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Thesis submitted to the Faculty of the
Virginia Polytechnic Institute and State University
in partial fulfillment of the requirements for the degree of

MASTER OF URBAN AFFAIRS
in
URBAN AFFAIRS

APPROVED:

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January 1993
Blacksburg, Virginia
ABSTRACT

Based on federal and state experience of the late 1970's and early 1980's, this paper examines various policy alternatives that government could implement in promoting renewable energy. The paper assumes that government has an interest in promoting renewables. Therefore, it makes no attempt to advocate why federal or state governments should promote renewable energy. It merely presents a variety of options that these governments might choose to promote renewables as a viable alternative to meet present and future energy demands.

The Carter and Reagan administrations at the federal level and the Brown, Deukmejian, and Wilson governorships in California are examined. This time period was selected because of the significant changes which occurred during the 1970's and 1980's in the energy economy and political arena and their resulting impact on the renewable energy industry. The contrast between one decade and the next starkly revealed the effects that government policy had in both cultivating and undermining a relatively infant industry. The thesis presents a detailed case study of Luz International to illustrate those effects.

The discussion focuses on the factors affecting the policy formulation process, with emphasis on the importance of the executive office, interest groups, and the legislature. This thesis argues that energy policy formulation is governed or shaped largely by factors that are beyond the control of the renewable energy industry. Examples of such factors are benefit coalitions, short-term mentality of elected officials, and lack of public awareness. Effective policy to facilitate the commercialization of renewable energy technologies must account for the conditions of the marketplace and the political process.
ACKNOWLEDGEMENT

First and foremost I would like to thank my parents for always providing me with support whenever needed. What I accomplished through both undergraduate and graduate school would not have been possible without their continued encouragement. For this and many other reasons I am eternally grateful to them.

Each of my advisors provided me with substantial guidance, accompanied by a great deal of patience, in writing and revising this thesis. The time they spent with me in refining my ideas and discussing the policy implications of federal and state energy policies elucidated the complexities of the policy process. Although I became frustrated at times with the development of this paper, my advisors were always there to lend an ear and assist me in sorting out the issues. Their enthusiasm for my work and my findings also served as an excellent stimulus for me. John Randolph, Richard Hirsh, and Max Stephenson I thank you.

I also wish to extend my gratitude to the friends with whom I would argue and debate the fine points of my research into the late hours of the morning. Those times were not only memorable, but also instrumental in sharpening my arguments. Specifically, I want to thank Brad Townsend and Russ Archembault for incessantly challenging my findings and always keeping a positive attitude.
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FEDERAL AND STATE RENEWABLE ENERGY POLICY:
LESSONS FROM THE LATE 1970'S AND EARLY 1980'S
by
Howard Lawrence Friedman
INTRODUCTION
Introduction

Renewable energy is, by definition, a resource that is continuous and cannot be depleted, such as sunlight and wind. Technologies using these resources have been around for many decades, but only recently have they been adapted for more broad-scale commercial applications. Examples of renewable energy include hydroelectricity, biomass, wind, and solar power. They can serve to reduce the amount of conventional fuels we use, but they are not a panacea. The near term potential of renewables estimated by some researchers is quite high, while others insist that it will be several decades before renewables can make a substantial contribution to nation's energy supply.

The role government assumes in promoting the technologies will determine in part the extent to which the renewables industry can increase its market share in meeting the energy needs of the country. This paper investigates the role that government can play in promoting renewable energy by examining past energy policy initiatives at the state and federal levels. The paper assumes that it is in the interest of government to stimulate the growth of the renewables industry. The main question asked is how can government promote renewables effectively and avoid some of the problems experienced over the last two decades? This paper does not justify why government should be involved with the promotion of renewable energy. The paper analyzes the different courses of action taken by government to encourage the development of renewable energy technologies (RETs) in the past, and the various options that it might exercise in the future. The major policy decisions affecting the growth of the renewables industry and the lessons that can be learned from Federal and California experience for formulating renewable energy policy are examined.

The analysis explores the initiatives presented under the Carter and Reagan administrations at the federal level and the Brown, Deukmejian, and Wilson administrations in California. The discussion is limited to this time period because of the dramatic shift in energy policy that occurred between the late 1970's and the early 1980's. Government support of renewable energy initiated in the late 1970's dissipated in the 1980's. This shift cast the future of the renewable energy industry into doubt. The time period offers many examples of both
positive and negative policy actions taken by government which provide valuable insight into the barriers encountered in formulating renewable energy policy.

Chapter 1 describes the energy policy process and the policy options that the government can employ to stimulate the renewable energy industry. It also points out some of the barriers that have impeded the growth of the renewables industry and that may continue to frustrate advocates as they promote renewable energy policy in the future. The main question asked is what prevents renewables from making a larger contribution to our energy supply and what can be done to remove any such impediments. Although technological and economic factors still frustrate attempts to increase the contribution of renewable energy to the domestic energy supply, there are institutional, political, and social barriers that hinder the formulation of effective policies encouraging the production and consumption of renewable energy. This chapter analyzes the issues surrounding the formulation of innovative renewable energy policy at the state and federal levels.

Chapter 2 examines the policies of the Carter and Reagan administrations that affected renewable energy. The question addressed in this chapter is how these two administrations affected the emergence of the renewable energy industry. It describes the major energy policy decisions of each administration emphasizing the shift in the perceived role of government and its corresponding effect on the renewable energy industry. This discussion shows how and why the federal government attempted to promote renewable energy in the late 1970's and largely abandoned that effort in the early 1980's.

Chapter 3 analyzes the renewable energy policies of the state of California during the same time period. This chapter asks how energy and tax policy in California affected the growth and viability of the renewable industry. California was selected because of the aggressiveness with which it initiated policies promoting renewable energy and attempted to alter its consumption of conventional energy. The chapter discusses the roles played by the Governors, the California Public Utilities Commission, and the utilities in both encouraging and hampering the renewables industry in the state. California's attempt to stimulate the growth of the renewable energy industry in both the residential and commercial sectors is examined. It ends with an assessment of the implications of the Golden State's efforts to promote renewables.
The fourth chapter considers the case of Luz International, a California based manufacturer of solar trough technology. The Luz chapter describes the way government policy affected the development and growth of a renewable energy firm in a specific significant case. Luz was the largest solar energy producer in the country until November of 1991, when it filed for bankruptcy. The rise and fall of the corporation over the last decade illustrates the way in which government policy first facilitated renewables development and later contributed to its demise. Luz was selected because of the richness of its experience and the opportunity it offers to analyze a major company from its beginning to its end.

The final chapter reviews the national and California experiences with renewables policy and draws some conclusions about the future of renewable energy. Lessons drawn from past experience illustrate the kinds of barriers and stumbling blocks that renewable energy policy promotion will encounter in the future. The impact of past policies affecting renewables is highlighted because of its importance in shaping present and future policy.

The chapters are linked together by the importance of political actors in influencing the direction of energy policy. The chapters highlight the role that the chief executive office of the federal government and the state governorship play in the development and implementation of energy policy. Other variables considered are the economy, governmental and non-governmental institutions, and social pressures.

Methodology

This study drew on interviews, government publications, and current policy literature. These sources provided the foundation to analyze the various policy options open to the government and the barriers faced by the renewables industry. Seventeen interviews were conducted with policy analysts and industry representatives who were involved with renewable policies during the 1970's and 1980's in order to test evidence obtained through a literature review. Interviews were conducted by telephone and in person in March, 1992. Approximately thirty open-ended questions were asked of each person on the topics of general energy policy, policy recommendations, and specific renewable energy policy initiatives. The interviews took from between a half hour to an hour and a half.
Chapter I - Energy Policy Options and the Policy Process

1.1. Introduction

This chapter presents the various policy options that could be exercised by federal and state governments to promote renewable energy. The chapter is based upon the following premises:

1) if a larger contribution is to come from renewable energy today, government policy promoting renewable energy technologies (RETs) is necessary;
2) if government policy makers decide that government should promote RETs, there are tested and effective policies that can do this;
3) enacting and implementing these policies is no simple task because of the complexities of the energy policy arena.

The first section lays out what policy options the government might exercise in stimulating the development and use of renewable energy technologies. There are two parts to the discussion, one concerning short-term policy options and one that addresses long-term policy alternatives. The chapter's second section analyzes the energy policy development process determining how and to what extent energy politics is affected by institutional, political, and social factors.

This chapter highlights the potential of the renewables industry through an analytic discussion of policy options and barriers. Emphasis is placed on those actions aimed specifically at increasing or decreasing government involvement in the development of renewable energy. The policy options are first identified and then categorized according to their applicability in both the short and long term. The first section begins with a discussion of the rationale behind government involvement in the energy market.
1.2 Government and the Promotion of Renewable Energy

Why has the government been involved in the energy market as much as it has over the last century? After all, the majority of the power generating industry in the United States is private. Government has largely intervened in the marketplace to correct market failures and imperfections. A few examples of government intervention include air pollution control, fuel efficiency standards for automobiles, and the oil depletion allowance. Electric and natural gas utilities have been regulated by government since the mid 1930's and earlier because of the natural monopoly positions that they occupy. The federal government and the states sought to use regulation to prevent wasteful and inefficient competition by creating a centralized electricity generating system. States regulated individual utilities by evaluating rate increases and operation expansions in the interest of retail customers. Government involvement was justified on the grounds of efficiency, which arose from the resulting economies of scale. The fact that power could be more cheaply produced by a central plant than by an individual consumer's own generator supported intervention (Barkovich, 1989).

Government intervention in the development of renewable energy sources has not been justified on the same grounds as utility regulation. However, there is a similarity in the economic rationale for intervention, since both address market imperfections. A market imperfection is any cost or benefit that is incurred or enjoyed by someone at the expense of another, e.g., burning coal but not having to pay the alleged environmental and health costs associated with its consumption. Market imperfections are counteracted through government intervention, since normal market mechanisms would not account for such costs. By not accounting for market imperfections (namely environmental externalities), the promotion of mature renewable energy technologies is impeded, because renewables do not have the social costs associated with conventional energy.

In the absence of market failure, it has been argued that the market is "inherently superior in promoting economically efficient energy outcomes for society" (Bohli and Darmstadter, 1991, p. 271). If all renewable energy technologies (RETs) were cost-competitive with conventional energy operations, there is little doubt that the private sector would already have begun to develop the appropriate technologies on its own. Some RETs have been
developed and perfected, such that they can operate competitively without public operating or capital subsidies (hydroelectric power). However, subsidies or incentives have been crucial for many RETs to make the transition from demonstration to commercialization, for example, windfarms in California (Byrne, 1986).

Most of the newer renewable applications are not cost-competitive with conventional energy production without public incentives (Nathan, 1985). The reason is two-fold. First, RETs as a whole, have not met expectations in efficiency and economic improvements set for them in the late 1970's. The technologies have simply not evolved as rapidly as anticipated. In part, this has led to renewable energy's less than expected contribution to our domestic energy supply. Second, general energy policy, subsidies to conventional energy, and the difficulty of quantifying social and environmental externalities have made the transition to commercialization for RETs an arduous struggle.

Government initially encouraged production of energy from renewables because of their long-term availability, thus, maintaining national security. Analysts have offered several reasons for why government should promote renewable energy. Initially, renewables were not promoted for their long-term availability or their relatively benign environmental impact. Over time other reasons have evolved for supporting the promotion of renewables. One reason is to ensure international economic competitiveness in technological areas that government and private industry have been investing billions of dollars. Another reason is environmental protection through energy diversity and the consumption of alternative energy sources. Claims are also made that the benefits of promoting renewable energy exceed the costs incurred by society. Assuming, however, that government is interested in promoting the production and consumption of renewable energy, how could it act? In other words, what options does government have to encourage the further development and use of renewable energy? To address this question, it is important to break the issue down into short and long term options because the effectiveness of each alternative varies over time. Certain policy options are applicable for the short-term while others call for a long-term commitment. The following discussion first addresses short-term policy strategies for federal and state governments.
1.2.1. Short-term Policy Options for Renewable Energy

Short-term policy options to promote renewable energy are those aimed at stimulating economic activity in a relatively small time frame. Although some of these options could be classified as also having a long-term impact, for analytical purposes they are referred to as short-term because of their immediate implementation. The three policy options are investment incentives, energy pricing, and demonstration and commercialization.

Investment Incentives

One alternative that might be exercised by government is to offer investment incentives to facilitate the commercialization of new technologies or the purchase of solar equipment for residential applications (see Table 1-1). Income or business investment tax credits and a property tax exemption can be provided to encourage economic activity and development that otherwise would not occur. The idea behind either state or federal investment credits is that they reduce the effective cost of renewable technology and thereby stimulate investment activity. Renewable energy projects are not expected to remain dependent on the continued provision of tax credits to make their operations profitable. The federal government could also continue offering an energy tax credit, but it too would have to be phased out over a short time period, as the price of energy increases or the cost of the renewable technology drops. The intention is to breed independence, not dependence. This requires close monitoring of the progress being made by the RETs.

