the issue of property included in the rate base, held that the test is whether such property is used and useful in supplying the service that the utility has undertaken to furnish [57]. Under this principle, it seems likely that a utility's investment in SHAC devices would be included in the rate base as being property useful in providing solar service.

If Colorado were to adopt the third policy option, it would appear from a review of Colorado's Public Utilities Law that the PUC would have no direct regulatory authority over a utility's wholly owned subsidiary. The extent of the regulation, if at all, would appear to be indirect. In a recent decision of the Colorado Supreme Court, People's Natural Gas Division of Northern Natural Gas Co. v. Public Utilities Commission, it was held that the PUC has authority to include only that portion of the capital structure of a diversified entity that (1) accurately reflects the actual capitalization of the utility operation or (2) finances the rate base thereof in the calculation of the rates [58]. The Court concluded that the PUC had authority to pierce the corporate structures of corporations that operate utility divisions, in order to separate the utility capital structure from that of nonutility operations and subsidiaries of the corporation [59].

Under this principle, the investment associated with ownership of SHAC devices by a utility subsidiary could not be imputed to the utility as part of its rate base. Utility operations and the regulation thereof would be totally separate from the subsidiary's activities to the extent that the utility's customers would not be financing the solar operation. Such a conclusion would be favorable to nonsolar utility customers under policy option three, who might otherwise be faced with the possibility of subsidizing a utility subsidiary's solar operations.

Two other issues should be mentioned that are relevant to SHAC system ownership by utilities that involve PUC regulation. First, since SHAC systems are not perfect substitutes for conventional heating and air conditioning systems, a solar user requires a certain amount of auxiliary energy. It is likely that this demand for conventional service from an electric or gas utility for back-up purposes will occur during periods of extended cloudy weather or extremely cold conditions. The relevant issue, which is beyond the scope of this article, is whether a utility may charge rates that are different than traditional rates for service provided to solar users for back-up purposes. In other words, may a utility discriminate for or against solar users in its rate-making practices [60]?

In addition, it is important to note that the optimum balance of regulation and competition shifts with time and can affect the market penetration rate of solar devices. Where regulation tends to be overly conservative, it can supplant rather than supplement free competition [61]. As an example, cable television grew rapidly as an unregulated industry from about 1950 to the early 1960s. After the early 1960s, the FCC assumed regulatory jurisdiction and stunted the industry's growth for the four-year period from 1968 to 1972. The period was characterized by intense political bargaining between the industry, broadcasters, and other parties where the government acted as an arbitrator. Such bargaining resulted in a retardation of the growth of the new technology both during the four-year period and thereafter [62]. A similar result is possible should SHAC system marketing be overly regulated, either by PUCs or the Federal Government.

2.2.1.2 Arguments Against Utility Ownership of Decentralized SHAC Devices

A common argument of those opposed to utility ownership of SHAC devices is that through unfair competition utilities may foreclose other solar manufacturers from the market [63]. It is possible that this result could occur by three means. First,

> [r]egulated utilities can use solar technology strategically as a means to create internal subsidies within their price structures and, thereby, to recapture some of the monopoly profits that regulation takes away as well as to foreclose competition in the solar energy business. For example, a joint solar/gas utility would have to work out a method of allocating its costs between solar-assisted and gas-only services. If it could effect an allocation that, in fact, attributed too much cost to gas, it would succeed in taking advantage of its monopoly in the gas business to subsidize its solar energy business. [64]

Such subsidization could occur when conventional utility operations contribute to the utility's or the subsidiary's solar activities. A strict regulatory policy by PUCs would be required to prevent the utility's conventional service rate payers from lowering solar costs for the solar operation. One effect of this subsidization would be lower costs of SHAC devices, which in turn would result in a utility or subsidiary being able to charge lower than market prices for its SHAC systems. Such a price differential could potentially force unregulated solar competitors from the market.

A second means by which unregulated solar suppliers could be foreclosed from the solar market is where utilities or their subsidiaries do not themselves manufacture SHAC devices, but instead give "just a few companies the lion's share of the business, [through their purchasing policies] rather than spreading around their purchases . . . . [Such a policy would allow utilities to] effectively decide which solar companies will be allowed to continue in business" [65]. Those unregulated companies not enjoying the business from utility purchases would likely be forced to discontinue operations.

Utilities may also find it economic to acquire the solar manufacturing company rather than to continue purchasing SHAC devices from it. Utilities would thus become vertically integrated in much the same way as the nation's large oil companies are. Such practices supress competition, allow price maneuvering within the different levels of the industry, and chill innovative research and development.

It has been argued that since utility profits are proportional to the value of property included in the rate base, utilities have a tendency to overcapitalize; i.e., to invest in overly durable equipment so as to increase the value of the rate base [66]. Overcapitalization under regulation for the purpose of expanding the rate base and hence utility profits, is known as the Averch-Johnson, and Wellisz (A-J-W) effect [67]. If the first and second policy options were implemented, the A-J-W effect could lead to utilities investing in solar technology that was excessively efficient in converting sunlight to heating or cooling energy, and that required little maintenance. If PUCs allowed such "gold plating" of the rate base from utility-owned SHAC devices, excessive solar costs and prices, as well as a possible slowdown in the adoption of innovative SHAC technologies, might result.

There also seems to be a lack of evidence that utility ownership of SHAC devices is justified under a natural monopoly theory [68]. The natural monopoly concept arises from the theory that it is better to have fewer utilities providing a certain service within a given area than to allow any number of entities to compete for business under a competitive market structure [69]. Natural monopolies are recognized and legitimated in special cases, since the unit cost of providing service is lower under a regulated monopoly than under competition. This fact arises because of (1) the elimination of costly duplication of facilities, (2) decreasing average unit costs as output increases, and (3) economies of scale resulting from the purchases of large quantities. Utility ownership of individual self-contained SHAC devices does not exhibit the same economies of scale as those present in utility ownership of a large electric power plant.

It has been contended that utilities, which are generally state regulated, are not really accountable to the public [70]. Customers of the utility are essentially a captive market with no choices, since a particular service within a given area is generally provided by only one company. Should policy one be implemented, the resultant lack of competition could lead to slow development of advanced technologies and provide no incentive to the utilities to be responsive to the wishes of the public. The main existing means of accountability, PUC proceedings, are costly and time consuming. Lack of accountability by a utility to its solar customers might therefore prove detrimental to rapid solar development.

Finally, a significant policy argument against utility ownership of SHAC devices is that utilities should not be given the authority to "own the sun" by owning and marketing SHAC devices [71]. Such control would seemingly allow too much discretion in utilities as to the rate of solar commercialization and the development of more innovative technologies. If utilities or their subsidiaries were to vary the rate of solar commercialization based on its profit-yielding characteristics, the use of solar energy could invariably be slowed while more emphasis was being placed on conventional energy supply.

2.2.1.3 Arguments for Utility Ownership of Decentralized SHAC Devices

Utility advocates list several advantages of utility participation in the marketing of SHAC devices.

> First, although solar energy utilizes the "free" energy from the sun, it requires additional first or capital cost. Since the construction industry is highly "first-cost intensive," we expect that solar energy will have some difficulty finding early, rapid acceptance. A utility company is used to high first-cost (capital intensive) business ventures. Utility company sponsorship in the "lease to the user" mode will do a lot to reduce this barrier . . . .
>
> Second, the sponsorship of a utility company may help to overcome market "fragmentation." If the utility company buys the equipment and leases it in a large-scale fashion, the solar industry will face at least one aggregated market (to the gas company). This may provide a large enough incentive to actively stimulate a solar energy system fabrication industry.
>
> Third, because a utility company already has a sales/distribution/service network that operates within the housing industry, the utility company scenario provides a way of "product fitting" solar energy systems.
>
> Finally, because of the traditional anti-innovation bias within the industry (a bias which is quite understandable given the industry environment), utility company sponsorship will help overcome some of the traditional "institutional-cultural biases" against solar energy that exist within the housing industry. [72]

In addition, since SHAC devices have the potential to adversely affect electric utility system load factors [73], utility ownership might ensure that the devices are designed to be used as an effective load management tool; i.e., designed to minimize any adverse impact upon the system load factor [74]. For example, SHAC designs that are currently potentially beneficial to the utility's system load factor use auxiliary energy only during off-peak periods. Such systems may also be capable of recharging their storage devices by off-peak auxiliary energy to be used during periods of adverse weather. Under utility ownership, the SHAC devices could be controlled by the utility to assure that auxiliary demand did not occur coincidentally with the system's peak.

Utility ownership and leasing is also "an option which can potentially bring solar energy to the public at attractive cost levels, with the solar system cost incorporated in a monthly utility bill. Utilities could potentially derive substantial economic benefits from controlling the utilization patterns of solar systems" [75]. In other words, utility ownership is a means of circumventing the barrier of high first cost through utility purchasing in a climate attendant to the energy business. Moreover, utilities have existing service, maintenance, and administrative operations (e.g., billing procedures that could easily be adapted to include the providing of solar service) that might easily be adaptable to a solar leasing scheme.

Utility ownership of solar devices might even help assure solar users of product quality [76]. Utilities having technical competence and expertise, could insure that the product leased to a consumer not possessing such knowledge meet certain reliability, safety, and performance criteria. Utility ownership, however, is only one solution to the product quality problem. The imposition of federal and/or state quality standards could instead solve the product quality problem. Solar warranties, be they state or industry initiated, may offer another solution to quality control.

Contrary to one of the arguments advanced against utility ownership of SHAC devices, utilities can seemingly achieve economies of scale in providing solar service to the public [77]. It is possible that economies of scale can be realized through large-volume purchases of the equipment and designs incorporating the use of centralized collector and storage systems. Under the latter configuration, a number of individual homes or apartments would receive heat or air conditioning from one collector/storage facility.

A final argument for utility ownership of SHAC systems takes into account the nature of the energy supply business and its policies of operation. It has been stated that utilities are the only organizations at present that face the proper incentives for optimizing the choice among energy alternatives. Since most consumers are not charged the marginal costs of providing conventional energy service, they are not faced with sufficient incentives to change to solar energy. Utilities can better weigh all factors contributing to the costs of various conventional and auxiliary energy sources so as to reach the most economic allocation of resources [78].

2.2.2 Federal and State Limitations on Utility Ownership of SHAC Devices

2.2.2.1 Utility and Utility Subsidiary Ownership of SHAC Devices and the Federal Antitrust Laws

Any discriminatory practice against either a solar user or the solar industry by utilities or subsidiaries having substantial control of solar development through their ownership policies, may give rise to an action based on the antitrust laws [79]. The earliest and most authoritative antitrust statute is the Sherman Act of 1890 [80], whose Section Two prohibits monopolization or attempts by persons or corporations to monopolize. Over the years, however, a huge body of antitrust law has grown through an accumulation of statutes, regulations, case law decisions, and policies [81].

Of particular relevance to solar power and utilities is Otter Tail Power Co. v. United States [82], where the Supreme Court ruled upon a Section Two [83] monopoly charge against an electric utility. Otter Tail, a major investor-owned electric utility, refused to sell wholesale power and declined to wheel power from another source to small communities seeking to establish municipal electric distribution systems. Otter Tail contended that Federal Power Commission (FPC) regulation of wholesale sales, wheeling, and interconnection shielded them from application of the antitrust laws and therefore barred antitrust action. The Supreme Court held that Otter Tail, by reason of its regulation by the FPC, was not immune to application of antitrust regulation as the Federal Power Act does not exempt electric utilities from the antitrust laws [84]. Of more importance is the Court's holding that the actions of Otter Tail in refusing to sell at wholesale to or to wheel power for the municipalities constituted anticompetitive and monopolistic practices in violation of Section Two of the Sherman Act [85]. After Otter Tail, a utility company's refusal under the first policy option to lease SHAC devices to certain consumers, or to purchase SHAC devices from certain solar manufacturers (grounded on a desire to protect its monopoly position) may be deemed anticompetitive and in violation of the Sherman Act. Utilities operating under the first and second policy options, by virture of their regulation, would not be immune from application of the antitrust laws. Moreover, under the second and third policy options, the acquistion of a competitor that has the effect of substantially lessening competition in the sale or purchase of SHAC devices may violate the antitrust laws [86].

Another decision of relevance to solar energy and utilities is Cantor v. Detroit Edison Co. [87], where the Supreme Court examined the relation between state regulatory authority and the antitrust laws. For several years, Detroit Edison followed a policy of supplying free light bulbs to its residential customers—a marketing practice approved as part of its rate structure by the Michigan Public Service Commission. A retail druggist and seller of light bulbs challenged the practice by arguing that Edison used its monopoly status to restrain competition in the sale of light bulbs in violation of the Sherman Act. Edison maintained that the state action exemption to application of the antitrust laws applied and was triggered by the state commission's approval of the marketing practice. The lower federal courts held, on the authority of Parker v. Brown [88], that the commission's approval of the practice constituted state action and exempted the practice from federal antitrust laws [89]. The Supreme Court reversed, stating that "state authorization, approval, encouragement, or participation in restrictive private conduct confers no antitrust immunity " [90]. The Court concluded that "neither Michigan's approval of the tariff filed by respondent, nor the fact that the lamp-exchange program may not be terminated until a new tariff is filed, is a sufficient basis for implying an exemption from the federal antitrust laws for that program " [91]. After Cantor, a commission-approved utility practice regarding solar ownership under the first or second policy options would not exempt the practice from the antitrust laws.

The state action exemption as applied to municipally owned utilities was recently considered by the Supreme Court in City of Lafayette v. Louisiana Power & Light Co. [92]. Cities owning municipal electric utilities brought an action against a privately owned utility, Louisiana Power & Light Co. (LP&L), on the basis of violation of federal antitrust laws. LP&L counterclaimed on the same basis. The case involved claims by the cities that LP&L had conspired to restrain trade and attempted to monopolize by preventing the construction and operation of competing electric systems and by foreclosing supplies from markets served by the company. In the counterclaim, LP&L alleged that the cities had conspired to displace LP&L in certain areas by requiring customers thereof to purchase electricity from the cities as a condition of continued water and gas service.

A decision by the District Court dismissing the counterclaim was reversed and remanded by the Court of Appeals [93]. The Supreme Court affirmed the decision of the Court of Appeals by rejecting an automatic immunity from federal antitrust laws for municipally owned utilities. The Court concluded that actions of state agencies or subdivisions are exempt only to the extent that such actions are "engaged in as an act of government by the State as sovereign, or, by its subdivisions, pursuant to state policy to displace competition with regulation or monopoly public service" [94]. Under the City of Lafayette principle, a municipality adopting discriminatory practices in the purchasing or selling of SHAC devices under the first or second policy option may be subject to federal antitrust laws. Only where it appears that a municipality has acted pursuant to the state's command would the state action exemption apply [95].

Another portion of the federal antitrust laws, the Robinson-Patman Price Discrimination Act, prohibits price discrimination in goods of like grade and quantity where the effect of such conduct is to substantially lessen competition or to tend to create a monopoly [96]. One case decided by the Supreme Court under the Robinson-Patman Act may be applicable to utilities who own and lease SHAC devices. In Federal Trade Commission v. Morton Salt Co., the practice of selling salt transported in interstate commerce at quantity discounts constituted a violation of the Robinson-Patman Act when only certain purchasers were able to take advantage of the discount [97]. The Court stated that

> [t]he Robinson-Patman Act was passed to deprive a large buyer of such advantages except to the extent that a lower price could be justified by reason of a seller's diminshed costs due to quantity manufacture, delivery or sale, or by reason of the seller's good faith effort to meet a competitor's equally low price. [98]

Furthermore, the Court reiterated previous holdings to the effect that harm, in fact, need not necessarily result in competition; only a reasonable "possibility" of such harm would be sufficient to base a cause of action [99]. Where a utility or a subsidiary receives quantity discounts in the purchase of SHAC devices as an instrument of favor from certain solar suppliers, such a transaction will be a possible violation of the Robinson-Patman Act.

A Clayton Act violation may occur if a utility or a subsidiary enters into an agreement with its SHAC system supplier to exclusively deal in the supplier's products rather than those of a competitor. Under this federal statute, a company may not sell goods on the condition that the recipient not buy the goods of a competitor if the effect of such a transaction may substantially lessen competition or tend to create a monopoly [100]. For example, in Atlantic Refining Co. v. FTC [101], Atlantic had agreed, in return for a certain commission, to assist Goodyear in promoting the sales of products to the oil company's retail service station dealers and wholesale outlets. Noting Atlantic's economic power in inducing its outlets to buy Goodyear products, the Court found the practice to be anticompetitive under the Clayton Act and, therefore, unlawful [102]. A similar result is likely should utilities prevent buyers of utility-owned SHAC devices from purchasing such devices from competitors.

2.2.2.2 Utility and Utility Subsidiary Ownership of SHAC Devices and State Trade Law

The legislative declaration of Colorado's trade law, the Colorado Unfair Practices Act [103], is "to safeguard the public against the creation or perpetuation of monopolies and to foster and encourage competition by prohibiting unfair and discriminatory practices by which fair and honest competition is destroyed or prevented" [104]. One significant section of the statute declares that it is unlawful for any corporation engaged in the sale of any product or service to discriminate between different locations by selling the product or service at lower rates in different locations [105]. However, the statute provides an exception for any service or product sold or furnished by a public utility subject to regulation by the PUC or by any municipal regulatory body [106]. Where utility ownership of SHAC devices under the first or second policy option is regulated by the PUC, rental prices will not be subject to scrutiny under this statute. However, the rental charged by a subsidiary under policy three, as well as the prices charged by solar manufacturers who supply SHAC devices to either utilities or subsidiaries, would be subject to scrutiny under the Colorado Act.

The Act would further require that the prices that would be charged by SHAC device suppliers to utilities or subsidiaries be no less than the cost to the manufacturer [107]. Cost is defined to be the sum of the cost of raw materials, labor, and all overhead expenses of the producer [108]. The Colorado Supreme Court has held that where a merchant was selling below cost (as defined within the statute) with an intent to destroy competition, such a practice was in violation of the statute [109].

Moreover, every agreement or contract intended to prevent competition is an illegal restraint of trade in Colorado [110]. Corporations engaging in any combination, conspiracy, or agreement restraining trade, or combining or conspiring to monopolize any part of the trade in Colorado are guilty of an unlawful conspiracy [111]. Unlike the price discrimination section discussed above, no exemption from application of these statutes is afforded to investor- or municipally owned public utilities [112]. Therefore, contracts, combinations, or conspiracies between a SHAC system supplier and a utility or subsidiary would be suspect as being illegal where the effect of such an arrangement is to restrain trade, to attempt to monopolize, or to prevent competition from other SHAC system suppliers [113].

2.2.3 Prohibition of Utility Ownership of SHAC Devices

If the fourth policy option were implemented, utilities and their subsidiaries would be prohibited from owning decentralized SHAC devices located upon their customer's premises. Such a prohibition would result in a competitive supply market consisting of large and small businesses engaged in the manufacture, installation, leasing, or sale of SHAC devices. The state would regulate these businesses the same as it does any other entities doing business in Colorado.

The creation of this competitive market structure could be achieved by either of two methods. First, to the extent that the PUC has jurisdiction over the ownership of SHAC devices by a utility, the PUC could prohibit such activity in either its rules and regulations or its general policy positions [114]. Before the PUC could prohibit a utility from owning SHAC devices, it must be shown that such ownership "affects" or "could affect" the utility's regulated business [115]. It is likely that this affection test could be satisfied when one considers the utility's desire to include the capital cost of SHAC ownership in its rate base, and the possibility of interservice rate subsidization between the utility's solar service and conventional energy service. In light of these factors, the PUC would have a legal basis for prohibiting utility ownership of SHAC devices if it chose to do so.

A second possible means of preventing utilities from entering the solar market is by state statute. Under a state's police power to adopt regulations promoting the health, safety, general welfare, and morals of its citizens [116], a state could pass legislation that either prohibited utility participation in the ownership of SHAC devices or prescribed the extent to which a utility or its subsidiary could become involved in the solar market. Legislation governing the extent of solar participation by investor-owned utilities or their subsidiaries does not exist in Colorado. However, precedent exists elsewhere for such a law. Legislation has been passed in California that requires the authorization of the PUC in the event that an electric utility, gas utility, or a subsidiary thereof desires to manufacture, lease, sell, or otherwise own or control any solar energy system [117].

The basic disadvantage in completely prohibiting utility involvement in the ownership of SHAC systems lies in the possibility that solar designs might not be optimized for utility load management programs. The greatest concern is that SHAC devices would not be designed so as to utilize only off-peak auxiliary energy. There is a more remote possibility that SHAC devices would be of poor quality without some controls imposed by utilities.

A summary of the implications of utility ownership of SHAC devices under the previously discussed four alternative ownership policies is presented below [118].

Ownership Policy	Potential Negative Implications	Potential Positive Implications
1. Regulated but Monopolistic Ownership of SHAC by Utilities	1. Absence of Regulated Monopoly Justifications 2. Regulatory Issues 3. Antitrust Issues	1. Optimized SHAC Design for Utility System Operation 2. High Quality of SHAC Device and Service
2. Regulated but Competitive Ownership of SHAC by Utilities	1. Regulatory Issues 2. Antitrust Issues	1. Same as Above 2. Advantages of Competition
3. Unregulated Competitive Ownership of SHAC by Utility Subsidiaries	1. Internal Subsidization 2. Antitrust Issues	1. Optimized SHAC Design for Utility System Operation
4. Utilities and Subsidiaries Prohibited from Owning SHAC	1. Inferior Product Quality 2. Non-Optimized SHAC Design from Utility Perspective 3. Regulation may Develop if Competitive Market Functions	1. Avoidance of Regulatory Issues

2.3 THE SPECIAL CASE OF SHAC DEVICE OWNERSHIP BY MUNICIPAL UTILITIES

A unique situation arises if municipally owned utilities are permitted to own SHAC devices under the first and second policy options. In Colorado, an exemption for municipally owned utilities from regulation by the PUC is provided in the Colorado Constitution [119] and is also recognized in the PUC jurisdiction section of the Public Utilities Law [120]. The Colorado Supreme Court has held that the PUC has no jurisdiction to regulate a municipally owned utility operating wholly within the territorial boundaries of a home rule city [121]. In another decision, the Colorado Supreme Court held that a state constitutional provision prohibiting the PUC from regulating utilities operated by a municipality within its boundaries, did not prohibit the PUC from regulating municipally owned utilities to the extent of their operations outside city boundaries [122]. Therefore, the extent of PUC regulation of SHAC device ownership activities by a municipally owned utility in Colorado would be confined to solar service provided outside municipal boundaries.

If a municipality were to furnish solar service to its citizens within the municipal limits, the city itself, through its proper officers, would possess the sole power of fixing general rental rates or regulation [123]. The extent of utility regulation by a municipality's legislative body is generally provided in the city charter. For example, the municipal charter for one Colorado city (Colorado Springs) provides that the city council shall "by ordinance or resolution establish rates, rules and regulations, and extension policies for the services provided by the Department of Utilities" [124]. The city council of Colorado Springs maintains a policy of approving and applying the same utility rates within municipal boundaries that the PUC has approved for service outside the municipality [125]. In similar cities, it is possible that charges for solar service provided by a municipality outside municipal limits would also apply to solar service provided within municipal limits if such charges were approved by the PUC.

Since municipally owned utilities may be regulated only in part, either by the PUC or the municipality, it is important to discuss whether such utilities should and whether they may own SHAC devices. It has been suggested that utility ownership of SHAC devices, if confined to municipally owned utilities, is preferable to ownership by investor- or privately owned utilities [126]. This preference arises from the fact that a municipal utility is (in theory at least) significantly more accountable to the public because (1) it is a public entity, (2) it is subject to direct control by publicly elected officials, and (3) it does not have a profit motive and thus would be unlikely to charge solar consumers heavy add-ons to retail cost [127]. This argument has merit in Colorado when one considers that PUC commissioners are not directly elected officials, but rather are appointed by the Governor with the consent of the state senate [128]. On the other hand, should a municipal utility seek to displace competition in the solar market by taking advantage of its monopoly status, such action would be state policy and, therefore, its anticompetitive SHAC system ownership activities would qualify for the state action exemption from application of federal antitrust laws [129]. It appears, however, that a municipal utility's relationships with SHAC device manufacturers or distributors would be subject to Colorado's restraint of trade laws [130].

Existing Colorado statutes seem to authorize ownership and control of SHAC devices by municipally owned utilities. The governing body of each municipality in Colorado has the power:

> (a)(I) To acquire waterworks, gasworks, and gas distribution systems for the distribution of gas of any kind or electric light and power works and distribution systems, including geothermal and solar systems, and all appurtenances necessary to any of said works or systems or to authorize the erection, ownership, operation, and maintenance of such works and systems by others. . . .
>
> (d) To assess from time to time, when constructing such water, gas, geothermal, solar, or electric light works and in such manner as it deems equitable, upon each tenement or other place supplied with water, gas, heat, cooling, or electric light, such water, gas, heat, cooling, or electric light rent as may be agreed upon by the governing body.
>
> (e) To condemn and appropriate so much private property as is necessary for the construction and operation of water, gas, geothermal, solar, or

> electric light works in such manner as may be prescribed by law; and to condemn and appropriate any water, gas, geothermal, solar, or electric light works not owned by such municipality in such manner as may be prescribed by law for the condemnation of real estate. [131]

It is not particularly clear whether the "solar works" referred to in this statute consist of decentralized SHAC devices or centralized systems such as solar power towers. Conceivably, the broad solar language could be interpreted to include both decentralized and centralized solar technologies since the services specifically referred to include heat, cooling, and electric light, all of which can be produced by both types of solar technologies. If this interpretation is correct, the law would seem not only to authorize municipal utilities to engage in SHAC ownership, but also to lease SHAC devices and assess rent in a manner agreeable to the governing body.

Municipal utility ownership of SHAC devices moved from theory to reality in 1973 in the City of Santa Clara, California [132]. The city-owned Santa Clara utility currently leases SHAC devices for heating swimming pools to approximately 100 customers. In addition, the city has installed, on a trial basis, SHAC devices for space heating in five homes. The city's program is now part of a California Energy Commission proposal to extend the role of local government entities in the development and commercialization of solar energy. The California municipal solar utility proposal states in part that:

> [m]unicipally operated utilities are ideally suited to introduce solar energy to consumers who are reluctant to assume the full financial and technical risks of a solar investment. Whether the utility leases or sells solar systems, the consumer is assured that his equipment will be effectively maintained and repaired. When a utility leases solar equipment or leases it with the option to buy, the consumer avoids the problems and risks of selecting, purchasing, and installing a system. [133]

The proposal is designed to result in a joint California Energy Commission/DOE funding effort that will provide local government entities with the information and assistance necessary to initiate their roles in solar commercialization. Among the goals of the proposal are to (1) develop and initiate marketing efforts to establish 50 to 100 operating municipal solar utilities by 1981, (2) initiate three to four large-scale pilot solar retrofit projects for domestic water heating in various housing applications (e.g., low/fixed income, high-rise residential units, low/middle income apartments, single family tracts), and (3) establish municipal financing options that are independent of state and local tax support [134]. Should this effort succeed, and be duplicated elsewhere, it will thrust municipal utilities to the forefront of SHAC system commercialization.

2.4 ALTERNATIVE UTILITY OWNERSHIP POLICIES

One alternative to the four previously discussed SHAC device ownership policies is to permit utilities to finance or insure solar systems [135]. This alternative appears legally feasible when one considers that several PUCs have expressly authorized programs by utilities to finance the installation of insulation to conserve natural gas [136]. Such an option would directly help resolve the high "first cost" problem now plaguing solar consumers, as well as indirectly assure solar consumers of the product's quality. Additionally, this alternative could result in SHAC system designs more favorable to the operation of the utility's system; i.e., solar systems requiring auxiliary energy only during periods other than on peak. Since the Colorado PUC has the authority to investigate the practices of any utility and to establish new practices in lieu thereof [137], it could establish a solar financing program for any utility within its jurisdiction. Unfortunately, utilities are not likely to favor this option because they would be required to assume all the risks without the financial benefits that would follow from including solar financing in the rate base. In addition, solar financing would require the utility to expend additional capital beyond that already expended in its conventional energy service operations.

Other alternatives have been suggested by those opposed to utility involvement in the ownership of SHAC devices [138]. First, local governments could establish community cooperatives that could purchase large quantities of SHAC devices, and thereby take advantage of these economies of scale and assure product quality. The devices could then be sold at a price equivalent to cost-plus administrative expenses. Second, the unregulated solar industries themselves could establish leasing or financing programs. A leasing program of this nature is underway in Florida. A third alternative is to limit utility participation in the solar market to servicing or maintenance programs. In conjunction with such programs, utilities could be used as a means for collecting and distributing solar and other energy-conserving consumer information. The National Energy Act envisions such a role for utilities [139]. While these alternatives have the benefit of preventing utilities from foreclosing competition in the solar market, the rate of solar commercialization and development may be less than under a program encouraging active involvement by utilities.

2.5 A CASE STUDY OF THE IMPLICATIONS OF SHAC SYSTEM OWNERSHIP BY UTILITIES IN CALIFORNIA

2.5.1 Investigation by the California PUC Energy Conservation Team

The California experience with utility involvement in ownership of SHAC devices is instructive to other states considering some degree of utility participation in the solar market.

In 1976, the California PUC Energy Conservation Team investigated the role of solar energy in supplying the state's energy needs. The investigation culminated in the preparation of a report that generally concluded that California should promote the accelerated use of solar energy. This conclusion was reached because of the rising costs of fossil fuels, the uncertainty regarding the availability of fossil fuel resources, the abundance of solar energy, the cost-effective uses of solar energy for space conditioning and water heating, and the fact that government incentives can facilitate the transition to the use of renewable and more abundant energy resources [140]. The report also concluded that the role of utilities should be to (1) provide their customers with SHAC device information; e.g., brand names of SHAC systems meeting interim specifications and the names of reputable solar contractors, (2) provide their customers with assistance in maintaining their SHAC devices, (3) assist their customers in financing SHAC devices until a significant sales level of solar systems business is established, and (4) develop incentive off-peak rates for back-up energy service to solar-equipped buildings [141]. The informational, maintenance, and financing services were estimated not to require significant additional utility expenditures. Where subsidies from other nonsolar rate payers were considered, such subsidies seemed best limited to the development of domestic water heating and passive space conditioning systems [142].

Of great significance was the Team's determination that utilities have a potential advantage over private enterprise in the marketing of SHAC devices. Utilities, if they were in the solar business today, were estimated to be able to cut costs over any competitor by about $200 on each system [143]. The California Team found that volume purchasing by a utility could reduce unit costs on all SHAC device components by as much as 40% to 50%, and that the utility could reduce the cost of installation by $100 or more on a typical water heating system [144]. And, with a customer service and maintenance department already established, a utility could easily expand into the solar market.

The Team concluded that utility involvement in the direct sales of SHAC systems was a policy question [145], and recommended that the legislature prescribe the degree to which utilities should be allowed to manufacture, sell, or lease solar equipment [146]. One unanimous policy recommendation was to prohibit utility companies or their subsidiaries from manufacturing, selling, installing, and leasing SHAC equipment unless the legislature declared that solar service was a utility service subject to regulatory jurisdiction [147]. Noting that a utility subsidiary engaged in the marketing of SHAC devices may not fall within PUC jurisdiction, the Team recommended that the regulated utility be precluded from using utility personnel, financial resources, and vehicles to promote the subsidiary's activities [148].

2.5.2 The "Sunflower" Opinion

While this report by the California PUC Energy Conservation Team was being prepared, the Southern California Gas Co. (SoCal) applied to the California PUC for authority to engage in a solar demonstration project. The demonstration project, called "Operation Sunflower," was to include construction and operation of approximately 315 solar systems in various residential, commercial, and industrial structures at a cost of nearly $11 million, over the 5-year life of the project. SoCal also applied for authority to include in its rates the amounts necessary to fund the solar energy program. SoCal alleged in its application that the goals of the project included (1) the investigation and determination of system costs, performance characteristics, feasibility, building and other code revisions, safety hazards, and the scope of the utility's role in the commercialization of solar-assisted appliances, (2) analysis of legal problems associated with solar energy, and (3) the testing of demonstration units to accelerate development of existing technologies [149].

Seven days of public hearings were held during which interested parties representing consumers' organizations, local governments, gas consumers, the PUC and the State Energy Commission presented testimony. The reaction to the SoCal proposal was overwhelmingly negative. In the words of the eventual PUC opinion, "[t]o say that [the consumer organizations]. . . did not support SoCal's application would be an understatement" [150]. The other interested parties also opposed the project on three grounds. First, it was thought that additional solar expense should be borne by the utility's shareholders and not the utility's rate-payers. Second, the question of utility involvement in the solar industry seemed an issue that would be more properly resolved after an investigation by the PUC and the Energy Commission. Third, many opposed the thought of spending $11 million of rate-payer funds to accomplish SoCal's goals [151]. It is probable that the response would be the same should a Colorado utility make a similar proposal.