In the residential sector, RETs could be promoted by offering tax credits, rebates, or loans. The best application of these investor side and consumer side incentives would be in combination (Quigley quoted in Gilbert, 1991, p. 304). The California experience suggests that tax credits would largely be claimed by middle and upper income households. Rebates and long-term low-interest loans could be offered to middle- and low-income households interested in purchasing and installing renewable energy equipment. This approach would allow a greater number of consumers to receive electricity from renewable energy, thus, conserving conventional energy sources. The only guide for the provision of these incentives by government ought to be that the benefits outweigh the costs (Bohi & Darmstadter, 1991). The
### Short Term

<table>
<thead>
<tr>
<th>Investment Incentives</th>
<th>Strengths</th>
<th>Limitations</th>
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<tbody>
<tr>
<td>I Rebates or fees</td>
<td>will encourage investment</td>
<td>does not reach lower classes</td>
</tr>
<tr>
<td>II Tax credits</td>
<td>can appeal to consumers in both residential and commercial sectors</td>
<td>may not attract long-term investors</td>
</tr>
<tr>
<td>III Long-term low interest loans</td>
<td>can reach middle and low income investors</td>
<td>does not meet mind set of most Americans</td>
</tr>
<tr>
<td>IV Research and Development tax credits</td>
<td>promotes commercialization of innovative technologies</td>
<td>extensive &amp; rigorous review process needed</td>
</tr>
<tr>
<td>V Property tax exemption</td>
<td>promotes economic activity where there otherwise would not be any</td>
<td>creates conflict between promoting econ. dev. and providing a sufficient tax base</td>
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#### Energy Pricing

| I Reevaluate cost of conventional energy use | increase ability of renewables to compete with conventional energy | uneven impact on the various social classes |
| II Pricing of environmental externalities | " " " | difficult to quantify environmental externalities |
| shift tax burden from income to pollution | " " " | adverse impact on lower classes |
| III Production and consumption tax | " " " | |

#### Demonstration and Commercialization

| IV Demonstration and commercialization pilot programs (near term projects) | same as IV | riskiness of the venture |
| II Joint development with private industry | " " " | need for public funding where not essential |
| III Provide equal funding to conventional energy and renewable energy | levels out the energy playing field for renewable energy | uncertainty of results |
drawback of this approach is that it is very expensive and demands a financial commitment that
a particular state may not be able to afford.

**Energy Pricing**

The second set of short-term options is regulating the manner or process by which
energy production and consumption is priced. This entails incorporating environmental
externalities and social costs into the price of conventional energy. Changing the price of
conventional energy in this fashion would directly improve the competitive position of
renewables while diminishing that of conventional energy. This is perhaps the most politically
difficult change to bring about given the extent to which current beneficiaries of government
intervention would stand to lose. Regardless of the potential opposition that might arise, if the
federal government were to reconsider the pricing of conventional energy use, the competitive
position of renewables could be markedly improved. In exercising this option, government
would attribute many of the "hidden costs" associated with conventional energy use to the price
that consumers pay for that energy (Heede, Oct. 1985). These hidden costs come in the form of
tax dollars allocated to maintain open international petroleum transportation routes, and build
and maintain interstate highways. They also come in the form of negative environmental
externalities.

The integration of environmental externalities into the price of conventional energy
would greatly enhance the ability of renewable energy sources to compete with conventional
energy sources like coal and oil (Hall, July 1990, p. 283). Not attributing these externalities to
the responsible party, unfairly distorts the market and prevents consumers from being aware of
the "real cost" of the fuel they purchase (Heede, Oct. 1985). Additionally, for many years,
producers were not held responsible for paying the full costs associated with drilling or mining
the resource they extracted. This practice encouraged producers to explore and extract more of
the depleteable resource as a result of direct subsidies. Government subsidies totaled almost $12
billion in 1984 for coal and oil alone (Heede, Oct. 1985). As an example, the market price of
electricity does not "reflect external costs such as the long-term effects on the environment; the
costs of excessive reliance on nonrenewable fuels; or the strategic costs of dependence on oil
from other countries" (Cruver, December 1989, p. 619). Both direct subsidy costs and external costs put RETs at a competitive disadvantage.

Some have proposed that government shift the tax burden from its basis on corporate income to the quantity of pollution, or damage to the environment, caused by the operations of the company (Brower and Meyer, 1992, p. 16). There has been much difficulty in quantifying these impacts. As further research quantifies externalities and integrates them into energy prices, renewable energy could become a more attractive alternative. It seems to be clear now though that "for environmental damage created by energy production and consumption to be integrated into the private cost of producing and consuming energy, recourse to non-market means, through the power of the government, is necessary" (Bohi & Darmstadter, 1991, p. 269). If the government is to intervene in this matter, the most important concern is to ensure that intervention is not based on entirely arbitrary standards. Environmental regulation that raises the cost of conventional energy may be one option. For example, the Clean Air Act calls for the control of power plant emissions, which led to the higher cost of coal-fired electricity.

Another option government could exercise would be to tax conventional energy production and consumption at higher levels. These taxes should not be determined arbitrarily, but rather through a formula which accounts for environmental costs and infrastructure maintenance costs (e.g., road repair). The tax could incorporate long-run fuel and replacement costs as well as availability. This could have the effect of lessening the strength of price signals to consume as much of our domestic energy sources as possible now and worry about it later. Feiveson and Rabl (1982, p. 322) argue in their report that "most of the shortcomings of subsidy strategies may be avoided if instead of subsidizing unconventional energy, we placed a tax on conventional energy sources". Taking this approach, they write, would have more of the desired effect of increasing reliance on renewable energy and conserving conventional energy supplies; the gasoline tax is a good example.

Demonstration and Commercialization

The last category of short-term options refers to the allocation of federal funding to facilitate the transition from demonstration to commercialization for RETs. Demonstration and
commercialization (D&C) funding support should be given to those technologies that show near-term promise. Collaborative pilot programs between the federal government and private industry seem poised to be the best investment for national dollars because the likelihood of private sector adoption of a technology is much greater if it has invested directly in a project. This approach to development would also focus the federal government's dollars on projects in which the private sector is interested in investing. By the same token, government investment ought to be based on whether or not the private sector would have developed the technology without government assistance. Logically, an unwise investment would be one that the private sector would have made on its own. Another limitation is that government cannot know what private actors would have done without incentives.

Through intervention in the D&C process, the federal government seeks to speed up the production and application of RETs in the marketplace. The intention of government D&C is to "bridge the gap between the processes of invention and those of social adoption and technological diffusion" (Roessner quoted in Byrne, 1986, p. 120). Government sponsored D&C should not be expected to develop particular technologies fully, but should only be expected to encourage the private sector to take the ideas and refine them.

Federal and state governments could implement these short-term policy options to promote technologies that are commercializable or close to commercialization. When deciding which policy options to implement, the federal government could consider the specific policy goals of energy diversity, independence, conservation, and environmental protection. By addressing each of these aims, the renewable energy industry could make a stronger argument for receiving more government support or eliminating that for non-renewable energy sources. Either way, the federal government might opt for providing equal funding to conventienal energy D&C and renewable energy D&C. Some argue that this would help to level the playing field (Interviews with Heede; Swezey; Rashkin).
## Long-term

**Regulation**

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<tr>
<td>I</td>
<td>redefine the scope of utility involvement</td>
<td>familiarity, expertise</td>
</tr>
<tr>
<td>II</td>
<td>Promote least cost energy planning</td>
<td>promotion of efficiency</td>
</tr>
<tr>
<td>III</td>
<td>Make it easier for nonutility producers to have access to utility market</td>
<td>increase efficiency; extends fossil fuel supplies</td>
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### Programs

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<td>I</td>
<td>Expand education and training services</td>
<td>foster greater public support at the grass roots level</td>
</tr>
<tr>
<td>II</td>
<td>Promote demand-side management</td>
<td>makes renewable energy a potentially more attractive alternative to conventional energy</td>
</tr>
<tr>
<td>III</td>
<td>Project procurement</td>
<td>create markets for RETs that otherwise would not exist</td>
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### Research and Development

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<tr>
<td>I</td>
<td>Give renewable fair share of R&amp;D dollars</td>
<td>provide more renewable technologies which are close to commercialization a boost</td>
</tr>
<tr>
<td>II</td>
<td>Joint development with private industry</td>
<td>develop projects that the private sector will adopt on a larger scale</td>
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1.2.2. Long-term Policy Options

There are also a number of long-term options available to federal and state governments to encourage the use of renewable energy (See Table 1-2). These options involve regulatory change, program implementation, and some research and development.

Regulatory Change

One of the first options open to government for long-term promotion of renewables is to make selected changes in the regulatory environment surrounding electricity production. First, an amendment to the Public Utility Holding Company Act could allow utilities to play a larger role in the promotion and utilization of renewable energy sources. As Blair Swezey, an analyst at the National Renewable Energy Laboratory (NREL) noted, "it is critical that utilities play a larger role if policy makers desire to have renewables contribute more" (Interview with Swezey). In the early 1980's, utilities were first exposed to renewable energy operations, such as wind farms and solar electricity generating systems. Many of the RETs were at a very primitive stage; there was much room for efficiency improvements. However, "many RETs are now at the stage where utilities can be owners of systems rather than purchasers of power" (Interview with Mike Lotker, Vice President for Business Development for Luz International). This could break open the market for renewable projects tremendously and encourage their further proliferation.

However, if the government was more interested in encouraging small, independent producers using renewable energy to enter the energy market than encouraging more renewable energy use, state governments could mandate that utilities purchase a certain amount of electricity from qualifying energy producers. This too could have the effect of increasing the contribution that renewable energy makes to our domestic energy supply. If greater competition is indeed desired in the domestic energy market, the federal government could require that independent energy producers be given greater access to the utility infrastructure. Easier transmission access for non-utility producers could be set up. This might remove a disincentive to begin operations using renewable energy, however, it might create further market inequities too.
Some states might engage in least-cost energy planning. State utility commissions could mandate that utilities purchase the lowest cost electricity, rather than continuing to use more costly resources (Gilbert and Henly quoted in Gilbert, 1991, p. 90). Least-cost energy planning seeks "to put end-use efficiency improvements and load management activities on an equal footing with more traditional supply-side resources" (CRS Rep. No. 90-275 SPR). As long-term costs including environmental externalities are taken more and more into consideration, electricity from renewable energy sources could become increasingly competitive as a least cost alternative.

**Programmatic Changes**

There are also programmatic measures that the government could take to promote renewable energy. One would be to expand education and training services provided to the public, government officials, utilities, and other industries in order to familiarize them with the issues, applications, potential, and limitations of renewable energy technologies. Ignorance about renewable energy seems to be a major stumbling block to increasing its use. Government programs informing people about renewables, such as publication production, might help to overcome this barrier.

Another program that state governments could choose to implement would be demand-side management (DSM), which relates primarily to conservation, but could include on-site renewables. "DSM incorporates all kinds of actions utilities take to modify their customers' demand for electricity. Such efforts include the implementation of programs to reduce electricity use, programs that redistribute electricity demand to spread it more evenly throughout the hours of the day and even programs that encourage strategic load growth" (Lamarre, 1992, p. 11). While its main emphasis is on efficiency improvements, DSM could encourage renewable energy use by getting consumers to cut down on their electricity demands during peak periods and install solar equipment, for example.

Government could increase project procurement activities to stimulate the entrance of the renewable energy industry into different areas. It could combine this with long-term research and development of promising technologies. In essence, the federal government would
create the market for the technology that the private sector develops on its own. An example of this is the Defense Department's decision to utilize photovoltaics in remote locations for military communications.

Research and Development

As with short term D&C projects, the government could engage in long-term joint development projects with companies interested in eventually adopting and further refining a technology. This might ensure that the government did not invest in a technology which the private sector would be neither willing nor able to develop in the future. The result of exercising this option might be that the more commercially promising technologies will be developed.

There are a host of different policy options that the government might select to promote the development of renewables. Each of the options mentioned have been implemented in some form over the last two decades. Both federal and state governments have been promoting renewables, but this promotion has been neither consistent nor stable. That is what ties all of the options together -- they have experienced on-again off-again government support. Once government has made the commitment to support the growth of the renewable energy industry, the options above might be implemented individually or in combination.

Through stability, the renewables industry would be taking its first step toward competing on a "level playing field." If the government were to equalize proportionally the levels of funding and the production incentives given to conventional and nuclear energy with that allocated for renewable energy development, the ability of RETs to compete with conventional energy could be improved. Another argument that has been offered is that "if all subsidies for all energy sources were eliminated, and decontrol of all fuels took place, that would be far preferable. . . to the existing state of affairs" (SEIR, p. 44, Feb. 8, 1982).