Not surprisingly, the California PUC denied the application by SoCal to increase rates. The basis of the decision was that "at this time it is not in the public interest to have SoCal's rate payers fund this 'demonstration project' [152]." The PUC further pointed out that the proposal may have been premature in that the State Energy Commission was legislatively charged with carrying out studies assessing the nature of solar energy resources to meet the needs of the state [153]. Since such studies were not complete, proposals such as SoCal's would not be favorably received.

2.5.3 Legislation Regarding Utility and Subsidiary Manufacture, Leasing, Sales, and Ownership of Solar Energy Systems

California's interest in regulating utility involvement with solar matters did not end with the PUC Energy Conservation Team investigation and the Sunflower opinion. A joint investigation by the PUC and the Energy Commission was instituted in 1976 to determine whether solar technologies might supply a significant part of the state's future energy needs. The initial phase of the proceeding encompassed 22 days of hearings and resulted in proposed joint findings and conclusions from both staffs [154]. On the issue of direct utility involvement in sales, leasing, and ownership of SHAC devices, it was found that (1) utilities appeared to have a distinct and potentially unfair marketing advantage over others seeking to sell or lease SHAC devices, (2) California utilities were interested in entering the solar energy field, and (3) representatives of the solar industry and various consumer groups opposed utility ownership, sales, or leasing of SHAC equipment [155]. From these findings, it was concluded that utilities should be allowed to enter the solar market on a limited basis only when such entrance is approved and monitored by the PUC. The extent to which utilities may be able to own, sell, or lease SHAC devices was left unsettled. However, it was thought that since utilities could be used as a means of accelerating the commercialization of solar energy, they should be able to finance, service, and collect data on SHAC systems [156].

As a follow-up to this investigation, California enacted a statute in late 1978 that provided the state with a mechanism for regulating privately owned utilities desiring to enter the solar market through the manufacture, sale, leasing, ownership, or control of solar systems [157]. The legislative findings and declarations are significant. They acknowledge the need for and desirability of a truly competitive solar market, and seek to guarantee such a market by PUC regulation of utilities. The legislature deduced that:

> it is in the best interest of the state to ensure competition in the solar energy industry [and to ensure that] . . . the solar energy industry . . . has the potential to be a truly competitive energy industry.
>
> . . . the current uncertainty with regard to the role of electrical and gas public utilities with regard to solar energy development hinders the full-scale development of the solar energy industry, and therefore requires legislative clarification.
>
> . . . there may be an inherent conflict for a public utility which furnishes gas and electricity on the one hand and develops solar energy on the other hand, and . . . it would be detrimental to the solar energy industry and to the state if privately owned public utilities used their status as monopolies to dominate the solar energy industry or exercise unfair market power.

> . . . the basis for regulation of public utilities extends to their participation in solar energy development as well as in the production and delivery of energy from conventional sources.
>
> It is, therefore, the intent of the Legislature that the Public Utility Commission be given a clear and explicit mandate to regulate the involvement of privately owned public utilities in solar energy development, and to ensure that the solar energy industry develops in a manner which is competitive and free from the potential dominance of regulated electrical and gas corporations. [158]

Under this statute, when an electrical or gas corporation or any subsidiary thereof desires to manufacture, sell, lease, or otherwise own or control any "solar energy system," it must first obtain the authorization of the PUC [159]. "Solar energy system" means equipment that uses solar energy to provide heating, cooling, or electricity and that has a useful life of at least three years. An electric plant is expressly excluded from the definition [160]. PUC authorization is not required where a utility decides to own or control any solar system for "experimental or demonstration purposes," or where the utility engages in a limited program of installation or use whose sole purpose is to investigate the cost-effectiveness of a solar application [161].

Once the utility has formally described its proposed solar program, the PUC is directed to grant authorization for the program if it finds that the program will (1) neither restrict competition nor restrict growth in the solar energy industry, (2) not unfairly employ any financial, marketing, distributing, or generating advantage the company may exercise by virtue of its public utility status, and (3) accelerate the development and use of solar energy systems for the duration of the program [162]. The PUC also has the authority to suspend or terminate any authorization whenever it finds the solar program no longer meets the above requirements [163].

Of course, the California statute must be implemented by the state PUC before its impact can be known. It seems, though, that California policy reflects the tension that exists regarding the marketing of SHAC devices. On the one hand, the state will not tolerate utilities using their inherent advantages to foreclose or discourage competition by industries manufacturing or selling SHAC devices. On the other hand, the state wishes to speed the market acceptance of solar technologies and seeks to rely on utilities (and their marketing strengths) to be a primary instrument in this accelerated commercialization effort. The state's PUC is responsible for reconciling these competing policies. It remains to be seen how it will do so.

2.6 UTILITY OWNERSHIP, SALE, AND LEASING OF SHAC DEVICES AND THE NATIONAL ENERGY ACT

In 1977, President Carter submitted to Congress a draft of proposed legislation to establish a comprehensive national energy policy [164]. After a year of modification by the House and Senate, the Congress passed a National Energy Act (NEA) which was signed by the President in 1978 [165]. Under the NEA, utilities are prohibited from supplying or installing any energy conservation measures except for clock thermostats, devices to increase the efficiency of furnaces (e.g., flue constrictors), and load management devices (e.g., equipment that allows utilities to control a customer's load). This prohibition does not apply to energy conservation measures that were required or permitted by a law or regulation in effect on or before the date of enactment of the

NEA, or to measures that were being installed or supplied by a public utility on or before the enactment date. Moreover, the Secretary of Energy is authorized to waive the prohibition upon petition of a utility if it is found that fair and reasonable prices would be charged, and such activity would not be inconsistent with the prevention of unfair or deceptive practices [166]. Therefore, utilities appear to be prohibited from "installing" or "supplying" SHAC devices, although the legislation is silent as to whether utilities may own such devices. Utilities are allowed to make small loans of no more than $300 for the purchase or installation of specified conservation measures, including solar and wind power equipment for water heating, space heating, and space cooling [167].

National concern regarding the role of utilities in solar commercialization was expressed in ways other than in the National Energy Act. In 1978, the White House initiated a Domestic Policy Review of solar energy which concluded that the Federal Government should establish a role for utilities that will accelerate solar implementation without threatening competition, product innovation, small solar businesses, or the opportunity of firms and citizens to enjoy the benefits of privately owned SHAC systems [168]. The Domestic Policy report suggested that federal action (1) encourage utility programs leading to increased solar system installations, (2) encourage utility supply planning consideration of decentralized and centralized solar applications, (3) explore the feasibility of using utilities or cooperatives to provide solar-derived heat, gas, or electricity on a community scale, and (4) support research and development to ensure the availability of future systems for utility applications [169].

It is significant to note that the Domestic Policy report specifically recommended that the Federal Government encourage utilities to finance, sell, lease, install, and service on-site solar equipment. It also thought it appropriate for federal agencies to support PUCs that consider solar technologies in their supply planning and decision-making processes [170]. Thus, while the National Energy Act may be silent as to utility roles regarding the sale, leasing, and servicing of SHAC devices, the Federal Government is not unaware of the issues. In fact, strategies that promote solar commercialization and at the same time maintain competition in the solar energy industry are being considered.

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SECTION 3.0

SOLAR UTILITY COMPETITION WITH EXISTING REGULATED ELECTRIC UTILITIES

To what extent may a solar utility legally compete with existing regulated utilities in providing electric service? To answer this question requires an understanding of the nature of a solar utility. A solar utility produces electricity by means of some centralized electricity-producing solar technology. The three technologies that may be used by such a utility are conversion of sunlight to heat (solar thermal), direct conversion of wind to electricity (WECS), and direct conversion of sunlight to electricity (photovoltaics). Solar utilities, like existing electric utilities, may be investor-owned, municipally owned, or federally owned.

The discussion that follows addresses the legal barriers that may be presented to a solar utility that seeks to compete with an existing electric utility for electric service customers. Significant legal issues arise once a solar utility is able to compete for service, but such issues are beyond the scope of this article. Some of these issues include power plant citing, securing access to sunlight and/or wind easements, securing easements on or over those of another public utility, financing capital expenditures, and environmental issues.

3.1 COMPETITION BY INVESTOR- OR PRIVATELY OWNED SOLAR UTILITIES

3.1.1 PUC Jurisdiction

Article XXV of the Colorado constitution [171] recognizes the broad authority of the Colorado PUC to regulate the facilities, service, rates, and charges of any public utility within Colorado. In Colorado, suppliers of electrical energy, including cooperative electric associations or nonprofit electric corporations, are classified as public utilities. Therefore they are subject to PUC jurisdiction, control, and regulation, and to the Public Utilities Law [172]. The Supreme Court of Colorado has interpreted the Colorado Constitution and the Public Utilities Law to mean that jurisdiction over the adequacy, installation, and extension of power services, as well as jurisdiction over the facilities necessary to supply, extend and connect the service, is exclusively vested in the PUC [173].

Under these principles, a solar company that desired to supply electric energy to the public or to members of an association formed by the company would be subject to PUC jurisdiction. So too, if a group of home, condominium, or apartment owners form an association and erect facilities to provide solar-generated electricity to themselves, the association may be classified as a public utility and find itself subject to PUC jurisdiction. Conceivably, a shopping center, research park, or other facility operating a solar power generating system for its own use may also be classified as a public utility if its tenants are considered to be "members" of an association.

The majority court rule confirms these conclusions. Most courts hold that public utility status is accorded to a company if it has "dedicated its property to public use" [174]. In Munn v. Illinois [175], the Supreme Court established the principle that when one devotes his property to a use in which the public has an interest; i.e., when used in a manner to affect the community at large, he must submit to regulation. The owner may then have to face the prospect of having the property and its operations controlled by the public for the common good. The Colorado Supreme Court has agreed that:

> to fall into the class of a public utility, a business or enterprise must be impressed with a public interest and . . . those engaged in the conduct thereof must hold themselves out as serving or ready to serve all members of the public, who may require it, to the extent of their capacity. [176]

Any organization that holds itself out as serving some of the public's power needs through solar technologies may be considered a utility.

Under the minority rule, certain activities that do not involve a dedication of property to the public use may nonetheless be "so affected with the public interest" as to give rise to PUC jurisdiction. This rule was applied in Cottonwood Mall Shopping Center, Inc. v. Utah Power & Light Co. [177], where a shopping center constructed an electric generating plant designed to supply power to its tenants. The court held that since both the shopping center tenants and the public at large would benefit from the supply of power, the activity conferred public utility status upon the shopping center. The shopping center was then subject to PUC regulation [178]. Under either rule, it seems certain that a private solar company desiring to generate electricity for public distribution both within a municipality and in other areas would qualify as a public utility and be subject to PUC jurisdiction.

3.1.2 Consequences of PUC Jurisdiction

Colorado public utilities law has a key impact on the ability of solar utilities to compete with existing regulated utilities. By Colorado statute, the construction of either a new facility or an extension of an existing system by a public utility cannot begin until the utility first obtains a certificate stating that the present or future public convenience and necessity requires the construction [179]. In Western Colorado Power Co. v. Public Utilities Commission [180], the Colorado Supreme Court held that this certification statute is the foundation of the regulated monopoly principle and was designed to prevent the duplication of facilities and competition between utilities. The only time the statute may be ignored is when existing utilities are found to be inadequate.

A further provision provides that when the PUC finds that there is or will be a duplication of service by public utilities in any area, the PUC shall in its discretion (1) issue a certificate assigning specific territories to one or each of the utilities, or otherwise define the conditions of rendering service and (2) order the elimination of the duplication upon "just and reasonable terms" [181]. Under the statute, it is mandatory that the applicant, prior to the construction of any new plant or system, prove that the public convenience and necessity requires such construction [182]. Where a utility has not expanded service into an uncertified area, that area remains open for certification by the usual procedures [183]. However, an intruding utility may not claim service in an area already adequately served by an existing utility [184].

A solar company desiring to construct a solar electric generating plant, as well as the necessary facilities for distribution, would therefore be required to seek and obtain a certificate. It is the certificate that will prove the major obstacle to a solar utility participating in the power generation market. At present, the likelihood of a solar utility being able to acquire a certificate is extremely limited. Except for a few uninhabited areas, the entire state is certified to existing utilities for electricity [185]. There are only two ways for a solar utility to acquire a certificate: (1) if existing utilities are found to be inadequate, or (2) if solar generated electricity is considered to be a "new" utility service. Unfortunately, the PUC has rarely determined that utility service is inadequate [186]. Nor is there historical basis for the PUC to distinguish between electricity supplied by fossil-fuel plants and that generated by other means—hydroelectric, nuclear, or solar [187].

Even assuming solar-generated electricity constitutes a new utility service, the ability of a solar utility to acquire a certificate would depend on whether the proposed solar service area is certified to an existing utility for electric service. If the area is already certified, the solar utility would be required, in addition to establishing the necessity and public convenience of the solar electric service, to show that the existing utility is either unwilling or unable to satisfy the demand for solar electric service [188]. The likelihood of such a showing is diminished by the fact that the existing utility's right to provide utility service under its certificate within its defined area, constitutes a property right that cannot be taken without due process of law [189].

In Town of Fountain v. Public Utilities Commission [190], the Colorado Supreme Court indicated the conditions that must be present before a utility (e.g., a solar utility) may apply for and properly receive a certificate from the PUC to provide utility service in an area previously certified to another utility. Fountain received a certificate to supply electricity to the area surrounding the town. The eastern one-half of this area contained no lines or distribution facilities from which to provide service. Another utility, Mountain View Electric Association, Inc., was certified in areas adjacent to Fountain's area and subsequently received authorization from the PUC to extend operations into Fountain's certified but unserved area. The reason for the decision was that the public convenience and necessity required Mountain View's service. Fountain objected to the PUC's determination. However, the court affirmed, holding that "a utility may apply for a certificate to serve in a certified area if it appears that the certified utility is either unwilling or unable to serve any existing or newly developing load within its certified territory" [191]. After Fountain, if a solar utility desires to acquire a certificate to serve an area already certified to another utility, the former must show that the latter is unwilling or unable to adequately provide the service. In Fountain, an absence of facilities appeared to be the key fact indicating an inability to serve the area. A similar showing would probably be necessary before a solar utility could be certified.

It is conceivable that other factors could be used to prove an unwillingness or inability to provide service. For example, economic infeasibility [192] or fuel shortages might constitute the existence of an inadequate existing service [193]. A legislative or PUC declaration that solar generated electricity is a "new" utility service may also lessen the burden on a solar electric utility seeking to establish an unwillingness to serve—particularly where an existing certified utility chooses not to generate by means of solar. However, it has been held that the first utility certified should be given the opportunity to supply any needed service before any other utility is allowed to compete with it [194].

No guidelines exist for PUC criteria regarding approval of a certificate of public convenience and necessity to construct a public utility facility [195]. With such broad discretion in making its decision on a certificate, the PUC could consider the economic interests of the utility's customers, or even the economic feasibility of constructing a solar power plant over one fueled by conventional energy sources. At present, there is no requirement that the PUC take into account such social costs as environmental degradation and depletion of nonrenewable resources. But should the PUC consider economic factors in its decision-making deliberations, such costs must be included.

The Colorado Supreme Court has in one instance sanctioned an economic feasibility analysis that suggested the usefulness of decisions that factor in costs of a social nature. In International Union, UMW of America v. Public Utilities Commission [196], it was implied that a PUC decision granting a certificate could be questioned where another type of power plant had a distinct and measurable economic advantage over the type certified [197]. Thus, when the solar thermal power plant alternative becomes economically competitive, a solar utility could argue that present economic and technical conditions support certification of a solar plant over one conventionally fueled. As times change and future social costs become more of a factor in policy considerations, the PUC might begin consideration of these costs as part of an economic feasibility analysis. When this change occurs, a solar utility would be in a good position to point out the social and environmental advantages of solar thermal generation over conventional power generation.

Another method by which a solar utility can gain entry into the electric service market is to purchase an existing utility's certificate of public convenience and necessity. A Colorado statute provides that:

> any certificate of public convenience and necessity or rights obtained under any such certificate held, owned, or obtained by any public utility, may be sold, assigned, or leased as any other property other than in the normal course of business, but only upon authorization by the Commission and upon such terms and conditions as the Commmission may prescribe. [198]

The ability of a solar utility to purchase a certificate from an existing utility thus rests in the discretion of the PUC. This discretion would nevertheless be substantially limited by the bargaining position of the existing utility. The authority of the PUC to exercise discretion relating to the sale of a certificate does not give the PUC the power to order the sale, for to do so might constitute a taking of property without just compensation [199].

An additional disincentive awaits solar utilities wishing to provide service within a municipality. As with other utilities, a privately owned solar utility desiring to operate exclusively within a municipality would be subject to the certification process [200]. In addition, either local laws might require a private utility serving the customers in a municipality to obtain a franchise, or a utility might seek a franchise on its own initiative [201]. However, in attempting to compete for service within a municipality, a solar utility may be in violation of an earlier franchise granted to an existing utility. Whether a violation would in fact occur by the competing solar utility depends on the specific provisions of the franchise. Nevertheless, since municipal franchises are analogous to the monopoly status that is conferred by a certificate, such franchise could represent yet another barrier to a private solar utility's ability to compete with existing utilities.

3.1.3 Suggested Alternatives

There are several means by which the aforementioned barriers to electric service competition by a privately owned solar utility may be removed. It has been suggested that PUCs could simply declare that they will choose not to exercise jurisdiction over solar electric generating facilities. Such a policy could be beneficial to solar development and electric customers if the policy was confined to certification procedures. Otherwise, consumers of solar-generated electricity would not be accorded the protection that rate [202] and service [203] regulation normally provides. Utilities threatened by competition would also likely respond that under the PUC jurisdictional statute [204], the PUC is compelled to exercise jurisdiction over any entity declared as a matter of law to be affected with a public interest. Solar utilities would fall within this definition and would therefore be subject to PUC jurisdiction.

Another possible means of allowing competition by a solar utility is to permit competition legislatively. A statute could simply state that the public interest demands that a utility providing solar-generated electricity be permitted to compete with existing utilities. Such a law would either remove the certification requirement or could be drafted to exempt solar utilities from PUC jurisdiction. Once competition is allowed, electric consumers could not be compelled to take service from one utility, but rather would be able to select service from the utility of their own choice [205].

Since a certificate in Colorado grants a utility a right to serve the public within its certified area, such a right constitutes a legally protected property right [206]. Therefore, either of the two preceding alternatives would be contested by the certified utility as amounting to a taking of property without due process [207]. It is true that the Constitution's protection against the taking of private property for a public use without just compensation is limited by a state's ability to regulate pursuant to the police power. However, when the regulation goes too far it may be recognized as a taking without just compensation [208]. A law that voids an existing utility's certificate, which results in a significant loss of customers, may be an example of regulation going too far.

California law offers a final example of how one state has approached the issue of solar utility competition with existing, regulated electrical utilities. In 1976, the California legislature enacted legislation encouraging the development of new sources of natural gas and electricity [209]. Private energy producers are broadly defined within the legislation to include persons or entities generating electricity from other than conventional sources for their own use and not for sale to others [210]. The statute to a certain extent exempts privately owned solar utilities from PUC jurisdiction, as it provides that "[a] private energy producer shall not be found to be an electrical corporation . . . as defined in this code solely because the electricity . . . is being transmitted in part through facilities owned by a public utility " [211]. Another section of the statute allows such utilities to use existing public utility transmission facilities where it is necessary to transmit the electricity from the generating source to the point of end use [212]. The statute provides an incentive for solar utilities in that it allows such utilities to use existing utility facilities without sanction of PUC regulations. Such strategies should be considered in other states seeking to promote solar power.

3.2 COMPETITION BY MUNICIPALLY OWNED SOLAR UTILITIES

Municipally owned utilities, to the extent of their operations within municipal boundaries, are not subject to the jurisdiction of the PUC in Colorado. And under Article XX of the Colorado constitution, home-rule cities are empowered to manage local and municipal matters, including the construction, acquisition, and operation of municipal utilities [213]. Since statutory and home-rule cities are not subject to PUC jurisdiction, utilities owned by municipalities have broad potential for experimenting with, developing, and operating solar facilities. In partial recognition of this potential, the Colorado legislature in 1975 granted municipalities the power to acquire or erect solar systems [214]. The statute provides that the governing body of each municipality has the power to acquire electric light and power works, including "solar systems and all appurtenances necessary to the operation of such works." The somewhat ambiguous language would seem to include solar systems designed to generate electricity.

The statute further provides that the municipality has the right to purchase or condemn the facilities of an existing franchise at their fair market value. Under this statute, and a Colorado Supreme Court case interpreting it [215], existing franchises within a municipality would not present a barrier to a municipality desiring to establish a solar municipal utility. A municipality could therefore condemn for purchase the electric works of any electric utility operating within municipal limits, and subsequently construct a solar generating facility to establish a solar municipal utility [216]. To the extent of solar electric service provided within municipal boundaries, the municipally owned solar utility would not be subject to PUC jurisdiction and hence, the certification procedures.

The Colorado Supreme Court has confirmed that a municipality seeking to provide a public service is not barred by the existence of a certified privately owned utility company providing a similar service. In United States Disposal Systems (USDA), Inc. v. City of Northglenn [217], the city passed an ordinance authorizing it to provide trash removal services. USDS argued that since it held a certificate granted by the PUC, the ordinance constituted an invalid exercise of the police power and a taking of private property without compensation. The Court concluded that the ordinance had a fair relation to the protection of the public health, and held that the municipality's actions constituted a reasonable exercise of the police power [218]. More importantly, the Court stated that under the Colorado Constitution, the PUC cannot interfere with municipalities in the exercise of their police power, and has no jurisdiction over municipally owned utilities [219]. The acquisition by a municipality of electric power works for the purpose of establishing a solar electric utility would probably be construed as a valid exercise of the police power. Therefore, the existence of a PUC certificate granted to an existing utility would constitute no legal barrier to this action.

In the absence of statutory and judicial law such as that found in Colorado, common law and constitutional provisions would govern the extent to which a municipality seeking to compete with an existing utility could ignore a previously issued franchise. A municipality that wishes to compete with an existing utility would be subject to scrutiny under the Contract Clause and Fourteenth Amendment of the Constitution [220]. The Contract Clause guarantees that no state shall impair the obligations of contract [221] and the Fourteenth Amendment protects against takings by a state of private property without due process of law [222].

Inasmuch as a municipal franchise to an existing utility is recognized as a binding contract [223], it is possible to argue that the municipality has contracted to give the utility the exclusive right to provide service. Impairment of such an agreement would be actionable under the Contract Clause [224]. However, it has been held that the grant of a franchise carries with it no implied contract that would foreclose competition by the municipality [225]. In addition, the Supreme Court has stated that the Contract Clause is not only

> qualified by the measure of control which the State retains over remedial processes, but the State also continues to possess authority to safeguard the vital interests of its people. It does not matter that legislation appropriate to that end has the result of modifying or abrogating contracts already in effect. [citation omitted] . . . Not only are existing laws read into contracts in order to fix obligations as between the parties, but the

> reservation of essential attributes of sovereign power is also read into contracts as a postulate of the legal order . . . . [226]

Therefore, a franchise granted to a utility by a municipality must be construed in accordance with the municipality's authority to exercise its police power. Since the establishing of a municipally owned solar utility would promote the health, safety, and welfare of the public, such an action would be considered a valid exercise of the police power.

An existing utility would have a stronger defense against competition from a municipally owned solar utility, when the express terms of the franchise provide that the company is to provide service free of competition from any other entities, including the municipality. Where a private utility holds a franchise that explicitly precludes the municipality from operating a similar facility, the former will find protection under the Contract Clause [227]. If solar electric service were considered to be a "new" utility service, an exclusive franchise for a given type of service would not protect the holder from solar utility competition [228]. And, if the power of a municipality to operate a utility is granted by the state constitution [229], the municipality will be allowed to compete even if the terms of the franchise to the private utility expressly prohibit solar competition by the municipality. Such a result is due to the fact that a franchise granted pursuant to state statute cannot abrogate the power constitutionally vested in a municipality [230]. The Contract Clause will thus pose only a minor limitation on a municipal solar utility seeking to compete with a franchised, existing electrical utility.

If a private utility cannot use the Contract Clause to defeat municipal competition, it will claim that such municipal involvement in the franchised area amounts to a "taking" of private property under the Fourteenth Amendment [231]. Such an argument is likely to be unsuccessful. In New Orleans Gas-Light Co. v. Louisiana Light Co., it was held that when a private utility has been granted a franchise that precludes competition, the authorization by the municipality of a similar venture does not constitute a taking when such authorization is an exercise of the police power [232]. To the argument that the municipality's competition would deprive the private utility of its property without due process, the Court in another case replied that

> [t]he decisions of this Court leave no doubt that a state [or a municipality by delegated authority] may, in the public interest, constitutionally engage in a business commonly carried on by a private enterprise, . . . citations omitted and compete with private interests engaged in a like activity. [233]

It seems, then, that regardless of whether the private utility asserts Contract Clause or takings claims, the question of whether a solar municipal utility may compete with a franchised utility will be determined according to whether the municipality is acting within the scope of the police power [234].

The final possible limitation on municipal solar utility competition with existing private utilities is the array of federal antitrust laws. Municipalities are not likely to be subject to the antitrust laws after the Supreme Court announced in Parker v. Brown that the Sherman Act's coverage does not extend "to restrain state action or official action directed by a state" [235]. The Parker state action exemption as applied to a municipally owned utility was more recently considered in City of Lafayette v. Louisiana Power & Light Co., where the Supreme Court held that actions of municipalities are exempt by the Parker doctrine when such actions are "engaged in as an act of government by the

State as sovereign, or, by its subdivisions, pursuant to state policy . . " [236]. The constitutional or statutory authority that a municipality in Colorado exerts to acquire or operate a municipal solar utility should easily qualify the action for the state action exemption from the antitrust laws.

3.3 COMPETITION BY FEDERALLY OWNED SOLAR UTILITIES

To what extent may solar utilities owned by the Federal Government compete with private electric utilities? Existing federal power agencies, such as the Bonneville Power Administration and the Tennessee Valley Authority, are basically generating and marketing agencies permitted to enter into contracts for the wholesale distribution of electric energy [237]. With the exception of the Rural Electrification Administration, the federal power authorities do not generally market electric energy directly to individual consumers on a retail basis [238].

If Congress or federal agencies were to establish solar electric utilities for the purpose of competing with existing utilities for business at the retail level, it is highly likely that these entities would be subject to PUC jurisdiction in Colorado. The applicable statute provides that every cooperative electric association and "every other supplier of electricity" are subject to the jurisdiction, control, and regulation of the PUC and to the provisions of the Public Utilities Law [239]. The Colorado Supreme Court has held that this statute makes no exceptions, and that every cooperative electric association, as well as every other supplier of electricity, is a public utility and therefore subject to PUC jurisdiction [240]. Thus, the certification procedures applicable to privately owned solar facilities discussed previously would equally be applicable to federally owned solar utilities.

The Tenth Amendment is another potential limitation on the ability of federally owned solar utilities to compete with existing utilities on a retail basis. Under the Tenth Amendment, "[t]he powers not delegated to the United States by the Constitution, nor prohibited by it to the States, are reserved to the States respectively, or to the people" [241]. In Fry v. United States, the Supreme Court recognized that under this amendment Congress may not exercise power in a manner that impairs a state's integrity or its ability to function effectively [242]. In National League of Cities v. Usery, another Tenth Amendment case, the Supreme Court recognized that the states have attributes of sovereignty which may not be impaired by Congress [243]. The Court in Usery held that Congress may not exercise the commerce power so as to limit state decisions regarding the conduct of integral governmental functions [244]. After Fry and Usery, it could be argued that a congressionally authorized solar utility so interferes with the states' regulation of public utilities, an integral governmental function traditionally of a local nature, that a Tenth Amendment violation has occurred [245].

3.4 REGULATED COMPETITION AS AN ALTERNATIVE TO THE REGULATED MONOPOLY STRUCTURE

Competition among regulated solar and nonsolar utilities is an alternative to the regulated monopoly energy supply market structure. The regulated competition model is currently in effect in Colorado for transportation utilities, as a result of a 1967 amendment to the applicable Colorado certification statute [246]. This law might serve as an example for states that wish to allow the consumer to choose between solar and fossil-fuel-generated power. Because of this amendment, a certificate of public convenience and necessity to operate a motor vehicle for hire for the transportation of property no longer constitutes an exclusive grant or monopoly. Instead, the PUC is authorized to grant more than one certificate for the transportation of property when it finds that public convenience and necessity require the competing service.

In Miller Bros., Inc. v. Pub. Util. Comm. the Colorado Supreme Court held that the 1967 amendment eliminated the requirement that existing service must be shown to be inadequate before a competing carrier may be certified [247]. After Miller Bros., the new controlling factor is the "public interest." The Court validated the statute despite the lack of definition of "regulated competition," and despite the fact that no standards were included under which the PUC might issue additional certificates [248]. This and other cases establish guidelines that may be used by the PUC in determining whether to issue a certificate to a common carrier wishing to compete with a certified carrier. These guidelines include determinations of whether (1) there is a public need for the service [249], (2) the economic feasibility of existing certified carriers would be lost [250], (3) there is a need for competition in providing the service [251], (4) the new carrier is willing and able to provide the service [252], (5) the competitor's service is unique in any way [253], and (6) the competitor's service is better in any way than existing service [254].

Guidelines similar to these could be applied in the event that existing electric public utilities are required to operate with solar utilities under a regulated competition model. An extension of the regulated competition model could promote the development of solar energy both by existing utilities and by privately owned companies desiring to establish solar electric utilities. And, under this model, a solar utility could compete with an existing utility in providing electric service. Through continuing vigilance, the PUC could still assure that wasteful duplication of facilities and excessive rates do not occur.

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SECTION 4.0

UTILITY RATES AND SERVICE POLICIES AS POTENTIAL BARRIERS TO THE MARKET PENETRATION OF DECENTRALIZED SOLAR TECHNOLOGIES

One drawback to the use of decentralized or on-site solar technologies (those designed to be located on or near the buildings to which heat or electricity is provided) is that they require an auxiliary energy source to assure continuous service when, because of weather conditions, the solar devices are unable to function [255]. Decentralized solar technologies that generally need some form of conventionally fueled back-up include SHAC systems, wind energy conversion systems (WECS), and photovoltaic energy conversion systems (PECS). These technologies generally use some form of energy storage—particularly thermal (liquid or air) or chemical (batteries). Where energy storage is depleted during periods of adverse weather, a conventionally fueled auxiliary system would be required to supply a building's energy needs [256]. Typical energy sources for auxiliary systems include electricity (heat pump and resistance heating applications), natural gas, propane, and fuel oil [257].

There may be institutional concerns that require auxiliary systems in solar-equipped facilities. Legislation designed to promote solar technologies has generally required that the system comply with design and performance standards [258]. Where the system fails to comply with the requirements of the legislation, the owner would not qualify for the benefits provided. It is conceivable that such legislation could be drafted to require the existence of a conventionally fueled auxiliary system in addition to a standard solar design. Also, building code inspectors may require that a solar-equipped facility utilize a conventionally supplied auxiliary system before the building receives certification of approval for use [259]. Moreover, some financial institutions will not authorize a mortgage loan on a new residence utilizing solar energy unless the residence also contains an electric or propane auxiliary [260].

Thus, in the near term, solar-equipped buildings will require some form of auxiliary energy. Existing utilities are likely suppliers of this auxiliary energy. The rates at which this auxiliary energy is purchased will significantly affect whether the particular solar application is economically feasible or cost competitive. In the earlier noted investigation conducted for the United States Department of Housing and Urban Development (HUD), interviewers posed questions to utilities supplying gas or electricity to HUD solar homes, and utilities within the same regions not supplying auxiliary services to HUD solar homes, but possibly to other solar buildings [261]. 91% of the utilities surveyed provided auxiliary service at standard rates that were believed to neither encourage nor discourage the use of solar energy for residential applications [262]. A significant number of the utilities expressed concern that the widespread implementation of solar energy would have an adverse impact upon them by increasing peak loads while decreasing total revenues [263]. As a result, many utilities are considering some type of rate structure that would directly impact the solar energy alternative.

When rates for auxiliary energy are considered, the major concerns of solar users are whether a utility can (1) charge higher or lower than traditional rates for electric or gas service provided for back-up purposes, and (2) refuse to purchase excess energy from electricity-producing solar technologies. The balance of this paper will analyze these issues, address the effects of decentralized solar technologies on electric utilities, provide examples of existing and proposed solar rates, and discuss the National Energy Act as it applies to rate making.