Although the largest barrier for the renewable energy industry is economic, certain institutional, political and social factors have confounded attempts to stabilize the policy environment for renewable energy. The next section deals with the factors affecting the formulation and implementation of energy policy. The overarching question is what factors
have influenced the policy process and sometimes served as barriers to adoption of the policy options mentioned above?

1.3. The Factors Affecting Renewable Energy Policy Development

Government support of the renewables industry in one form or another over the last two decades has underlied its progress. While many have praised the positive impact that the government has had on the development of renewables, others point out the harm that has arisen from intervention. As Mike Lotker of Luz has noted, "artificially stepping in and making the power from [a renewable energy] source more cost-effective than it is without [government incentives], caused solar trough technology to be introduced to the market long before it otherwise would have appeared. Had Luz not gone the tax credit route, none of [the company's success or failure]would have happened" (Interview with Lotker). His point is that without government intervention, in the form of regulation and incentives, many of the solar and wind industries would not have been able to prosper as they did in the early 1980's. At the same time premature development projects also would not have arisen.

Government intervention in the late 1970's and early 1980's was based on the assumption that energy prices would continue to rise. The policy options that both federal and state governments exercised to stimulate the renewables industry during that time were effective in facilitating the creation of an industry. However, the question still remains: was the manner in which the government intervened inherently problematic for the renewable industry's long-term viability? Could it be argued that government adopted a short-term strategy when a long-term approach would have better fit the events which followed? Were there other factors besides cost that prevented the renewables industry from obtaining greater acceptability?

The factors that affect renewable energy policy development are numerous and varied. They vary depending on the particular RET in question, and they are numerous in the sense that they are present in tradition, policies, and institutional infrastructure. This section addresses some of those factors and the barriers they can act as in the short and long-term. Each step of the policy development process encounters different factors which affect the formulation of renewable energy policy options.
Although there are technological limitations associated with each RET, the larger factors will continue to be institutional, political, and social. Institutional factors are those that are inherent to governmental infrastructure that largely affect the implementation of energy policy, while political factors are those which arise primarily during the formulation of energy policy. However, in some cases this distinction is blurred. Certainly, there are serious concerns over renewable energy storage, transmission, reliability and cost. The following discussion is limited to broader policy concerns, but is not meant to downplay the importance of the technological limitations of RETs. The discussion is limited to the cited factors because each can represent a stumbling block (barrier) to renewable technology advancement and policy development.

Institutional Factors

The first set of factors are institutional ones (see Table 1-3). The first institutional factor which can sometimes serve as a barrier is the fact that coequal branches have responsibility for policy development. As policy makers know, "policy in the U.S. government is invariably a product of interaction between Congress and the presidency, [such] that guidance for administrators blends the preferences of each." (Derthick, 1990, p. 69). Martha Derthick's insight points up two important dimensions. First, policy stems from both the executive and legislative branches; as a result, the perceived role of government is not unitary. Second, the "political arena", as John Kingdon calls it, encourages conflict, confrontation, and ambiguity. For energy this means that the policy formulation process has many interests pulling in different directions with diverse claims for support. Although this is closely associated with political relations, it is institutional infrastructure which confines the boundaries of debate.

The second institutional factor is the general conflict orientation of the energy policy arena. The arena is deeply conflictual because parties are deeply divided. To understand why renewable energy policy has taken the shape that it has over the past two decades, it is important to identify dominant elements in the policy environment. "Policymaking cannot adequately be studied apart from the environment or context in which it occurs. Demands for policy actions stem from problems and conflicts in the environment and are transmitted by groups, officials, and others to the political system" (Anderson, 1990, p. 43-4).
Table 1-3: Factors Affecting the Promotion of Renewable Energy

**Institutional Factors**
- a) origin of policy: the agenda of the executive office
- b) conflict oriented (bargaining, compromise, and incrementalism)
- c) a combination of interests and forces preserving the status quo
- d) uneven playing field for renewable energy
- e) difficulty of quantifying environmental externalities

**Political Factors**
- a) short-term mentality of public officials
- b) influence of political action committees and other interest groups
- c) influence of the conventional energy industry and utilities
- d) preponderance of benefit coalitions
- e) inability to establish consistent support
- f) public unwillingness and inability to look long-term

**Social Factors**
- a) lack of an informed public about the costs and benefits of energy use
- b) lack of familiarity among public officials, bureaucrats, and the public regarding the costs and the potential of renewable energy
- c) unwillingness to change patterns of energy consumption in the absence of crisis (stasis)
- d) preoccupation with short-term earnings
- e) unwillingness to recognize the strategic value of renewable energy use
On an institutional level, by constitutional design, the executive office sets the tone for federal policy, but may not preclude other participants from influencing its formulation. "Institutionalized biases -- some deliberately created by constitutional design, others rooted in history and tradition -- make some policy outcomes far more likely than others" (Rosenbaum, 1987, p. 66). Certainly, as Rosenbaum points out, there is a strong tendency toward bargaining, compromise and incrementalism in the formulation of energy policy. These three characteristics partially explain the story, but not all of it. The renewable energy industry has been afforded support largely in the form of inconsistent, unreliable, and lackluster policy options. There are circumstances under which a bargaining process may produce very substantive policy. The system, however, is inclined to work in the opposite direction. The history and tradition of our institutions have made for an energy market that encourages consumers and producers to look to the short-term rather than the long-term. The outcomes which have been far more likely than others at the federal level are those that advocate the use and development of conventional rather than renewable energy.

Two federal decisions in particular encouraged the use of oil and gas through tax preferences: Internal Revenue Code (IRC) Section 263 (e) which allowed oil and gas companies to expense intangible drilling costs and abandonment losses, and IRC 611-614, which provided the depletion allowance. Both had the intention of encouraging oil and gas companies to explore, discover, and tap resources long before it would otherwise occur (See Lazarri, June 7, 1988, p. 1-4). The renewables industry has not been afforded the same favor, at least not consistently for long periods.

A third institutional factor is the steadfastness with which the government holds to the status quo because of its concern over untried and untested approaches. When the renewables industry began to emerge two decades ago, it could garner very little support for its projects. The executive and legislative branches saw no immediate economic gain from encouraging the use of renewable energy over more conventional sources of energy. The more traditional sources of energy offered public familiarity, high output (determined by Btu), and ease of transport, not to mention low cost service to consumers. Renewables could not offer any of these. Except for a few million dollars invested in research and development, renewables
received minimal federal support in comparison to the development of oil, coal, gas and nuclear technologies. A perennial bias has been toward investing in capital intensive projects and spurring quick growth rather than long-term sustainable growth. Project managers had "a 'natural' desire to employ advanced equipment, because purchases of big technology constituted a rational strategy given the regulatory constraints" (Hirsh, 1989, p. 81). The conventional energy industry is such that it can extract, refine, and use natural resources very quickly. Consequently, they have been a very attractive source for maintaining economic growth in the short-term. Past policy neglected to take into account the fact that less of this resource would be available to fuel economic growth for future generations.

If renewables are to make further strides in the market, they must first and foremost be given more opportunities to demonstrate that they can provide a reliable and cost-competitive source of energy for both commercial and residential consumers. Although opponents of this argument insist that renewables have already been given many opportunities, there is still room to accommodate innovative applications further. Several analysts suggest that the market cannot be relied upon to determine which sources of energy develop now or later. "The rules of the present energy economy were established to favor systems now in place" (Weinberg & Williams, 1990). In addition, "because of continuing imperfections and failures, it is unrealistic to expect an uncorrected 'free' market to solve U.S. energy problems." (Stobaugh and Yergin, 1980, 271-94).

The fourth institutional factor is the broad support that the conventional energy industry continues to receive. Policy has not favored promotion and adoption of new technologies. Some have put it very simply that the renewable energy industry is the "new kid on the block that cannot be trusted" (Kennel and Shea, 1991, p. 86). Others have argued that there is a deeply rooted bias in the benefit coalitions which has arisen to ensure that new policy at the very least does not threaten the market position of the conventional energy industry (Anton, 1989). Both critiques illustrate part of the frustration the renewables industry has faced in its attempts to "level the playing field" with conventional energy. To expect that this behavior would be altered radically in less than two decades is unrealistic. Despite the long-term economic and
environmental good that renewables offer, change will take time as renewables prove themselves in the energy market and institutional mechanisms change.

One of the largest factors, which serves as a barrier, is the difficulty of identifying hidden costs and quantifying environmental externalities. Some have argued that until environmental externalities are taken into consideration in the pricing of energy, renewables will not be able to increase their market share markedly (Interview with Kenneth Sheinkopf, an analyst with the Solar Energy Industries Association). Identifying hidden costs is just as complicated because of the traditional practice of using tax dollars for numerous programs which support the existing infrastructure - production, transportation, etc... The major criticism of attaching costs to externalities is that it is an arbitrary process that unfairly penalizes the conventional energy industry. This is not surprising given the extent to which the conventional energy industry is expected to bear the burden of these costs relative to the renewables industry.

**Political Factors**

Political actors make choices that result in policy and its implementation. Despite the formidable barriers outlined above, several policies were implemented to stimulate the renewables industry. Some, like the tax credits, were initially successful, but eventually led to more trouble than help. As Martha Derthick, a policy analyst, has argued, "major policy change can never be expected to work smoothly from the start. Implementation must be to a considerable extent incremental, experimental, and adaptive. . . Regulations. . . will need 'debugging' in the ordinary course of events." (Derthick, 1990, p. 211). Tax credits were restructured over the decade, but were annually renewed because of political and bureaucratic skepticism of their actual impact (See GAO/RCED-83-8, March 7, 1983). Today, many people--the public, legislators, and utility representatives--remain uncertain about what renewables can actually be used for and what their potential is. The largest determinants of the future of the renewables industry are the political dimensions underlying public policy decisions. Along with the fall in energy prices, the political environment over the last decade became less favorable for renewables.
While institutions set the boundaries for policy debate, the politics determine the direction of the debate. During the past decade, that debate has largely favored existing patterns of energy use. In the middle of Reagan's administration, for example, subsidies for fossil fuel technologies were over sixteen times greater than subsidies for the renewables industry (Heede, Oct. 1985; based on R&D and incentives). Even President Bush's National Energy Strategy, issued in 1991, advocated greater production of conventional energy, drilling in both the Arctic National Wildlife Refuge (ANWR) and the outer continental shelf (NES, p. 91; See also Doyle, 1991, p. 15). Although the Strategy also calls for an increase in the production of energy from renewables, which is supposed to "reduce demand for fossil fuels," production of natural gas, oil, coal and especially nuclear are all slated to increase (See NES, p. 120, 1991).

Energy policy during the last decade has been dominated by short-term proposals, that have typically ignored the benefits that renewables offer. For many years the policy decision made has usually been the one that was most politically expedient. One of the reasons why energy policy is so frequently targeted for short-term results is because of the demands placed on politicians to serve the interests of their constituencies and to support their hopes of being reelected. This points to the first political factor -- the short term mentality of public officials. "The demand for well-planned long-range solutions is not easily incorporated into a system based on incremental politics. Each energy source generates its own problems, interest groups, and Congressional and governmental structures" (Anderson, et al, 1984, p. 104-5).

The second political factor is the influence that political action committees and other interest groups have on the formulation of energy policy. Interest group activity has revolved around attempts to secure favorable policy benefits. Institutions of government and interest groups have both sought favorable policy support. In some cases this has led to policy paralysis when attempting to promote new and alternative energy sources. For example, the energy tax credits offered to commercial production of electricity came under attack during the early 1980's because of the perception that they were ineffective and the competing interests for that federal money. In 1985 the tax credits were not renewed before the end of the year's Senate session because of it's inability to come to a consensus on whether they should be extended. Although they were extended in the next session, the paralysis of the policy makers, which was rooted in
the deep divisions over perceived effectiveness, sent unfavorable signals to the renewables industry and their investors (See SEIR, Sept. 21, 1981, and May 13, 1986). This paralysis lasted into the middle of 1986, leaving many companies fearful of not being able to complete development projects already under way.

The third political factor relates to the integral role that the conventional energy industry continues to play in maintaining growth in our economy. From a historical perspective, energy politics have been dominated by the interests of the conventional energy industry. For three quarters of this century we built our country economically on the abundance of natural resources. The oil and coal industries were traditionally capital and man-power intensive, thus giving their interests a priority over other interests (this is no longer the case; See Flavin and Lenssen, Dec. 1990). Politically, they had a great deal of power to influence the direction of policy and, consequently, which sources of energy we used. Oil fueled the growth of the automobile industry and the massive highway system in this country (Rae, 1971). Petroleum is used in the manufacture of numerous goods. The coal industry has been influential in heavy manufacturing and other industries, in which the United States has always played a leading role. Because of its natural resources the United States was able to industrialize very rapidly during the last century. The speed with which it extracted and used conventional energy resources made all this possible.

The infrastructures of governmental and private institutions are primarily oriented toward the promotion and use of conventional energy: "The substance of public policies is shaped by the character of the governmental institutions making them and by the accepted rules of the game among decision makers" (Rosenbaum, 1987, p. 35-6). It is important to recognize that institutions are inherently biased toward familiar forms of operation, and the preservation of the status quo. In this case, they are biased against the use of renewable energy (Heede, 1985; See Flavin and Lenssen, 1990). The relative dearth and short-term character of the policy support given renewables illustrates the imbalance of funding in favor of nuclear projects, and continued dependence on petroleum. The voices that speak the loudest and are heard the most are those which are the best organized, and oftentimes it is those that have a desire to maintain the status quo. As a result, some policy outcomes are more likely than others (Chubb, 1983).
Additionally, many of the policies that were implemented in the 1980's offered long-term solutions, but were themselves only short-lived.

The fourth political factor of benefit coalitions served to frustrate attempts by the renewables industry to secure favorable policy support. Benefit coalitions are participants in the policy process who seek to preserve present benefit distributions. Although benefit coalitions were usually established on a tenuous basis, as a group they have persisted and grown stronger with time. This further thwarted attempts by renewable energy supporters to obtain sufficient political support that, due to the energy market, would necessitate diminishing the market share of current beneficiaries. As one report noted, "few topics can turn out more lobbyists, or stir up more politicians than proposals that would raise the prices for gasoline, or reduce tax breaks for the oil industry... Special interests watch over every comma and semicolon of federal energy policy, and vigorously protect their pocketbooks" (CSM, Feb. 7, 1991).

One of the factors which this alludes to is the inability to establish consistent support for innovative energy policies. From some people's perspectives, "Washington has done little to steer away from a collision course with energy vulnerability. Congress has been timid and procrastinating, unable to surmount partisan and ideological differences over individual features of a policy," which has strongly reflected public dissensus on energy issues. (Miller, Industry Week, Jan. 6, 1992, p. 34). That is one reason why most policy which is intended to stimulate the renewables industry is often a very watered down form of the original bill, very similar to what happened to PURPA. Once passed, the responsible coalitions quickly dissipated. As Charles O. Jones has remarked, "programs often reflect an attainable consensus rather than a substantive conviction" (Jones, 1984, p. 166).

Those in the renewables industry came to perceive government support as unreliable. The tenuous character of support would not have been perceived as onerous as it was had it not been for the fact that conventional energy and favored alternatives like nuclear continued to receive financial support throughout the 1980's, while renewable support sharply declined. The drop in support for renewables arose from the Reagan administration's desire to devolve policy decision-making to the states and to rely on the market to determine which sources of energy were used. The government was no longer to serve as an agent for change and technological
innovation for new, alternative technologies using renewable energy. As David Davis put it, "the abrupt change in governmental philosophy that swept in with Reagan hit the new fuels particularly hard. After a decade or more of federal nurture, the new fuels found themselves orphaned, or at least abruptly weaned" (Davis, 1982, p. 245).

Social Factors

The third general class of factors is social. These obstacles are not as easily identified as political and institutional factors, but are just as problematic for renewables. The first factor relates to the difficulty of communicating to the public the benefits and costs associated with the use of renewable energy. The majority of the public is ignorant about where their tax dollars go and how the price of gasoline is set in this country. This has proven to be a tremendous stumbling block as the renewables industry has attempted to increase its market share in the residential sector, for example. The willingness to change water or space heating units to solar equipment is complicated by the high up-front investment costs of the units and the relatively long payback.

The second social factor is a lack of familiarity among public officials, bureaucrats, and the public with renewable technology and its potential. Without this knowledge, informed decisions regarding policy formulation and program implementation cannot be reached. Until RETs receive more visibility and attain perceived success they will continue to struggle to prove themselves as an acceptable and reliable source of energy. Once people begin to understand the strengths and limitations of RETs, the contribution to be made by renewable energy will likely begin to rise (Interview with Jan Hamrin, former executive director of the Independent Energy Producers Association, and Blair Swezey).

The third social factor is an apparent unwillingness in the country to change patterns of energy production and consumption in the absence of crisis. Historically, this has meant that government has not sought to implement policies promoting renewable energy unless the country was faced with an immediate crisis and our dependence on imported oil was threatened. Although this situation of being "shocked" into awareness and then action has changed in the last couple of years, renewable advocates have yet to see continued national support for the
development of long-term renewable energy policy. Consumers as a group also do not change their patterns of consumption easily. Without a crisis for support, renewable energy policy lacks definition and salience especially since it is not cost competitive.

Renewable advocates have been left with the perception that the government is either unwilling or unable to offer long-term support for renewable energy, which highlights a fifth institutional factor. Our pattern of energy use continued unabated for almost three quarters of a century until the nation experienced its first energy crisis. Despite this crisis and a second one less than a decade later, the federal government made little progress in changing that behavior and looking long-term. "National policy has long followed the assumption that the more we extract and use our natural resources, the faster we build up our economy.... As energy became cheaper in this country than in many others, we came to use it more and more intensively, ultimately becoming dependent upon large energy flows" (Krutilla and Page quoted in Paul and Russo, 1982, p. 21).

1.4. Conclusions

Energy policy during the time period examined was important on two levels. First, it illustrates that policy makers have not really learned from the past energy crises. The combination of unwillingness and inability have made for energy policy which is devoid of long-term solutions. The dilemma of conflicting criteria also continues to hamper efforts. Policy support for the different sources of energy has been very inequitable as well. It continues to encourage the use and development of conventional energy, without much regard for the future or the environment. Second, policy makers are continually constrained by interest groups and their own desire for reelection. These are short-term concerns. Consequently, policy is designed for relatively short-term results. Rather than a concern for a long-term supply of energy, the major objective of energy policy over the last decade has been the assurance of "an adequate supply of energy at reasonable cost" (SEIR, June 24, 1985, p. 209), as then Energy Secretary John Herrington attested.

An inability to implement policy for the long-term will continue to plague the renewables industry. So long as benefit coalitions maintain their influence on the formulation of
energy policy, the future of renewable energy will remain hazy. Numerous scholars have pointed out that the existing institutional tensions which overlay all federal policy making are deep and persistent. "They arouse frequent conflict and multiply the plurality of interests that must be satisfied." Since decision making is often such a protracted process, any type of coherent and incisive proposed solution or course of action is often frustrated (See Rosenbaum, 1987, p. 37; Jones, 1984, p. 5; and Chubb & Peterson, 1989, p. 57-63). The structure of institutions in this country seems to counteract the efforts of renewable energy advocates in pushing for long-term support. As Charles O. Jones noted, what the Framers envisioned was a government which would preserve domestic tranquility, promote the health of the economy, defend civil liberties, and maintain national security. "[They] were more concerned about preventing tyranny than they were about facilitating policy development" (Jones, 1984, p. 6). Innovative policy which is what renewables need may simply not be likely given the nature of energy politics. V.O. Key wrote in 1942 that "as a general rule it is much easier to prevent legislative action than to bring it about" (Key, 1942, p. 214, ). One explanation that has been offered is that "large organizations, both public and private, have difficulty maintaining a consistent interest in longer-term issues because short-term issues are considered so much more important" (ISEIR, p. 363, Nov. 24, 1987). This is coupled with attempts to prevent or remove policy promoting renewable energy development and use.

Each of these factors in some way influences the process of both formulating and implementing renewable energy policy. Sometimes these factors serve to confound attempts to formulate effective renewable energy policy. This chapter has presented some of the options that government may implement in the future and the factors that will affect both their formulation, and their implementation.

The next chapter examines the manner in which policy formulation at the federal level exhibited the influence of these factors and how the Carter and Reagan administrations addressed the energy issue in general.
Chapter 2- The Promotion of Renewable Energy at the Federal Level

2.1. Introduction

Over the past two decades, energy policy at the federal level has undergone numerous changes whose consequences for the growth and existence of the renewables industry have not been altogether positive. This chapter highlights the energy policies and programs that the Carter and Reagan administrations initiated and their effects on the renewable energy industry. After discussing policy developments under each administration, the chapter offers different explanations for why renewable energy has not been able to increase significantly its contribution to United States' domestic energy supply, emphasizing the role that federal government support has played in cultivating new energy sources. The chapter proceeds chronologically beginning with the late 1970's and ending with the late 1980's.

The first section describes in brief the policies and programs that President Carter promoted to increase the use of renewable energy. Even though conservation was the primary goal of Carter's efforts, his policies envisioned renewable energy playing an integral role in decreasing the nation's reliance on conventional energy sources over time. For this reason, this section is limited to a description of only those energy decisions affecting the growth of the renewables industry and the development of renewable energy technologies [RETs]. The section concludes with a discussion of the accompanying effect that each policy had in light of other developments.

The second section reviews the energy policies and programs of the Reagan administration which reversed those sought during Carter's administration. It takes into consideration changes in the regulatory environment, the tax structure, government sponsored research and development, and market expectations. After presenting the significant policy decisions made during his administration affecting renewable energy growth, the description shifts to the overall impact that Reagan's energy policies had on energy management and use.

The final section draws together the experiences of the Carter and Reagan administrations to determine the effect that the two administrations' policies and programs had on the growth of the renewables industry. It examines the assumptions underlying each
administration's energy decisions and their resulting energy policies. Emphasis is placed on the specific content of change between the two administrations. The intent of this section is to elucidate not only the primary forces driving energy policy over the last two decades, but also the effect that inconsistent and unstable policy support has had on the renewables industry as a whole.

2.2. The Carter Administration

When Jimmy Carter became President in 1977, he brought with him a grand energy agenda. In his first year of office, President Carter made energy his central domestic issue. The energy program he developed had four general objectives: "to centralize federal energy planning through institutional reform, to achieve greater energy efficiency and conservation through selective use of market forces and a major expansion of federal regulatory authority, to rapidly increase federal spending on research and development of new technologies for energy conservation and production, and to ensure that environmental protection and social equity would be important in these programs" (Rosenbaum, 1987, p. 6). The cornerstone for meeting these objectives was the National Energy Act (NEA). Before the development of the NEA in 1978, the federal government did little to promote renewable energy beyond providing minimal R&D support.

In spite of the energy crisis of 1973-74, very little in the way of direct promotion of alternative energy had been undertaken by the federal government until President Carter took office. Prior to 1977, federal energy planning was split among nine different agencies (Davis, 1982, p. 281). In that year, Carter sought to consolidate many of the energy related activities of these different agencies into one new department, the Department of Energy (DOE). DOE was to be the mechanism by which Carter was to implement the five components he included as part of his NEA of 1978. Although he was not the first president to propose the creation of an energy department, he pursued it more aggressively than his predecessors. After passing the House and the Senate, President Carter signed the legislation creating DOE into law on August 4, 1977.
Fourteen months later, Carter signed the NEA, two portions of which were the Energy Tax Act (ETA) and the Public Utilities Regulatory Policies Act (PURPA). These were the first pieces of federal legislation aimed directly at encouraging the development and use of renewable energy. The other three components of the act were: the National Energy Conservation Policy Act; the Powerplant and Industrial Fuel Use Act; and the Natural Gas Policy Act.

The next two sections address the changes wrought by ETA and PURPA.

2.2.1. Policies and Programs Initiated
2.1.1.1. The Energy Tax Act (ETA)

ETA provided "income tax subsidies for investments in renewable energy technologies (solar, wind, geothermal) and nonconventional energy technologies (biomass, gasohol, synthetic fuels, bioconversion)" (Lazzari, CRS Rep. #88-455 E, June 7, 1988, p. 6). ETA amended certain sections of the Internal Revenue Code to provide tax incentives that were intended to dampen future increases in demand for foreign oil, encourage the conservation of fossil fuels, stimulate domestic energy production, and increase the use of more abundant domestic sources of energy -- renewable energy being one of those sources (Senate Report No. 95-529, p. 6). The tax incentives were designed to make alternative energy sources more attractive to investors by improving their cost-competitiveness. The particular tax incentives came in the form of tax credits and exemptions for both residential and commercial renewable energy applications.

A tax credit was also made available to individual consumers who invested in renewable energy source equipment. Such devices included solar space and water heating units, wind power generators, and geothermal space heating and cooling units. Consumers received a 30% credit on the first $2000 and a 20% credit on remaining costs. The maximum credit allowed was $2200. Therefore, if the installation of a residential solar device cost five thousand dollars, the consumer would receive a tax credit of one thousand two hundred dollars. Consumers who purchased such equipment between April 20, 1977 and January 1, 1986 were eligible to receive this credit. With the passage of the Crude Oil Windfall Profits Tax Act (WPT Act) in 1980, the credit level was raised to 40% of a $10,000 expenditure.
For those in the industrial sector investing in alternative technologies, a 10% business energy tax credit (ETC) was created. This was provided in addition to the 10% business investment tax credit (ITC), which was available to those making investments in their business property (See table 2-2). Property eligible for the ETC included solar or wind energy projects and a number of nonrenewable alternative energy uses, like shale oil equipment. For property to be eligible for the ETC, it had to be purchased after September 30, 1978 but before December 31, 1982 (See P.L. 95-618). The ITC was available to those investing in all types of equipment, not just renewable energy equipment or other alternative energy technologies. The only exception was for property that served a structural function as part of an edifice. The ETC was set to be refundable through December of 1979.