4.1 ELECTRIC UTILITY RATE REGULATION

Electric utility rate making [264] is subject to regulation by the states under the police power [265], and by the Federal Government under the commerce clause of the United States Constitution [266]. Of the four principal components of public utility regulation (price fixing, control of entry, prescription of quality and conditions of service, and imposition of an obligation to serve all applicants under reasonable conditions) [267], rate regulation is the key consideration for the solar industry [268].

Rates are regulated primarily because electric utilities have been considered natural monopolies. Natural monopoly means that the electric utility, by virtue of its inherent characteristics rather than by legal restrictions or financial persuasiveness, cannot operate efficiently and economically unless it enjoys a monopoly of its market [269]. The natural monopoly concept arises from the notion that it is better to have fewer electric utilities within a given area that can provide the public more efficient and economic service than to allow any number of utilities to compete for business under a competitive market structure [270]. Natural monopolies of this kind were recognized because the unit cost of providing service is lower with a monopoly than under competition. The bases for this conclusion are that (1) monopolies eliminate costly duplication of facilities, (2) utilities realize decreasing average unit costs as output increases, and (3) economies of scale are realized when utilities are able to utilize larger, more efficient facilities [271].

Rate regulation has also been regarded as a substitute for competition [272]. Since customers of electricity generally have not been able to bargain in the setting of rates for service provided by the electric utility, price regulation is necessary to protect the public interest by shielding customers from the potential excesses of monopoly pricing [273]. Price regulation also serves to allow the electric utility to achieve a reasonable profit on its investment [274].

4.1.1 Principles of Rate Regulation

Early decisions by the Supreme Court addressed the constitutionality of state-imposed price fixing or rate regulation for public service and other businesses. Initially, if the business was devoted to a use in which the public has an interest; i.e., when used in a manner to affect the community at large, the business was subject to state regulation [275]. In later decisions, the presence or absence of a natural monopoly situation seemed dispositive on the issue of the constitutionality of state regulation [276].

In Smyth v. Ames [277], the Supreme Court established a minimum standard by which to evaluate the constitutionality of state rate-fixing statutes. The Court held that rate regulations that do not afford the regulated entity the opportunity to earn fair and just compensation would be a deprivation of property without due process of law in violation of the Fourteenth Amendment [278]. Recognizing that rate determination was primarily a state function, the Court held that whether the rates are low enough to constitute a Fourteenth Amendment violation is an issue subject to judicial review [279].

The constitutional standard was expanded in subsequent decisions. Rates should generate enough revenue not only for operating expenses but also for the capital costs of providing the service [280]. Such costs include dividends on the equity and service on the debt. The return on equity should be sufficient to assure confidence in the financial position of the utility so as to maintain credit and attract capital [281].

In FPC v. Natural Gas Pipeline Co., Chief Justice Stone, speaking for the Supreme Court stated that:

> The establishment of a rate for a regulated industry often involves two steps of different character, one of which may appropriately precede the other. The first is the adjustment of the general revenue level to the demands of a fair return. The second is the adjustment of a rate schedule conforming to that level so as to eliminate discriminations and unfairness from its details. [282]

Step one basically involves the ascertainment of the electric utility's annual revenue requirement. Under step two of the regulatory process, a desirable rate structure should (1) generate sufficient revenues to cover the revenue requirement [283], (2) distribute the burden of achieving the revenue requirement fairly among all classes of customers, and (3) be designed to discourage wasteful use but promote efficient use of utility services [284]. Rate structure formulation involves allocating the revenue requirement, generally on a cost-of-service basis, among the various customer classes in proportion to the costs they impose upon the utility. The general legal tests applicable to rate structure design are that rates shall be just and reasonable and shall not be unduly discriminatory [285]. These tests for a rate structure should be kept in mind when considering rate structures that may be imposed upon users of solar technologies.

4.1.2 Regulatory Bodies

The function of regulatory bodies in the rate regulation process involves administration of rate making statutes at the federal, state, and local levels. Upon application by a utility for a rate increase, regulators are charged with verifying the components of the revenue requirement, assuring that rate structures are not unduly discriminatory, and approving rates into law following the administrative process. In many cases, hearings are held at which utility personnel, customer intervenors, and regulators present their cases on revenue requirement and rate structure formation. Since these regulatory agencies would pass on the validity of rates for solar users, it is important to understand their powers and responsibilities.

4.1.2.1 Federal Energy Regulatory Commission

The Federal Energy Regulatory Commission (FERC) was established on October 1, 1977 under the Department of Energy (DOE) Organization Act [286]. The responsibilities of the Federal Power Commission (FPC) under the Federal Power Act [287], pertaining to electric utility rate regulation, were expressly transferred to FERC by the DOE Act [288].

Application of federal electric utility rate regulation is limited to the transmission of electric energy in interstate commerce and to the sale of electric energy at wholesale in interstate commerce [289]. A sale of electric energy at wholesale is defined as a sale of electric energy for resale [290]. As defined also within the Federal Power Act, electric energy is transmitted in interstate commerce if transmitted from a state and consumed at any point outside that state [291].

A solar user operating an electricity-producing solar technology designed to generate electric energy to a utility for resale, or the utility that purchases the solar-generated electric energy might therefore be subject to FERC jurisdiction. An exemption from FERC jurisdiction may be available for electricity-producing solar technologies under the Public Utility Regulatory Policies Act of 1978 (part of the National Energy Act) [292]. A solar user who sees FERC regulation as a detriment to his operation in parallel with an electric utility may wish to pursue this exemption. However, the protection afforded by FERC rate regulation could assure that the solar user's buy-back rates are just and reasonable.

What protections are granted solar users whose rates are subject to FERC regulation? The Federal Power Act provides that rates and charges received by a utility for the transmission or sale of electric energy subject to FERC jurisdiction shall be just and reasonable [293]. Any rate that is not found to be just and reasonable is deemed unlawful. Regarding any sale subject to FERC jurisdiction, the Act also requires that no utility shall (1) grant any undue preference or advantage to any person or subject any person to undue prejudice or disadvantage, or (2) maintain any unreasonable difference in rates between localities or classes of service [294]. It has also been held that differences in rates are justified only where they are predicated upon differences in facts; i.e., costs of service or otherwise. Where a difference in rates is being challenged as discriminatory, judicial review centers around whether there are factual differences to justify classification of rates [295].

While the FERC may not be involved with rate making for nonpower-producing solar technologies (SHAC systems), the significant body of case law that has developed concerning rate discrimination issues certainly provides insight to resolution of similar issues at the state level. Additional federal rate regulation as enacted by the National Energy Act is addressed later in Section 4.7.

4.1.2.2 State and Local Regulatory Bodies

States have the authority to regulate utilities under their police power [296]. This regulatory power includes the authority to regulate and prescribe reasonable rates to be charged by utilities for the services they provide [297]. The rate-making function is solely legislative whether carried out by the legislature itself or by municipalities or commissions (e.g., PUCs) to which the power has been delegated [298]. It is not, therefore, within the power of a court to fix or prescribe rates to be charged by a utility [299]. Judicial power over rate making is limited to the determination of whether rates are just and reasonable, discriminatory, or whether rates are in violation of state and federal constitutional provisions [300].

PUC jurisdiction to regulate electric rates is limited to matters of local distribution and does not extend to interstate sales of electric energy for resale [301]. Generally, a section within a state's public utilities law confers PUC regulatory jurisdiction over specified utilities [302]. In Colorado, for example, a public utility includes every common carrier, pipeline corporation, gas corporation, electrical corporation, water corporation, person, or municipality operating for the purpose of supplying the public, or every corporation or person declared by law to be affected with a public interest [303].

PUC regulatory jurisdiction over municipal utilities varies from state to state. For example, the New York and Wisconsin commissions receive their authority to regulate municipal electric utility rates by statute [304]. The Colorado constitution, on the other hand, provides an exemption for municipally owned utilities from regulation by the PUC of facilities, service, and rates [305]. In Colorado, for a municipality furnishing electricity to its citizens within municipal limits, the city itself, through its municipal charter and city officers, possesses the sole power of fixing the rates to be charged [306].

PUC rate-making jurisdiction is significant to the solar user operating wind or photovoltaic energy conversion systems designed to supply electric energy back to a utility. To the extent that a solar user is subject to licensing, franchises, site regulations, and certification for public convenience and necessity, PUC regulation acts as a disincentive for equipment operation as a parallel generator [307]. However, PUC rate regulation may be beneficial to the solar-electric power producer desiring to sell electric energy back to a utility in that rates are generally statutorily required to be just and reasonable [308]. Moreover, a PUC may compel electric utilities to purchase excess power from electricity-producing solar tecnologies that qualify for parallel operation. If the setting of buy-back rates is primarily left to the utility, the solar-electric power producer would be at a definite disadvantage in bargaining position. Without PUC review, the utility would probably refuse to purchase any excess electric energy from the solar user.

In Hawaii, the state legislature may have responded to the issue of electricity-producing solar systems. Facilities that produce or furnish power primarily from nonfossil fuel sources for internal use, but which sell excess energy to local utilities, are generally exempt from PUC jurisdiction [309]. While the intent of the legislation was to encourage parallel operation of facilities designed to burn waste products of the sugar industry, solar-fired facilities may fall within the scope of the act. The legislation also requires utilities to purchase excess energy at rates to be arbitrated by the PUC [310].

4.2 ELECTRIC UTILITY COSTS AND RATE STRUCTURES

To understand the rates that may be imposed by utilities on those who choose to use solar technologies, it is necessary to understand the way in which rates are determined, as well as the various types of rate structures available to the rate maker. Rates are formulated largely on the basis of utility cost. Cost estimates give rise to a number of rate possibilities, some of which are likely to be used against solar users to compensate utilities for the costs that solar technologies may impose on the utility.

4.2.1 Electric Utility Costs

For the design of rate structures, electric utilities will generally undertake fully distributed cost studies that analyze past operations for a given period and allocate the revenue requirement among the various classes of service. Initially, the revenue requirement is functionalized into generation, transmission, and distribution costs [311]. The functionalized costs are then classified into groups bearing a relationship to a cost-defining characteristic of the services rendered. Typically, these classifications are demand, energy, and customer. Demand or capacity costs are those that vary with the kW of demand imposed on the system by customers. Energy costs vary with the number of kWh produced to serve customer usage, and include fuel, operation, and maintenance costs associated with converting fuel to electric energy, and possibly the costs to purchase power from neighboring systems. Customer costs are those related to the existence of specific customers and vary with the number of customers served.

The functionalized and classified costs are allocated to customer classes. The three primary customer classes are industrial, commercial, and residential [312]. Energy-related costs are allocated on the basis of consumption by each class. Customer costs are allocated in accordance with the customer-related facility, metering, and billing costs associated with each class. Demand costs can be allocated in any of several methods. The peak responsibility method allocates demand costs on the basis of each customer class's demand at the time of the system peak. Another method, the noncoincident peak method, allocates demand costs proportional to the peak demand of the individual class regardless of when that demand occurs.

If it is desired to create a rate structure based on time-differentiated costs, additional steps are involved. Rating periods are selected and can be seasonal, resulting in rates differing between winter and summer, or based on time of day, resulting in rates differing between diurnal on- and off-peak periods. Two generally accepted principles are observed: (1) periods of greater system load have associated with them a greater portion of fixed costs per unit of demand and (2) periods of greater system load have associated with them a greater portion of variable costs per unit of consumption [313]. Rates are generally designed with demand and energy costs higher for the seasonal and possibly daily peak period than for the corresponding off-peak period.

If rates are to be designed on the basis of marginal cost; i.e., the cost of adding an additional unit of output, a different costing approach is used by the utility. Under a marginal-cost-pricing scheme demand, energy and customer costs are derived and can be non-time-differentiated, time-differentiated by season, or time-differentiated by time of day. Economists and some regulators contend that, ideally, consumers ought to pay a price equal to the marginal cost of the service on the basis that marginal-cost pricing results in economic efficiency and optimum allocation of resources [314].

4.2.2 Rate Structures and the Solar User

4.2.2.1 Declining Block Rates

The declining block rate structure has been the most widely used type for residential and other small volume customers. If a separate minimum or customer charge is not provided in the rate, this charge is incorporated into the first energy block—typically 10 kWh. The rate structure is divided according to blocks of kWh energy consumption, and a decreasing price per unit of energy for successive consumption blocks is offered [315].

The stepped-down effect is achieved by lumping a greater portion of the demand costs into initial consumption blocks. In this manner, utilities attempt to assure that demand costs will be recovered from each customer. Thus, a solar user whose energy savings occur in outer consumption blocks is credited only with energy cost savings rather than demand cost savings. Typically, 70% of the customer's bill is recovered through energy consumption in the initial blocks and the remainder is collected from outer block consumption. This is why an 80% solar-heated home may only result in a 30% savings on the utility bill [316].

The effect of successively lower rates for each block of consumption is that both the incremental and average costs of elecricity to the customer decrease with increasing consumption. The customer's bill is calculated by cumulating the charges incurred within each block beginning with the first and continuing through the last kWh consumed in the billing period. Rate structures were designed on this basis to reflect the decreasing average costs associated with increasing consumption [317].

4.2.2.2 Flat Rates

Early flat-rate structures charged the customer a lump sum regardless of the quantity consumed or time of use [318]. Now, however, the typical flat structure contains a customer or minimum charge, plus a constant charge per kWh of consumption [319]. This constant charge reflects energy costs and demand costs equally distributed over the customer classes' anticipated total energy consumption. The flat-rate structure design would be appropriate where average costs in providing service are neither decreasing nor increasing.

This design also serves as an alternative to the declining block structure where a jurisdiction has decided to eliminate it. The flat-rate structure promotes conservation goals since there exists no economic incentive to increase consumption. A solar user taking auxiliary service under this rate would realize some demand cost savings in his bill (more than under a declining block rate), regardless of the consumption block in which his energy savings occur. Thus, from a commercialization standpoint, this rate is more beneficial to solar users than the declining block rate.

Approximately 30 state commissions have either experimented with or have ordered flat-rate structures or the flattening of declining block rates [320]. Commission policies in approximately 25 states encourage the use of flat rates or promote rate flattening [321]. A challenge in 1974 to the declining block rate structure proposed in an application for a rate increase by the Potomac Electric Power Co. (Pepco) resulted in a flattening of the declining block structure [322]. A year earlier, the New York commission ordered Consolidated Edison Co. to replace its declining block rate structures for residential, small industrial, and small commercial customers with a flat charge per kWh of consumption and a standard minimum charge [323].

4.2.2.3 Inverted Rates

An inverted rate structure is essentially the inverse of the declining block rate structure. The price charged per kWh of electric energy consumption rises with each successive block, and results in both the incremental and average costs of electricity per kWh increasing with increased usage [324]. Higher charge tail-end blocks are created by placing a greater portion of the demand costs in these blocks. Where long-run average costs to provide service are increasing, this type of rate structure is appropriate.

The inverted rate structure is consistent with conservation goals since higher usage customers are charged more per unit of energy consumption than lower usage customers. It has been argued that alternative conservation measures such as insulation requirements are more effective, because the inverted structure could result in decreased total energy consumption without a resulting decrease in system peak demand. Such an effect would possibly cause unit costs and rates to increase [325].

Where such rates have been in effect, commissions report both positive feedback regarding fairness to customers and the effects on energy conservation, and negative feedback from customers having all-electric homes or those who use large amounts of electricity for reasons of health [326]. A significant capacity cost savings would result to the solar user since solar energy savings occur in tail-end blocks. Thus, the solar user would see a greater proportional reduction in his utility bill under this rate than under both declining block and flat rates.

Inverted rates are available in Idaho during the peak load season, and an electric utility in Florida offers an inverted residential conservation rate [327]. A form of rate inversion occurred in a 1972 Virginia Electric and Power Co. (Vepco) case, in which a new rate block of consumption over 600 kWh was priced higher than the preceding block, resulting in a U-shaped rate [328]. U-shaped rate structures have also been utilized in the District of Columbia, North Carolina, and South Carolina [329].

4.2.2.4 Lifeline Rates

Lifeline rates are those providing a low-cost initial block for residential customers on the basis of need [330]. It is argued that everyone needs a certain amount of electricity and that society should provide for such needs by subsidizing a low consumption block. Most lifeline proposals identify the low consumption area ranging from 300 to 700 kWh—a quantity designated to cover necessary minimum service for lighting, heating, and cooking [331]. The lifeline concept was designed to help the poor and elderly who generally must pay a greater percentage of their income for utility services. Studies have shown that low consumption users, however, are not necessarily members of the low income and elderly classes [332].

The lifeline block rate is subsidized and would be provided at below cost. The following block would be priced to cover the actual cost of service, and subsidization for the initial block is recovered from the tail-end blocks [333]. A solar user who managed to confine his auxiliary energy usage to the lifeline quantity would realize a substantial savings in the user's utility bill. The savings would consist of both demand and energy cost savings, since the lifeline service is subsidized by the following consumption blocks.

Jurisdictions differ as to whether lifeline rates are valid or are in violation of state antidiscrimination statutes because of the subsidizing by higher usage blocks of the lifeline block. Orders by commissions in the District of Columbia, Pennsylvania, and Rhode Island limited rate increases in the residential class to usage blocks greater than 450 kWh, 500 kWh, and 300 kWh, respectively [334]. A one-year lifeline demonstration project was undertaken by Maine in 1976 and 1977 [335]. Late in 1977, a similar experiment was underway in Arizona. Rather than having a low-priced initial consumption block, the customer charge was forgiven for residential customers who used less than 700 kWh a month [336].

In Colorado, the issue of preferential rate treatment for certain consumers recently went to the state's supreme court. The PUC ordered gas utilities to implement reduced gas rates for low-income elderly and low-income disabled persons. These rates were to be subsidized by all other customers. Colorado's Public Utilities Law prohibits utilities from granting preferential rates to any person [337], and requires the PUC to prevent unjust discriminations in rates [338]. The Court held that since the rates were preferential, the PUC's order violated the Public Utilities Law [339]. It was concluded that

> although the PUC has been granted broad rate-making powers by Article XXV of the Colorado Constitution, the PUC's power to effect social policy through preferential rate making is restricted by statute no matter how deserving the group benefitting from the preferential rate may be. [340]

Some commissions have approved the concept of lifeline rates. In 1975, the California legislature passed the Miller-Warren Energy Lifeline Act [341]. This act required the state commission to establish lifeline quantities of gas and electricity necessary to supply the minimum energy needs of the average residential user for space and water heating, lighting, cooking, and food refrigeration [342]. Lifeline rates designed to promote energy conservation and help poor consumers were adopted by the South Dakota commission in 1977 [343]. The commission accepted the staff's recommendation not to wait for the legislature to act upon social welfare legislation because such a delay would fail to provide relief to the company's needy customers and to provide energy conservation incentives [344]. Such an attitude would certainly also favor solar users whose installation of solar technologies promoted energy conservation.

4.2.2.5 Demand Rates

Demand rate schedules have been referred to as Hopkinson rates, two-part rates, or demand/energy rates. This type of rate schedule has been widely used for medium and large commercial and industrial customers, but also finds application in the residential sector as well [345]. Typically, the demand schedule provides for a two-part rate consisting of separate charges for maximum demand and energy usage.

Since this rate structure contains a demand element, the average rate a customer pays varies directly with the individual load factor [346]. As the customer increases energy consumption without a corresponding increase in peak demand, or decreases peak demand without a corresponding decrease in energy consumption, the load factor will increase and the average rate will decrease. As the customer's load factor decreases because of the pattern of use, the average rate will correspondingly increase.

The reason for implementation of this rate structure by the electric utilities is to encourage high load factor uses, on the theory that such uses will, in the aggregate, contribute to system load factor improvement. A customer who cannot vary demand, however, is encouraged by this rate structure to increase energy consumption in order to improve load factor. Such an encouragement is contrary to the goal of energy conservation.

A solar user whose peak auxiliary demand did not coincide with the utility's peak, would be penalized under this rate. The user's savings could fall below those realized under other rate types since solar systems have an inherently low load factor. Where the demand charge is based upon the solar customer's noncoincident peak demand rather than the customer's contribution to the system peak demand, load factor improvement by the customer may not necessarily contribute to overall system load factor improvement. If such a customer, in response to the demand rate, attempts to even out distribution of demand by either (1) increasing off-peak demand or (2) decreasing peak demand (depending on the time of the system peak relative to the customer's peak), this shifting could work to decrease system load factor. And, if the solar customer's off-peak demand corresponds with the system's peak demand, case (1) would result in an increase to system peak demand. If the solar customer's peak demand corresponds with the system's off-peak demand, case (2) would result in a less even distribution of demand for the system.

In 1933, the Massachusetts Department of Public Utilities ordered that a demand charge of $1.50 per kW was applicable to customers having demands in excess of 2 kW [347]. The Supreme Court of Illinois has also held that the application of a demand charge along with an energy charge in substitution of the standard rate was not discriminatory, and stated that the demand charge was necessary to recover a portion of the fixed costs incurred by the utility in meeting the customer's demand regardless of the amount of power consumed [348]. In an application by two electric companies to the New Hampshire commission for authority to increase rates, customer dissatisfaction with an excess demand charge for the residential sector led to its elimination [349].

4.2.2.6 Time-of-Use Rates

Time-of-use rate structures are also known as time-of-day (TOD) rates or rates based on peak load pricing (PLP) [350]. Time-differentiated rates can be based on seasonal on- and off-peak periods or daily on- and off-peak periods. These rate structures can be developed from historic accounting costs or some application of marginal costs.

TOD rates are intended to shift consumption from peak to off-peak periods and thereby slow the need for new capacity additions. Also, with significant differentials in the price charged for demand and energy at peak periods and that charged at off-peak periods, customers should be induced to decrease peak demand and thereby increase their load factors. With less demand imposed on the system at peak periods, operating costs will be lower, resulting in postponement of numerous rate increases [351].

The adoption of seasonal or TOD rates based on LRIC has several advantages and disadvantages. The advantages include avoidance of capacity additions by a reduction in future peak loads; savings in operating costs (primarily fuel costs) when peak demand is served by more efficient base load and cycling plants rather than peaking units; encouragement of load leveling; and the provision of direct pricing signals to the consumer regarding the marginal-cost consumption, imposed at various times upon the electric utility [352]. Opponents to the establishment of TOD rate structures argue that (1) marginal-cost pricing of electric service does not produce optimal results unless all alternatives for this service are priced at marginal cost; (2) in a period of decreasing average costs, marginal-cost pricing yields revenues falling short of the revenue requirement, and in a period of increasing average costs, marginal-cost pricing yields revenues in excess of the revenue requirement; (3) peak shifting or needle peaks will occur, necessitating periodic revisions in pricing structures contrary to the objective of rate structure stability; (4) the effects of TOD pricing, highly dependent on price elasticity of demand, are not readily ascertainable and customer response is uncertain; (5) traditional notions of fairness in allocating demand costs are not promoted; and (6) the costs of administration and metering outweigh any benefits that may be realized [353].

Additional costs in implementing a TOD rate structure must be weighed against the benefits such a structure will convey. Where metering equipment is already installed or readily available, as is the case for large industrial and commercial users in many areas, implementation of TOD rates should begin in these sectors rather than for smaller users (e.g., solar users) where meter retrofit would require considerable expense. The administrative costs of additional meter reading, billing expenses, and reset procedures for timing devices following unplanned outages can be significant and should be considered. For utilities already experiencing near optimal generating efficiencies or high load factors, costs to implement TOD rates may outweigh the benefits conferred. Where these additional costs are not prohibitive, the TOD rate structure appears to be best suited for auxiliary service to solar facilities. This rate (1) could encourage off-peak use of solar auxiliaries, (2) could assure that solar systems are designed to be compatible with utility systems, (3) would not discriminate for or against solar users, and (4) would properly reflect demand and energy cost savings resulting from the use of solar energy.

A recent decision by a New York appellate court addressed the fairness of TOD rates [354], concluding that such rates applicable to a limited number of Long Island Lighting Company's (Lilco) large customers were unlawfully discriminatory [355]. Long-run incremental cost as a basis of electric utility rate structure design received a more thorough exposition in Madison Gas and Electric Co. [356], where the Wisconsin Public Service Commission held that

> the appropriate benchmark for the design of electric rates . . . is marginal cost as represented by the practical variant long-run incremental cost. If electric rates are designed to promote an efficient allocation of resources, this is a logical starting point. [357]

More recently, TOD rates and rates having seasonal differentials have been approved by commissions on mandatory, optional, or experimental bases in nearly every jurisdiction [358].

4.2.2.7 Interruptible Rates

Interruptible rates are potentially beneficial to solar users not requiring auxiliary energy during system peaks. Interruptible rates are for customers who agree to have their use curtailed by the electric utility during peak loading or periods of system emergencies [359]. The utility can reduce peak loading by interrupting service to some customers during system peaks, thereby reducing capacity demand and entitling customers served under this rate structure to lower rates.

Traditionally, this type of rate has been offered to industries willing to encounter the risk of service interruptions in order to receive lower rates [360]. In order to interrupt a customer's load, the utility utilizes radio-controlled devices or limiting circuit breakers [361]. For commercial and residential solar heating and cooling applications, costly radio-controlled devices would not be necessary; time-controlled circuit breakers could be used within the building to interrupt auxiliary service during peak periods.

The cost savings resulting from service to controlled users over the costs imposed upon the system by noncontrolled customers can be computed on the basis of either marginal or accounting costs. Under this form of rate structure, a solar building would probably forego only a few days of auxiliary energy service per year [362]. The savings to a customer with a 1,400 sq ft residential dwelling served by an eastern utility under interruptible rates could be as high as $600 per year [363].

Court and utility commission decisions have confirmed the validity of offering lower rates for interruptible service. In Wolf v. United Gas Public Service Co. [364], bakery owners charged that interruptible rates were discriminatory. The court held that a customer cannot complain that a gas rate is discriminatory unless it is shown that others operating under similar conditions are charged less [365]. In a similar rate discrimination case, a coal operators' association contended that a gas company's interruptible rates were discriminatory and resulted in unfair competition with other types of fuel [366]. The Illinois utility commission held that offering lower rates for interruptible gas service did not constitute unjust discrimination [367].

4.3 EFFECT OF RATES ON SOLAR SYSTEM ECONOMICS

It is highly likely that some form of conventionally fueled auxiliary system will be needed to provide a solar building's heating and cooling needs during periods of adverse weather. Because utility system loads can vary with solar auxiliary demands, utilities may need to design a separate rate structure to apply directly to solar users. The variety of rate structures implemented has a significant effect upon solar system economics and may prove to be a factor that solar designers must account for in new system designs. Conversely, the type of solar design used may govern the kind of rate structure the utility implements; e.g., a system needing only off-peak auxiliary energy could be given off-peak rates.

4.3.1 Demand/Energy Electric Rates—The Colorado Experience

In October 1975, the Colorado utility commission found that a mandatory demand/energy rate was just and reasonable when applied to residential service where electric heating is the principal source of heat or the primary back-up source to another form of heat [368]. The rate was designed in part to yield revenues to cover the company's extra costs incurred in providing auxiliary electric service to solar-equipped facilities [369]. Intervenors and solar advocates contended that the demand charge, based on a customer's noncoincident peak demand, would be discriminatory toward those solar customers whose peak demand did not coincide with that of the company's system. Also, the demand charge, designed to penalize those customers having load factors less than 22%, was certain to penalize solar customers in that solar system auxiliaries with low energy consumption are characterized by a low load factor [370].

After the initial decision, a complaint proceeding was instituted on April 5, 1976, by the Home Builders Association of Metropolitan Denver against Public Service Co. of Colorado, challenging the residential demand/energy rates [371]. The commission, by its own order, decided to investigate the rates and invited intervention by interested persons [372]. Leave to intervene was also granted by the commission to the Environmental Defense Fund and the Architects' Group, who argued the inappropriateness of the demand/energy rate as applied to solar customers.

Home Builders contended that the rates were unjust and unreasonable because they were implemented by the company without sufficient data or experimentation, and further alleged that they unlawfully discriminated between residential electric users subject to the rates and those who were not subject to the rates. Testimony presented by the intervenors advocated the use of marginal-cost pricing by the implementation of TOD or flat rates. They felt that the demand/energy rates made no allowance for timing of customer demand and utility cost variations with time; accurate price signals were not provided to consumers regarding their consumption patterns; in many instances (e.g., with automatic electric heat, hot water, and air conditioning) consumers were unable to control demand and manage loads to take advantage of the rates; and the economics of energy storage systems (including solar) would be threatened by the rates. The solar advocates testified that: (1) TOD or flat rates would be less discriminatory toward solar users whose demand and energy requirements (generally occurring during evening hours) occurred noncoincidentally with the system peak; (2) if a peak/off-peak differential in charges resulting from the use of a TOD rate structure was substantial, solar designers would design systems to keep back-up demands entirely off the system's peak; and (3) the demand/energy rate would hinder the development and utilization of alternative energy sources, and insure that the alternative systems that do emerge are not as efficiently designed as they could be under a more sensible rate structure [373].

The commission ultimately decided that the new rates were to be provided on an optional basis [374]. The issues regarding solar rates and the applicability of TOD rate structures to solar technologies were to be considered in subsequent, ongoing generic hearings.

The effect of the demand/energy rate on solar users can be seen by comparing the monthly utility bills of an all-electric home and a solar-equipped home under the demand/energy rate [375], the all-electric declining block rate [376], and the general residential service declining block rate [377] of Public Service Co. of Colorado, proposed for the fall of 1978 [378]. Table 4-1 indicates the heat requirements of a typical single-family, all-electric residence and a 70% solar-heated residence losing 10,000 Btus per degree day [379]. The data corresponds to a well-insulated 2,000 sq ft house. Denver weather data for 1974 was used to ascertain the monthly electric energy consumption and peak demand for both types of houses. It was assumed that all-electric usage other than space heating created a peak demand of 10 kW and caused an energy consumption of 900 kWh each month. It was further assumed that a heating peak demand of 10 kW occurred coincidentally with the peak demand of other electric usage, but that 50% of the other usage demand was applied toward heating the house. Therefore, peak electrical demand ranged between 10 and 15 kW. For the solar house when auxiliary heat was necessary, it was assumed that the lowest monthly temperature occurred at the end of an extended cloudy and cold period and that the electric auxiliary created the same heating demand as the heating equipment in an all-electric home [380].

Table 4-2 provides a comparison of the monthly and annual electric bills for all-electric and solar houses under each of these three rate structures. Under both the RH-1 and R-1 declining block rate structures, a 70% solar-heated home yields a savings of 35% on the annual electric utility bill. However, the percentage savings under the demand/energy rate drops by more than half to only 15%. This reduction in savings may be significant enough to change a marginally economic solar system into an uneconomic investment [381]. Tables 4-1 and 4-2 also reveal that the demand/energy rate (RD-1) will result in a monthly bill savings greater than the electric heating rate (RH-1) only if the customer's load factor is more than approximately 23%. Only during the months of January and December did the solar house exceed a load factor of 23%, thereby saving on the monthly bill under the demand/energy rate compared to both declining block rates. If economically feasible, a type of demand limiter or controller should be considered by the solar customer in order to improve on load factor and thereby take advantage of the demand/energy rate. It should be noted that the residential heating all-electric declining block rate (RH-1) results in monthly bills that are 15% higher than those under the general residential declining block rate (R-1) for both the all-electric and solar houses.

4.3.2 Standby Service Gas Rates—The Salt Lake City Experience

The Mountain Fuel Supply Co. in Salt Lake City, Utah, a natural gas utility, maintains a standby service rate in addition to its other rate schedules [382]. From an inspection of the applicability of the various rates, it appears that the standby service rate would apply to a solar user who utilizes natural gas to fire an auxiliary heating system [383].

Table 4-3 provides a comparison of the monthly heat and gas requirements for a gas-heated home and a 70% solar-heated home based on 1974 Denver weather data. To calculate the gas requirements, it was assumed that the gas had a heat value of 1,000 Btu per ft^3 of natural gas. It was further assumed that the furnace had a conversion efficiency of 50%.