Originally the ETC was set at 10%, but in 1980 with the passage of the WPT Act, the credit was raised for some renewable energy property (geothermal, wind, and solar) and newly introduced for others (hydroelectric, ocean thermal, and biomass). Depending on the energy source the credit ranged from 10% up to 15%. A number of renewable energy companies relied upon this provision to make their operations profitable. The ETA stimulated investment in these operations sooner than otherwise would have been the case, and prompted investment where it might not have occurred at all. As Table 2-2 illustrates, after 1980, the number and amount of credits substantially decreased, leaving the renewables industry to survive on its own. Only biomass and solar/wind property were provided with incentives.

2.1.1.2 The Public Utilities Regulatory Policies Act (PURPA)

The passage of sections 201 and 210 of the Public Utilities Regulatory Policies Act (PURPA) (See P.L. 96-917) was the second important component for stimulating the development of a renewable energy industry. The goal of PURPA was to increase cogeneration and small power production (Hallaron, Power Engineering, Sept. 1985, p. 44). PURPA "was designed to encourage the development of [solar, wind, and geothermal] technologies, among others" by requiring utilities to interconnect with qualifying facilities composed of cogenerators and small independent power producers (Philip Sharp, House Hearing, June 14, 1990, p. 1). It was intended to stimulate development of more efficient facilities while keeping utility rate
Table 2-2: Summary of Business Energy Investment Tax Credits

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<td>Credit</td>
<td>Exp. Date</td>
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<tr>
<td>Ocean Thermal</td>
<td>no provision</td>
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<td>15%</td>
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<tr>
<td>Synfuels</td>
<td>10%</td>
<td>Dec. 1982</td>
<td>no provision</td>
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<tr>
<td>II Biomass Property</td>
<td>no provision</td>
<td></td>
<td>10%</td>
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<tr>
<td>IV Natural Gas from Geopressed Brine</td>
<td>10%</td>
<td>Dec. 1982</td>
<td>no provision</td>
</tr>
<tr>
<td>V Shale Oil Equipment</td>
<td>10%</td>
<td>Dec. 1982</td>
<td>no provision</td>
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increases to a minimum. The Act was also designed to encourage utilities and state utility commissions to consider the broader goal of energy conservation.

According to a Federal Energy Regulatory Commission Report, PURPA "designated certain small power production and cogeneration facilities as qualifying facilities (QFs) eligible for various benefits" (FERC, Oct. 1, 1990, p. i). The power from cogeneration is the "simultaneous production of electricity and industrial power from steam" (National Journal, Aug. 4, 1979, p. 1192). A qualifying facility is any small power-producing facility generating less than 81 MWe (recently removed altogether for solar facilities), which "uses some combination of biomass, waste, geothermal, or other renewable resource as the primary energy source" (Hallaron, Power Engineering, Sept. 1985, p. 44). A cogeneration facility is "a facility which produces electric energy and steam or forms of useful energy which are used for industrial, commercial, heating, or cooling purposes" (Gilbert, 1991, p. 73). Another stipulation is that a utility can have no more than a 50% interest in the profits and losses of any QF. Consequently, utilities have been precluded from playing a major role in financing non-utility renewable energy projects. This left renewable energy companies dependent upon non-utility financing.

Once established as a QF, a facility was able to begin operating and in many cases receive quite favorable rates of return for electricity production based on avoided cost payments. Utilities were mandated by FERC to purchase electricity from these QFs at an avoided cost rate, which is "equal [to] the fuel and generating capacity costs 'avoided' by the utility" by making these purchases (Sawyer, 1986, p. 22). Some states determined avoided cost payments through an administrative process, while others established these avoided costs through a competitive bidding process. FERC granted states the right to set the avoided costs as they chose; all that FERC required was that avoided cost payments were provided in some form. This was one of the key elements for stimulating the entrance of non-utility generators into the energy market. In some states like California, the response from QFs was overwhelming (Interview with Jan Hamrin).

The most important aspect of PURPA related to the growth of the renewable energy industry is that it created guaranteed markets for electricity generated by non-utility generators.
As long as the non-utility generator met the requirements under PURPA as a QF, surplus power from cogenerators or additional power from small producers had to be purchased by the utility. In being required to purchase QF power, "the growth of small, decentralized, and efficient energy producers" was stimulated (Rosenbaum, 1987, p. 184). Solar and wind developers benefited substantially from this arrangement because they were able to demonstrate to investors that their projects would continue to receive a steady stream of cash once completed.

PURPA was designed as an intergovernmental program, consequently its implementation varied from state to state. PURPA was formulated to permit latitude among the states with the differences in state and regional climate and natural resources in mind. Consequently, its impact has been different in each state. The Carter administration wanted the Secretary of Energy to have ultimate control over the pricing of electricity (Rosenbaum, 1987). Congress rejected this proposal and opted instead to give that authority to FERC. The agency was given independent authority within DOE to stipulate rate settings, to price electricity, and to have the last word in rate cases. So, although each state was given authority over how to implement the requirements of PURPA, the federal government retained ultimate responsibility and authority for oversight of their effects.

PURPA exempted renewable energy companies from the requirements of the Public Utility Holding Company Act of 1935 (PUHCA). PUHCA was a response to "mergers and the creation of holding companies in the stock market of the 1920's" to impede efforts by the electric power industry to restructure their capital (Gilbert, p. 66). Government intervened because these holding companies were failing to provide adequate service to their customers (Barkovich, 1989, p. 61). PUHCA limited the extent to which utilities could hold a capital interest in other companies, thereby, essentially defining what a utility was. With the passage of PURPA, small renewable and/or cogeneration producers were exempted from the narrow definition of a utility under PUHCA, and were allowed to generate electricity for sale to utilities. The importance of this exemption to the viability of the renewables industry lies in the favorable operating environment it created for them in which to generate electricity. Since they were not technically utilities, they were not subject to regulation by state commissions.
Since its inception, overall PURPA has "substantially increased the number of [small power] production projects and the amount of electricity derived from alternative energy sources" (Pfeffer, Lindsay, and Associates, [DOE Study], Mar. 25, 1986; p. 94 ISEIR). A 1990 report detailed the increase in the number of filings for qualifying facilities from 1980 to 1989 (See Table 2-3). That number peaked in 1986, but declined thereafter, perhaps because of other external factors such as uncertainty over the continued availability of the tax credit. Nevertheless, filings remained significantly above 1980 levels. Only a fraction of these new filings was for solar facilities however. As David Fiksen of Public Citizen wrote, "requiring utilities to give preference to small scale renewable energy resources when contracting for new capacity would provide a tremendous incentive to develop these technologies" (ISEIR, June 30, 1987).

Together ETA and PURPA encouraged the growth of non-utility power producers. It was up to the states to determine the extent to which PURPA would increase the amount of electricity obtained from renewable and other alternative energy sources. The response varied from state to state, as was expected. These two components of Carter's NEA were intended to facilitate an easier transition for an infant industry while fostering energy conservation.

2.1.1.3. The Crude Oil Windfall Profit Tax Act of 1980 (WPT ACT)

The Crude Oil Windfall Profit Tax Act of 1980 (P.L. 96-223) initiated an excise tax on domestic oil production, increased the energy tax credit for certain technologies, introduced a new tax credit for some technologies, and allowed more property to qualify for the tax credits. The residential and business energy tax credits were raised for renewable energy applications. As noted above, the residential credit was raised from 30% to 40% and the business energy tax credit was increased from 10% to 15%. Property such as equipment used to generate power from solar or geothermal energy became eligible. Costs incurred in the drilling of an on-site geothermal well and a number of home structural components also became eligible for the residential credit.

The business energy tax credit (ETC), aimed at increasing the contribution made by renewable energy, was not only increased, but also broadened to include a number of other
Table 2-3: Renewable Energy Facility Filings (1980-1989)

Renewable Power Facility Filings
(in megawatts, MW)

<table>
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</thead>
<tbody>
<tr>
<td>Biofuels</td>
<td>3,054</td>
<td>1,839</td>
<td>1,109</td>
<td>1,002</td>
<td>614</td>
<td>7,618</td>
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<tr>
<td>Geothermal</td>
<td>681</td>
<td>1,404</td>
<td>140</td>
<td>209</td>
<td>26</td>
<td>2,460</td>
</tr>
<tr>
<td>Small Hydro</td>
<td>1,283</td>
<td>1,827</td>
<td>152</td>
<td>187</td>
<td>129</td>
<td>3,578</td>
</tr>
<tr>
<td>Solar</td>
<td>228</td>
<td>62</td>
<td>30</td>
<td>470</td>
<td>5</td>
<td>790</td>
</tr>
<tr>
<td>Wind</td>
<td>1,426</td>
<td>298</td>
<td>220</td>
<td>234</td>
<td>48</td>
<td>2,226</td>
</tr>
<tr>
<td><strong>Totals</strong></td>
<td><strong>6,672</strong></td>
<td><strong>5,430</strong></td>
<td><strong>1,651</strong></td>
<td><strong>2,102</strong></td>
<td><strong>912</strong></td>
<td><strong>16,667</strong></td>
</tr>
</tbody>
</table>

technologies, such as hydroelectric and ocean thermal. The rules for qualification were also significantly "liberalized" (See Lazzari CRS Rep. 88-455 E, 1988). The dates of expiration for most of the credits were extended beyond their original deadlines and the refundable tax credit was repealed.

Overall, the WPT Act quickened the hopes of many in the renewables industry. In the face of increasing energy prices, the decontrol of natural gas, and continued federal support for renewable energy, this optimism seemed well founded. The renewables industry also benefitted from increased federal budget allocations for energy technology research and development under the Carter administration.

2.1.1.4. Research and Development

Richard Ottinger, a law professor at Pace University, has defined federal government research and development as it pertains to energy as "programs to accelerate the introduction of new energy technologies into the marketplace" (Ottinger quoted in Byrne and Rich, 1986, p. 5). The assumption underlying government R&D is that the private sector would not otherwise develop the technology. The goal of government R&D is to reduce the costs of a technology enough to encourage the private sector to adopt and introduce it on a commercial scale.

Research and development funding for renewable energy technologies was vastly increased during Carter's second year in office. The number and size of these programs more than tripled in the four years Carter occupied the Oval Office (based on total dollars allocated to DOE) (See Sissine, IB 90110).

Renewable energy R&D funding was "allocated by the Carter administration for technologies likely to achieve commercialization quickly" (Rosenbaum, 1987, p. 201). The network of federal laboratories became heavily engaged in research and development of a variety of alternative technologies ranging from photovoltaics to large wind turbine generators. However, some of the laboratories, such as Lawrence Livermore, focused strictly on nuclear development which has received over $23 billion in current dollars from 1948 through 1991 (CRS IB 90110, 1991). Prior to 1973, renewable energy received no federal funding for research and development. Since that time, renewables have received a total of $5 billion in
Table 2-1: Research and Development Comparison (1974-1991)

DOE Funding for various energy sources (in current million $)

<table>
<thead>
<tr>
<th></th>
<th>FY74</th>
<th>FY75</th>
<th>FY76</th>
<th>FY77</th>
<th>FY78</th>
<th>FY79</th>
<th>FY80</th>
<th>FY81</th>
<th>FY82</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean Coal Tech.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fossil Energy</td>
<td>79.2</td>
<td>142.9</td>
<td>350.3</td>
<td>535</td>
<td>718.1</td>
<td>750.2</td>
<td>732.7</td>
<td>916.6</td>
<td>181.1</td>
</tr>
<tr>
<td>Nuclear Fission</td>
<td>497.3</td>
<td>630.4</td>
<td>960.6</td>
<td>1065</td>
<td>1051</td>
<td>1081</td>
<td>1097</td>
<td>1127</td>
<td>1063</td>
</tr>
<tr>
<td>Solar/Renewables</td>
<td>20.8</td>
<td>75.1</td>
<td>199.4</td>
<td>336.9</td>
<td>525.7</td>
<td>667.5</td>
<td>718.5</td>
<td>708.1</td>
<td>275</td>
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<tr>
<th></th>
<th>FY83</th>
<th>FY84</th>
<th>FY85</th>
<th>FY86</th>
<th>FY87</th>
<th>FY88</th>
<th>FY89</th>
<th>FY90</th>
<th>FY91</th>
<th>TOTAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clean Coal Tech.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>98.2</td>
<td>149.1</td>
<td>199.1</td>
<td>190</td>
<td>554</td>
<td>391</td>
<td>1581.4</td>
</tr>
<tr>
<td>Fossil Energy</td>
<td>222.1</td>
<td>277.4</td>
<td>298.9</td>
<td>314.2</td>
<td>396.8</td>
<td>347.9</td>
<td>380.6</td>
<td>416.6</td>
<td>461.2</td>
<td>21102.8</td>
</tr>
<tr>
<td>Nuclear Fission</td>
<td>849.5</td>
<td>758.1</td>
<td>600.6</td>
<td>589.6</td>
<td>605.3</td>
<td>582.8</td>
<td>609.1</td>
<td>595.9</td>
<td>306.5</td>
<td>22194.1</td>
</tr>
<tr>
<td>Solar/Renewables</td>
<td>254.7</td>
<td>207</td>
<td>200.5</td>
<td>170.2</td>
<td>143.6</td>
<td>117.8</td>
<td>110.8</td>
<td>110.5</td>
<td>157.8</td>
<td>15094.4</td>
</tr>
</tbody>
</table>

R&D funding support (through 1991). The peak occurred in 1980, the last year of the Carter administration, when renewable energy programs received $718 million (See Table 2-1).

Carter demonstrated that he was willing to commit the necessary resources to bring particular RETs to the brink of commercialization. Although funding was at an all-time high for renewable energy, the General Accounting Office reported and noted, that "the Carter administration...had no plans for achieving the 20 percent solar goal" it had set out in the Domestic Policy Review, and had failed to implement administrative measures that had to be taken to coordinate agency efforts (Frankel quoted in Byrne and Rich, 1986, p. 78). In 1980, a situation of administrative disorder and pessimism emerged. Because of that the future of renewable energy was also cloudy. The renewable energy industry found solace in the level of support that it was being given in R&D and in financial incentives. The industry's main concern was to preserve government support, which would allow it time to develop market-ready technology and an infrastructure stable enough to compete with the conventional energy industry.

2.1.1.5. The Solar Energy and Energy Conservation Bank

One of the more notable, but least implemented, Carter initiatives to promote the use of renewable energy was the Solar Energy and Energy Conservation Bank, or "solar bank" (never implemented under Reagan). As part of the Energy Security Act of 1980, the solar bank was designed to provide "low interest loans and grants...as a means of overcoming the high initial cost barrier and extending renewable energy use to more middle and low-income populations" (Sawyer, 1986, p. 20). A total of $525 million was allocated for use over three years for this program. In the first year, $120 million was appropriated by Congress for bank operation. The successful implementation of the program hinged on Carter being reelected.

By removing the cost barrier, Carter's energy department staff believed that residential consumers who were interested in retrofitting their space or water heating units could do so. The idea was that this would not only help these consumers to cut down on their electricity bills, but would also work toward conserving energy, promoting increased public awareness of the potential of renewable energy, and stimulating the solar industry. By opening up a new market
to the renewables industry, solar in this case, the industry would be able to demonstrate the effectiveness of the technology to a larger portion of the population, thus, presenting the opportunity to garner greater political support. Nevertheless, "in the rush to demonstrate that RETs were 'market ready', [some] like the solar space and water heaters," were plagued with problems (Sawyer, 1986, p. 21). The results of a solar demonstration program were so miserable that the once brimming optimism of the government and industry quickly subsided (US HUD, 1980).

Although there was no direct connection between the solar bank and the demonstration program, the chance to demonstrate reliability and effectiveness was lost. Political support for the solar bank consequently declined, and, with the election of Reagan, it faced an extremely rough path to operation. In fact, much of the funding that was allocated for the solar bank was ultimately used by states to pay for energy efficiency programs and not for the purchase of renewable devices.

2.1.2. Carter's Impact on the Renewables Industry

The Carter administration clearly set the stage for the growth of a viable renewables industry. Whether the industry was ready to emerge is still a subject of debate (Interview with Lozker). Most economic forecasts about future energy prices indicated that the price of energy would continue to rise in the 1980's. The various tax credits were formulated and extended on the basis of that assumption. PURPA was also designed in the belief that the price of conventional energy would rise, thus, making electricity generated from renewable energy more attractive. The tax credits and other incentives were not intended to be permanent.

Carter initiated the first feasibility studies and market projections regarding the potential of renewable energy. Renewable advocates believed that renewable energy had a great deal of promise assuming a concerted federal effort to promote it. Some RETs were projected to become competitive with conventional energy sources soon, if an aggressive federal R&D effort was adopted and incentive programs were implemented. Sales of renewable energy devices to residential consumers reached $600 million in 1981 (Sawyer et al, 1984). By 1981, there were over thirty-five companies competing for wind energy system business and 15 megawatts of
wind capacity had already been installed in California. Annual sales of photovoltaic cells had risen to over $57 million in that same year (Best and Cleveland, 1984). Almost $3 billion had been devoted to renewable projects between 1977 and 1981, leading to the development of a variety of RETs, one of which was the parabolic trough solar collector, which was later refined by Luz International. Biomass use increased by almost 68% between 1975 and 1981. Over 5 million homes used biomass as their primary heating element by 1981 (Sawyer, 1984, p. 20).

Carter's National Energy Plan (NEP) was intended to "promote energy efficiency and reduce dependence on imported oil" by developing alternatives and creating incentives for private industry to run with the new technologies (Rosenbaum, 1987, p. 6). The Carter administration's energy plan embodied more than just the desire to change the direction of domestic energy use and oil dependence. According to the President, his energy initiative represented "the moral equivalent of war" (CQ, Energy Policy, p. 252). This stance on energy issues characterized the vigor with which he pursued his NEP. His initiative also called for national sacrifice for the future through energy conservation, but Carter found it difficult to obtain public support for this request. To promote conservation, he had to tie his initiatives to renewable energy. The reason for this is that it was easier to obtain support for renewable initiatives than it was for conservation measures because conservation lacked what Rosenbaum has called "political sex appeal."

Despite enjoying Democratically controlled majorities in Congress, Carter encountered little but conflict in energy policy making. Some argue that this conflict was due to "the political incompetence" of the Carter administration (Rosenbaum, 1987, p. 7). The failure of the Carter administration to get the public behind its energy initiative, Rosenbaum argues, also made Carter's goals that much more elusive. Others insist that what contributed more to the difficulties of the Carter administration was the lack of communication between his energy planners and key figures in Congress. The importance of obtaining supporters, they say, lies in the need for executive policy "to assemble a winning coalition of policy influentials such as congressman and interest groups" (Chubb, 1983, p. 233). Without these essential ingredients, policy formulation can be very troublesome, if not paralyzing, as Carter often experienced.
The biggest problems with his energy plan were that it "suffered from excessive haste in formulation and complexity in design, from incompetent political management and feeble public appeal, from bad timing, and in cohesive congressional support for its major objectives. . . By the time [Ronald] Reagan came to Washington, the Carter program, whatever its intrinsic merits might have been, was largely discredited" (Rosenbaum, 1987, p. 8). "Getting a policy that asked for sacrifice and higher prices through Congress proved to be beyond Carter's leadership ability" (Anderson, 1990, p. 98). He failed to provide adequate leadership, thus, invoking skepticism and doubt among the public and the rest of government that what was promised could be delivered.

The more insurmountable challenge for Carter was the task of altering tradition, both political and social. Over the last century specific channels by which interest groups appeal to legislators for support have arisen. Over time bonds have been established between government and industry. The automobile and petroleum industries, for example, have invested vast resources to reinforce those bonds by contributing to campaigns and sustaining lobbying efforts. Carter sought to create a policy that called for Congressmen to alter their relationships with these interest groups. Obviously, these interests had much to gain from continued government support. The threat to that support triggered an onslaught of lobbying to prevent change. As Douglas Bohi of Resources for the Future has commented, no other issue in Washington brings out more lobbyists than those affecting the operations and profits of the fossil fuel industry (Interview with Bohi).

Socially, Americans in general were not willing to sacrifice for the future either. The public was used to having a steady, uninterrupted flow of cheap energy. To ask citizens to curtail their energy consumption, proved to be too much. Although many opinion polls indicated that consumers would be willing to pay extra for renewable energy, conservation initiatives could not muster similar support. One explanation is that renewable energy use would allow citizens to continue consuming at the same rate, whereas conservation necessitated a reduction in use. Certainly, real progress was made in efficiency improvements without having to change people's lifestyles, but it was not as substantial as Carter had hoped. United
States' reliance on cheap oil was a dependence that proved too strong for Carter to diminish significantly through conservation measures.

The primary message that Carter tried to send to the public was that we were facing an energy crisis that would only get worse if we did not deal with it. The renewable and alternative energy industry was able to meet this crisis, but not as strongly as Carter had hoped. The allure of renewable energy was more powerful than that for conservation. Consequently, Carter was oftentimes forced to tie the two together in order to get conservation programs passed. Additionally, whereas Carter portrayed a very bleak picture of future scenarios to the public, one which they were unwilling to consider seriously, Reagan offered a rosy option of no sacrifice and reduced government intervention (politically both values were held dearly by the public). With the change in the occupant of the executive office came a dramatic shift in general energy policy.

After the inauguration of Ronald Reagan in January 1981, the renewable energy industry received its first glimpse of what its future would be like in the coming decade. The perceived proper role for government in energy matters shifted from one of intervention under Carter to one of laissez-faire under Reagan. As this shift occurred, political support for renewable energy sources became first uncertain, later inconsistent, and finally absent (Interview with Sam Rashkin, an analyst with the CEC).

2.2 The Reagan Administration

Michael Halbouty, the soon to be head of President Reagan's energy task force, declared in 1978, that

there is no question that the public is confused about the energy situation... I would like to clarify a flagrant misconception by making it perfectly clear that there is no energy crisis in the United States. This country has a tremendous amount of energy potential. But there is a very serious energy problem—in fact, the problem is a crisis—namely, Washington has politically manipulated, interfered, and imposed dictatorial controls and regulations which severely stymied discretionary productive efforts by the energy industries (Brewster, 1984, p. 60).

Although voiced a full two years before Ronald Reagan became president, this statement captures neatly the position later adopted by Reagan his administration. Sacrifice was not to be
requested, an energy crisis demanding that the public conserve energy was said not to exist, and
the reduction of domestic production was not a solution to the country's economic ills.

The Reagan approach to energy use and management was to reduce government
intervention and allow the free market to determine energy production and consumption
patterns. The proclaimed role for national government was limited to "maintaining and
increasing the Strategic Petroleum Reserve, assuring ample fuel supplies for the military and
public safety, coordinating international emergencies, safeguarding mineral resources on Federal
lands, assisting in private sector planning, and providing information" (CRS Rep. No. 88-455 E,
1988). Aggressively promoting renewable energy development was no longer considered a
responsibility of the federal government; but of the private sector. Reagan insisted that
"increased reliance on market decisions offers a continuing national referendum which is a far
better means of charting the Nation's energy path than a stubborn reliance on government
dictates or on a combination of subsidies and regulations" (NEPP, 1981:1).

2.2.1. Policies and Programs Initiated

Along with this philosophy of not intervening in the free market came a switch from
demand-side economics to supply-side economics. Emphasis was placed on energy production
rather than conservation and energy management for the long-term. The Reagan administration
believed that any other approach would unnecessarily distort the market by favoring some
sources of energy over others, without any guarantee that government intervention would allow
the least cost fuel to be consumed. Unlike the Carter administration, the Reagan administration
argued that the free market, not government regulation, should determine the nation's energy
mix (Katz, June 1984). Except for supporting the nuclear industry with subsidies, the Reagan
administration stressed the pre-eminence of the free market principle.

Reagan's adoption of energy strategies revolving around the "free-play" of the market,
brought with it an abandonment and sometimes forceful attack on incentives created by the
Carter administration to promote the renewables industry. According to analysis in the Solar
Energy Intelligence Report, the basis for the attacks lay in the results of studies of the
effectiveness of tax credits, such as those undertaken by Charles River Associates (1981) and

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Booz, Allen and Hamilton (1983). Both studies, along with a Treasury Department analysis, reported that the tax credits were a heavy drain on the federal budget, on the order of $1.8 billion dollars a year (SEIR, p. 310, Sept. 21, 1981).

Under Reagan, "energy tax policy initially centered on the concept of removing barriers to production of [fossil] fuels and opposed using the tax law to promote...conservation, or alternative energy development" (CRS Rep. No. 88-455 E, 1988, p. 13). The National Energy Policy statement submitted by the Reagan administration in July 1981, as required by law, called for the repeal of the WPT Act, which had expanded and increased tax incentives for renewable energy while penalizing the production of domestic oil. The attack on business and residential energy tax credits was also motivated by the belief that they were "not necessary in view of the substantial incentives to capital formation provided in the Economic Recovery Tax Act of 1981" ((CRS Rep. No. 88-455 E, 1988, p. 13).