Table 4-1. **Comparison of Heat and Electrical Power Requirements for 10,000 Btu/Degree Day All-Electric and 70% Solar-Heated Homes in Denver Based on 1974 Weather Data[a]**

	Heating Degree	Lowest Temp.	Heat Requirements (Btus)		Heat Supplied by Solar Energy		All-Electric House[b] Power Requirements		Solar-Equipped House[c] Power Requirements	
Month	Days	(°F)	Total	Peak	(Btus)	(%)	Energy kWh	Demand kW	Energy kWh	Demand kW
JAN	1,277	-17	12,770,000	34,200	5,400,000	42%	4,643	15.0	3,060	15.0
FEB	831	2	8,310,000	26,300	5,700,000	69%	3,336	12.7	1,665	12.7
MAR	671	5	6,710,000	25,000	6,000,000	89%	2,867	12.3	1,108	12.3
APR	507	20	5,070,000	18,800	4,800,000	95%	2,386	10.5	979	10.5
MAY	137	33	1,370,000	12,300	3,900,000	100%	1,302	10.0	900	10.0
JUN	67	37	670,000	11,700	3,600,000	100%	1,096	10.0	900	10.0
JUL	0	50	0	6,300	0	100%	900	10.0	900	10.0
AUG	9	45	90,000	8,300	3,000,000	100%	926	10.0	900	10.0
SEP	199	33	1,990,000	13,300	4,100,000	100%	1,483	10.0	900	10.0
OCT	381	28	3,810,000	15,400	5,600,000	100%	2,017	10.0	900	10.0
NOV	803	5	8,030,000	25,000	5,300,000	66%	3,254	12.3	1,700	12.3
DEC	1,043	4	10,430,000	25,400	5,200,000	50%	3,957	12.4	2,433	12.4
TOTALS	5,925		59,250,000		40,330,000	68%	28,167		16,345	

[a] Assumes the home to have an appliance peak demand of 10 kW each month of which 50% heats the house.
[b] Assumes only the minimum load necessary to heat the house is drawn.
[c] Assumes the peak heating demand occurs when outdoor temperature is lowest and the solar system cannot provide useful heat.

Table 4-2. Comparison of Electric Utility Bills for 10,000 Btu/Degree Day All-Electric and 70% Solar-Heated Homes in Denver

	All-Electric Home Bill			70% Solar Home Bill		
Month	RD-1[a]	RH-1[b]	R-1[c]	RD-1[a]	RH-1[b]	R-1[c]
JAN	$98.78	$142.40	$123.70	$ 82.93	$ 98.52	$ 85.57
FEB	78.33	106.17	92.22	61.61	59.85	51.96
MAR	72.36	93.17	80.92	54.75	44.41	38.55
APR	61.78	79.84	69.33	47.70	40.58	35.22
MAY	49.33	49.79	43.22	45.31	37.43	32.48
JUN	47.27	44.08	38.26	45.31	37.43	32.48
JUL	45.31	37.43	32.48	45.31	37.43	32.48
AUG	45.57	38.46	33.38	45.31	37.43	32.48
SEP	51.14	54.81	47.58	45.31	37.43	32.48
OCT	56.49	69.61	60.44	45.31	37.43	32.48
NOV	76.23	103.90	90.24	60.68	60.82	52.81
DEC	83.59	123.39	107.18	68.33	81.14	70.47
TOTALS	$766.18	$943.05	$818.95	$647.86	$609.90	$529.46

[a]Demand/Energy Rate
[b]All-Electric Declining Block Rate
[c]General Residential Declining Block Rate

Table 4-3. **Comparison of Heat and Natural Gas Requirements for 10,000 Btu/Degree Day Gas-Heated and 70% Solar-Heated Homes Based on 1974 Denver Weather Data**

Month	Heat Requirements[a] (Btus)	Heat Supplied by Solar[a] (Btus)	Heat Supplied by Solar[a] (%)	Gas Requirements (ft^3)[b,c] Gas Home	Gas Requirements (ft^3)[b,c] Solar Home
JAN	$12,770,000	$5,400,000	42%	$25,540	$14,740
FEB	8,310,000	5,700,000	69%	16,620	5,220
MAR	6,710,000	6,000,000	89%	13,420	1,420
APR	5,070,000	4,800,000	95%	10,140	540
MAY	1,370,000	3,900,000	100%	2,740	0
JUN	670,000	3,600,000	100%	1,340	0
JUL	0	0	100%	0	0
AUG	90,000	3,000,000	100%	180	0
SEP	1,990,000	4,100,000	100%	3,980	0
OCT	3,810,000	5,600,000	100%	7,620	0
NOV	8,030,000	5,300,000	66%	16,060	5,460
DEC	10,430,000	5,200,000	50%	20,860	10,460
TOTALS	$59,250,000	$40,330,000	68%	$118,500	$37,840

[a]Heat figures obtained from Table 4-1.
[b]Assumes gas heat value of 1,000 Btu per ft^3 natural gas.
[c]Assumes 50% efficiency on furnace.

The gas requirement figures from Table 4-3 were applied to the Mountain Fuel Supply Co. general service (GS-1) and firm standby service (F-3) rates to compare utility bills for both types of homes [384]. This comparison is illustrated in Table 4-4. Even though heat requirements for homes in Salt Lake City were not used, the figures provide a reasonable relative comparison of bills under the two applicable rates. Under the general service rate, a 70% solar-heated home provides a savings of 58% on the annual gas utility bill compared with the annual utility bill of the gas-heated home. If the solar user is required to take the firm standby service rate, however, no savings in the annual utility bill result from the use of solar heating. In fact, the solar home's annual utility bill under the firm standby service rate is 19% higher than that for the gas-heated home under the general rate, and 183% higher than it would be under the general service rate. The firm standby service rate, if mandatory for solar-equipped facilities, is a definite barrier to the use of solar energy.

4.3.3 Electric Service Advance Deposits

The City of Columbia, Missouri owns and operates an electric distribution system to provide electric service to its residents. In September 1977, the city passed an ordinance pertaining to the supply of electricity for standby or supplemental purposes, requiring solar customers desiring electric service for standby or supplemental purposes to enter into an electric service agreement with the city [385]. This agreement states:

> WHEREAS, the facilities and premises to be connected for electric service will utilize solar energy for the purpose of comfort space heating, and
>
> WHEREAS, Customer desires to install electric space heating facilities and equipment for standby and/or supplementary purposes, such standby and supplementary equipment to be utilized only when weather conditions are such that the solar system cannot provide the energy required to heat Customer's premises and maintain the desired temperature . . . .
>
> 2. The rate charged Customer by City, for electric energy shall be the same as that rate which is charged to other Customers in the same class who utilize a form of energy other than electricity for comfort space heating. . . .
>
> 6. At the time of receiving service Customer shall deposit with City, the amount of $200.00 in addition to the regular service deposit. This additional deposit shall be used for the purpose of adjusting the Customer's charges in the event a higher rate is adopted for standby service to solar equipped facilities . . . . Should City find that a higher rate is not warranted, this additional deposit will be credited to Customer's Account or refunded. [386]

In short, a solar user in Columbia is required to pay an additional advance deposit of $200 to cover a potential increased solar rate, and cannot take advantage of the promotional electric heating rate [387] offered for seven months beginning in November, even though an electrical back-up is utilized [388].

For comparison purposes, the electric energy requirements of Table 4-1 were applied to the Columbia rates to ascertain the effect on solar system economics. Table 4-5 illustrates monthly utility bills for (1) an all-electric home under the promotional electric

Table 4-4. Comparison of Gas Utility Bills for 10,000 Btu/Degree Day Gas-Heated and 70% Solar-Heated Homes

	Gas-Heated Home Bill	70% Solar-Heated Home Bill	
Month	GS-1[a]	GS-1[a]	F-3[b,c]
JAN	$ 40.80	$25.62	$ 33.91
FEB	28.26	12.24	22.37
MAR	23.76	5.70	17.77
APR	19.15	4.30	16.70
MAY	8.10	4.30	16.05
JUN	1.88	0	16.05
JUL	0	0	16.05
AUG	.25	0	16.05
SEP	5.59	0	16.05
OCT	10.42	0	16.05
NOV	27.47	12.57	22.67
DEC	34.22	19.60	28.73
TOTALS	$199.90	$84.33	$238.45

[a]General Service Rate.
[b]Firm Standby Service Rate.
[c]Assumes a daily maximum input rating of 2,400 ft^3 (typical home furnace input rating of 100,000 Btu/hr - 1,000 Btu/ft^3 x 24 hr/day = 2,400 ft^3/day).

Table 4-5. **Comparison of Utility Bills for Electric-Heated and 70% Solar-Heated Homes Based on Columbia, Missouri, Electric Service Rates**

	Electric-Heated Home Bill	70% Solar-Heated Home Bill	
Month	Electric Heat Rate[a]	Regular/Solar Rate[b]	Electric Heat Rate[a]
JAN	$111.08	$ 96.62	$ 78.10
FEB	83.85	56.47	49.04
MAR	74.08	40.44	37.44
APR	64.06	36.59	34.75
MAY	41.48	33.82	33.11
JUN	40.09	33.82	33.82
JUL	33.82	33.82	33.82
AUG	34.73	33.82	33.82
SEP	51.23	33.82	33.82
OCT	66.60	33.82	33.82
NOV	82.14	57.48	49.77
DEC	96.74	78.57	65.04
TOTALS	$779.95	$569.09	$516.35

[a]Promotional electric heating service rate.
[b]Regular electric service rate—mandated for solar-equipped facilities.

heating rate, (2) a 70% solar home under the rate required for a solar facility, and (3) a 70% solar home under the promotional electric heating rate. If the solar home could take advantage of the promotional electric heating rate, a 34% savings in the annual electric utility bill would result when compared to the annual bill for an electric-heated home. Under the required rate the annual utility bill savings is reduced to only 27%. If the $200 deposit is added to the first year's bill, the savings in the first year is reduced to only 1%. The higher rate for auxiliary energy to solar buildings and, more significantly, the added $200 service deposit, make the solar alternative unattractive for residents of Columbia, Missouri.

In a 1915 case involving the refusal of a telephone utility to render service without an advance payment from the customer, the United States Supreme Court recognized the generally accepted rule that a regulation or policy requiring payment in advance, or a fair deposit to secure payment for public utility services is reasonable [389]. The Arizona Supreme Court has held, however, that for a utility to enforce the requirement of a deposit against some of a utility's applicants but not against all, constitutes improper discrimination [390]. As the regulation of rates charged by a municipal electric utility is not within the jurisdiction of the Missouri Public Service Commission [391], an investigation of the Columbia municipal charter or city ordinance pertaining to utility charges would be required to ascertain whether the $200 deposit required from only solar customers is unduly discriminatory.

4.3.4 Rate Structures and Solar System Design

One study has examined the potential impacts of four different rate schedules upon utilities and solar commercialization [392]. Rate-structure inversion or flattening of traditional declining block rates would increase energy cost savings realized by solar users and thereby provide a marginal incentive for solar energy use. This incentive is likely to encourage broader application of solar energy but would not have an influence on an hourly variation of solar utilization [393].

A time-of-day (TOD) rate structure would encourage a shift in consumption patterns from peak to intermediate or off-peak periods, and provide an incentive to use energy-conserving technologies capable of displacing a portion of peak requirements [394]. Under TOD rates, solar-equipped facilities could be designed optimally for the benefit of both the solar user and the electric utility by providing off-peak storage capacity. The economic impact of TOD rates upon the utility would depend upon its individual operating characteristics, combined with the administrative, metering, and special control costs associated with this rate structure [395].

A third possibility considered the establishment of special rates for solar users designed to encourage the use of off-peak power while discouraging peak demands [396]. Special rates would require, for PUC approval, a showing that they are not unduly discriminatory within or between classes of customers. Policy positions justifying the existence of lifeline structures might be raised in support of special solar rates. As with TOD rate structures, a peak/off-peak differential in rates to solar users would require special metering and controls, and possibly additional administrative costs to the utility.

A demand charge for solar users was found to have only marginal value for optimal solar/utility design. While the individual customer would be encouraged to reduce peak demand, the peak capacity requirements for the utility would not necessarily be reduced [397]. Moreover, any such rate structure developed for solar users should consider the balance between the benefits derived from increased solar energy commercialization and the costs to both the utilities and nonsolar rate payers [398].

In another study, it was discovered that the type of rate structure imposed by an electric utility for auxiliary service significantly affects the most cost-effective design of the solar system. For a southwestern summer peaking utility, a building having 30 m^2 of collector area is most cost-effective under a rate structure based on average accounting costs. Under a rate structure based on marginal-cost pricing, however, a building with 50 m^2 of collector area is the most cost-effective solar alternative [399].

For a solar building in Colorado Springs, imposition of a demand/energy rate for back-up electricity for heating purposes was found to be discriminatory toward the solar user [400]. The solar building peak demand was found to occur during off-peak periods in eight of nine nonsummer months [401]. The effect of such discrimination would be a financial barrier to the purchase of a solar energy system. However, in another investigation involving two eastern utilities, the demand/energy rate structure was not found to be discriminatory against solar users. This investigation concluded that demand and customer-related costs were identical for solar and conventional customers, and that only energy-related costs were reduced by a solar system [402].

Two studies found that under traditional rate structures based on average accounting costs, solar users are subsidized by other customers [403]. Where such rate structures exist and a revenue deficiency results from the widespread use of solar energy, electric utilities will be forced to increase the rates to solar users to recover the cost of service. Such rates would cause adverse public reaction and retardation of the market penetration of solar technologies [404]. Allowing solar users to acquire back-up energy under traditional residential declining block rates results in improper design of the solar collector and storage system [405]. One report appropriately summarized that:

> [u]nder existing rate schedules there is no apparent incentive to optimize the sizing and design of SHAC [solar heating and cooling] or passive system to benefit utilities and solar users alike. Under existing average-cost pricing schemes, utility revenue from solar will be highly mismatched to the costs imposed by solar users. This is less likely the case under marginal-cost pricing. Demand energy charges (Hopkinson tariff) are inefficient because of a poor relationship between the building peak and the utility peak. Whether these demand charges are more economically efficient than average-cost pricing is dependent on weather conditions and building design. It is conceivable utility peaks may be spiked by demand charges to solar users. In none of the cases examined was marginal-cost pricing found to be more discriminatory, or allocatively less efficient than average-cost pricing. This, however, may not be the case for all utilities and requires individual analysis. [406]

Given that non-time-differentiated rates based on average accounting costs do not (1) adequately allocate costs to serve customers with unusual load patterns such as residential air conditioning customers or solar-heating customers, (2) promote energy conservation, or (3) discourage peak period consumption [407]; TOD rate structures appear to be the appropriate solution to load factor conflicts involving electric utilities and solar system design [408]. In a Wisconsin Public Service Commission case mandating TOD rates for Wisconsin Electric Power Company's (Wepco) 500 largest residential customers, the commission noted that TOD rates based on marginal-cost pricing are expected to produce nine derivative benefits:

(1) Cost minimization on the part of the utility is encouraged.
(2) Equity and fairness in the prices charged will be promoted.
(3) System utilization or load factors will be improved.
(4) Environmental damages or externalities will be reduced.
(5) Energy conservation may be improved, and for any specified level of end-use electric energy requirements, the energy efficiency of supplying it will be increased.
(6) Earnings stability will be increased as net revenue replaces gross revenue requirements as a more important regulatory mechanism.
(7) Tariff stability will be achieved as pressures for rate increases are reduced.
(8) Consumer freedom of choice will be increased and ways to avoid inflationary rate increases offered.
(9) Contrasted with other rate reforms, namely inverted or all-equal flat rates, industrial and employment interests are protected and stimulated. [409]

It may be concluded that where metering and associated administrative costs are not prohibitive, the most desirable rate structure for auxiliary service to solar users, from the standpoint of both the utility and the consumer, is a time-differentiated scheme based on marginal-cost pricing. Under this form of rate structure, the solar user theoretically would not be subject to rate discrimination either in favor of or against his interest. Furthermore, the load factor conflict under traditional rate structures will not arise, and proper signals are provided to consumers to purchase equipment designed for optimal off-peak auxiliary energy usage. The results of TOD rates for solar auxiliaries are likely to (1) promote national goals of energy conservation and environmental protection, (2) eliminate barriers to solar market penetration imposed by traditional discriminatory rate structures, (3) encourage the shifting of peak period energy usage to other periods, thereby promoting utility goals of improved system load factor and more efficient system operation, and (4) relieve the burden of subsidizing one class of customers by other rate payers.

4.4 IMPACTS OF SOLAR SYSTEMS ON ELECTRIC UTILITIES

When evaluating the appropriateness of rate structures for solar auxiliary systems, one must also consider the effects of these systems on an electric utility's load pattern. Since a rate structure should reflect the true costs of providing service, it is necessary to ascertain the impact of solar auxiliary use on two utility system characteristics in particular—the coincident peak demand and the load factor [410].

In one analysis of solar technologies, the Office of Technology Assessment (OTA) investigated the costs of providing back-up power from an electric utility [411]. The costs of providing auxiliary service were found to be sensitive to the following four factors: (1) the cost of equipment by region, available financing and the local cost of fuel, (2) local climatic conditions and their correlation with the utility's peak demand, (3) the type of solar design including collector area and storage capacity, and (4) the number of solar buildings in the utility's service area [412]. Utility costs were determined for an incremental number of variously equipped houses and were compared on this basis. In effect, the study utilized an incremental costing methodology for the comparison of back-up costs to solar and nonsolar houses.

The results of the OTA investigation are summarized in Table 4-6. This table compares the cost per kWh of providing electricity to the designated building, with the cost of serving a similar building using an electric heat pump. For example, the cost to serve a

Table 4-6. **The Fractional Difference Between the Utility Costs [¢/kWh] Required to Provide Back-up Power to the Systems Shown and the Costs to Provide Power to a Residence Equipped with an Electric Heat Pump [see note for explanation]**

	Albuquerque	Boston	Fort Worth	Omaha
1. Single-family house with gas heat, hot water, and air conditioning*	0.02	-0.09	-0.15	0.03
2. Single-family house with gas heat and hot water, and central electric air conditioning*	0.26	0.28	0.15	0.32
3. Single-family house with baseboard heat, electric hot water and window air conditioning*	-0.14	-0.14	-0.15	-0.10
4. Single-family house with solar heat and hot water backed up with a heat pump and electric hot water*	0.01	-0.13	0.06	-0.07

*Compared with single-family house with electric hot water and heat pump.

NOTE: let C_r = incremental utility costs resulting from adding 1,000 reference houses with heat pumps

let K_r = the incremental number of kWh generated when 1,000 reference houses with heat pumps are added to the utility

let C_t and K_t = the equivalent quantities resulting from adding 1,000 houses with a different kind of energy equipment

Then the fractional change illustrated above is given as follows:

$$F = \frac{(C_t/K_t)-(C_r/K_r)}{(C_r/K_r)}$$

solar home in Boston is 13% less than the cost to serve a nonsolar home equipped with a heat pump. An examination of Table 4-6 indicates in general that (1) electricity costs are lower for houses using electric resistance heat, and higher for houses using gas heat and electric air conditioning when compared to a house using a heat pump; and (2) a solar house costs the utility more per kWh than a conventional house using baseboard heat, but less than a house using gas heat and electric air conditioning.

While off-peak storage can be utilized by both solar and nonsolar buildings, the reduction in utility costs to provide back-up and conventional service is significant [413]. Table 4-7 illustrates the impact of off-peak storage on utility costs for both nonsolar and solar houses, compared to a reference house using electric-resistance space and water heating and window air conditioners. Utility costs are reduced by nearly 50% for electricity supplied to a nonsolar home capable of storage for heat, hot water, and cooling. Under the same off-peak storage design for a solar house, the reduction in utility costs amounts to nearly 40%.

Another study concluded that the widespread application of solar systems is likely to have two primary effects on the financial positions of electric utilities: (1) reducing electric utility revenues during periods when solar energy is being used, and (2) either increasing or decreasing the electric utility's peak demand requirements, depending upon the type of load being displaced and the utilization pattern of the installed solar systems [414]. Similarly, an investigation studied the projected effects of residential solar heating for a period from 1975 to 2000 on two eastern electric utilities. It concluded that under rate structures that recover the cost of service through an energy charge alone, electric utilities will suffer revenue deficiencies from solar-heating customers unless these customers are charged a different energy rate than the conventional-heating customers [415].

Yet another study investigated the impacts of solar systems upon summer and winter peaking utilities [416]. In the case of a southwestern summer-peaking utility, it was found that a solar building on peak days for a 6-year period required auxiliary demand from 9% to 98% less than the electrical demand of a similar, absorption, air conditioning-equipped, conventional building. Annual consumption for the conventional building was 38,216 kWh with an absorption cooler and 21,515 kWh with a compression cooler. The solar building consumed 20,515 kWh annually with 15 m^2 of collector area, and only 147 kWh with 66.9 m^2 of collector area [417].

In the case of a winter-peaking utility, demands for auxiliary energy in the solar building ranged from 0% to 95% less than those for the conventional building. Annual electrical energy consumption for the conventional building in the winter peaking utility was 34,565 kWh with the use of an absorption cooler and 25,688 kWh with the use of a compression cooler. On the other hand, the solar building required 14,487 kWh with 30 m^2 of collector area and only 3,523 kWh with 100 m^2 of collector area [418].

Table 4-8 is a summary of the demand effects on various utilities by a solar building having 66.9 m^2 of collector area relative to a conventional building. For both the summer- and winter-peaking utilities, service to the solar building for auxiliary purposes resulted in revenue deficiencies to the utility. The utility, under the existing rate scheme, would not recover total costs of serving from solar customers [419].

Taken together, the computer simulation studies portray conflicting impressions of the effects of solar auxiliary demands on electric utilities. With a solar system capable of storage facility recharge by either solar or auxiliary energy, confining auxiliary recharge

Table 4-7. The Impact of Off-peak Storage on Utility Costs
[fractional increase or decrease in back-up costs per kWh–see notes]

	Albuquerque	Boston	Fort Worth	Omaha
Nonsolar houses				
o Off-peak storage for heat and hot water	-0.37	-0.38	-0.29	-0.34
o Off-peak storage for heat, hot water, and cooling	-0.47	-0.45	-0.48	-0.44
Houses with solar heating and hot water				
o No off-peak storage	0.03	-0.11	-0.12	-0.06
o Off-peak storage for heating and hot water	-0.11	-0.24	0.003	-0.21
o Off-peak storage of heating, hot water, and cooling	-0.03	-0.35	-0.32	-0.36

Notes: The "reference house" is a single-family house using electric-resistance heating and hot water and window air conditioners. All solar houses generate only heating and hot water from solar energy.

Let C_r = added utility costs resulting from the addition of 1,000 reference houses

K_r = added kWh resulting from the addition of 1,000 reference houses

C_t = added utility costs resulting from the addition of 1,000 test houses (type noted in left column above).

K_t = added utility costs resulting from the addition of 1,000 test houses

The fractional change ratio shown above is calculated as follows: $F = \dfrac{(C_t/K_t) - (C_r/K_r)}{(C_r/K_r)}$

Table 4-8. Ratio of Solar Demand to Conventional Demand at Peak

Residential Building I with a 66.9m^2 Collector*

UTILITIES	Wisconsin Power and Light	New England Electric System	Georgia Power	Public Service of New Mexico	Arizona Public Service	Sacramento Municipal Utility District
1975	.38	.85	.05	.29	0.0	.23#
1974	.22	.93	.14	.53#	0.0	.29
1973	.78	.73	.27	.35	0.0	1.56
1972	.79#	1.00	.48	1.00	0.0	
1971	.93	.08	.97	.28	0.0	0.0
1970	.94	1.00	.17	.06	0.0	0.0
1969	1.00	1.00	.33	1.07	0.0#	0.0
1968	.97	.57#	.12#		0.0	.32
1967	.74	1.00	.27		0.0	.22
1966	1.00	1.00	2.68		0.0	.22
Average of Ratios **	.78	.82	.56	.51	0.0	.32
Weighted Averages	.77	.78	.45	.49	.00	.32

*Solar building uses absorption cooler, conventional building uses compression cooler, and both buildings use electric-resistance heating.

**The average of ratios is average of figures presented here. Weighted averages takes into consideration the magnitude of each year and is the better representation of capacity effect.

#Represents year in which conventional demand is the highest.

to off-peak or intermediate periods would reduce peak period demand. Such a system could limit a solar auxiliary's peak period demand to no more than two-thirds of the peak period demand for an all-electric heating system [420].

4.5 ELECTRIC RATE DISCRIMINATION LAW

Significant concerns of solar users, the electric utility, and nonsolar rate payers involve whether rates can be legally designed to discriminate for or against solar users, and whether electric utilities can refuse to provide back-up service to solar users [421].

It is a general rule that public utilities cannot unreasonably discriminate in rates charged to customers similarly situated, of the same class, or for the same service under like conditions [422]. Typically, only "unreasonable" differences in rates are prohibited [423], and differences in rates between customers are valid only where there exists a "reasonable" basis for distinguishing them [424]. Unfortunately, where courts or state commissions have ruled on the issue of discrimination in utility rates, they have not made particularly clear what constitutes reasonable discrimination [425].

A victim of a discriminatory rate practice is likely to seek relief by challenging the practice under state antidiscrimination statutes, federal antidiscrimination statutes, and state and federal consitutions. The common law may also prohibit discrimination by public utilities. For example, in City of Texarkana v. Wiggins, the Supreme Court of Texas said:

> The common-law rule that one engaged in rendering a service affected with a public interest or, more strictly, what has come to be known as a utility service, may not discriminate in charges or service as between persons similarly situated is of such long standing and is so well recognized that it needs no citation of authority to support it. The economic nature of the enterprise which renders this type of service is such that the courts have imposed upon it the duty to treat all alike unless there is some reasonable basis for a differentiation. Statutes have been enacted in almost every state making this common-law rule a statutory one. [426]

4.5.1 State Antidiscrimination Law

Because a major objective of utility rate regulation is the prevention of undue discrimination or unreasonable preferences, nearly every state has a statute prohibiting pricing practices that favor one customer over another [427]. Under New York's Public Service Law, for example, an electric utility may not charge or receive from any customer a greater or lower compensation for electricity than it charges or receives from any other customer, for providing like and contemporaneous service under substantially similar conditions [428]. The statute further prohibits an electric utility from granting any undue or unreasonable preference or advantage to any customer, or subjecting any customer to any undue or unreasonable prejudice or disadvantage [429]. However,

> Nothing in this chapter shall be taken to prohibit a gas corporation or electrical corporation from establishing classifications of service based upon the quantity used, the time when used, the purpose for which used, the duration of use or upon any other reasonable consideration, and providing schedules of just and reasonable graduated rates applicable thereto. [430]

Similarly, a Colorado statute provides that no public utility shall, as to rates, grant any preference or advantage to any customer [431]. As to classification, the Colorado utilities commission has held that classification of electric customers for rate making must be founded upon the cost to the utility of providing the various classes of service [432]. In another decision, the commission held that classification of utility customers is proper only where rate differences are based upon a reasonable or fair difference in conditions which logically justifies a different rate [433].

Most state antidiscrimination laws thus proscribe rate discrimination only where such discrimination is "unreasonable, unjust, undue, or unlawful" [434]. PUCs are given broad discretion over the determination of whether rates are unlawfully discriminatory [435]. Therefore, a solar user who feels he is a victim of a discriminatory rate practice must first seek and exhaust administrative remedies through the PUC before a court proceeding may be had [436]. Once in court, the solar user is required to bear the burden of proving that the rates charged are discriminatory [437]. In view of these procedural requirements, it would be difficult for individual solar users to successfully challenge a discriminatory rate practice.

How do solar users meet their burden by proving that the rate charged against them is discriminatory? A general principle emerging from the decisions is that rate differences for various classes of electric customers are permissible if based on reasonable considerations [438], such as differences in the cost of service [439], the quantity of electricity used, and the time, duration, and purpose of use [440]. It is likely that since solar customers have low-load factors, variable demands, different costs to serve, and a need to use off-peak electricity, such customers may be classified separately from standard residential or commercial customers for rate-making purposes.

In one jurisdiction, however, utilities may not impose higher rates on solar users. In 1977, the Illinois legislature amended the state's public utility antidiscrimination statute [441] to include the following paragraphs:

> No public utility providing electrical or gas service shall consider the use of solar energy by a customer as a basis for establishing higher rates or charges for any service or commodity sold to such customer; nor shall a public utility subject any customer utilizing solar energy to any other prejudice or disadvantage on account of such use.
>
> This amendatory Act of 1977 shall cease to have any force or effect five years after its effective date. [442]

This important Illinois solar provision is capable of two interpretations. First, and more likely, the statute seems to prohibit charging a solar customer a rate higher than what the customer would otherwise qualify for in the absence of the solar device (i.e., if the solar customer's auxiliary system is electrically supplied, the statute appears to allow him to take advantage of an all-electric discount rate). Second, the statute might prohibit charging a solar customer a rate higher than the lowest rate in effect for that customer's particular customer class. Under this interpretation, solar customers would be able to take advantage of an all-electric rate (generally lower than the standard residential service rate) despite the form of auxiliary energy used for back-up purposes.

Whether commissions and courts will approve of rates that, like the Illinois statute, discriminate in favor of solar users (by considering such discrimination reasonable), may depend on the jurisdiction's view of promotional rates [443]. For example, a New Jersey court in Rossi v. Garton held that a $150 credit to electric-space-heating customers was not discriminatory when the credit was for a promotional effort [444]. The court interpreted the antidiscrimination statute to prohibit only "unjust" discriminations, and stated that "[i]f 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 " [445].

Rossi was cited by the Supreme Court of Maine in Gifford v. Central Maine Power Co. [446]. In this case, promotional allowances offered to encourage increased use of electric energy were found to be "reasonably expected to provide ultimate benefits to every customer and were fairly shown not to be excessive, disproportionate, unreasonable or unjustly discriminatory within the meaning of the [antidiscrimination] statute [447]. The Supreme Court of Oklahoma similarly held in State v. Oklahoma Gas and Electric Co. that promotional practices reasonably calculated to improve the utility's load factor and benefit all consumers by reducing the cost of energy, are not unjustly discriminatory [448].

Solar users should be warned that some promotional activities of little value to the utility and its customers have been struck down as unduly discriminatory [449]. An attempt by an electric utility to waive the extra cost of underground residential distribution in exchange for a builder creating a wholly electric community was held in violation of Maryland's antidiscrimination statute [450]. The Maryland commission ruled that the waiver provision resulted in undue discrimination between the company's customers by imposing unequal charges on the same types of customers for the same service [451]. The Supreme Court of Missouri similarly invalidated an agreement between an electric company and a builder that provided the builder with promotional allowances contingent upon homes being built utilizing electric heat [452].

Because solar systems have the potential to reduce utility capacity expansion and fuel expenditures and thereby reduce costs to all customers, it could be argued that discrimination in favor of solar users is not unreasonable or unlawful. This form of benign discrimination produces indirect benefits to all rate payers, and is consistent with national policy goals of energy conservation and environmental protection. Commissions and courts have supported measures that conserve energy in the form of programs to finance the installation of insulation [453], and have prohibited the end uses of energy that do not contribute to conservation [454]. Conceivably, a program that directly assists solar customers while indirectly benefitting other customers is likely to be found reasonable. The United States Circuit Court for the District of Columbia has ruled that a rate order can be upheld even though it contains certain provisions that, taken separately, had discriminatory aspects, provided that the rate as a whole demonstrated an overall balance of effects and purposes in furtherance of the public interest [455]. Under this principle, it could be argued that discriminating in favor of solar users is in fact in the public interest as it supports energy conservation.

4.5.2 Federal Antidiscrimination Law

A second possible approach for a solar user who feels victim to a discriminatory rate practice imposed by a utility is to seek relief under federal antitrust statutes [456]. These laws, however, can also outlaw policies that provide special benefits to solar users. The Supreme Court has recently held that the Federal Power Act provides no clear legislative intent to make the antitrust laws inapplicable to electric utilities [457]. It was further held that the actions of the utility in refusing to sell at wholesale or to wheel, constituted anticompetitive and monopolistic practices in violation of Section Two of the Sherman Act [458]. Under these principles, an electric utility's decision to punish solar users with exorbitant rates, if based on a desire to protect its monopoly position, might be deemed anticompetitive and in violation of the Sherman Act. In another recent case, the Court has held that the "state action" exemption to application of the antitrust laws does not apply by the mere fact of state utility commission approval of a utility practice [459]. Therefore, a commission-approved utility rate practice that discriminates either for or against solar users does not appear to have a state action exemption from the antitrust laws.

The Court has also held that a municipality adopting discriminatory practices, in the providing of utility services in furtherance of its own policies, may be subject to federal antitrust laws [460]. Only when a municipality has acted pursuant to the state's command would the state action exemption apply [461]. Thus, both investor-owned and municipally owned electric utilities could be subject to antitrust scrutiny if their pricing practices exhibit monopolistic tendencies. A solar user could maintain that high back-up rates, designed to slow solar commercialization into the energy market, were anticompetitive and so monopolistic as to be in violation of the Sherman Act.

4.5.3 Constitutional Law

The United States Constitution may provide restraints on a utility's ability to pass discriminatory rates for or against solar users. Under the Fourteenth Amendment, it is unconstitutional for "any state" to deprive any person of property without due process of law, or to deny to any person the equal protection of the laws [462]. Where utility companies are involved, a major issue is whether utility practices are sufficiently state connected to be subject to the Fourteenth Amendment. Discriminatory practices not attributable to the state; i.e., that are wholly independent from the state, do not fall within Fourteenth Amendment prohibitions [463].