Reagan began his campaign to eliminate certain tax credits in early September 1981. Reagan's proposal arose in part because he was unable to persuade Congress to go along with a cut in Social Security. This desire to reduce federal expenditures in many areas was driven by his plan to cut the federal budget by $13 billion for the following fiscal year (SEIR, Sept. 28, 1981, p. 317). These tax credits had been continually viewed by the federal legislature as revenue losers. Reagan also argued that they did not elicit the desired behavior. In the face of unprecedented budget deficits and falling general energy prices in the 1980's it was difficult to argue on behalf of their continued provision. In spite of this, the House and Senate was able to block Reagan's initiative to remove energy tax credits in 1981 by collecting enough names (221 signatures) on a "resolution of disapproval to assure defeat of any such proposal" (SEIR, Oct. 12, 1981, p. 333).


One measure which did adversely affect the competitiveness of the renewables industry early on in Reagan's administration was the Economic Recovery Tax Act (ERTA) of 1981. The changes it made to federal tax law effectively reduced the tax rate for fossil fuels more than it did for tax rates on investments in renewable energy projects. Thus, as a Renewable Energy
Institute report noted, on a comparative basis the difference between investment in fossil fuel projects and renewable energy projects became minimal (REI, Nov. 4, 1982). The most important change that ERTA brought was in the length of time that energy producing equipment could be depreciated. Under a refined version of the accelerated cost recovery system, or ACRS, depreciable wind and solar assets were placed on a five year cost recovery schedule while certain fossil fuel assets were costed over ten years. The net effect was to diminish the difference in benefits from investing in conventional energy projects versus alternative energy projects.

Two other relevant ERTA-related changes were the reduction of the windfall profit tax and the introduction of an alternative energy R&D tax credit. The reduction of the effective tax penalty partially removed a disincentive to produce oil domestically. The R&D tax credit was offered to those in the private sector engaged in research and development of alternative technologies (See CRS Rep. No. 88-455 E for extensive discussion).

2.2.1.2. Research and Development Under Reagan

Funding for renewable energy R&D programs dropped by over 50% in Reagan's first two years. All energy research and development appropriations were reduced by almost thirty-seven percent in less than three years, and renewable energy support declined by over seventy percent during this time (See CRS IB90110, 1991). Funding bottomed out in FY1990 at $110.5 million. Outwardly, Reagan proclaimed that the market, not the government, should determine which sources of energy we use. However, while he was cutting funding for most energy sources he was increasing R&D for the nuclear industry. In making the changes that he did, Reagan anticipated that the mechanisms of "the marketplace [would] control the price and supply of oil and other energy sources" (Cooper, Oct. 12, 1990, p. 587). Within months of assuming office Reagan began slashing budgets for programs and attempting to consolidate and eliminate departments and agencies in many sectors, not just energy.

The primary arm for renewables research, the Solar Energy Research Institute (SERI), received absolutely no funding for four years under Reagan. The director of the institute, Denis Hayes, a pioneer in the promotion of renewable energy, was fired by the Reagan administration
to make room for "people more ideologically in line with the Administration" (Narum, 1992, p. 40). Senator Gary Hart had underscored the significance of Hayes' appointment in July 1979, when he commented that "[Hayes] is the voice of hope at a time when the country needs hope in the field of energy" (ISEIR, July 30, 1979, p. 303). The Reagan administration stance was that government had no business using tax dollars to fund renewable research and development projects that the private sector could do a better job developing. Consequently, Reagan cut funding for both fossil energy and renewables. As Eugene Frankel wrote, "the Reagan administration rendered ineffective the very vehicle by which technology transfer to private industry could have taken place" (Frankel quoted in Byrne and Rich, 1986, p. 81).

The renewable energy R&D budget cuts caused a disruption of established programs that "made effective policy implementation virtually impossible" (Narum, p. 40). It led to the abandonment of certain RETs, that were in their prototype phase, and coming close to commercialization. An example of one of these RETs was the small wind turbine adopted by U.S. Windpower, that had to be financed through third party investment, something which is more akin to commercial ready technologies. When cutting programs, little consideration was given to the stage of development of the individual technologies and what their near-term potential was. As Walter Patterson argued, "timing is crucial for a new energy technology" (Patterson, 1992, p. 188). Reagan eliminated allocations for many of the more promising small scale RETs and remaining funding was allocated for more risky "high-tech" projects (Katz, June 1984, p. 141-2). Timing was not a concern when determining which technologies to promote and which to terminate. Reagan was opposed to this type of government spending as a matter of ideology - irrespective of timing, type, or scale of technology.

2.2.1.3. Tax Reform Act of 1986

The Tax Reform Act of 1986 (TRA) brought a number of changes to energy tax policy, changes that were both positive and negative for the renewables industry. Energy tax policy changes affected both conventional and alternative energy production and research. The Reagan administration contended that the tax system should be neutral, promote economic efficiency, and not inhibit free market mechanisms. In part the TRA was prompted by several problems
which had developed in the energy tax structure. The broad gauged systematic issues that prompted reform were also true for energy specifically. The following is a list of those problems perceived as requiring correction:

1) complications and inequities of the income tax system
2) a narrow tax base
3) the distortion of basic economic choices and resource allocation
4) incentives for tax shelters and other abuses
5) tax system discouragement of investment and savings
6) and, the impediment to economic growth from disincentives (CRS 88-455 E, p. 16).

The first change specific to energy was in how intangible drilling costs were expensed for oil producers. The amortization of their costs was raised to 30% over 5 years. Prior to the TRA, 20% could be amortized over 3 years. Costs incurred overseas also had to be amortized, but were set on a 10 year basis or were included in cost depletion calculations. A second change was that geothermal, oil, and gas property was no longer to be eligible for a percentage depletion of expenses from activities not directly related to actual production. These were minor changes, but they did slightly remove production disincentives from fossil fuel production that placed renewables at a marginally increased disadvantage.

A third change was creation of new incentives for the energy industry. Oil and gas property investments were not subject to the passive loss limitation requirements aimed at stemming tax shelter investments. Also, a new minimum tax did not include the expensing deduction in full as a preferential tax item. "Only the difference between the deduction above 65% of net income would be treated as a preference item" (CRS Rep No. 88-455 E, June 1988).

As for alternative energy applications, changes in the tax structure were quite favorable. The TRA extended the ETC for solar, geothermal, ocean thermal, and biomass property (See Table 2-4). In two cases, the energy tax credits were to be reduced over time. Wind power was the only renewable category which did not receive a credit extension. The TRA did not make the extensive program of residential tax credits for renewables retroactive to 1985 when they
## Table 2-4: Energy Tax Credits (1978 - 1991)

### Energy Business Tax Credits for Various Renewable Energy Applications (% rate)

<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Biofuels</td>
<td>0</td>
<td>0</td>
<td>10</td>
<td>10</td>
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<tr>
<td>Geothermal</td>
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<td>10</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Ocean Thermal</td>
<td>0</td>
<td>0</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
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<td>15</td>
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<tr>
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<td>0</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<td>12</td>
<td>15</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Solar Thermal</td>
<td>10</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>12</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Wind Property</td>
<td>10</td>
<td>10</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
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<td>0</td>
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<td>0</td>
</tr>
</tbody>
</table>

had expired. Authorized as part of the National Energy Act of 1978, the residential tax credits expired in 1985, bringing to an abrupt halt the growth of the residential solar heating industry (Quigley quoted in Gilbert, 1991, p. 294): "The number of solar-equipment manufacturers in the water- and space-heating end of the business fell from 185 to 20 following the removal of the subsidies," said Scott Sklar of SEIA (Miller, 1991, p. 52). Photovoltaic system purchases were also promoted during the late 1970's and early 1980's, but after 1986 when the federal government "eliminated previously applicable tax credits, . . .the purchases of photovoltaic systems declined markedly" (Walton & Hall, 1990, p. 253; see also Smith, EPRI Rep. GS-6303).

2.2.2. Reagan's Impact on the Renewables Industry

Overall, the impact of Reagan promoted policies on the renewables industry was not positive. Nevertheless, more important than Reagan's antagonism was the fact that energy prices fell during the 1980's causing interest in renewables to wane rapidly. Richard Andrews argued that "it was not that [Reagan] was necessarily opposed to the environment. . .but that he was so categorically anti-government in domestic affairs that neither the specifics of the issues nor the real problems that had evoked regulation mattered: the issue was the size of the government per se" (Narum, 1992, p. 42). Nevertheless, "the effect on the solar programs of the Reagan administration's budget cuts and its reversal in federal policy was quite severe" (Frankel quoted in Byrne and Rich, 1986, p. 81).

This lack of support for renewables under the Reagan administration was manifested in the tax policies initiated, the continued attacks on energy tax credits, and the massive reductions in federal R&D funding. Reagan gave no indication that an energy crisis existed. For him, the only crisis that existed "was that created by the government policies that had held back the development of the country's abundant energy resources" (Tugwell, 1988, p. 127). This is evident in his effort to remove disincentives to domestic energy production, which had been put in place during the Carter administration. Each of Reagan's tax policies was designed to remedy perceived impediments to fossil fuel production. As his administration removed production
disincentives, it further reduced the competitiveness of alternative energy sources whose market position had already been weakened by low energy prices throughout the 1980's.

In the early 1980's, in the throes of a recession, the federal government sought ways to trim federal expenditures. The business investment tax credit, for example, cost the government billions of dollars in lost revenue from the stand point of the Reagan administration. Therefore, it was an expenditure that should be eliminated. The Reagan administration perceived that government had no place in intervening in the market in this fashion. Consequently, the renewables industry could not look to the government for either reliable support or encouragement.

During the Reagan years, the renewables industry lost much of the ground that it had gained in the latter part of the 1970's. One example was the 90% reduction in solar heating unit manufacturers (Challenge Nov./Dec., Flavin, p. 9, 1990). Due in part to the phase out of energy tax credits and reduced R&D, many of the largest companies involved in developing renewable projects sold their shares in the market and exited. A few companies, such as Luz International, were able to remain in the market, but became dependent on continued provision of federal and state financial incentives.

Reagan joined his refusal to acknowledge the importance of both short and long-term energy projects with an alternative interpretation of requirements to meet the energy challenge facing the nation (Tugwell, 1988, p. 127). As a result, the unwillingness of his administration to provide support for renewable projects with near term potential, helped to undermine many earlier optimistic forecasts regarding the potential contribution of renewables to the national energy supply. The Reagan administration facilitated the destabilization of the renewable energy industry by offering, what Richard Heede, an analyst with the Rocky Mountain Institute, has called, "lackluster support" (Interview with Heede).

Reagan administration policy concerning energy management and use was drastically different from that of the three preceding administrations (Rosenbaum, 1987). President Reagan claimed that by decontrolling oil prices, removing disincentives to their production, and opening up new tracts of public domain for exploration, the energy needs of the country would be met (Wall Street Journal, August 5, 1980). His administration also believed that by allowing
these changes, the supply of cheap oil would not be interrupted by disruptions on the global market (Katz, 1984). Using the way he handled oil issues as an example, it became apparent to many analysts that an energy supply for the long-term was not taken into consideration in most of Reagan's energy plans. Despite Reagan's optimism about tapping potential domestic energy supplies, as Katz pointed out, "no energy experts ha[d] been found who agree[d] with his assessments" (Katz, 1984). Reagan succeeded, however, in convincing the majority of the public that we indeed did not have any energy problems, thus, effectively removing political support for promoting renewable energy.

In defense of Reagan's policy approach, his director of OMB, David Stockman, argued, "energy should be treated like any other commodity and allowed to equilibrate supply with demand at an appropriate market clearing price. Any government policy constituted an unjustified interference in the workings of the marketplace." (Frankel quoted in Byrne and Rich, 1986, p. 79-80). At the time, limited government was very appealing to the public. Stockman's perspective afforded the Reagan administration great latitude in eliminating funding for renewables and other so-called "revenue drains." The long-run good of energy policy was not of great concern to his administration.

2.3. Conclusions
2.3.1. Inconsistency and Instability of Energy Policy

One scholar summarized the effect of the change in administration from Carter to Reagan as a "turnabout in policy [that] has left the fledgling solar industry unsure, despite rapid technical advances, whether it can survive in the marketplace" (Rosenblatt, 1982, p. 221). Although Rosenblatt was referring only to the solar industry, this same apprehension was experienced by the entire renewables industry. The industry could no longer look to the government with certainty to receive regulatory or policy support, regardless of the near-term promise or long-term potential demonstrated. The resulting relationship between government and industry did not become hostile, but it did become unstable. Investors basically lost their
source of support. They could still invest, but it was at much higher risk and with few or no tax advantages.

For most analysts, the biggest stumbling block to further growth of the renewables industry has continued to be cost in relation to continued low cost conventional energy. However, an unstable and inconsistent energy policy environment has also made the transition to commercialization for RETs and the establishment of a firm market base elusive. As general R&D declined and the continued provision of federal tax incentives remained questionable, that apprehension was realized.