The actions of a municipally owned utility are obviously "state actions" and would fall within these prohibitions. The issue of whether the action of an investor-owned utility might constitute sufficient state action was addressed in Jackson v. Metropolitan Edison Co. [464]. Noting that regulated utilities often are required by law to seek PUC approval for practices that an unregulated business would be free to institute, the Court held that approval by the PUC of such a practice, where the commission did not put its weight on the side of the practice by ordering it, was not state action [465]. The state action test articulated by the court was whether a "sufficiently close nexus" between the state and the challenged practice of the utility justified treating the practices as those of the state [466]. The fact that the company enjoyed at least a partial monopoly in the supply of electric service within its service area, resulting from regulation under state law, did not contribute to the close nexus required for state action [467].

Under this case, PUC approval of a discriminatory practice by a utility for or against solar users may be an insufficient nexus to constitute state action. And, in the absence of state action, equal protection challenges based upon the Fourteenth Amendment will fail. On the other hand, if a PUC initiates further involvement by either ordering that the discriminatory practice be undertaken by the utility, or conducting a specific investigation of the merits of the practice, it is likely that a sufficiently close nexus and state action exists [468].

Even if state action for a particular utility rate practice does exist, the solar customer seeking to use constitutional grounds for invalidating the practice must still show that the practice is either a denial of property without due process, or a denial of equal protection. While the United States Supreme Court has not directly addressed this question, lower courts have suggested that a solar user would find no relief in the Fourteenth Amendment. One lower federal court has concluded that residential users of electricity do not have a property interest protected by the due process clause in the rates they pay for service [469]. Where an action is commenced challenging a discriminatory rate practice by a utility as denial of the equal protection of the laws, a rational basis test is generally applied. From the standpoint of the solar user, a rational basis exists for classifying such a user separately from other customers [470]. It is also probable that a court would find separate classification of solar customers reasonably related to the objective of recovering their costs to serve [471]. Thus, it is likely that a solar user will fail on an equal protection challenge to auxiliary service rates.

4.6 EXISTING AND PROPOSED SOLAR AND WIND RATES

In a 1977 rate structure revision survey, each PUC was asked what policy it has adopted to insure that electric rates do not discriminate against or discourage the use of solar, wind, or other small generation for supplemental power [472]. Many commissions replied that solar rates were being studied or were under investigation in generic rate hearings [473]. As of early 1978, public utilities under PUC jurisdiction in Illinois, Kansas, Michigan, New Hampshire, New York, North Carolina, South Carolina, Utah, and Wisconsin had special solar rates [474].

Of the commissions having solar rates on file or policies affecting such rates, most favored the use of supplemental energy sources and maintained policies against discrimination. For example, the California commission believed that existing rates did not discriminate against users of solar energy, wind energy, or small electric-generating facilities [475]. The stated policy of the Indiana commission was to "encourage supplemental generation of power" [476]. In Kansas, the commission adopted a filing by one utility that would include customers with a solar heating system in applicable lower all-electric or space-heating rates [477]. The Michigan commission had a special rate on file for auxiliary service to residential customers generating their own power, with provision for the sale of excess power by the customer back to the utility at reasonable cost [478]. The Montana commission encourages the development of small supplemental hydro, solar, and wind generation [479]. The New York commission has rates on file from various utilities pertaining to solar and windmill customers and has ordered modifications to these rates to assure that they are not discriminatory [480]. The North Carolina commission has required that residential rate structures be adjusted so that customers utilizing alternative energy sources would not be disqualified from a lower rate (all-electric or water heating) for which they would otherwise be qualified [481]. Only one commission discouraged the use of alternative energy sources; in Oklahoma, supplemental or auxiliary power cannot be installed without commission approval [482].

4.6.1 Typical Solar Rates

Orange and Rockland Utilities, Inc. in New York maintains a rate applicable to residential service with solar-assisted electric water and space heating [483]. The rate is temporary and available on an experimental basis to the first 20 applicants who use the company's electric service for single-family residential purposes and whose entire space-and water-heating requirements are supplied through a combination of electric space- and water-heating facilities and solar energy collectors. Service under the solar rate must have commenced by December 31, 1977, and will terminate on December 31, 1979. To be eligible for service under this classification, a customer is required to agree to accept system modifications, where feasible, made at the expense of the company to improve customer load characteristics through the use of hot and cold storage and off-peak charging capabilities. The customer must also permit the company to use special equipment to measure their loads, to measure the solar energy collected, and to obtain any other data necessary to determine the operating characteristics of solar installations.

The effect of the solar rate is to charge solar customers the lowest rates accorded to residential users with electric space and water heating during the period October through May [484]. During the remaining months, solar customers are charged normal rates [485]. Because water heating in the summer could be substantially performed by the solar unit, providing a water-heating discount would subsidize general use and air conditioning.

Similarly, electric utilities in North Carolina, South Carolina, Illinois, and Utah grant the discounts to solar users that are provided to electric space- or water-heating customers. Duke Power Co. in North Carolina provides electric service to customers in both North and South Carolina, offering an experimental all-electric/solar residential service rate to residences, condominiums, mobile homes, or individually metered apartments where the energy required for all water heating, cooking, and space conditioning is supplied by electricity or solar energy [486]. The company has the right to install, monitor, and operate metering and control devices on the customer's solar and electrical equipment to determine the effect of solar collection on electric service demand and usage. In effect, the solar rate provides to solar consumers the discount afforded to all-electric consumers [487] over the general residential service rate [488]. The company also offers an experimental water-heating electric/solar residential service rate [489]. In addition to the same metering requirement as for the solar space-conditioning rate, the solar water-heating rate contains certain specifications regarding water-heating capacity and performance. The solar water-heating rate provides solar customers the discount given to customers under the residential service water-heating electric rate [490].

Both Commonwealth Edison Co. and Central Illinois Light Co. (Cilco) make available to their customers a temporary residential solar-assisted electric space-heating rate [491]. Edison's rate is available on an experimental basis to the first 100 applicants for service who use the company's electric service for residential purposes and whose entire space-heating requirements are supplied through a combination of electric and solar space-heating facilities. Customers served under this rate must permit the company to use special equipment to measure their loads, the solar energy collected, and to obtain any data necessary to ascertain the operating characteristics of the solar buildings served. The solar rate provides customers with the discount accorded to electric space-heating customers [492] in other than summer months over the general residential rate [493]. Cilco's solar rate is available on an experimental basis to the first 50 applicants for service who use the company's service for domestic purposes and whose entire space-heating requirements are supplied through a combination of permanently installed space-heating facilities and solar energy collectors. Unlike Edison's solar rate, Cilco's rate does not require the auxiliary system to be electric. In all but summer months, Cilco's solar customers are provided with the electric space-heating discount [494] over the residential rate [495].

Electric utilities in New Hampshire and Wisconsin, as well as offering solar customers an all-electric discount, maintain rates for providing off-peak and controlled electric service. The Public Service Co. of New Hampshire has entered into a special contract with Total Environmental Action, Inc., to provide off-peak electricity for use as auxiliary energy in a solar-heated home [496]. The special off-peak solar contract rate is lower (energy charge) than the charges for the all-electric space-heating rate [497], but higher than the rate for controlled water-heating service [498]. Under the contract, the solar home is equipped with a special electric hydronic thermal storage device, and certain specifications regarding the electric water-heating device and the building's total heat loss must be achieved. Wisconsin Power and Light Co. maintains a supplemental energy off-peak service rate for 100 customers who agree to use off-peak service and who have maximum monthly demands of less than 75 kW [499]. The purpose of the rate is to encourage the development of supplemental energy sources that will reduce the consumption of typical fuels, and provide an incentive to use energy during off-peak hours. Supplemental energy sources do not include natural gas, propane, electricity, fuel oil, or coal.

Rates for off-peak service designed to be controlled by the company are offered by Kansas Gas and Electric Co. (KG&E), Wisconsin Public Service Corp. (WPS), and Detroit Edison Co. KG&E's rate is an experimental off-peak storage rider limited to 200 customers [500]. The Kansas rate is applicable to electric service for storage equipment used in space heating, cooling, and water heating normally supplied from solar sources, electrically separated from the customer's normal usage. WPS's rate is available to the first 100 customers that enter into contracts with the company for service to storage-type space-heating and/or space-cooling systems in single-family residential dwellings [501]. A solar user under this rate would suffer an added fixed charge, but enjoy a savings in energy charges for controlled service provided to his auxiliary system compared to the company's residential service rate [502]. Detroit Edison's experimental solar-assisted water-heating service rate is available to the first 500 customers taking service under the company's D1-D4 schedule designations who desire controlled water-heating service to a solar-assisted electric water heater [503]. The solar customer who takes water-heating service under this rate is faced with a second service charge, but a reduced energy charge compared to the company's residential electric space-heating rate [504]. In its review of Edison's solar rate proposal, the Michigan commission found that Edison's proposal to conduct a study of solar-assisted electric water heating and to offer a rate for such service was just, reasonable, and in the public interest [505].

4.6.2 The Colorado Controversy Revisited

As noted earlier in section C, in 1976 the Colorado PUC ordered a proposed mandatory demand/energy rate for all-electric and solar customers to be optional [506], and left issues regarding separate rates for solar customers to be considered in the generic hearings [507]. In the generic hearings, Public Service Co. of Colorado (PSCo) proposed a residential solar service demand/energy rate designed to be applicable only to residential service where solar energy was the principal source of heat [508]. The solar rate was developed from the residential demand service rate by maintaining the same customer and energy charges, but reducing the demand charges by 50% [509]. To qualify for service under this solar rate (1) the solar energy system must be designed to provide a minimum of 60% of the space-heating requirements for the building and must be equipped with adequate storage facilities, and (2) service would be available only when the energy was used to supplement solar storage facilities; i.e., electric space heating other than that supplying heat directly to the storage facility would not be permitted.

The effect of PSCo's proposed solar rate on solar system economics can be determined by the following analysis. Table 4-9 illustrates the electrical power requirements for a single-family all-electric home and a 70% solar-heated home in Denver. Based on this data, the monthly utility bills were calculated for the 70% solar-heated home under the proposed solar rate, and are compared in Table 4-9 to the all-electric home monthly bills that would result under rates effective during the fall of 1978. It was assumed that the 70% solar-heated home fully qualified under the requirements listed by PSCo for the residential solar service rate.

Table 4-9 indicates that the 70% solar-heated home under the proposed solar rate yields a savings of 44% on the annual electric utility bill of an all-electric home served under the demand/energy rate (RD-1). The savings increases to 54% if the all-electric home is served under the all-electric declining block rate (RH-1). In comparing utility bill savings for only the 70% solar-heated home served under existing rates and the proposed solar rate, a savings of 33% is realized from the proposed solar rate (RDS) compared to the demand/energy rate (RD-1). The proposed solar rate results in an annual utility bill savings of 29% compared to the all-electric declining block rate (RH-1).

It can be seen that PSCo's proposed solar rate would result in a significant increase (from 15% to 44%) in the annual savings realized by a 70% solar-heated home compared to an all-electric home served under the demand/energy rate. The increase in savings (from 35% to 54%) is also significant when comparing the 70% solar-heated home's bill under the proposed rate to the all-electric home's annual bill under the all-electric declining block rate. However, the requirements of qualification for the proposed solar rate are stringent, particularly since the storage facility and auxiliary system must be designed for off-peak recharge only, and no auxiliary heating service can be supplied on peak. This requirement, however, promotes the objective of solar system designs compatible with and favorable to electric utility systems. It is possible that solar systems incapable of storage recharge by auxiliary sources could require predominantly off-peak power as a back-up once the solar-charged storage has been depleted. Unfortunately, these solar systems, while not necessarily detrimental to the utility's load factor, would be unable to qualify for service under the proposed solar rate. In this respect, the proposed rate is inefficient. But in view of the significant savings that could be obtained from service under the proposed solar rate, PUC approval and PSCo's implementation of the rate would remove a potential barrier to the commercialization of solar energy in Colorado.

An investigation of solar rates conducted by the Colorado Office of Energy Conservation recognized the advantages of basing rates on marginal-cost pricing; particularly to the solar customer who would have the potential to realize not only fuel savings but also capacity savings [510]. A three-part rate incorporating separate demand, energy, and customer charges was suggested to best reflect the marginal costs of providing service. Rather than adjusting demand and energy charges according to time of use to reflect the differing utility costs of providing service at peak and off-peak periods, the investigation indicated that demand costs could vary according to the particular solar system served [511]. The highest capacity charge for solar users was assigned to solar systems having no storage capacity and the lowest charge to systems capable of off-peak auxiliary recharge and utility controlled interruption. Between the two extremes were varying capacity charges depending upon type of auxiliary system and storage capacity. However, it was thought that a rate structure that varied capacity charges with the level of solar system sophistication would be administratively unworkable [512].

Table 4-9. **Electrical Power Requirements for an All-Electric Home and a 70% Solar-Heated Home in Denver and Comparison of Electric Utility Bills for All-Electric and 70% Solar-Heated Homes Based on PSCo's Proposed Residential Solar Service Rate**

	All-Electric Home Power Requirements[a]		Solar Equipped Home Power Requirements[a]		All-Electric Home Bill			70% Solar Home Bill		
Month	Energy (kWh)	Demand (kW)	Energy (kWh)	Demand (kW)	RD-1[b]	RH-1[c]	R-1[d]	RD-1[b]	RH-1[c]	RDS[e]
JAN	4,643	15.0	3,060	15.0	$ 98.78	$142.40	$123.70	$ 82.93	$ 98.52	$ 58.93
FEB	3,336	12.7	1,665	12.7	78.33	106.17	92.22	66.61	59.85	41.29
MAR	2,867	12.3	1,108	12.3	72.36	93.17	80.92	54.75	44.41	35.07
APR	2,386	10.5	979	10.5	61.78	79.84	69.33	47.70	40.58	30.90
MAY	1,302	10.0	900	10.0	49.33	49.79	43.22	45.31	37.43	29.31
JUN	1,096	10.0	900	10.0	47.27	44.08	38.26	45.31	37.43	29.31
JUL	900	10.0	900	10.0	45.31	37.43	32.48	45.31	37.43	29.31
AUG	926	10.0	900	10.0	45.57	38.46	33.38	45.31	37.43	29.31
SEP	1,483	10.0	900	10.0	51.14	54.81	47.58	45.31	37.43	29.31
OCT	2,017	10.0	900	10.0	56.49	69.61	60.44	45.31	37.43	29.31
NOV	3,254	12.3	1,700	12.3	76.23	103.90	90.24	60.68	60.82	41.00
DEC	3,957	12.4	2,433	12.4	83.59	123.39	107.18	68.33	81.14	48.49
TOTALS	28,167		16,345		$766.18	$943.05	$818.95	$647.86	$609.90	$431.54

[a]From Table 4-1
[b]Demand/Energy Rate
[c]All-Electric Declining Block Rate
[d]General Residential Declining Block Rate
[e]Proposed Solar Residential Demand/Energy Rate

4.6.3 Wind Rates

Providing auxiliary service to customers utilizing wind power, photovoltaic, or other electricity-producing solar systems (small power producers) involves issues other than the aforementioned load factor conflict. From an electric utility standpoint, the load factor of a small power producer will not be high since the systems are expected to result in minimal auxiliary energy use. In addition to the rates charged for auxiliary service to decentralized electricity-producing solar technologies, a major concern of the small power producer is whether an electric utility can refuse to purchase any excess electric energy the small power producer may wish to generate back into the grid, and if not, at what rate shall the utility purchase such power.

A 1975 George Washington University study found that most utilities prohibit reverse power flows back into the utility grid where auxiliary service is provided to a self-supplying customer [513]. Because this practice would effectively deprive the nation of electricity when depletable resource conservation is a major national goal, consumers, PUCs, and legislatures have responded in a manner favorable to the small power producer.

As part of a rehabilitation project on a tenement in New York City, project leaders installed a solar system for water heating and a 2 kW wind power generator planned to supply the solar system circulating pumps and lighting loads [514]. Negotiations began between Consolidated Edison Co. (Con Ed) and the Energy Task Force involved in the project regarding the conditions of service to the windmill-equipped facility. Con Ed was unwilling to allow reverse flow because of its concern with the windmill's effect on transformers and computerized controls, and possible hazards to line workers. The New York utilities commission reversed Con Ed with a rate schedule that may become a model for service to windmill customers.

For windmill customers, a minimum monthly charge is increased proportionally to the windmill's capacity in kW [515]. The minimum monthly charge of $4.96 plus $6.80 per kW of windmill capacity acts as a disincentive for customers to install larger capacity units. The capacity charge should instead be based upon the capacity of the load served by auxiliary energy when the windmill is not in operation. Moreover, the customer credit for reverse flow power includes only an energy credit and no capacity credit. A capacity credit would provide more incentive to utilize windmill devices in parallel operation with the utility's system.

An additional meter charge is assessed for the use of a meter to measure reverse flow, and the company will credit the customer its average cost of fuel per kWh for reverse flow electric energy. Provisions allow the company to install on the customer's premises any equipment needed to measure data necessary for determining the operating characteristics of a windmill served under this rate. The indemnification clause, which provided that "each customer shall agree in writing to hold the Company harmless and indemnify it for any damages or injury in any way resulting from the installation or operation of his equipment," was deleted from the final tariff. Otherwise, windmill operators would probably have needed to purchase liability insurance for their units—another cost disincentive to windmill operation.

Central Hudson Gas and Electric Corp. in New York also recently filed revisions to its tariff to establish additional charges and credits for service to windmills operated in parallel with its system [516]. The rate applies to electric service in single-family dwellings or apartments in multi-family dwellings. This rate also requires additional demand and metering charges for service to windmills. A credit is provided for energy generated back to the company equal to the company cost of fuel per kWh. No limitations are imposed on the capacity size of the windmill or upon the number of customers that may obtain service under the rate.

Southern California Edison Co. maintains experimental parallel generation rate schedules for domestic [517] and general [518] applications. The rates were instituted primarily to encourage limited cogeneration by utility customers and to give the utility experience with parallel operation by small power producers. The domestic parallel generation rate is applicable to domestic service (lighting, heating, cooling, and power in a single-family accommodation) where a part or all of the electrical requirements of the customer can be supplied by a source other than the company, and where a source is connected for parallel operation. Customer sources may include, but are not limited to, windmills, waterwheels, solar conversion, tidal action, and geothermal devices.

Unlike the New York companies, Southern California Edison makes use of a "net energy charge" when crediting the small power producer for energy generated back to the company. Net energy is defined as energy supplied by the company, less energy generated by the customer, and fed back into the company's system. This approach favors the small power producer because, in addition to fuel cost savings upon reverse power flows, any capacity costs lumped into the energy charges will also be saved. In New York, only fuel savings and not capacity savings were credited to the windmill operators. The effect of Southern California Edison's rates is to encourage parallel generation operation by giving to small power producers all potential savings the utility realizes from their excess generation.

4.7 THE NATIONAL ENERGY ACT AND ELECTRIC UTILITY RATE MAKING

The National Energy Act (NEA) [519] is comprised of five acts, addressing utility rate reform [520], energy taxes [521], energy conservation [522], coal conversion [523], and natural gas policies [524]. Certain sections of the Public Utility Regulatory Policies Act of 1978 [525] (the Act), deal specifically with electric utility rate making. Other provisions apply to small power producers encompassing rate-making policies, parallel operation policies, and exemption from the Federal Power Act.

The purposes of the regulatory policies title of the Act are to encourage conservation of energy supplied by electric utilities, efficient use of resources and facilities by electric utilities, and equitable rates to electric consumers [526]. The first purpose is to foster conservation by the ultimate end-users of electricity. The second purpose is directed at optimization of the efficiency of use of facilities and resources by electric utilities. The second purpose includes the use of rate reform to conserve energy resources. However, where rate reform is initiated for this reason, rates must continue to be equitable to consumers [527].

Federal standards established by the Act address cost of service, declining block rates, time-of-day (TOD) rates, seasonal rates, interruptible rates, and load management techniques [528]. It is of great significance to solar users that rates charged by electric utilities to each customer class must be designed, to the maximum extent possible, to reflect the costs of service to that class [529]. The methods prescribed by PUCs or nonregulated utilities must also identify differences in cost incurrence attributable to differences in customers, demand, and energy charges, as well as differences in daily and seasonal time of use [530].

While federal rate-making standards are not mandatory under the Act, solar users are assured that consideration will be given to standards potentially beneficial to solar commercialization. As noted earlier [531], arguments can be made to show that TOD and interruptible rates as well as load management techniques, are well suited to solar technologies and would provide benefits to both solar consumers and electric utilities. Solar consumers wishing to advocate a particular standard in a regulatory proceeding are now guaranteed a federal right of intervention. More important, the cost barrier to challenging rate making practices may have been removed by the Act. As a special interest group, solar consumers could qualify for state, PUC, or utility reimbursement of legal expenses associated with any regulatory proceeding if certain tests; e.g., financial hardship, are met. In general, all utilities subject to the statute will be required to consider rate-making practices that may not have received consideration in the past and that are directly beneficial to solar commercialization. Moreover, mechanisms are provided by which solar and other electricity consumers will have easier access to and possibly more influence upon the rate-making and regulatory processes.

Title II of the Act, regarding Federal Energy Regulatory Commission (FERC) and Department of Energy (DOE) responsibilities [532], contains provisions which might affect rate making, service, and regulatory policies toward electricity-producing solar technologies; e.g., wind and photovoltaic systems. The Federal Power Act is amended [533] to include the definitions of "small power production facility" and "cogeneration facility" [534]. A small power production facility produces electricty (from any fuel) and steam or other forms of useful energy (such as heat) used for industrial, commercial, heating, or cooling purposes. The Conference Report provides that "[t]he definition of small power production facility includes solar electric systems, wind electric systems, systems which produce electric energy from waste or biomass, and electric energy storage facilities [535]. Depending upon the requirements prescribed by FERC, a solar small power producer who uses a majority of the energy and occasionally sells excess to a utility is likely to qualify.

Within a year from the enactment date, FERC is to prescribe rules that require electric utilities to offer to sell electric energy to qualifying small power production facilities and qualifying cogeneration facilities, and to purchase electric energy from these facilities. The rules are to ensure that the rates for the purchase from and sale of electric energy to these facilities will be "just and reasonable" to the utility's consumers and in the public interest, and will not discriminate against owners of these facilities [536].

FERC is also required, after consultation with PUCs, electric utilities, and small power producers and after public notice and opportunity for interested persons to comment, to establish rules under which small power producers may be exempted from the Federal Power Act, the Public Utility Holding Company Act, and state law pertaining to rate regulation of electric utilities. FERC must determine that such exemption is necessary to encourage small power production. Small power production facilities whose power production capacity exceeds 30 MW will not be entitled to the above exemption. One exception is that small power production facilities utilizing biomass as a primary energy source would be entitled to exemption from the Public Utility Holding Company Act and state rate regulation law.

The provisions regarding small power producers are generally consistent with those in earlier proposals of the Act. If electricity-producing solar technologies qualify as small power production facilities, their owners will be benefitted by future rules prohibiting rate discrimination in the purchase of auxiliary energy and in the sale of excess energy.

Moreover, solar users are assured that electric utilities can no longer summarily refuse to purchase excess energy from qualifying small power production facilities. A solar small power producer might secure exemption from federal and state rate regulation where the producer considers such regulation as detrimental to parallel operation with a utility. For the qualifying solar small power producer, the Act resolves several issues that could have hindered the commercialization of electricity-producing solar technologies.

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SECTION 5.0

CONCLUSION

As solar technologies become more workable and marketable, the likelihood of utility involvement in the development of solar energy increases. Such involvement is suspect for many reasons. One concern lies in the regulated monopoly status of most public utilities. Should such existing public utilities play a large role in the marketing of SHAC devices, and should the utility's certificate of convenience and public necessity foreclose competition by solar utilities, existing utilities will be able to determine the rate, the quality, and the success of the commercialization of solar technologies. It is important for law and policy makers to consider the implications of this degree of utility control over the new but growing solar market. Alternatives to utility involvement in the solar energy field should be explored, and strategies that limit or at least regulate utility decisions regarding solar technologies should be understood.

Another concern is due to the fact that decentralized solar technologies generally require an auxiliary energy system to assure continuous service through periods of adverse weather. Where electricity is used as a back-up energy source, the rates electric utilities charge for the auxiliary service have a significant impact upon solar system economics and thus the commercialization of solar energy. Since solar users potentially can exhibit low load factors, different costs to serve, and variable demands, they can be classified separately from other electric customers for rate-making purposes. In the past, rates for auxiliary service to solar facilities have hindered solar commercialization.

Utilities may be one means of accelerating the speed with which solar energy is accepted by the public. Nevertheless, the consequences of and alternatives to using utilities should be fully examined before utilities assume such a critical role in the solar commercialization effort.

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REFERENCES

1. See R. G. Jones, H. M. Sramek, and J. M. Pelster, Analysis of State Solar Energy Policy Options 3-4 (June 1976) (prepared by the Energy Policy Project of the National Conference of State Legislatures for the Federal Energy Administration, FEA Contract No. CO-12-60496-00) [hereinafter cited as Solar Policy Options]. This report contains analyses of solar market economics, tax incentives, the relationship between solar energy and electric utilities, and the implications for state policies.

2. See id. at 3; 1 Office of Technology Assessment, Application of Solar Technology to Today's Energy Needs 19 (June 1978) [hereinafter cited as OTA Report]. Residential and commercial energy uses; i.e., hot water, space heating, air conditioning, electricity for lighting and other miscellaneous uses, and gas for cooling, accounted for approximately 36% of the total U.S. energy demand in 1975. Transportation accounted for 26% with the remaining 38% demanded by the industrial sector. Id.

3. See H. Rau, Solar Energy 59 (1964); OTA Report, supra note 2, at 18. It has been claimed that: (1) on-site solar hot water systems are economically competitive with electric hot water systems in most parts of the United States today; (2) on-site solar space heating is, or soon should be, marginally competitive with heat pump and electric resistance heating systems in many areas of the United States; (3) decentralized solar space heating and hot water systems may be competitive with oil or gas fired applications by the mid-1980s; and (4) on-site solar air conditioning devices will appear economically attractive in the 1980s.

4. See Bradley, Designing and Siting Solar Power Plants; 98 Consulting Engineer, March 1977, at 80, 83 (issue no. 3).

5. See OTA Report, supra note 2, at 36.

6. See id. at 36-37. Not all active solar systems make use of an energy storage system. Fewer yet employ an energy-conversion system.

7. See id. at 286-89. One-axis tracking collectors move along one axis to track the sun's movement during the day whereas two-axis tracking collectors move independently about two axes to follow the sun. Flat-plate collectors can provide temperatures generally ranging between 57°C and 97°C. Where higher temperatures are required for industrial processes, or to operate heat engines, concentrating or tracking collectors would be required. For an extensive analysis of collector designs, environmental impacts, collector costs, and collector performance, see id. at 243-326.

8. For a detailed feasibility and cost analysis of energy storage technologies including thermal, mechanical, and chemical forms see id. at 427-503.

9. See id. at 40.

10. The average costs of battery storage for storing electricity in chemical form range from $63 to $93 per kWh. See id. at 470. The prices stated above apply to lead-acid batteries lasting 500-1,000 charge/discharge cycles and capable of storing 5 MW-hours of energy with a 10-hour discharge. Automobile-type batteries are unsuitable for power applications since repeated full discharge will result in damage to the batteries. Industrial traction batteries used in forklifts and similar equipment have lifetimes of 2,000 cycles and are available for $80 per kWh. Id.

11. For a technical discussion of the costs and performance of a variety of heat engine devices, see id. at 327-89.

12. See id. at 37.

13. See Bradley, supra note 4, at 80-84; Electric Power Research Institute, Spinning a Turbine with Sunlight, 3 EPRI Journal, March 1978, at 14-19 (issue no. 2 [hereinafter cited as EPRI Solar-Thermal]. See generally D. Spencer, Solar Energy: A View From an Electric Utility Standpoint 13-21 (prepared by the Electric Power Research Institute for the American Power Conference in Chicago, Ill., April 21-23, 1975).

14. A watt is a unit of power equal to one joule per second. A kW is 1,000 watts and a MW represents 1,000,000 watts. One horsepower is equivalent to 746 watts. Energy can generally be expressed as the product of power and time. Thus, a 1,000 watt light bulb burning for one hour consumes one kWh of energy.

15. The cost of the Sandia test facility was approximately $21 million. See EPRI Solar-Thermal, supra note 13, at 17.

16. See Bradley, supra note 4, at 81-82; EPRI Solar-Thermal, supra note 13, at 17.

17. See Bradley, supra note 4, at 83.

18. See EPRI Solar-Thermal, supra note 13, at 17.

19. See Brancato, New Approaches to Current Problems in Electric Utility Rate Design, 2 Colum. J. Envt'l L. 40, 47-49 (1975).

20. For a general discussion of the operation, costs, and applications of photovoltaic energy conversion systems, see Electric Power Research Institute, The Sun on a Semiconductor, 3 EPRI Journal, March 1978, at 20-25 (issue no.2) [hereinafter cited at EPRI Solar-Photovoltaics]; OTA Report, supra note 2, at 391-426; D. Spencer, supra note 13, at 21-28.

21. See EPRI Solar-Photovoltaics, supra note 20, at 23.

22. See D. Spencer, supra note 13, at 24.

23. See EPRI Solar-Photovoltaics, supra note 20, at 24-25.

24. See id. at 22,24.

25. See id. at 21; OTA Report, supra note 2, at 393-94.

26. See OTA Report, supra note 2, at 343. DOE's present goals are to cut photovoltaic costs (1) to $7,000 per peak kW in fiscal year 1979, (2) to between $1,000 and $2,000 per kW by the end of fiscal year 1982, (3) to $500 per kW by the end of fiscal year 1986, and (4) to between $100 and $300 per kW by the end of fiscal year 1990. See id. at 394.

27. See Electric Power Research Institute, The Earth as a Solar Heat Engine, 3 EPRI Journal, March 1978, at 43, 43-44 (issue no. 2).

28. See id. at 44.

29. See id. at 45.

30. See id.

31. The structure of the program encompasses five areas: (1) program development, technology, applications of wind energy, legal, social, and environmental issues, and wind characteristics, (2) small machines (less than 100 kW capacity), (3) 100 kW-scale systems, (4) megawatt-scale systems, and (5) large multi-unit systems or "wind farms." See id.

32. 1 Department of Housing and Urban Development, Working Papers on Marketing and Market Acceptance, ch. 6 at 14 (Spring 1978) (Preliminary Findings and Analysis, prepared for the Solar Demonstration Program, Division of Energy, Building Technology and Standards, Office of Policy Development and Research, U.S. Depts. of Housing and Urban Development) [hereinafter cited as HUD Report].

33. See id.

34. See id. ch. 6 at 20.

35. See id. ch. 6 at 18.

36. See id. ch. 6 at 19.

37. See S. Feldman & B. Anderson, The Public Utility and Solar Energy Interface: An Assessment of Policy Options 178-179 (December 31, 1976) (prepared for the Energy Research and Development Administration—Division of Solar Energy, ERDA Contract No. E(49-18) - 2523) [hereinafter cited as Utility and Solar Interface]. A variation of the same analysis appears in R. Bezdek, J. Margolin, T. Sparrow, G. Sponsler, A. Ezra, R. Spongberg, A. Miller, F. Meeker, E. Roseman, & M. Misch, Analysis of Policy Options for Accelerating Commercialization of Solar Heating and Cooling Systems 220-22 (February 1978) (prepared by the Behavioral Studies Group, Program of Policy Studies in Science and Technology, The George Washington University, for the Department of Energy, Assistant Secretary for Conservation and Solar Applications—Division of Solar Applications, Contract No. EX-76-G-01-2534) [hereinafter cited as SHAC Policy Options]. See also R. Noll, Maintaining Competition in Solar Energy Technology in Federal Trade Commission, The Solar Market: Proceedings of the Symposium on Competition in the Solar Energy Industry 179, 181 (June 1978) (presented at the December 15-16, 1977 Solar Energy Symposium sponsored by the Federal Trade Commission's Bureau of Competition).

38. See R. Noll, supra note 37, at 182; SHAC Policy Options, supra note 37, at 222-24; Utility and Solar Interface, supra note 37, at 180-81.

39. In re Use of the Carterfone Device in Message Toll Telephone Service, 13 F.C.C.2d 420 (1968). In this case, the telephone companies sought to apply penalties contained in a tariff to customers who used the Carterfone interconnection device. According to the tariff, use of such equipment conferred a right upon the telephone company to remove or disconnect the device or to suspend or terminate service. Id. at 427 (app. A). The FCC agreed with and adopted the examiner's findings that the Carterfone filled a need and did not adversely affect the telephone system. It was held that "application of the tariff to bar the Carterfone in the future would be unreasonable

and unduly discriminatory." Id. at 423. The FCC further concluded that "the tariff has been unreasonable, discriminatory, and unlawful in the past, and that the provisions prohibiting the use of customer-provided interconnecting devices should accordingly be stricken." Id.

40. The text accompanying notes 42-55 infra addresses whether a utility in Colorado that is somehow involved in the ownership of SHAC devices located upon a customer's premises would be subject to PUC regulation of such activity.

41. United States v. Western Electric Co., [1956] Trade Reg. Rep. (CCH) 91 68,246. According to the decree, AT&T is enjoined from engaging in the manufacture of any equipment of a type not sold or leased to companies of the Bell System for use in furnishing common carrier communications service, except equipment used in the manufacture or installation of equipment of a type so sold. The decree also provides that AT&T is enjoined from engaging in any business other than the furnishing of common carrier communications services. Id.

42. Colo. Rev. Stat. § 40-1-101 et seq. (1973).

43. Colo. Const. art. XXV.

44. Colo. Rev. Stat. at § 40-1-103(1).

45. Id.

46. 159 Colo. 262, 279, 411 P.2d 785, 794 (1966), appeal dismissed and cert. denied, 385 U.S. 22, rehearing denied, 385 U.S. 984 (1966).

47. Colo. Rev. Stat. at § 40-5-101.

48. Western Colo. Power Co. v. Pub. Util. Comm., 159 Colo. 262, 273, 411 P.2d 785, 791 (1966), appeal dismissed and cert. denied, 385 U.S. 22, rehearing denied, 385 U.S. 984 (1966).

49. Colo. Rev. Stat. at § 40-3-101(1).

50. For a detailed presentation of public utility rate regulation as one aspect of the regulatory process, see J. Bonbright, Principles of Public Utility Rates 147-283 (1961); P. Garfield & W. Lovejoy, Public Utility Economics 27-189 (1964); 1 A. Priest, Principles of Public Utility Regulation 45-226 (1969). See also Huntington, The Rapid Emergence of Marginal-Cost Pricing in the Regulation of Electric Utility Rate Structures, 55 B.U.L. Rev. 689, 698-718 (1975); R. Feuerstein, Utility Rates and Service Policies as Potential Barriers to the Market Penetration of Decentralized Solar Technologies (1978) (unpublished paper, prepared for the Solar Energy Research Institute, on file with the authors).

51. Colo. Rev. Stat. at 40-3-101(2).

52. See LaBate v. North Federal Water System, 62 P.U.R.(n.s.) 92, 102 (Colo. Pub. Util, Comm. 1945).

53. In re LaBate, 64 P.U.R.(n.s.) 411, 413 (Colo. Pub. Util. Comm. 1946).

54. Id.

55. Farmers Elec. & Power Co. v. Town of Ault, P.U.R. 1920 D, 214, 225 (Colo. Pub. Util. Comm.. 1920).

56. See generally J. Bonbright, supra note 50, at 159-237; P. Garfield & W. Lovejoy, supra note 50, at 56-83; 1 A. Priest, supra note 50, at 139-90.

57. Glenwood Light and Water Co. v. City of Glenwood Springs, 98 Colo. 340, 343, 55 P.2d 1339, 1340 (1936).

58. ____ Colo. ____, 567 P.2d 377, 380 (1977).

59. Id. at ____, 567 P.2d at 380-81.

60. This issue and others pertaining to utility rate and service policies toward solar users are given extensive treatment in the text beginning infra at note 255.

61. See 2 A. Kahn, The Economics of Regulation: Principles and Institutions 1 (1971).

62. The cable television discussion was adapted from H. Peterson, Resource Allocation Under Alternative Regulatory Scenarios (Sept. 21, 1976) (Utah State University, unpublished paper, on file with the authors). The paper presents a microeconomic and mathematical analysis of various situations that may occur in the development of the solar industry. The three regulatory and organizational arrangements considered are: (1) no regulation of solar or conventional energy supplies, (2) regulated monopoly providing both solar and conventional energy, and (3) regulated monopoly providing conventional energy and an unregulated industry providing solar.

63. See K. Bossong, The Case Against Private Utility Involvement in Solar/Insulation Programs, Solar Age, Jan. 1978, at 23, 24; George Washington University, Summary of Proceedings of Solar Heating and Cooling Commercialization Workshop 14, 22 (May 1977) [hereinafter cited as Proceedings]; A. Hirshberg, Solar Energy Industries Workshop: Summary Paper 12 (April 20, 1978) (prepared for the Department of Energy's Solar Energy/Utility Conference held on March 28-29, 1978 at George Washington University); SHAC Policy Options, supra note 37, at 225-26; G. Swetnam, F. Eldridge & D. Jardine, Energy Rate Initiatives Study of the Interface Between Solar and Wind Energy Systems and Electric Utilities 82 (March 31, 1977) (prepared by the Mitre Corp. for the Federal Energy Administration, Office of Synfuels, Solar, and Geothermal Energy, Contract No. P05-77-4242-0) [hereinafter cited as Energy Rate Initiatives]; Utility and Solar Interface, supra note 37, at 183-84.

64. R. Noll, supra note 37, at 184.

65. K. Bossong, supra note 63, at 24. See also A. Hirshberg, supra note 63, at 14.

66. See A. Hirshberg, supra note 63, at 15; R. Noll, supra note 37, at 183; SHAC Policy Options, supra note 37, at 224-25, Utility and Solar Interface, supra note 37, at 182-83.

67. See H. Averch & L. Johnson, Behavior of the Firm Under Regulatory Constraint, 52 Amer. Econ. Rev. 1052 (Dec. 1962).

68. See R. Noll, supra note 37, at 183; SHAC Policy Options, supra note 37, at 224; Utility and Solar Interface, supra note 37, at 181-82.

69. In re Application of the Long Acre Elec. Light & Power Co., 1 P.S.C.R. 226, 249-50 (1st Dist. N.Y. Pub. Serv. Comm. 1908). See also J. Bonbright, supra note 50, at 10-13; P. Garfield & W. Lovejoy, supra note 50, at 15-19; 1 A. Priest, supra note 50, at 361-65. But see id. at 321-24.

70. See K. Bossong, supra note 63, at 25.

71. See id. at 26. See also Utilities and Solar Energy: Will They Own the Sun?, People & Energy, Oct. 1976, at 2; Northcross, Who Will Own the Sun?, The Progressive, Apr. 1976, at 14-16.

72. Dean & Miller, Utilities at the Dawn of a Solar Age, 53 N. D. L. Rev. 329, 350-51 (1977) quoting Hirshberg & Schoen, Barriers to the Widespread Utilization of Residential Solar Energy: The Prospects for Solar Energy in the U.S. Housing Industry, 5 Pol'y Sci. 453, 468 (1974). For a variation of the Dean and Miller article, see N. Dean & A. Miller, Plugging Solar Power Into the Utility Grid, 7 Envt'l L. Rep. 50069 (1977); Environmental Law Institute, Legal Barriers to Solar Heating and Cooling of Buildings 86 (March 1978) (prepared for the Department of Energy, Assistant Secretary for Conservation and Solar Applications, Division of Solar Applications, Contract No. EX-76-C-01-2528); SHAC Policy Options, supra note 37, at 358.

73. See, e.g., H. Lorsch, Implications of Residential Solar-Space-Conditioning on Electric Utilities ch. 1 at 3 (Dec. 1976) (prepared by The Franklin Institute Research Laboratories for the National Science Foundation, Contract No. NSF-C1033(AER-75-18270)). But see S. Feldman & B. Anderson, Utility Pricing and Solar Energy Design (Sept. 1976) (prepared for the National Science Foundation, Grant No. APR-75-18006).

Feldman and Anderson found that SHAC devices, depending on climatic regions, collector sizing, and the utility's system, do not necessarily adversely affect an electric utility's load factor and concluded that:

> [n]o general statement can be made regarding the impact of SHAC upon the load curve of the electric utility industry. This analysis must be performed on an individual utility basis, since variations in the ambient weather conditions, load curves and generation mixes of utilities will be the prime determinants in the magnitude of the impact.
>
> Id. at 117.

Load factor is a measure of an electric utility's average use of its capacity as a percentage of the maximum capacity, or the ratio of average power to peak power for a given period. Utilities strive to operate at high load factors to achieve the optimum and most efficient use of facilities for a given generating capacity, thereby improving profits and ensuring relative reductions in electricity price. Solar Policy Options, supra note 1, ch. IV at 4.

74. See SHAC Policy Options, supra note 37, at 227-28; Utility and Solar Interface, supra note 37, at 186.

75. Booz-Allen & Hamilton, Inc., The Effectiveness of Solar Energy Incentives at the State and Local Level, ch. I at 6 (March 1976) (prepared for the Federal Energy Administration, Office of Synfuels, Solar and Geothermal Energy, Contract No. C0-05-50272-00) [hereinafter cited as BAH Report].

76. See SHAC Policy Options, supra note 37, at 228-29; Utility and Solar Interface, supra note 37, at 187-88. See also Proceedings, supra note 63, at 21.

77. See Energy Rate Initiatives, supra note 63, at 81.

78. See SHAC Policy Options, supra note 37, at 229; Utility and Solar Interface, supra note 37, at 188. See also Energy Rate Initiatives, supra note 63, at 81, Proceedings, supra note 63, at 21-22.

79. See Dean & Miller, supra note 72, at 336-37. See also D. Zillman, Solar Energy, Public Utilities, and the Competitive Economy in Federal Trade Commission, The Solar Market: Proceedings of the Symposium on Competition in the Solar Energy Industry 214, 217-22 (June 1978) (presented at the Dec. 15-16, 1977 Solar Energy Symposium sponsored by the Federal Trade Commission's Bureau of Competition). For a more in-depth discussion of federal antitrust laws and their impact on solar energy commercialization, see J. Gross, Impact of the Antitrust Laws on the Commercialization of Solar Energy (1978) (unpublished paper, prepared for the Solar Energy Research Institute, on file with the authors).

80. 15 U.S.C. § 1-7 (1976).

81. Many treatises are available that provide helpful discussions of the antitrust laws. See E. Gellhorn, Antitrust Law and Economics (1976); American Bar Association Section of Antitrust Law, Antitrust Law Developments (1975); R. Posner, Antitrust Law: An Economic Perspective (1976); P. Areeda, Antitrust Analysis (1974). The basic antitrust statutes are codified at 15 U.S.C. § 1 et seq. (1976).

82. 410 U.S. 366 (1973), rehearing denied, 411 U.S. 910 (1973).

83. Section Two of the Sherman Act provides that:

> Every person who shall monopolize, or attempt to monopolize, or combine or conspire with any other person or persons, to monopolize any part of the trade or commerce among the several States, or with foreign nations, shall be deemed guilty of a felony, and, on conviction thereof, shall be punished by fine not exceeding one million dollars if a corporation, or, if any other person, one hundred thousand dollars, or by imprisonment not exceeding three years, or by both said punishments, in the discretion of the court.

15 U.S.C. at § 2.

84. 410 U.S. at 372-75.

85. Id. at 377-79.

86. See, e.g., United States v. American Tobacco Co., 221 U.S. 106 175-84 (1911).

87. 428 U.S. 579 (1976).

88. 317 U.S. 341 (1943).

89. Cantor v. Detroit Edison Co., 392 F. Supp. 1110 (E.D. Mich. 1974), aff'd, 513 F.2d 630 (6th Cir. 1976) (affirmed without published opinion), rev'd, 428 U.S. 579 (1976).

90. 428 U.S. at 592-93.

91. Id. at 598.

92. ______ U.S. _____, 98 S.Ct. 1123 (1978). The special case of the municipal utility will be discussed separately.

93. City of Lafayette v. Louisiana Power & Light Co., 532 F.2d 431 (5th Cir. 1976); 98 S.Ct. 1123 (1978).

94. _____ U.S. at _____, 98 S.Ct. at 1137.

95. See Parker v. Brown, 317 U.S. 341 (1943).

96. 15 U.S.C. §§ 13, 13a, 13b, 21a (1976). The Act provides in part:

> It shall be unlawful for any person engaged in commerce, in the course of such commerce, either directly or indirectly, to discriminate in price between different purchasers of commodities of like grade and quality, where either or any of the purchases involved in such discrimination are in commerce, where such commodities are sold for use, consumption, or resale within the United States . . . where the effect of such discrimination may be substantially to lessen competition or tend to create a monopoly in any line of commerce, or to injure, destroy, or prevent competition with any person who either grants or knowingly receives the benefit of such discrimination, or with customers of either of them: Provided, That nothing herein contained shall prevent differentials which make only due allowance for difference in the cost of manufacture, sale, or delivery resulting from the differing methods or quantities in which such commodities are to such purchasers sold or delivered . . . And provided further, That nothing herein contained shall prevent persons engaged in selling goods, wares, or merchandise in commerce from selecting their own customers in bona fide transactions and not in restraint of trade; And provided further, That nothing herein contained shall prevent price changes from time to time where in response to changing conditions affecting the market for or the marketability of the goods concerned . . . .

Id. at § 13(a).

97. 334 U.S. 37 (1948).

98. Id. at 43.

99. Id. at 46.

100. 15 U.S.C. § 14 (1976):

> It shall be unlawful for any person engaged in commerce, in the course of such commerce, to lease or make a sale or contract for sale of goods, wares, merchandise, machinery, supplies, or other commodities, whether patented or unpatented, for use, consumption, or resale within the United States or any territory thereof or the District of Columbia or any insular possession or other place under the jurisdiction of the United States, or fix a price charged therefor, or discount from, or rebate upon, such price, on the condition, agreement, or understanding that the lessee or purchaser thereof shall not use or deal in the goods, wares, merchandise, machinery, supplies, or other commodities of a competitor or competitors of the lessor or seller, where the effect of such lease, sale, or contract for sale or such condition, agreement, or understanding may be to substantially lessen competition or tend to create a monopoly in any line of commerce.

101. 381 U.S. 357 (1965), rehearing denied, 382 U.S. 873 (1965).

102. Id. at 371.

103. Colo. Rev. Stat. § 6-2-101 et seq. (1973). For a detailed analysis of Colorado trade regulation laws, see Ducker, Antitrust and the Lay Lawyer, 44 Den. L. J. 558 (1967).

104. Colo. Rev. Stat. at § 6-2-102.

105. Id. at § 6-2-103(1).

106. Id. at § 6-2-103(2).

107. Id. at § 6-2-105(1).

108. Id. at § 6-2-105(2).

109. Dikeou v. Food Distributors Assn., 107 Colo. 38, 47-49, 108 P.2d 529, 533-34 (1940).

110. Colo. Rev. Stat. § 6-4-101 (1976 Cum. Supp.):

> Every contract or combination in the nature of a trust or conspiracy in restraint of trade or commerce is declared illegal. Every combination, conspiracy, trust, pool, agreement, or contract intended to restrain or prevent competition in the supply or price of any article or commodity constituting a subject of trade or commerce in this state, or every combination, conspiracy, trust, pool, agreement, or contract which controls in any manner the price of any such article or commodity, fixes the price thereof, or limits or fixes the amount or quantity thereof to be manufactured, produced, or sold in this state or monopolizes or attempts to

monopolize any part of the trade or commerce in this state, is declared an illegal restraint of trade.

111. Colo. Rev. Stat. § 6-4-102 (1973).

112. See id. at § 6-4-103.

113. For a recent federal case interpreting section 101 see Q-T Markets, Inc. v. Fleming Companies, 394 F.Supp. 1102, 1106-07 (D. Colo. 1975).

114. See Dean & Miller, supra note 72, at 355-56.

115. See id. at 355 citing G. Turner, Trends and Topics in Utility Regulation 20 (1969).

116. See Noble State Bank v. Haskell, 219 U.S. 104 (1911). Justice Holmes, speaking for the court, said: "the police power extends to all the great public needs [citation omitted] . . . . It may be put forth in aid of what is sanctioned by usage, or held by the prevailing morality or the strong and preponderant opinion to be greatly and immediately necessary to the public welfare." Id. at 111.

117. Cal. A.B. No. 2984 (Sept. 1978) (adds § 2775.5 to the Cal. Pub. Util. Code). This legislation and the events leading to its passage are considered more fully in the text accompanying notes 140-63 infra.

118. Derived in part from SHAC Policy Options, supra note 37, at 234; Utility and Solar Interface, supra note 37, at 198.

119. Colo. Const. art. XXV.

120. Colo. Rev. Stat. at § 40-1-103(1).

121. City and County of Denver v. Publ Util. Comm., 181 Colo. 38, 45-46, 507 P.2d, 871, 874-75 (1973).

122. City of Loveland v. Pub. Util. Comm., ______ Colo. ______, 580 P.2d 381, 383-85 (1978).

123. See City of Lamar v. Town of Wiley, 80 Colo. 18, 23, 248 P. 1009, 1010 (1926).

124. Colorado Springs, Colo., Charter art. VI § 34.1 (1977).

125. See Colorado Springs, Colo., Ordinance 77-144 (Sept. 27, 1977).

126. See K. Bossong, supra note 63, at 6.

127. See id.

128. Colo. Rev. Stat. at § 40-2-101(1).

129. See City of Lafayette v. Louisiana Power & Light Co., ______ U.S. ______, 98 S.Ct. 1123, 1137 (1978) and the text accompanying notes 92-95 supra.

130. See Colo. Rev. Stat. at §§ 6-4-101 to 109. See also the text accompanying notes 103-13 supra.

131. Colo. Rev. Stat. at § 31-15-107 (emphasis added).

132. See California State Energy Commission, Proposal for the Development of Municipal Solar Utilities 8 (June 14 1978, revised July 8, 1978) (submitted by the California Energy Resources Conservation and Development Commission to the Department of Energy).

133. Id. at 1.

134. See id. at 2.

135. See Dean & Miller, supra note 72, at 356.

136. E.g., re Pacific Power & Light Co., 69 P.U.R.3d 367 (Idaho Pub. Util. Comm'. 1967); Re Michigan Consol. Gas Co., 1 P.U.R.4th 229 (Mich. Pub. Serv. Comm. 1973).

137. Colo. Rev. Stat. at § 40-3-111(2).

138. The following alternatives were obtained primarily from K. Bossong, supra note 63, at 6.

139. The entire National Energy Act is comprised of five separate acts: Public Utility Regulatory Policies Act of 1978 Pub. L. No. 95-617, _____ Stat. _____ (1978); Energy Tax Act of 1978, Pub. L. No. 95-617, _____ Stat. _____ (1978); National Energy Conservation Policy Act, Pub. L. No. 95-619, _____ Stat. _____ (1978); Power Plant and Industrial Fuel Use Act of 1978, Pub. L. No. 95-620, _____ Stat. _____ (1978); Natural Gas Policy Act of 1978, Pub. L. No. 95-621, _____ Stat. _____ (1978). For a general summary of the five acts, see Department of Energy, Information: The National Energy Act (Nov. 1978) (from DOE's Office of Public Affairs); Environmental Study Conference, National Energy Act Fact Sheet (1978).

Under the National National Energy Conservation Policy Act, governors and nonregulated utilities will submit to DOE energy conservation plans requiring utilities to inform residential customers of suggested energy conservation measures including devices to utilize solar energy or wind power. As part of this informational requirement, utilities must make public lists of installers and lenders who might install and finance these energy conservation measures. For each residential customer, utilities are required to offer to inspect his residence and inform him of the estimated cost of purchasing and installing the suggested measures as well as the expected energy savings that are likely to result. In addition, utilities are required to offer to arrange for the installation and financing of the suggested measures. Pub. L. No. 95-619, at §§ 213-15.

140. See California Public Utilities Commission Energy Conservation Team, A Study of the Viability and Cost-Effectiveness of Solar Energy Application for Essential Uses in the Residential Sector in California, ch. I at 1-2 (Oct. 7, 1977).

141. See id. ch. III at 1-3.

142. See id. ch. III at 5.

143. See id. ch. III at 9.

144. See id. ch. III at 8-9.

145. See id. ch. III at 9.

146. See id. ch. III at 11.

147. See id.

148. See id. ch. III at 9.

149. The solar law issues included those related to sun rights and ownership of solar installations. Application of Southern California Gas Co. for authority to (a) engage in a solar demonstration project and (b) to include in its rates the amounts necessary to fund a solar energy program, Decision No. 88224, at 2 (Cal. Pub. Util. Comm., Dec. 13, 1977).

150. Id. at 3.

151. Id. at 4-5.

152. Id. at 5.

153. Id. at 5 n.1. The particular legislation cited in the opinion charging the Energy Commission to carry out research into alternative sources of energy is Cal. Pub. Res. Code §§ 25401, 25216(c) (West 1977).

154. Joint Investigation by the Pub. Util. Comm. and the Energy Resources Conservation and Development Comm. into the Availability and Potential Use of Solar Energy in California, CPUC Case No. 10150, ERCDC No. 76-R&D-1 (April 14, 1978) (proposed joint findings and conclusions of the staffs. The California PUC ordered that:

> an investigation is instituted by the California Public Utilities Commission to determine and evaluate the proposed programs for the sales, leasing, installation and related servicing of solar devices by public utilities subject to this Commission's jurisdiction. This investigation is for the purpose of adopting rules or appropriate orders to insure that such programs preserve the competitive nature of the solar industry and protect the interests of individual solar product consumers, while placing no undue burden on the utilities' rate payers.
>
> . . . no utility under the jurisdiction of this Commission may proceed, in a manner which utilizes rate-payer funds, with the implementation of a program for the direct sales, leasing, installation and related servicing of solar devices without authorization from this Commission.
>
> . . . any utility under the jurisdiction of this Commission which now or in the future intends to proceed with a program for the direct sales, leasing, installation and related servicing of solar devices, notwithstanding the above order, must file with this Commission a full description and report on present and proposed programs for the sale, leasing, installation and related servicing of solar energy systems by each respondent utility, discussing [various enumerated concerns] . . ., within 30 days from the effective date of this order.

Order Instituting Investigation by the Public Utilities Commission into Intended Programs for the Sales, Leasing, Installation and Related Servicing of Solar Devices by Public Utilities, O.I.I. No. 13, at 2-3 (April 4, 1978).

155. CNC Case No. 10150 at 27-28.

156. Id. at 28-29.

157. Cal. A.B. No. 2984 (Sept. 1978) (an act to add § 2775.5 to the Pub. Util. Code).

158. Id. at § 1.

159. Id. at § 2(a).

160. Id. at § 2(d).

161. Id. at § 2(a).

162. Id. at § 2(b).

163. Id. at § 2(c).

164. The President of the United States, National Energy Act: A Draft of Proposed Legislation to Establish a Comprehensive National Energy Policy, H.R. Doc. No. 95-138, 95th Cong., 1st Sess. (1977).

165. The House version of the National Energy Act was passed by that body on August 5, 1977. H.R. 8444, 95th Cong., 1st Sess. (1977). As with the President's proposal, the House version contained provisions requiring each state regulatory authority and nonregulated utility to submit a residential energy conservation plan to the Federal Government. These plans were to include utility programs consisting of, inter alia, procedures whereby a utility will offer to install or finance certain conservation measures provided that the program adequately prevented unfair, deceptive, or anticompetitive acts. Within the Act, residential energy conservation measures were defined to include "devices to utilize solar energy or windpower for any residential energy conservation purpose, including (but not limited to) heating of water, space heating or cooling." H.R. 8444 at 101(10)(I). After two years from the date of enactment of the proposed House bill, utilities would be required to offer to install suggested energy conservation measures included in the utility programs. Utilities would have been prohibited from installing residential energy conservation measures under the House proposal if: (1) it was determined by the PUC or FEA that a sufficient number of suppliers of suggested measures existed within the area served by the utility, (2) the PUC, FEA, or FTC determined that supplying or installing such measures by a utility would have a substantial anticompetitive effect, or (3) the PUC or FEA determined that prohibiting utilities from engaging in such activities would not substantially reduce the number of residential customers likely to have such measures installed. In effect, both regulated and nonregulated utilities would have been permitted to install, supply, or finance SHAC devices under the House's National Energy Act proposal.

The Senate's proposal, passed by that body on September 13, 1977, would have allowed the governor of each state and each nonregulated utility to submit residential energy conservation plans to the FEA. H.R. 5037, 95th Cong., 1st Sess. (1977). As with the House proposal, these plans were to include utility programs which allowed utilities to offer to install or finance suggested measures as prescribed by the Administrator of the FEA. Utilities would have been prohibited from installing residential energy conservation measures or making a loan to finance the purchaser installation of such measures. Therefore, under the Senate's version, the extent to which a utility could become involved in the installation or financing of SHAC devices would have been left to the discretion of the Administrator of the FEA (now the Department of Energy).

166. National Energy Conservation Policy Act, Pub. L. No. 95-619, at § 216. See also Conference Report: National Energy Conservation Policy Act, S. Rep. No. 95-1294, 95th Cong., 2d Sess. 99-100 (1978).

167. Pub. L. No. 9a5-619, at § 216.

168. See Status Report on Solar Energy Domestic Policy Review ch. VI at 8 (Aug. 28, 1978) (Public Review Copy, Draft).

169. See id. ch. VI at 9-11.

170. See id.

171. The Colorado constitutional provision provides that:

> In addition to the powers now vested in the General Assembly of the State of Colorado, all power to regulate the facilities, service and rates and charges therefor, including facilities and service and rates and charges therefor within home-rule cities and home-rule towns, of every corporation, individual, or association of individuals, wheresoever situated or operating within the State of Colorado, whether within or without a home-rule city or home-rule town, as a public utility, as presently or as may hereafter be defined as a public utility, by the laws of the State of Colorado, is hereby vested in such agency of the State of Colorado as the General Assembly shall by law designate.Until such time as the General Assembly may otherwise designate, said authority shall be vested in the Public Utilities Commission of the State of Colorado; provided however, nothing herein shall affect the power of municipalities to exercise reasonable police and licensing powers, nor their power to grant franchises; and provided, further, that nothing herein shall be construed to apply to municipally owned utilities.

172. Colo. Rev. Stat. § 40-1-103(2) (1973).

173. Intermountain Rural Electric Association v. District Court, 160 Colo. 128, 134, 414 P.2d 911, 914 (1966). See also City and County of Denver v. Pub. Util. Comm., 181 Colo. 38, 43-44, 507 P.2d 871, 873 (1973).

174. E.g., Allen v. R. R. Comm. of California, 179 Cal. 68, 175 P. 466 (1918).

175. 94 U.S. 113, 126 (1877).

176. City of Englewood v. City and County of Denver, 123 Colo. 290, 300, 229 P.2d 667, 672-73 (1951).

177. 440 F.2d 36 (10th Cir. 1971).

178. Id. at 42.

179. Colo. Rev. Stat. at § 40-5-101(1). Certain exemptions from application of the statute are provided for extensions of facilities necessary in the ordinary course of business: (1) within any city, county, or town within which a utility is already lawfully operating, (2) into territory either within or without a city, county, or town contiguous to the utility's facilities and not already served by a public utility providing the same service, and (3) within or to territory already served by the utility. In Western Colo. Power v. Pub. Util. Comm.. 163 Colo. 61, 428 P.2d 922 (1967) the Supreme Court of Colorado stated that these exceptions are for "housekeeping" purposes, allowing the legislature to permit extensions necessary in the ordinary course of business without further application for a certificate. Id. at 71, 428 P.2d at 927.

180. 159 Colo. 262, 73, 411 P.2d 785, 791 (1966), appeal dismissed, 385 U.S. 22, rehearing denied, 385 U.S. 984 (1966).

181. Colo. Rev. Stat. at § 40-5-101(2).

182. Western Colo. Power Co. v. Pub. Util. Comm., 159 Colo. 262, 273, 411 P.2d 785, 791 (1966) appeal dismissed and cert. denied, 385 U.S.22, rehearing denied, 385 U.S. 984 (1966).

183. See Western Colo. Power Co. v. Pub. Util. Comm., 163 Colo. 61, 71-72, 428 P.2d 922, 927-28 (1967).

184. Pub. Util. Comm. v. Home Light & Power Co., 163 Colo. 72, 83 428 P.2d 928, 934 (1967).

185. See K. Hillhouse, Legal and Institutional Perspectives on Solar Energy in Colorado 65, 73 (Nov. 1977) (prepared for the National Science Foundation, Grant No. APR-75-18247).

186. See Town of Fountain v. Pub. Util. Comm., 167 Colo. 302, 447 P.2d 527 (1968).

187. See K. Hillhouse, supra note 185, at 65.

188. See text accompanying notes 190-94 infra.

189. Western Colo. Power Co. v. Pub. Util. Comm., 163 Colo. 61, 69, 428 P.2d 922, 926-27 (1967). See also K. Hillhouse, supra note 185, at 73.

190. 167 Colo. 302, 447 P.2d 527 (1968).

191. Id. at 307, 447 P.2d at 529. See also Publ Util. Comm. v. Home Light and Power Co., 163 Colo. 72, 428 P.2d 928 (1967).

192. See text accompanying notes 196-97 infra.

193. See Pub. Serv. Co. of Colo. v. Pub. Util. Comm. 142 Colo. 135, 350 P.2d 543 (1960), cert. denied, Union Rural Elec. Assn. v. Pub. Serv. Co. of Colo., 364 U.S. 820 (1960). In this case, the Colorado Supreme Court recognized the authority of the PUC to grant extension rights to utilities for service to areas certified to other utilities if adequate service is not being provided and the public convenience and necessity so

requires. Id. at 151, 350 P.2d 551. See also Western Colo. Power Co. v. Pub. Util. Comm., 159 Colo. 262, 411 P.2d 785 (1966), appeal dismissed and cert. denied, 385 U.S.22, rehearing denied, 385 U.S. 984 (1966).

194. Pub. Serv. Co. of Colo. v. Pub. Util. Comm., 142 Colo. 135, 149, 350 P.2d 543, 550 (1960), cert. denied, Union Rural Elec. Assn. v. Pub. Serv. Co. of Colo., 364 U.S. 820 (1960), quoting, South Suburban Motor Coach Co. v. Levin 269 Ill. App. 323 (1934).

195. See K. Hillhouse, supra note 185, at 72.

196. 170 Colo. 556, EGO 463 P.2d 465, 467 (1970).

197. In the UMW case, Public Service Co. of Colorado applied for a certificate to construct the nuclear generating station at Ft. St. Vrain. The UMW contested the issuance of the certificate on the grounds that (1) there was a lack of evidence upon which the economic feasibility of the project could be determined and (2) the nuclear plant would constitute an undue risk to the health and safety of the general public. The Court stated that changes in technology, pollution regulations, and the cost of fuel may in the future make fossil-fueled plants economically unfeasible. The Court further stated that sufficient evidence existed in the record to support the PUC's finding that neither a fossil-fueled plant nor a nuclear plant had a measurable economic advantage over the other and that the proposed project was therefore economically feasible. Id. at 560-61, 463 P.2d at 467.

198. Colo. Rev. Stat. § 40-5-105 (1973) (emphasis added).

199. Pub. Util. Comm. v. Home Light & Power Co., 163 Colo. 72, 85, 428 P.2d 928 (1967).

200. See note 171 supra.

201. See K. Hillhouse, supra note 185 at 80.

202. See Colo. Rev. Stat. at § 40-3-101(1) requiring that all charges received by any public utility for any service rendered be just and reasonable.

203. See id. at § 40-3-101(2) wherein it is provided that utility service shall promote the public safety and in all respects be just and reasonable.

204. Id. at § 40-1-103.

205. See, e.g., Blue Ridge Elec. Membership Corp. v. Duke Power Co. 258 N.C. 278, 128 S.E.2d 405 (1962); Cass County Elec. Coop. v. Otter Tail Power Co. 93 N.W.2d 47 (N.D. 1958).

206. Western Colo. Power Co. v. Pub. Util. Comm., 163 Colo. 61, 69, 428 P.2d 922, 926-27 (1967).

207. See Pennsylvania Coal Co. v. Mahon, 260 U.S. 393 (1922).

208. See id. at 415.

209. Cal. Pub. Util. Code §§ 2801-16 (West Supp. 1978).

210. Id. at § 2802.

211. Id.

212. Id. at § 2812.5

213. Colo. Const. art. XX §§ 1,6.

214. Colo. Rev. Stat. § 31-15-707 (1973). See also text accompanying note 131 supra.

215. Public Service Co. v. City of Loveland, 79 Colo. 216, 245 P. 493 (1926).

216. A municipality could not purchase generating plants constructed for private use, or use outside the municipality. See Pikes Peak Power Co. v. City of Colorado Springs, 105 F. 1 (8th Cir. 1900). Moreover, where a franchise has been granted to a private company to provide electric service within a municipality, the electric power works cannot be condemned or purchased within twenty years after the granting of the franchise without the consent of the owner of the franchise. Colo. Rev. Stat. at § 31-15-707(a)(IV).

217. ____ Colo. ____, 567 P.2d 365 (1977).

218. Id. at ____, 567 P.2d at 367.

219. Id. at ____, 567 P.2d at 368.

220. Wilson, Jones, Morton, & Lynch, The Sun: A Municipal Utility Energy Source (1976) (prepared for the city of Santa Clara, California with the support of the Energy Research and Development Administration, Contract No. E(04-3)- 1083) [hereinafter cited as Municipal Energy Source].

221. U.S. Const. art. I § 10, cl. 1.

222. U.S. Const. amend, XIV § 1.

223. Larson v. South Dakota, 278 U.S. 429, 432 (1929).

224. Walla Walla City v. Walla Walla Water Co., 172 U.S. 1 (1898).

225. Madera Waterworks v. City of Madera, 228 U.S. 454, 456 (1913); Skaneateles Waterworks Co. v. Village of Skaneateles, 184 U.S. 354, 363 (1902).

226. City of El Paso v. Simmons, 379 U.S. 497, 508 (1965), rehearing denied, 30 U.S. 926 (1965), citing and quoting from Home Building & Loan Assn. v. Blaisdell, 290 U.S. 398, 434-35 (1934).

227. New Orleans Gal-Light Co. v. Louisiana Light Co., 115 U.S. 650 (1885).

228. See Larson v. South Dakota, 278 U.S. 429 (1929).

229. See Colo. Const. art. XX, §§ 1,6.

230. See Municipal Energy Source, supra note 220 at 4.

231. The rights granted in a municipal franchise have been held to constitute property rights entitled to protection by the Fourteenth Amendment. City of Los Angeles v. Los Angeles Gas & Elec. Corp., 251 U.S. 32, 39 (1919).

232. 115 U.S. 650, 671-72 (1885).

233. Puget Sound Power & Light Co. v. Seattle, 291 U.S. 619, 624 (1934).

234. See Grand Trunk Western Ry. Co. v. City of South Bend, 227 U.S. 544 (1913).

235. 317 U.S. 341, 351 (1943).

236. ____ U.S. ____, 98 S.Ct. 1123, 1137 (1978).

237. See E. Berlin, C. Cicchetti, & W. Gillen, Perspective on Power 157-63 (1974) (Appendix C). Appendix C of the publication provides an excellent summary of federal power agencies.

238. Under the Rural Electrification Program, the REA finances qualified cooperative associations for the purpose of providing generation, transmission, and distribution of electric power to rural residents not receiving central station service. See id.

239. Colo. Rev. Stat. §40-1-103(2) (1973).

240. Western Colo. Power Co. v. Pub. Util. Comm., 159 Colo. 262, 280, 411 P.2d 785, 794-95 (1966), appeal dismissed and cert. denied, 385 U.S. 22, rehearing denied, 385 U.S. 984 (1966).

241. U.S. Const., amend. X.

242. 421 U.S. 542, 547 n.7 (1975).

243. 426 U.S. 833, 842, 845 (1976).

244. Id. at 855.

245. But see Jackson v. Metropolitan Edison, Co., 419 U.S. 345 (1974), where state regulation by the PUC of a privately owned utility was not considered to be an attribute of state sovereignty.

246. See Colo. Rev. Stat. § 40-10-105 (1973) which provides in part that:

> The granting of any certificate of public convenience and necessity to operate a motor vehicle for hire for the transportation of property shall not be deemed to be an exclusive grant or monopoly, and the doctrine of regulated competition shall prevail. The Commission has authority to grant more than one certificate of public convenience and necessity to operate motor vehicles for the transportation of property over the same route or a part thereof or within the same territory or a part thereof if the commission finds that the present or future public convenience and necessity requires or will require such operation.

247. 185 Colo. 414, 431-32, 525 P.2d 443, 451-52 (1974).

248. Id. at 430-31, 525 P.2d at 451.

249. Wells Fargo Armored Service Corp. v. Pub. Util. Comm., _____, Colo. _____, 545 P.2d 707, 709 (1976).

250. Id.

251. Id. at ____, 545 P.2d at 709-10.

252. Id. at ____, 545 P.2d at 710.

253. See Miller Bros., Inc. v. Pub. Util. Comm., 185 Colo. 414, 435, 525 P.2d 443, 453 (1974).

254. Id.

255. It is possible to design solar systems with sufficient charging and storage capacity to eliminate the need for conventionally fueled auxiliary systems. However, the most common and economic designs include some form of auxiliary system. See generally B. Anderson, Solar Energy: Fundamentals in Building Design 235-40 (1977); G. Daniels, Solar Homes and Sun Heating 40-41 (1976); J. Duffie & W. Beckman, Solar Energy Thermal Processes 271 (1974).

256. Utility and Solar Interface, supra note 37, at 1.

257. B. Anderson supra note 255 at 235.

258. E.g., Wash. Rev. Code Ann. § 84.36.410 (Supp. 1977), wherein it is provided that "[s]olar] energy system means equipment which meets the minimum standards, if any, promulgated by the United States Department of Housing and Urban Development. . ." Id. at § 84.36.410 (1).

259. E.g., Atlanta, Ga. Heating, Ventilating, and Air Conditioning Code art. 24, § 2401.1 (1977). The code provides that "[s]olar system utilization shall be considered as bonus or auxiliary energy." It further states that "[a] primary heating, ventilating and air conditioning system which conforms to this Code shall be required with energy utilized such as electricity, gas, or oil." Id.

Also, the heating requirements of standard building codes may be difficult to satisfy by a solar system without the aid of a conventionally fueled auxiliary system. See, e.g., BOCA Basic Mechanical Code § M-108.1 (1975) (72 degrees in the winter assuming outside temperatures given in the ASHRAE Handbook of Fundamentals); ICBO Uniform Building Code §§ 1311, 1405 (1976) (70 degrees, three feet off the floor in habitable rooms of residential occupancies).

260. Interview with Woody Leigh, Chief Appraiser, Midland Federal Savings, in Denver, Colo. (July 1978). Mr. Leigh further indicated that additional constraints on loans to solar facilities may be imposed by secondary mortgage purchasers in the form of design and performance standards. The solar facility would be required to meet such standards before a secondary purchase could occur.

261. See HUD Report, supra note 32, ch. 6 at 14.

262. See Id. ch. 6 at 15.

263. See Id. ch. 6 at 19.

264. See 2 supra at note 50. See also 1 A. Kahn, the Economics of Regulation: Principles and Institutions 20-57 (1970); Jones, Judicial Determination of Public Utility Rates: A Critique, 54 B.U.L. Rev. 873, 875-94 (1974).

265. See Gainesville v. Gainesville Gas and Elec. Power Co., 65 Fla. 404, 62 So. 919, 921 (1913). Accord Iowa - Illinois Gas & Elec. Co. v. Birmingham, 66 F.Supp. 441 (S. D. Iowa 1946); Preston County Light and Power Co. v. Renick, 145 W. Va. 115, 113 S.E.2d 378 (1960 For police power justifications see, e.g., Florida Power & Light Co. v. City of Miami, 98 F.2d 180 (5th Cir. 1938) cert. denied, 305 U.S. 644 (1938); In re Niagara, Lockport & Ontario Power Co., 229 App. Div. 295, 241 N.Y.S. 162 (App. Div. 1930).

266. U.S. Const. art. I, § 8, cl. 3.

267. 1 A. Kahn, supra note 264, at 3, 20.

268. Id. at 20. See also 1 A. Priest, supra note 50, at 31.

269. J. Bonbright, supra note 50, at 11; 1 A. Kahn, supra note 264, at 11.

270. In re Application of the Long Acre Elec. Light and Power Co., 1 P.S.C.R. 226, 249-50 (1st Dist. New York Pub. Serv. Comm. 1908).

271. P. Garfield & W. Lovejoy, supra note 50, at 17-19. Decreasing average unit costs as output increases may be apparent for the short run; i.e. where technology and a time period are fixed and output is increased until physical plant capacity is reached. In the long run, though, the decreasing average unit cost trend, in many instances, has reversed. See, e.g., E. Berlin, C. Cicchetti, & W. Gillen, supra note 237, at 1-11; Brancato, New Approaches to Current Problems in Electric Utility Rate Design, 2 Colum. J. Envt'l L. 40, 46-47 (1975); Huntington, supra note 50, at 692; Samuelson, Battle Lines are Being Generated for Reform of Electric Utility Rates, 8 Nat'l J. 1474 (1976).

272. J. Bonbright, supra note 50, at 10; P. Garfield & W. Lovejoy, supra note 50, at 1, 16.

273. 1 A. Priest, supra note 50, at 1, 4; MacDonald v. FPC, 505 F.2d 355, 363 (D.C. Cir. 1974); P. Garfield & W. Lovejoy, supra note 50, at 16, 1 A. Kahn, supra note 264, at 21.

274. P. Garfield & W. Lovejoy, supra note 50, at 1.

275. Munn v. Illinois, 94 U.S. 113, 126 (1877).

276. See, e.g., Minneapolis & S. L. R. R v. Minnesota, 186 U.S. 257, 261 (1902); Wolff Packing Co. v. Court of Industrial Relations, 262 U.S. 522 (1923).

277. 169 U.S. 466 (1898).

278. Id. at 526.

279. Id.

280. FPC v. Hope Natural Gas Co., 320 U.S. 591, 603 (1944).

281. Bluefield Water Works & Improvement Co. v. Pub. Serv. Comm., 262 U.S. 679, 692-93 (1923); FPC v. Hope Natural Gas Co., 320 U.S. at 603.

282. 315 U.S. 575, 584 (1942).

283. P. Garfield & W. Lovejoy, supra note 264, at 44. Revenue requirement can be summarized by the following simple equation. Total cost of Service = Revenue Requirement (RR) = E + d + T + (V-D)R, where:

E	= Operating Expenses
d	= Depreciation Expenses
T	= Taxes
V	= Gross valuation of property serving the public
D	= Accrued Depreciation
V-D	= Rate Base (net valuation)
R	= Rate of Return (a percentage)
(V-D)R	= Fair Return or Earnings allowed on the rate base

Id. at 44-45.

284. J. Bonbright, supra note 50, at 292. See also 1 A. Priest, supra note 50, at 329.

285. P. Garfield & W. Lovejoy, supra note 50, at 145; 1 A. Kahn, supra note 264 at 54; 1 A. Priest, supra note 50, at 344.

286. DOE Organization Act, Pub. L. No. 95-91 § 401(a), 91 Stat. 565, 582 (1977).

287. 16 U.S.C. § 791a. et seq. (1976).

288. Pub. L. No. 95-91 at § 402(a)(1)(B), 95 Stat. 584.

289. 16 U.S.C. at § 824(b).

290. Id. at § 824(d).

291. Id. at § 824(c).

292. Pub. L. No. 95-617, 92 Stat. 3117 (1978).

293. 16 U.S.C. at § 824d(a).

294. Id. at § 824d(b).

295. St. Michaels Util. Comm. v. FPC, 377 F.2d 912, 915 (4th Cir. 1967).

296. See Railroad Comm. v. Los Angeles Ry. Corp., 280 U.S. 145, 151-52 (1929).

297. Iowa-Illinois Gas & Elec. Co. v. Birmingham, 66 F.Supp. 441, 442 (S.D. Iowa 1946).

298. E.g., Minnesota Rate Cases, 230 U.S. 352, 433 (1913); Colorado Interstate Gas Co. v. FPC, 324 U.S. 581, 589 (1945); rehearing denied, 325 U.S. 891 (1945).

299. E.g., Montana-Dakota Util. Co. v. Northwestern Pub. Serv. Co., 341 U.S. 246, 250-52 (1951); Cooper v. Tampa Elec. Co., 154 Fla. 410, 17 So.2d 785, 786-87 (1944).

300. See Smythe v. Ames, 169 U.S. 466, 526 (1898); Terminal R.R. Assn. v. United States, 266 U.S. 17, 30-31 (1924).

301. Pub. Util. Comm. of Rhode Island v. Attleboro Steam & Elec. Co., 273 U.S. 83 (1927).

302. See, e.g., N.Y. Pub. Serv. Law at § 5.1; Wis. Stat. Ann. § 196.02 (West 1957).

303. Colo. Rev. Stat. at § 40-1-103(1).

304. N.Y. Pub. Serv. Law at § 65; Wis. Stat. Ann. at §§ 196.01 to .03.

305. Colo. Const. art. XXV.

306. City of Lamar v. Town of Siley, 80 Colo. 18, 23, 248 P.1009, 101 (1926).

307. See generally Dean & Miller, supra note 72, at 345-50.

308. See, e.g., N.Y. Pub. Serv. Law § 65.1 (McKinney 1955); Wis. Stat. Ann § 196.03(1) (West 1957); Colo. Rev. stat. § 40-3-101(1) (1973).

309. Hawaii Rev. stat §§ 269-1, 27 (1976).

310. Id. at § 269-27.2(b).

311. Electric Utility Rate Design Study, Rate Design and Load Control 24 (Nov. 1977) (report to the National Association of Regulatory Utility Commissioners (NARUC) sponsored by the Electric Power Research Institute (EPRI), the Edison Electric Institute (EEI), the American Public Power Association (APPA), and the National Rural Electric Cooperative Association (NRECA) [hereinafter cited as Rate Design Study]. This report is a summary and evaluation of research done in 1976 and early 1977 by the Rate Design Study Group in the area of (1) technical feasibility of time-differentiated rates, (2) technical feasibility of direct load controls, and (3) desirability of time-differentiated rates, load controls, or both to control and shift peak period use. Some 49 reports have been or are in the process of being completed and address the three foresaid areas.

312. See J. Bonbright, supra note 50, at 355-56; 1 A. Kahn, supra note 264, at 79.

313. Rate Design Study, supra note 311 at 27.

314. J. Bonbright, supra note 50, at 318-19; 1 A. Kahn, supra note 264, at 65-67. For an excellent discussion of marginal-cost pricing as it applies to electric utility rate structures, see generally Huntington, supra note 50.

315. P. Garfield & W. Lovejoy, supra note 50 at 155. A declining block rate structure incorporating the customer charge would appear in the following form:

First 10 kWh or less	$3.00
Next 30 kWh	.045 per kWh
Next 60 kWh	.039 per kWh
Next 100 kWh	.027 per kWh
All over 200 kWh	.020 per kWh

316. See Strabala, Solar Energy: Cheaper or Not? Denver Post, Dec. 4, 1978, at 4, col. 1.

317. Increased public concern over environmental protection, a need to conserve natural resources, and steadily increasing utility bills has precipitated an extensive review of traditional rate-making practices. Since the early part of the century through the late 1960s, the electric utility industry was characterized by long- and short-run decreasing average costs due to economies of scale and technological development. This phenomenon justified the existence of declining block rate structures. Lately, much has been written indicating that, in general, long-run average costs for the electric utility industry have been increasing since the late 1960s or early 1970s. See, e.g., Huntington, supra note 264, at 692; Samuelson, Battle Lines are Being Generated for Reform of Electric Utility Rates, 8 Nat'l J. 1474 (1976).

Significant factors contributing to this trend reversal include (1) the rising cost of money to utilities for financing capital expenditures, (2) the rising cost of construction labor and materials, (3) the costs of necessary pollution control equipment, (4) rapidly escalating fuel costs, and (5) delays associated with newly constructed plants. Traditional declining block rates have been challenged as inconsistent with economic principles and as contrary to environmental and conservation goals. Alternative rate structures have been proposed or adopted as a result of these challenges and include flat, inverted, lifeline, demand, time-of-day (TOD), and interruptible rates.

318. P. Garfield & W. Lovejoy, supra note 50, at 154. For a legal and economic discussion of flat rates, see Aman & Howard, Natural Gas and Electric Utility Rate Reform: Taxation Through Rate Making?. 28 Hast. L. J. 1085, 1111-13 (1977).

319. A typical flat-rate structure contains a monthly customer charge of $1.40 and a flat energy charge of $.04194 per kWh. Commonwealth Edison Co., Residential Service Rate 1.

320. S. Elstein, State Initiatives for Electric Utility Rate Reform 5 (1978); see I. Stelzer, Rate Structure Revision: A Federal or State Problem, at Table C cols. 5-6 (1977) (National Economic Research Associates Rate Structure Revision Survey).

321. See I. Stelzer, supra at Table C cols. 5-6.

322. Re Potomac Electric Power Co., 3 P.U.R.4th 65 (D.C. Pub. Serv. Comm. 1974).

323. Consol. Edison Co., Case 26309, 13 N.Y.P.S.C. 1491, 1528 (1973).

324. A typical inverted rate structure appears as follows:

Customer Service Charge	$2.50
First 500 kWh	.0385 per kWh
Next 500 kWh	.0415 per kWh
All over 1000 kWh	.0445 per kWh

Detroit Edison Co., Residential Electric Service, Domestic, Schedule D1.

For a legal and economic discussion of inverted rates, see Aman & Howard, supra note 318, at 1107-11.

325. See Mann, Rate Structure Alternatives for Electricity, 99 Pub. Util. Fort., Jan. 20, 1977, at 31 (issue no. 2); S. Elstein, supra note 320 at 5.

326. S. Elstein, supra note 320, at 5.

327. I. Stelzer, supra note 320, at C-3,4.

328. Re Virginia Electric & Power Co., 95 P.U.R.3d 281 (Va. St. Corp. Comm. 1972). The revised rates appeared as follows:

First 90 kWh	$.05490 per kWh
Next 120 kWh	.02797 per kWh
Next 390 kWh	.01787 per kWh
All over 600 kWh	.02197 per kWh

329. I. Stelzer, supra note 320, at C-3, 9, 11.

330. Rate Design Study, supra note 311, at 40. For a legal and economic discussion of lifeline rates, see Aman & Howard, supra note 318, at 1113-16.

331. S. Elstein, supra note 320, at 10.

332. Id. citing J. Pace, Lifeline Rates and Energy Stamps (1975) (National Economic Research Associates). See also Environmental Law Institute, Lifeline Rates — Are They Useful? (Jan. 1976) (Energy Conservation Project Report No. 4); Howe, Lifeline Rates — Benefits for Whom?, 97 Pub. Util. Fort., Jan 29, 1976, at 22 (issue no. 3).

333. Francfort & Woo, Lifeline and Incremental Cost Residential Electric Rates, 99 Pub. Util. Fort., Feb. 17, 1977 at 166 (issue no. 4).

334. I. Stelzer, supra note 320, at C-3, 11.

335. Id. at C-5.

336. Id. at C-1.

337. Colo. Rev. Stat. § 40-3-106(1)(1973).

338. Id. at § 40-3-102.

339. Mountain States Legal Foundation v. Pub. Util. Comm., ______ Colo. ______, p.2d ____, Dec. No. 28151, at 7 (1978).

340. Id. For similar results in other jurisdictions see re Consol. Edison Co. of N.Y., 85 P.U.R.3d 276, 296-7 (N.Y. Pub. Serv. Comm. 1970); Pennsylvania Pub. Util. Comm. v. Philadelphia Elec. Co., 91 P.U.R. 3d 321, 372 (Penn. Pub. Util. Comm. 1971); re Pub. Serv. Co. of N.H., 95 P.U.R.3d 401, 448 (N.H. Pub. Util. Comm. 1972); re Rate Concessions to Poor Persons and Senior Citizens, 14 P.U.R.4th 87,92 (Ore. Pub. Util. Comm. 1976).

341. Cal. Pub. Util. Code § 739 (West 1975 & Supp. 1978).

342. Id. at § 739(a).

343. Re Mont.-Dak. Util. Co., 21 P.U.R.4th 1, 29-30 (S.D. Pub. Util. Comm. 1977).

344. Id. But see the arguments opposing social rate making in Ranniger, Electric Rates — Where We Have Been, Where We Are Going, 99 Pub. Util. Fort., May 12, 1977, at 29 (issue no. 10). Ranniger states that the problems encountered in the various lifeline proposals are:

(1) The benefits of lifeline proposals cannot administratively be isolated to the poor or elderly.
(2) Lifeline rates fail to benefit a significant proportion of the poor due to their unique situations or patterns of consumption.
(3) Lifeline proposals, instead of conserving energy, may actually stimulate greater consumption since most of the schemes reduce bills for customers who use considerably more than the minimum.
(4) Redistribution of income is more properly a government function than a utility function.
(5) Lifeline rates run counter to one of the current emphases in rate design, that of covering all costs incurred in producing and delivering energy.
(6) Proposals for recovering lost revenues as a result of lowering rates for minimum necessary use are fraught with difficulties and inequities.

Id. at 33.

345. P. Garfield & W. Lovejoy, supra note 50, at 156; Public Service Co. of Colo., Residential Demand Service, Schedule RD-1 (Effective Aug. 23, 1978). This rate is optional and applicable to residential service where electric heating is the principal source of heat or the primary back-up source to another form of heat. The rate contains the following charges:

Demand Charge:	
First kW of billing demand or less	$7.50
All over 1 kW of billing demand, per kW	3.20
Energy Charge:	
All kWh used, per kWh	.01001

346. P. Garfield & W. Lovejoy, supra note 50, at 157. Load factor is an indication of the average use of facilities as a percentage of the maximum use or the ration of average power to peak power for a given period. For example, if a utility system during a given 24-hour period supplied customers with a total of 168,000 kWh of energy and

recorded a peak demand during that period of 10,000 kW, the load factor for that period would be 70%, i.e., (168,000/24)/10,000=.70. An individual customer's load factor can be similarly calculated.

347. Re Customers of Cambridge Elec. Light Co., P.U.R. 1933D, 113, 117-18 (Mass. Dept. of Pub. Util. 193).

348. Antioch Milling Co. v. Pub. Serv. Co. of Northern Ill., 4 Ill. 2d 200, 123 N.E. 2d 302, 306.

349. Re Pub. Serv. Co. of N.H., 27 P.U.R. 2d 113, 126 (N.H. Pub. Sev. Comm. 1959).

350. Peak-load pricing is discussed generally in E. Berlin, C. Cicchetti & W. Gillen, supra note 237, at 29-51; Grainger, A Practical Approach to Peak-Load Pricing, 98 Pub. Util. Fort. Sept. 9, 1976, at 19 (issue no. 6); Mann, supra note 325, at 31-32; Task Force No. 1, The Development of a framework for Peak-Load Pricing Appropriate to the United States 1-74 in Analysis of Various Pricing Approaches: Topic 1 (Feb. 1977) (prepared for the Elecric Utility Rate Design Study, available from EPRI); Teed, A Practitioner Looks at Peak-Load Pricing, 97n Pub. Util. Fort., Jan. 29, 1976, at 26 (issue no. 3); Wenders, The Misapplication of the Theory of Peak-Load Pricing to the Electric Utility Industry, 96 Pub. Util. Fort., Dec. 4, 1975, at 22 (issue no 12). See also Huntington, supra note 264, at 723-25. A shift from traditional pricing policies and rates to peak load pricing was strongly recommended in Energy Policy Project of the Ford Foundation, A Time to Choose 257-60, 328, 340 (1974).

351. Mann, supra note 325, at 32.

352. E. Berlin, C. Cicchetti & W. Gillen, supra note 237, at 29-30, 46; Huntington, supra note 50, at 723, 735.

353. 1 A. Kahn, supra note 264, at 69-70; Sherry, Cutting the Marginalists Gordian Knot, 99 Pub. Util. Fort., Feb. 17, 1977, at 21 (issue no. 4). The problem of second best, where substitute goods or services are priced below marginal costs is considered in Huntington, supra note 50, at 747-49; 1 A. Kahn, supra note 264, at 195-99. See also E. Berlin, C. Cicchetti & W. Gillen, supra note 237, at 40-46, 127, 132 (Appendix B, Some Mathematics of Public Utility Pricing: A Synthesis of Marginal-Cost Pricing, Regulatory Constraints, Averch-Johnson Bias, and Peak-Load Pricing and Block Pricing) also published as Cicchetti & Jurewitz, Public Utility Pricing: A Synthesis of Marginal Cost, Regulatory Constraints, Averch-Johnson Bias, Peak-Load and Block Pricing, in Studies in Electric Utility Regulation 89 (Cicchetti & Jurewitz eds. 1975). See also Aman & Howard, supra note 318, at 1094-95; Huntington, supra note 264, at 722, 723, 738-41.

Meter availability for small volume commercial and residential customers is a significant problem. See Cicchetti, The Design of Electricity Tariffs, 96 Pub. Util. Fort., Aug. 28, 1975, at 25, 31 (issue no. 5). Depending upon the type of TOD rate structure employed, meters designed to measure kWh consumption at different periods or a combination of off- and on-peak demand and energy consumption cost from $44 to $140 for single phase service. Rate Design Study, supra note 311, at 68-72. More sophisticated meters can cost upwards of $300. Id.

354. For a general discussion of the legality of marginal-cost pricing in light of claims of undue discrimination, see generally Kadane, The Legality of Marginal-Cost Pricing for Utility Service, 5 Hofstra L. Rev. 755 (1977).

355. New York Council of Retail Merchants v. Pub. Serv. Comm., 404 N.Y.S.2d 899 (App. Div. 1978).

356. 5 P.U.R.4th 28 (Wis. Pub. Serv. Comm. 1974). For an in-depth discussion of the case, see generally Cudahy and Malko, Electric Peak-Load Pricing: Madison Gas and Beyond, 47 Wis. L. Rev. 47 (1976); Huntington, supra note 264 at 749-50; Note, Reform of Electricity Pricing in the United States, 25 Buff. L. Rev. 183, 196-209 (1975).

357. 5 P.U.R. 4th.

358. See I. Stelzer, supra note 320, at Table C cols. 7-8.

359. Rate Design Study, supra note 311, at 39.

360. Dean & Miller, supra note 72, at 343.

361. Rate Design study, supra note 311, at 39.

362. Utility and Solar Interface, supra note 37, at 155.

363. Id.

364. 77 S.W.2d 1091 (Tex. Ct. App. 1934).

365. Id. at 1094.

366. Illinois Coal Operators' Assn. v. The Peoples Gas, Light & Coke Co., 7 P.U.R.(n.s.) 403, 405 (Ill. Commerce Comm. 1934).

367. Id. at 416-17.

368. In re Proposed Increased Rates and Charges Contained in Tariff Revisions Filed by Pub. Serv. Co. of Colo., Decision No. 87640 (Colo. Pub. Util. Comm., Oct. 21, 1975).

369. Testimony of James H. Ranniger, Manager of Rates and Regulations, Pub. Serv. Co. of Colo., Investigation and Suspension Docket No. 935, Exhibit No. 36 at 14 (Sept. 22, 1975).

370. Testimony of Dr. Ernst Habict, Jr. and Dr. William Vickrey for the Environmental Defense Fund before the Colo. Pub. Util. Comm. Investigation and Suspension Docket No. 935 (Sept. 22, 1975).

371. Home Builders Assn. of Metropolitan Denver v. Pub. Serv. Co. of Colo., Case 5675 (Colo. Pub. Util. Comm., April 5, 1976).

372. In re Investigation of Residential Demand Rates of Pub. Serv. Co. of Colo., Case No. 5685, Decision No. 88822 (Colo. Pub. Util. Comm., May 25, 1976).

373. Testimony of W. J. Gillen and D. J. Frey for the Environmental Defense Fund and the Architect's Group, Home Builders Assn. of Metropolitan Denver v. Pub. Serv. Co. of Colo., Cases No. 5675, 5685, Decision No. 89573, Exhibits 25, 26 (Colo. Pub. Util. Comm., Oct. 26, 1976).

374. Cases No. 5675, 5685, Decision No. 89573 at 6.

375 Pub. Serv. Co. of Colo., Residential Demand Service, Schedule RD-1 (Effective Aug. 23, 1978). The rate is applicable to overhead residential service where electric heating is the principal source of heat or the primary back-up source to another form of heat. The applicable charges are:

Demand Charge:	
1st kW of Billing Demand or less	$7.50
All over 1 kW of Billing Demands	$3.20 per kWh
Energy Charge:	
All kWh	$0.01001 per kWh

376. Pub. Serv. Co. of Colo., Residential Heating Service, Schedule RH-1 (Effective Aug. 23, 1978). The rate is applicable to overhead residential service where electric heating is the principal source of heat or the primary back-up source to another form of heat. The applicable charges are:

First 200 kWh or less	$9.46
Next 800 kWh	$0.03995 per kWh
All over 1,000 kWh	$0.02772 per kWh

377. Pub. Serv. Co. of Colo., General Residential Service, Schedule R-1 (Effective Aug. 23, 1978). The rate is applicable to overhead residential service except where electric heating is the principal source of heat or the primary back-up source of heat to another form of heat. The applicable charges are:

First 30 kWh or less	$1.72
Next 70 kWh	$0.04317 per kWh
Next 900 kWh	$0.03467 per kWh
All over 1,000 kWh	$0.02409

378. The cost comparison has been liberally adapted from that provided in Mills, Demand Electric Rates: A New Problem & Challenge for Solar Heating, 19 Am. Soc'y Heating, Refrig. & Air Conditioning Eng. J., January 1977, at 43 (issue no. 1). The rates used in the comparison have been updated to those in effect during the fall of 1978.

379. Btu (British thermal unit) is a unit of work or energy and is defined as the quantity of heat required to raise the temperature of 1 lb. (mass) of water from 63° F to 64° F. 1 Btu = 778.3 ft 1 lb. = 1,055 J = 2.931×10^{-4} kWh.

380. Mills, *supra* note 378, at 42.

381. *Id.*

382. Mountain Fuel Supply Co., Firm Standby Service, Schedule F-3 (Effective April 5, 1978). The rate is applicable to natural gas service for residential, commercial, or industrial use at one point of delivery where such use acts as a standby to the use of other fuels or other forms of energy. The applicable charges are:

Initial Charge:	$97.90 per year payable in monthly installments of $8.16 per month.

Demand Charge:	\$39.44 per year per 1,000 ft^3 or fraction thereof of maximum daily input rating of gas-fired equipment payable in equal monthly installments.
Commodity Charge:	All gas at \$1.212 per 1,000 ft^3

383. In subsequent communications, however, company representatives indicated that the standby service rate was not intended to be applicable to residential solar customers.

384. Mountain Fuel Supply Co., General Service, Schedule GS-1 (Effective April 5, 1978). The rate is applicable to natural gas service for residential, commercial, or industrial uses at one point of delivery and includes heating of large buildings not eligible for high-load factor or interruptible rates. The applicable charges are:

Monthly Minimum		\$4.30 (Winter Only)
Continuous Service Credit		\$1.00 (Winter Only)

	(November-May)	(June-October)
First 200 ft^3	\$4.30	\$0.140548/100 ft^3
Next 1,800 ft^3	\$0.197004/100 ft^3	\$0.140548/100 ft^3
Next 3,000 ft^3	\$0.169399/100 ft^3	\$0.140548/100 ft^3
Next 45,000 ft^3	\$0.140548/100 ft^3	\$0.129524/100 ft^3
Over 50,000 ft^3	\$0.139413/100 ft^3	\$0.128422/100 ft^3

385. Columbia, Mo., Ordinance 7563 (Sept. 6, 1977).

386. Id. at exhibit A.

387. The Columbia, Mo., residential service rate applies to all customers where service is supplied to a residential dwelling unit. The charges are:

Monthly Minimum \$2.97
First 40 kWh \$0.07353 per kWh
Next 60 kWh \$0.04668 per kWh
Next 900 kWh \$0.03510 per kWh
Over 1,000 kWh \$0.02878 per kWh

Except where the customer has permanently installed in a domestic area a minimum of five kW of utility-approved electric space-heating equipment which is the sole source of comfort space heating, the rate shall be \$0.0283 per kWh for all kWh over 850 kWh for seven consecutive months beginning in November. Columbia, Mo., Rev. Ordinances ch. 15, art. V. § 15,550 (1978).

388. The additional advance service deposit and prohibition of application of promotional all-electric rates imposed upon solar customers were removed by the city early in 1978.

389. Southwestern Tel. & Tel. Co. v. Danaher, 238 U.S. 482, 490 (1915); Union Light, Heat, & Power Co. v. Mulligan, 197 S.W. 1081. In Union, the Kentucky Ct. of Appeals, while recognizing the general rule, further held that the rule permitting a utility to require the deposit does not permit it to hold the consumer's money without paying interest thereon. Id. at 1085.

390. Wickenburg v. Sabin, 68 Ariz. 75, 200 P.2d 342, 344 (1948). Accord, Barriger v. Louisville Gas & Elec. Co., 196 Ky. 268, 244 S.W. 690 (1922).

391. See Mo. Ann. Stat. §§ 386.020, 386.250 (Vernon Supp. 1978).

392. BAH Report, supra note 75, ch. VI at 1-9.

393. Id. ch. VI at 3-4.

394. Id. ch. VI at 5.

395. Id. ch. VI at 6.

396. Id. ch. VI at 7-8.

397. Id. ch. VI at 8-9.

398. Id. ch. VI at 9.

399. S. Feldman & B. Anderson, supra note 73 at 87; Utility and Solar Interface, supra note 37, at 51, 148-49.

400. Dickson, Eichen, & Feldman, Solar Energy and U.S. Public Utilities, 5 Energy Policy, Sept. 1977, at 195, 202-03 (issue No. 3); Utility and Solar Interface, supra note 37 at 55.

401. See Dickson, Eichen, & Feldman, supra at 203, Table 4-5; Utility and Solar Interface, supra note 37, at 56.

402. H. Lorsch, supra note 73, ch. 9 at 1.

403 See id. ch. VI at 10-15; S. Feldman & B. Anderson, supra note 73, at 118; Utility and Solal Interface, supra note 37, at 58.

404. Koger, Regulatory Constraints on Solar Energy and Thermal Storage Installations, 101 Pub. Util. Fort., Jan. 19, 1978, at 9, 11 (issue no. 2).

405. Id.

406. S. Feldman & B. Anderson, supra note 73, at 118-19.

407. H. Lorsch, supra note 73, ch. 8 at 15.

408. See Jones, supra note 1, ch. IV, at 16-18; Koger, supra note 404, at 11. See generally Feldman & Anderson, Financial Incentives for the Adoption of Solar Energy Design: Peak-Load Pricing of Back-Up Systems, 17 Solar Energy 339 (April 1975) [hereinafter cited as Financial Incentives].

409. Findings of Fact and Order, Dockets 6630-ER-2, 6630-ER-5 at 19-20 (Wis. Pub. Serv. Comm. 1978).

410. The supply of auxiliary electricity to solar-equipped buildings does not necessarily always affect the utility's operating characteristics adversely because potential benefits

can also accrue. These potential benefits include (1) incremental utility fuel savings, (2) plant capacity displacement, and (3) more efficient management of utility loads. Dickson, Eichen, & Feldman, supra not 400, at 196. Contra D. Spencer, Solar Energy: A View from an Electric Utility Standpoint 10 (presented at the American Power Conference, Chicago, Ill., Apr. 21-23, 1975) (Solar Systems may not result in capacity savings).

411. See generally OTA Report, supra note 2, at 151-59.

412. Id. at 151.

413. Id. at 156-57.

414. BAH Report, supra note 75, ch. I at 5, ch. VI at 2.

415. H. Lorsch, supra note 73, ch. 1 at 3-6.

416. S. Feldman & B. Anderson, supra note 73.

417. Id. at 83, 85.

418. Id. at 97, 99.

419. Id. app. H at 7, app. J at 6. The Feldman and Anderson investigation was continued with the objective to perform a systematic evaluation to determine an optimum peak mitigating solar building design. See S. Feldman, B. Anderson, R. Wirthshafter, M. Abrash, C. Carter, P. Sullivan, J. Kohler, & J. Breeze, The Impact of Active and Passive Solar Building Designs on Utility Peak Loads (Sept. 30, 1977) (interim report to the Energy Research and Development Administration, Division of Solar Energy, Contract No. EG-77-G-01-4029).

Preliminary results indicate that (1) on the average, solar collectors do reduce peak demands of buildings, (2) a solar building does not demand the same peak energy as a nonsolar building, (3) increases in building, and (4) the difference in demand between an active solar building and a passive solar building is relatively slight. Id. at 45, 46.

420. Energy Rate Initiatives, supra note 63, at 51 citing C. Peterson, Use of Off-Peak Electric Energy to Alleviate Peak Load Problems of Solar Space and Water Heating Systems (unpublished).

421. See generally EPRI, Solar Homes: The Winning Combination, 3 EPRI Journal, Mar. 1978, at 6-13 (issue No.2); S. Robinson, Solar and Utilities: An Example in Cooperation, Solar Age, Dec. 1978, at 20-23.

422. E.g., State ex rel. North Carolina Util. Comm. v. City of Wilson, 252 N.C. 640, 114 S.E.2d 786, 791 (1960); F.&R. Laxarus & Co. v. Pub. Util. Comm., 162 Ohio St. 223, 122 N.E.2d 783, 786 P.U.R. 3d 313, 317 (1954). For a general discussion of rate discrimination, see Dean and Miller, supra note 72, at 333-37; 1 A. Priest, supra note 50, at 285-326.

423. Citizens Util. Co. v. Ill. Commerce Comm., 50 Ill.2d 35, 276 N.E.2d 330, 336 (1971).

424. Hicks v. City of Monroe Util. Comm., 237 La. 348, 112 So.2d 635, 644, 29 P.U.R.3d 275, 285 (1959).

425. See, e.g., Louisiana v. FPC, 503 F.2d 844 (5th Cir. 1974) wherein the court stated that the "FPC could assist the court if it would define what it believes is meant by the phrases 'undue preference or advantage' and 'undue prejudice or disadvantage' . . . ." Id. at 864. See generally Permian Basis Area Rate Cases, 390 U.S. 747, 790-92 (1968); 1 A. Priest, supra note 50, at 288-89.

426. 246 S.W.2d 622, 624 (1952).

427. Unlike many other states, Louisiana has no statute applicable statewide that prohibits unreasonable discrimination in rate making by a utility. The courts in Louisiana, though, have jurisprudentially adopted the general rule that a utility's rate structure must be nondiscriminatory. State ex rel. Guste v. Council of New Orleans, 309 So.2d 290, 294, 9 P.U.R.4th 353, 357 (La. 1975), cert. denied, Craft v. Louisiana, 423 U.S. 1075 (1976).

428. N.Y Pub. Serv. Law § 65.2 (McKinney 1955).

429. Id. at § 65.3.

430. Id. at § 65.5. See also Hayes v. Niagara Mohawk Power Corp., 63 Misc.2d 581, 312 N.Y.S.2d 436, 437-38 (Sup. Ct. 1970), rev'd on other grounds, 35 App. Div.2d 1072, 316 N.Y.S.2d 520 (App. Div. 1970), aff'd, 30 N.Y.2d 579, 330 N.Y.S.2d 795 (1972); 50 App. Div.2d 338, 377 N.Y.S.2d 671 (App. Div. 1975), aff'd 40 N.Y.2d 1047, 392 N.Y.S.2d 239, 360 N.E. 918 (1976).

431. Colo. Rev. Stat. § 40-3-106 (1973).

432. Lamar Alfalfa Milling Co. v. Lamar, Case No. 1597, Decision No. 8549 (Colo. Pub. Util. Comm. 1036).

433. School Dist. No. 47 v. Lakewood Sanitation Dist., 68 P.U.R.(n.s.) 385, 393 (Colo. Pub. Util. Comm. 1947).

434. 1 A. Priest, supra note 50, at 288.

435. See, e.g., Pittsburgh v. Pub. Util. Comm., 78 A.2d 35, 38 (1951); General Motors Corp. v. Pub. Util. Comm., 47 Ohio St.2d 58, 351 N.E.2d 183, 189 (1976); Chicago Bd. of Trade v. United States, 223 F.2d 348, 354, 9 P.U.R.2d 475, 482 (D.C. Cir. 1955).

436. See Smith v. Southern Union Gas Co., 58 N.M. 197, 269 P.2d 745, 747-48 (1954); Ten Ten Lincoln Place, Inc. v. Consolidated Edison Co., 273 App. Div. 903, 77 N.Y.S.2d 168, 168 (App. Div. 1948).

437. See, e.g., Smith v. Pub. Serv. Comm., 351 S.W.2d 768, 772 43 P.U.R.3d 43, 47 (Mo. 1961). See also 1 A. Priest, supra note 50, at 324-25.

438. E.g., Hicks v. City of Monroe Util. Comm., 237 La. 848, 112 So.2d 635, 644, 29 P.U.R.3d 275, 285 (1959).

439. Jager v. State, 537 P.2d 1100, 1109 (Alaska 1975).

440. E.g., Cleveland Elec. Illuminating Co. v. Pub. Util. Comm., 42 Ohio St.2d 403, 330 N.E.2d 1, 18-19 (1975); Penn. Pub. Util. Comm. v. Metropolitan Edison Co., 86 P.U.R.3d 163, 195-96 (Penn. Pub. Util. Comm. 1970).

441. Ill. Ann. Stat. ch. 111 2/3, § 38 (Smith-Hurd 1966). The statute provides inter alia that:

> No public utility shall, as to rates or other charges, service, facilities, or in other respect, make or grant any preference or advantage to any corporation or person or subject any corporation or person to any prejudice or disadvantage. No public utility shall establish or maintain any unreasonable difference as to rates or other charges, services, facilities, or in any respect, either as between localities or as between classes or service.

442. Ill. Ann. Stat. ch. 111 2/3, § 38 (Smith-Hurd Supp. 1978) (amended by P.A. 80-431, § 1, effective Aug. 30, 1977)(emphasis added).

443. Promotional activities for the purpose of stimulating business have been declared nondiscriminatory and upheld in many jurisdictions. See, e.g., Re Promotional Practices of Elec. and Gas Util., 65 P.U.R.3d 405 (Conn. Pub. Util. Comm. 1966); Re Delaware Power & Light Co., 56 P.U.R.3d 1 (Del. Pub. Serv. Comm. 1964); Rossi v. Garton, 88 N.J. Super. 233, 211 A.2d 806, 60 P.U.R.3d 210 (N.J. Super. Ct. App. Div. 1965); Gifford v. Central Maine Power Co., 217 A.2d 200, 63 P.U.R.3d 208 (Me. 1966); In re City Ice & Fuel Co., 260 App. Div. 537, 23 N.Y.S.2d 376, 37 P.U.R.(n.s.) 218 (App. Div. 1940); Re Promotional Activities by Gas and Elec. Corps., 68 P.U.R.3d 162 (N.Y. Pub. Serv. Comm. 1967); Watkins v. Atlantic City Electric Co., 67 P.U.R.3d 483 (N.J. Bd. of Pub. Util. Comm'rs 1967); Virginia State Corp. Comm. v. Appalachian Power Co., 65 P.U.R. 3d 283 (Va. Corp. Comm. 1966). See also State v. Oklahoma Gas and Elec. Co., 536 P.2d 887, 9 P.U.R.4th 369 (Okla. Sup. Ct. 1975).

444. 88 N.J. Super. 233, 236, 211 A.2d 806, 808, 60 P.U.R.3d 210, 212, (N.J. Super. Ct. App. Div. 1965).

445. Id.

446. 217 A.2d 200, 63 P.U.R.3d 208 (Me. 1966).

447. Id. at 203, 63 P.U.R.3d at 212.

448. 536 P.2d 887, 896, 9 P.U.R.4th 369, 380 (Okla. Sup. Ct. 1975).

449. See, e.g., McBride & Son Builders, Inc. v. Union Electric Co., 526 S.W.2d 310 (Me. Sup. Ct. 1975); Re Southwest Gas Corp., 61 P.U.R.3d 467 (Cal. Pub. Util. Comm. 1965); Re Carolina Power & Light Co., 52 P.U.R.3d 561 (N.C. Util. Comm. 1964); Re Portland General Elec. Co., 67 P.U.R.3d 417 (Ore. Pub. Util. Comm. 1967); Re Duke Power Co., 54 P.U.R.3d 574 (N.C. Util. Comm. 1964); Suburban Md. Home Builders Assn. v. Potomac Elec. Power Co., 72 P.U.R.3d 282 (Md. Pub. Serv. Comm. 1968).

450. Suburban Md. Home Builders Assn. v. Potomac Electric Power Co., 72 P.U.R.3d 282 (Md. Pub. Serv. Comm. 1968).

451. Id. at 289.

452. McBride & Son Builders, Inc. v. Union Electric Co., 526 S.W.2d 310, 313 (Me. Sup. Ct. 1975).

453. See, e.g., Re Pacific Power & Light Co., 69 P.U.R.3d 367, (Idaho Pub. Util. Comm. 1967); In re Application of Mich. Consol. Gas Co. for Authorization of a Program for the Conservation of Natural Gas, 1 P.U.R.4th 229 (Mich. Pub. Util Comm. 1973).

454. See, e.g., Nat'l Swimming Pool Inst. v. Kahn, 80 Misc.2d 655, 364 N.Y.S.2d 747, 9 P.U.R.4th 237 (Sup. Ct. 1975); Leroy Fantasies, Inc. v. Swidler, 44 App. Div.2d 266, 354 N.Y.S.2d 182, 4 P.U.R.4th 334 (App. Div. 1974); Colo. Pub. Util. Comm., Decision No. 87640 (October 21, 1975).

455. Pub. Serv. Comm. of N.Y. v. FPC, 516 F.2d 746, 749, 10 P.U.R.4th 478, 480 (D.C. Cir. 1975).

456. See Dean and Miller supra note 72, at 336-37. See also D. Zillman, supra note 79, at 217-22.

457. Otter Tail Power Co. v. United States, 410 U.S. 366, 372-75 (1973).

458. Id. at 377-79.

459. Cantor v. Detroit Edison Co., 382 F. supp. 1110 (E.D. Mich. 1974), aff'd 513 F.2d 630 (6th Cir. 1975)(affirmed without published opinion), rev'd, 428 U.S. 579 (1976).

460. City of Lafayette, Louisiana v. Louisiana Power & Light Co., 532 F.2d 431 (5th Cir. 1976), aff'd, ____ U.S. ____, 98 S.Ct. 1123 (1978).

461. See Parker v. Brown, 317 U.S. 341 (1943).

462. U.S. Const. amend. XIV § 1.

463. See, e.g., Burton v. Wilmington Parking Auth., 365 U.S. 715 (1961); Shelly v. Kraemer, 334 U.S. 1 (1948).

464. 419 U.S. 345 (1974).

465. Id. at 357.

466. Id. at 351.

467. Id. at 358.

468. Public Utility Commission v. Pollak, 343 U.S. 451 (1952).

469. Georgia Power Project v. Georgia Power Co., 409 F. Supp. 332, 338 (N.D. Ga. 1975). Accord, Georgia Power Co. v. Allied Chemical Corp., 233 Ga. 558, 212 S.E.2d 628, 631 (1975).

470. See, e.g., Allied Chemical Corp. v. Georgia Power Co., 236 Ga. 548, 224 S.E.2d 396, 399 (1976).

471. See, e.g., Wood v. Public Utilities Commission, 4 Cal.3d 288, 481 P.2d 823, 93 Cal. Rptr. 455, 83 P.U.R.3d 494 (1971), citing e.g. Rinaldi v. Yeager, 384 U.S. 305 (1966); Dandridge v. Williams, 397 U.S. 471 (1970).

472. I. Stelzer, supra note 320, at 10.

473. E.g., California, Colorado, Massachusetts, Pennsylvania, and Rhode Island are studying the feasibility of rates for alternative energy users. See id. at D-1, 4, 8.

474. Interview with Richard Darwin, National Regulatory Research Institute (NRRI), Columbus, Ohio (July 24, 1978). Mr. Darwin indicated that NRRI was currently conducting an investigation for the Federal Government of existing solar rates.

475. Id. at D-1.

476. Id. at D-3.

477. Id.

478. Id. at D-4.

479. Id. at D-5.

480. Id. at D-6.

481. Id. at D-7.

482. Id. at D-8.

483. Orange and Rockland Utilities, Inc., Service Classification No. 7 (issued Oct. 7, 1977). The applicable charges are:

	Summer Months (June-September)	Other Months (October-May)
First 13 kWh or less	$4.07	$4.07
Next 47 kWh	$0.0845 per kWh	$0.0845 per kWh
Next 70 kWh	$0.0739 per kWh	$0.0739 per kWh
Next 370 kWh	$0.0739 per kWh	$0.0651 per kWh
Next 500 kWh	$0.0709 per kWh	$0.0509 per kWh
Next 1,000 kWh	$0.0709 per kWh	$0.0386 per kWh

The above charges were effective June 1, 1978.

484. Orange and Rockland Utilities, Inc. Service Classification No. 1, Residential Service With Elec. Space and Water Heating (effective June 1, 1978). The applicable charges are:

	Summer Months (June-September)	Other Months October-May
First 13 kWh or less	$4.07	$4.07
Next 47 kWh	$0.0845 per kWh	$0.0845 per kWh
Next 70 kWh	$0.0739 per kWh	$0.0739 per kWh
Next 370 kWh	$0.0739 per kWh	$0.0651 per kWh
Next 500 kWh	$0.0509 per kWh	$0.0509 per kWh
Over 1,000 kWh	$0.0709 per kWh	$0.0386 per kWh

485. Orange and Rockland Utilities, Inc., Service Classification No. 1, General Residential Service (effective June 1, 1978). The applicable charges are:

	Summer Months (June-September)	Other Months (October-May)
First 13 kWh or less	$4.07	$4.07
Next 47 kWh	$0.0845 per kWh	$0.0845 per kWh
Next 70 kWh	$0.0739 per kWh	$0.0739 per kWh
Next 370 kWh	$0.0739 per kWh	$0.0739 per kWh
Next 500 kWh	$0.0709 per kWh	$0.0651 per kWh
Over 1,000 kWh	$0.0709 per kWh	$0.0621 per kWh

486. Duke Power Co., General Service All-Electric/Solar, Schedule RAX (NC&SC) (effective Sept. 1, 1978). The applicable charges are:

	North Carolina	South Carolina
Basic Facilities Charge	$4.30	$4.30
First 350 kWh	$0.0288 per kWh	$0.0314 per kWh
Next 950 kWh	$0.0348 per kWh	$0.0374 per kWh
Next 200 kWh	$0.0311 per kWh	$0.0337 per kWh
All over 1,500 kWh	$0.0259 per kWh	$0.0285 per kWh

487. Duke Power Co., Residential Service All-Electric, Schedule RA (NC&SC)(effective Sept. 1, 1978). The applicable charges are provided supra at note 476.

488. Duke Power Co., General Residential Service, Schedule R (NC&SC)(effective Sept. 1, 1978). The applicable charges are:

	North Carolina	South Carolina
Basic Facilities Charge	$4.30	$4.30
First 350 kWh	$0.0288 per kWh	$0.0314 per kWh
Next 950 kWh	$0.0444 per kWh	$0.0470 per kWh
Next 200 kWh	$0.0420 per kWh	$0.0446 per kWh
All over 1,500 kWh	$0.0347 per kWh	$0.0373 per kWh

489. Duke Power Co., Residential Service Water Heating—Electric/Solar, Schedule RWX (NC&SC)(effective Sept. 1, 1978). The applicable charges are:

	North Carolina	South Carolina
Basic Facilities Charge	$4.30	$4.30
First 350 kWh	$0.0288 per kWh	$0.0314 per kWh
Next 950 kWh	$0.0349 per kWh	$0.0375 per kWh
All over 1,300 kWh	$0.0340 per kWh	$0.0366 per kWh

490. Duke Power Co, Residential Service Water Heating—Electric, Schedule RW (NC&SC)(effective Sept. 1, 1978).

491. Commonwealth Edison Co., Residential Service—Solar—Assisted Electric Space Heating, Rate 14E (effective Oct. 14, 1977). The applicable charges are:

Customer Charge	$1.40
First 350 kWh	$0.04194 per kWh
All over 350 kWh	$0.01963 per kWh

except that the net charge shall be $0.04194 per kWh for use all over 350 kWh per month in the Customer's first monthly billing period with an ending meter reading date on or after June 15 and in the three succeeding monthly billing periods.

Central Illinois Light Co., Residential Solar-Assisted Electric Space-Heating, Rate 4 (in effect Summer 1978). The applicable charges are:

Customer Charge	$1.10
First 200 kWh	$0.05036 per kWh
Next 200 kWh	$0.04658 per kWh
All Over 400 kWh	$0.02798 per kWh

However, during the five consecutive billing months beginning with June of each year, all energy in excess of 400 kWh shall be billed at $0.0535 per kWh.

492. Commonwealth Edison Co., Residential Service—Electric Space-Heating, Rate 14 (in effect Summer 1978).

493. Commonwealth Edison Co., Residential Service, Rate 1 (in effect Summer 1978). The applicable charges are:

Customer Charge	$1.40
All kWh	$0.04194 per kWh

494. Central Illinois Light Co., Residential Electric Space-Heating, Rate 3 (in effect Summer 1978). The applicable charges are illustrated <u>supra</u> at note 394.

495. Central Illinois Light Co., Residential Service, Rate 1 (in effect Summer 1978). The applicable charges are:

	Summer (June-October)	Winter (November-May)
Customer Charge	$1.10	$1.10
First 200 kWh	$0.05036 per kWh	$0.05025 per kWh
Next 200 kWh	$0.05025 per kWh	$0.05025 per kWh
All over 400 kWh	$0.05350 per kWh	$0.05025 per kWh

496. Pub. Serv. Co. of N.H. with Total Envt'l Action, Inc., Special Contract—Electricity, Contract No. NHPUC-37 (January 21, 1977). Under this contract, auxiliary heating service is presently provided to a solar home utilizing a Megatherm electric hydronic thermal storage device during off-peak hours (10 p.m.—7 a.m.) at a rate of $0.024 per kWh.

497. Pub. Serv. Co. of N.H., Residential All-Electric Space-Heating Service, Rate D (tariff 22 in effect Summer 1978). The applicable charges are:

Customer Charge	$4.85
First 500 kWh	$0.0394 per kWh
All Over 500 kWh	$0.0315 per kWh

498. Controlled water-heating service is provided at an energy charge of $0.0195 per kWh. Interview with Charles Stetson, Director of Rates and Load Research, Pub. Serv. Co. of N.H. in Manchester, N.H. (Aug. 10, 1978).

499. Wis. Power & Light Co., Supplemental Energy Off-Peak Service, Schedule Rz-2.1 (effective Oct. 10, 1977). The applicable charges are:

Fixed Charge	Energy Charge
$3.50 up to 50 kW connected	$0.071 per kWh on-peak
$6.50 over 50 kW and up to 75 kW connected	$0.075 per kWh off-peak

Pricing Periods

On-peak period: 8 a.m. to 10 p.m., Monday through Saturday.
Off-peak period: 10 p.m. to 8 a.m., Monday through Saturday, plus all day Sunday.

500. Kan. Gas and Elec. Co., Experimental Off-Peak Storage Rider, Schedule OPS 678 (effective June 1978). The applicable charge is $0.0201 per kWh for all consumption.

501. Wis. Pub. Serv. Corp., Residential Space-Cooling and Space-Heating Controlled (Special), Schedule Rc-S1 (effective June 5, 1978). The applicable charges are:

	Summer (July-October)	Winter (November-June)
Fixed Charge	$3.85	
Energy Charge	$0.0210 per kWh	$0.0200 per kWh

502. Wis. Pub. Serv. Corp., Urban Residential Service, Schedule Rg-1 (in effect Summer 1978). The applicable charges are:

	Summer (July-October)	Winter (November-June)
Fixed Charge	$2.75	$2.75
First 200 kWh	$0.0462 per kWh	$0.0435 per kWh
Next 1,300 kWh	$0.0375 per kWh	$0.0314 per kWh
All Over 1,500 kWh	$0.0375 per kWh	$0.0287 per kWh

503. Detroit Edison Co., Experimental Solar-Assisted Water-Heating Service, D5.1 (in effect Summer 1978). The applicable charges are:

Service Charge	$1.50
All kWh	$0.0243 per kWh
Interim Surcharge, All kWh	$0.0096 per kWh

504. Detroit Edison Co., Residential Electric Space-Heating Service, D2 (in effect Summer 1978). The applicable charges are:

	Summer (June-October)	Winter (November-May)
Service Charge	$2.50	$2.50
Energy Charge		
First 500 kWh Summer, First 800 kWh Winter	$0.0385	$0.0385
Next 500 kWh Summer	$0.0415	
All Over 1,000 Summer, All Over 800 Winter	$0.0445	$0.0345

505. In re Application of Detroit Edison Co. for Authority to Supply Electric Energy for Experimental Solar-Assisted Water-Heating Service, Case No. U-5731 at 2-3 (Mich. Pub. Serv. Comm. May 1, 1978).

506. Home Builders Assn. of Metropolitan Denver v. Pub. Serv. Co. of Colo., Cases No. 5675, 5685, Decision No. 89573 (Colo. Pub. Util. Comm., Oct. 26, 1976).

507. Generic Hearings, Case No. 5693 (request for investigation as ordered in Decision No. 89068 (Colo. Pub. Util. Comm. July 13, 1976). See note 374 for accompanying text supra.

508. Testimony of James H. Ranniger, Manager of Rates and Regulations, Pub. Serv. Co. of Colo., Case No. 5693 at exhibit JHR-10 (filed Aug. 5, 1977).

509. The solar rate, as it would appear compared with the residential demand service rate effective Aug. 23, 1978 is as follows: Pub. Serv. Co. of Colo., Residential Solar Service, Schedule RDS. The applicable charges are:

Demand Charge	
1st kW of Billing Demand or Less	$5.90
All Over 1 kW of Billing Demand	$1.60 per kW
Energy Charge	
All kWh	$0.01001 per kWh

510. Colorado Office of Energy Conservation Memorandum, Re Electric Utility Rates for Solar Uses 2-5 (April 6, 1978).

511. Id. at 6.

512. Interview with Ronald Lehr, Attorney, Office of the Governor, Office of Energy Conservation, State of Colorado in Denver, Colorado (Sept. 27, 1978).

513. L. Mayo et al., Legal-Institutional Implications of Wind Energy Conversion Systems (WECS) 124 (Sept. 1977) (prepared by the Program of Policy Studies in Science and Technology; George Washington University for the National Science Foundation, NSF Grant No. APR-75-19137).

514. Unless noted otherwise, much of the following New York windmill experience is adopted from J. Carter & T. Finch, Wind & Solar at East 11th, Wind Power Digest, Summer 1977, at 12-17.

515. Consolidated Edison Co. of New York, Service Classification No. 2, General—Small (effective March 7, 1977; special provisions effective May 23, 1977). The applicable charges are:

Energy Charge	
First 10 kWh or less	$4.96
Next 890 kWh	$0.0810 per kWh
All Over 900 kWh	$0.0745 per kWh

Under special provision C, service to windmill generators operating in parallel with the company's system encompass additional charges and credits:

Minimum Charge (in addition to the $4.96 above)	$6.80 per kW of generator capacity
Reverse Flow Meter Charge	$1.00

Credit for power generated by the windmill back into the company's system equal to the average cost of fuel per kWh to the company.

516. Central Hudson Gas & Elec. Corp., Service Classification No. 1 (effective Aug. 10, 1977; special provisions effective October 10, 1977). The applicable charges are:

Single-Phase Service	Gross	Net
First 12 kWh or less	$2.85	$2.70
Next 60 kWh	$0.07750 per kWh	$0.07550 per kWh
Next 78 kWh	$0.05750 per kWh	$0.05650 per kWh
All Over 150 kWh	$0.03945 per kWh	$0.03894 per kWh

Under special provision 1.2 for windmill operation in parallel with the company's system, additional charges and credits are provided:

Demand Charge	$2.50 per kW of windmill capacity
Customer Meter Charge	$1.00

For energy supplied by the customer to the company, there will be a credit equal to the company's average cost of fuel per kWh.

517. Southern California Edison Co., Domestic—Parallel Generation, Experimental Schedule No. D-PG (1978). The applicable charges are:

Customer Charge	$6.55
Net Energy Charge:	
First 100 kWh	No Charge
Next 200 kWh	$0.03562 per kWh
All Over 300 kWh	$0.02332 per kWh

Net energy is energy supplied by the Company minus energy generated by the customer and fed back into the Company's system at such time as customer generation exceeds customer requirements. Net energy cannot, however, have a negative value for purposes of determining charges under this schedule.

518.Southern California Edison Co., General Service—Parallel Generation, Experimental Schedule No. A-PG-A (1978). The applicable charges are:

Customer Charge (single phase service)	$8.00
Net Energy charge:	
First 100 kWh	No Charge
Next 400 kWh	$0.06000 per kWh
Next 1,000 kWh	$0.04150 per kWh
Next 1,500 kWh	$0.03410 per kWh
All Over 3,000 kWh	$0.02679 per kWh

519. For a comprehensive summary of the five acts collectively referred to as the National Energy Act, see S. Glazer, Fact Sheet: National Energy Act (1978) (prepared by

the Environmental Study Conference); Office of Public Affairs, Department of Energy, Information: National Energy Act (1978).

In 1977, President Carter submitted to Congress a draft of proposed legislation to establish a comprehensive national energy policy. The President of the United States, National Energy Act: A Draft of Proposed Legislation to Establish a Comprehensive National Energy Policy, H.R. Doc. No. 95-138, 95th Cong., 1st Sess. (1977). The President's proposal was comprehensive in nature and considered the five topics covered in the National Energy Act (NEA). Part E of the President's proposal, "Public Utility Regulatory Policies," was premised on a finding that generation, transmission, and sale of electricity affect interstate commerce, and that adequate and reliable supplies are necessary for both the general welfare and national security. Id. at § 501(a). The purpose of the electric utility rate-making sections were (1) to establish national policies with respect to electric utility rate making which encourage economic efficiency, ensure that rates are designed to minimize energy consumption, to reduce the need for new generating capacity, and provide fair rates to consumers, and (2) to increase the efficiency of energy resource use in the generation and transmission of electric power through greater use of cogeneration, interconnection, and wheeling. Id. at § 501(b).

The House version of the NEA was passed by that body on August 5, 1977. H.R. 8444, 95th Cong., 1st Sess. (1977). Consistent with the President's proposal, the House version included the five broad areas, with Part V covering public utility regulatory policies. In addition to the purposes indicated in the President's proposal, the House version had as two purposes greater consumer representation in regulatory proceedings and technical and financial assistance to state regulatory authorities. Id. at § 501.

The Senate Proposal was comprised of five separate bills with one devoted to public utility regulatory policies. H.R. 4018, 95th Cong., 1st Sess. (1977). In addition to the purposes provided in earlier proposals, the Senate version had as a purpose an interim solution for the subsistence residential electrical needs of the elderly. Id. at § 102. This version was passed by the Senate on October 6, 1977.

As the House and Senate maintained different positions on public utility regulatory policies of the NEA, both legislative chambers agreed upon a conference on H.R. 4018. Action was completed by the conference committee on December 1, 1977, resulting in an unofficial Summary of Conference Agreement. Conference Committee, Summary of Conference Agreement on the Public Utility Regulatory Policies Act, H.R. 4018 (Dec. 31, 1977) (unofficial). The ultimate result is the Public Utility Regulatory Policies Act of 1978 and other acts signed by President Carter late in 1978.

520. Public Utility Regulatory Policies Act of 1978, Pub. L. No. 95-617, 92 Stat. 3117 (1978).

521. Energy Tax Act of 1978, Publ L. No. 95-618, 92 Stat. 3174 (1978).

522. National Energy Conservation Policy Act, Pub. L. No. 95-619, 92 Stat. 3206 (1978).

523. Power Plant and Industrial Fuel Use Act of 1978, Pub. L. No. 95-620, 92 Stat. 3289 (1978).

524. National Gas Policy Act of 1978, Pub. L. No. 95-621, 92 Stat. 3350 (1978).

525. Publ. L. No. 95-617, 92 Stat. 3117 (1978). See also Conference Report: Public Utility Regulatory Policies Act of 1978, S. Rep. No. 95-1292, 95th Cong., 2d Sess. (1978).

526. Pub. L. No. 95-617, at § 101 (Title I—Retail Regulatory Policies for Electric Utilities).

527. S. Rep. No. 95-1292, at 69. Electric utilities with retail sales above 500 million kWh are subject to the statute. Pub. L. No. 95-617 at § 102.

528. Pub. L. No. 95-617, at § 111(d).

529. Id. at § 111(d)(1).

530. Id. at § 115(a).

531. Those standards potentially beneficial to solar users are discussed in the text accompanying notes 315-357, supra.

532. Pub. L. No. 95-617, at §§ 201-14 (Title II - Certain Federal Energy Regulatory Commission and Department of Energy Authorities).

533. See 16 U.S.C. § 796 (1976).

534. Pub. L. No. 95-617, at § 201.

535. S. Rep. No. 95-1292, at 89.

536. Pub. L. No. 95-617, at § 201(b)(c). Regarding the purchase of electric energy by utilities from small power producers, "just and reasonable" is to be interpreted for the protection of electric consumers in receiving service at equitable rates. It is not intended that small power producers, by virtue of this common regulatory language, become subject to the same tests traditionally administered to electric utility rate applications to ascertain what are just and reasonable rates. S. Rep. No. 95-1292, at 97.

For the sale of electric energy to small power producers by electric utilities, "just and reasonable" refers to traditional utility rate-making concepts. Id. at 98. Thus, the rate would likely be based on the utility's cost to serve the small power producer.

537. Pub. L. No. 95-617, at § 210(e)(1).

*U.S. GOVERNMENT PRINTING OFFICE: 1979-0-677-083/33