Under Reagan cuts in federal support were prompted by a number of variables: first, a shift in the stated proper role of government; second, a desire to reduce federal government spending in the entire energy area, i.e., eliminating perceived revenue drains, with the noted exception of nuclear energy; and, third, the greater reliance on the private sector to invest in research and development rather than the government doing so. David Narum has been very critical of Reagan's actions arguing that "without research and development expenditures, the development and introduction of new energy technology on a large scale cannot be accomplished in our energy intensive society" (Narum, Jan. 1992, p. 41). The Reagan administration insisted instead that the private sector should pay for the majority of research and development, especially for small scale RETs. This is the reason why the R&D credit was created in the TRA of 1986.

Carter, on the other hand, sought to facilitate commercialization of those RETs which were, in the near-term, the most promising. Although he too focused a great deal of attention on building up the Strategic Petroleum Reserve, his major concern lay with developing a diverse supply of energy for the long-term. One of the persons who shared President Carter's concern with energy diversity in the short and long-term was Robert San Martin the director of energy conservation for the Department of Energy. He emphasized that government support in, for example, renewable R&D was of great importance:

As the research and development process proceeds, more information is gained, lower cost systems are developed, so we can anticipate that the technology based energy supply options will have cost[s] that decrease over time as we learn more and more about these particular resources.
With consistent support the potential contribution of these RETs would be enhanced, and without it the private sector would have little incentive to adopt technologies whose costs were otherwise prohibitive. Consequently, the sudden cuts that renewables suffered when Reagan assumed office were quite detrimental to their continued progress toward commercialization.

Reagan did not perceive a need for the federal government to intervene in energy issues. The Reagan administration insisted that energy concerns could be dealt with outside of a "global context," and that we did not have to worry about diminishing our domestic supply of resources in the present (Brewster, 1984). By not developing prototypes for the private sector to adopt and refine, Reagan effectively eliminated any incentive for the industry to develop the technology. As Eugene Frankel has noted,

\[
\text{Industry and national laboratory officials have consistently testified that to commercialize a new energy technology, the private sector must see a working model of reasonable size from which it can make projections as to the likely cost and performance of commercial systems. Without such a demonstration, the cost of engineering development, the risk of failure, and the time to realize a payback are all too great to make the technology development investment appear worthwhile to senior corporate management. (Frankel quoted in Byrne and Rich 1986, p. 81)}
\]

As a result of the abandonment of many of the RET projects by the federal government, a large number of the domestic companies that had invested millions of dollars in readying RETs for large scale commercialization, under Carter, left the market under Reagan.

Scott Sklar, the director of SEIA, pointed out that "lapses, changes and expirations of the tax incentives and cuts in U.S. research and development programs at the Department of Energy have severely hindered or crippled the U.S. renewable energy industries" (Scott Sklar, Renewable Energy industries, Hearing Before the House subcommittee on Energy and the Environment, December 16, 1986, p. 118). In one sense, Reagan policies discouraged potential manufacturers from entering the market. Reagan policy action also revealed broad debate over what role the federal government should be expected to play in promoting renewable energy. Robert Stokes, who is the deputy director of research at SERI, argued that "the federal government has to be the lightning rod and take the lead. Private industry is interested in
photovoltaics, geothermal, solar thermal, wind. .But primary funding and impetus as well as incentives must come from the federal government" (The Denver Business Journal, April 16, 1990).

A consequence of the government reducing its role in promoting technologies was the need to rely on non-governmental investment in projects that were not yet commercializable. Some wind and solar companies had to depend on financing that hinged on continued availability of tax credits. As Reagan continually attacked the tax credits during his administration, securing adequate financing sometimes became an enormously difficult task. Again, despite making technological improvements, the industry had to contend with the elimination of government provided incentives, upon which they were dependent.

Through government intervention over the past two decades the renewables industry was able to establish a market niche rapidly. However, as the 1980's progressed, that progress quickly faded. Why this market share diminished did not have to do so much with technological inefficiencies as it did with the collapse of previously rising energy prices and an ideological shift in the perceived role of government, i.e., meaning less public support in the face of adverse market conditions (Frankel quoted in Byrne and Rich, 1986, p. 84). Some abuses of the energy tax credit by investment companies in wind and solar projects also led to the dissipation of public support. What further hampered efforts to maintain support for the funding of renewable energy was the fact that the public had been "lulled into complacency by the sinking price of gasoline and heating oil, Americans lost interest in energy policy"(Cooper, Oct. 12, 1990, p. 591). If government support had remained commited to renewables, it could have forestalled their decline.

2.2.2. Expectations of the Federal Government and Renewable Energy

Some, like Joskow and Pindyck (Jan. 1979, p. 18), have argued that "the government should use its limited resources to reduce the cost of producing [RETs], but should avoid in any way determining the specific technologies that are developed." Since production and consumption incentives, as well as research and development at the federal level, have been largely biased in favor of conventional energy and large scale capital intensive projects, it should
Come as no surprise that the renewable energy contribution to our energy supply has not risen above 10% (See Monthly Energy Review, May 1991). As a source at NREL remarked, if renewables are to make a larger contribution to our domestic energy supply within the next decade, government must assume a role beyond research and development; "it must send the message that government is concerned" (Interview with Blair Swezey). Reagan's initiatives conveyed precisely the opposite message.

At the time that tax credits were initiated, the price of oil was around fourteen dollars/barrel and natural gas cost about thirty cents/cubic foot. Tax credits were expected to nurture infant industries like wind and solar at least a decade before normal market forces were expected to do so. By 1979, a year after they were initiated, oil prices rose to about thirty-five dollars/barrel, and natural gas was deregulated. After 1981, energy prices dropped and government support for renewable energy development began to wane. Given the fall in energy prices, the question among interested analysts became; "Do we as a nation want to encourage the use of solar energy" and other forms of renewable energy? (Morris, 1985, p. 12). If the answer was 'yes,' the question then became should people expect the government to continue providing incentives to an industry that was expected to stand on its own, albeit under different economic circumstances? Additionally, should the government be expected to design commercial scale technologies?

Underlying the provision of tax credits as well as the implementation of PURPA were the assumptions that renewable energy would be competitive within a few years, that nonrenewable resource conservation represented a social good beyond what the market accounted for, and that energy prices would continue to rise. With real prices of energy decreasing over the last decade instead of increasing, continued support of renewable energy incentives was questioned by both advocates and skeptics. The dilemma this created for policy makers was in trying to justify their continued existence or elimination depending upon which perspective one adopted about the potential of renewables in the near and long-term.
Chapter 3 - California's Response to the Promotion of Renewable Energy

3.1. Introduction - California and Renewables

California has been an international leader in the promotion and use of renewable energy since the mid-1970's. Before the federal government initiated an energy tax credit, California had already offered one for two years (Quigley quoted in Gilbert, 1991, p. 294). By 1985, over 4000 MW of QF capacity were delivering electricity to the power grids of California utilities, 280 MW of which came from renewables (REI, p. 2-1). Over 30% of all renewable energy production in the country, excluding large hydro, was generated in California. The percentage of electricity consumed in the state which came from renewables had reached 13.44% in 1989 (Rader, The Power of the States, Public. Citizen, p. 10, June 1990). In all, California produced over ninety-four percent of the solar electric, wind, and geothermal power in the country as well. Electricity production from photovoltaics in California yielded over seventy-eight percent of the nation’s electricity from this source (States News Service, May 11, 1989). One might ask, why was California so far ahead of the rest of the country in diversifying its energy supply? The answer is simple: the political environment in California has been very supportive of the renewable energy industry, California has an abundant supply of wind and sunshine, and demand for electricity in the state has grown continually, thus calling for new capacity.

This chapter outlines the major policies initiated in California affecting the growth of the renewables industry. California was selected for study because of the instrumental role the state has played in demonstrating to other states how aggressively to promote the use of alternative energy sources, including renewables. California has been one of the most progressive states in implementing policies and programs to stimulate renewable energy production and encourage its consumption. The discussion will proceed chronologically, beginning with the governorship of Jerry Brown and ending with that of Pete Wilson. Throughout, the discussion of the policies initiated under these administrations highlights the role that politics played in their outcome. The second section examines the important role that the California Public Utilities Commission (CPUC) has played in implementing PURPA and creating a favorable environment for small, independent energy producers. The third section describes the evolving role of utilities in
California in promoting renewable energy. The utility companies also played an integral role in the growth of the renewables industry both positively and negatively.

3.2. The Governors

3.2.1. Governor Brown

Governor Jerry Brown began the trend of supporting and developing renewable energy during his administration. Soon after Brown took office in late 1974 he began to alter the energy regulatory environment by appointing two new commissioners to the state Public Utility Commission, who were more ideologically in line with him. He ordered the California Energy Commission (CEC) and the CPUC to reevaluate the state's energy needs, and renewable energy's potential to contribute to those needs. Brown used the study's conclusions to begin turning the state toward greater energy diversity and resource conservation. What explained Brown's attitude toward renewable energy? Barbara Barkovich has argued that Brown had a strong leaning toward environmental and consumer interests: "Brown was also personally interested in small-scale technology, leading him to be a proponent of the use of dispersed, innovative sources of energy such as solar and wind power and of energy conservation" (Batinovich, p. 69).

The agent of change for Brown was the CEC, which was formed in the early stage of his first administration to facilitate the transformation in energy use. The bill authorizing its formulation was signed by Reagan when he was governor. The main responsibility of the CEC was developing energy demand and supply forecasts for the state as well as ruling on utility requests to add additional power (Friedman in Gilbert, p. 15). The state public utility commission, the CPUC, regulated the utilities and their energy production cycles along with reviewing requests for rate increases.

During his eight years in office, Brown helped to foster dramatic change in the electricity generating market. Most notably he facilitated the creation of a very favorable operating environment for small, independent power producers. Unlike Ronald Reagan, who preceded him in office, Governor Brown advocated increased government involvement in the energy sector. Governor Reagan was very pro-business and anti-interventionist, while Brown
Table 3-1: California Tax Credits (1978-1986)

**Solar Energy and Conservation Tax Credits in California**

<table>
<thead>
<tr>
<th>Year</th>
<th>Bill</th>
<th>Credit</th>
<th>Expiration</th>
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<tbody>
<tr>
<td>1976</td>
<td>SB 218</td>
<td>10% up to $1000</td>
<td>12/31/80</td>
</tr>
<tr>
<td>1977</td>
<td>AB 1558</td>
<td>5% up to $3,000 net of federal credits</td>
<td>12/31/80</td>
</tr>
<tr>
<td>1978</td>
<td>AB 3623</td>
<td>55% up to $3,000 net of federal credits</td>
<td>12/31/80</td>
</tr>
<tr>
<td>1980</td>
<td>AB 2036</td>
<td>55% up to $3,000 net of federal credits</td>
<td>12/31/83</td>
</tr>
<tr>
<td>1980</td>
<td>AB 2030</td>
<td>40% up to $1,500 net of federal credits</td>
<td>12/31/83; varies</td>
</tr>
<tr>
<td>1983 State</td>
<td>budget</td>
<td>50% for solar systems up to $3,000 net of federal credits</td>
<td>12/31/86 for solar and wind energy; 12/31/86 for energy conservation credits</td>
</tr>
<tr>
<td>1983</td>
<td>SB 298</td>
<td>Reduced credit limits</td>
<td>See text for more info</td>
</tr>
<tr>
<td>1983</td>
<td>AB 2158S</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1985</td>
<td>SB 125</td>
<td>Gross of federal credit</td>
<td>12/31/86</td>
</tr>
<tr>
<td></td>
<td>SB 1079</td>
<td>10% 1-family; 25% 1+ family up to $1,000</td>
<td>12/31/86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10% all dwelling structures up to $1,000</td>
<td>12/31/86</td>
</tr>
<tr>
<td></td>
<td></td>
<td>10% 1-family up to $750; 25% 1+ family, no maximum</td>
<td>12/31/86</td>
</tr>
</tbody>
</table>

was pro-consumer and pro-environment. Brown sought to reform the way electricity was priced and to diversify the sources of that electricity. In addition to promoting change and renewables in the energy generating market, he also wanted to stimulate the use of renewable energy technology in the residential sector.

The first tax credit offered to encourage individuals in the residential sector to purchase solar water and space heating units was enacted in 1976 (See Table 3-1). "Since 1976, California has enacted eight laws that authorize tax credits for investments in certain classes of energy-saving capital equipment in residential dwellings" (Quigley quoted in Gilbert, 1991, p. 294). This first law (SB 218) qualified individual and corporate tax payers purchasing solar heating units for a 10% tax credit. The credit could be used toward the costs incurred in the acquisition and installation of solar equipment used for heating, cooling, or electricity production. The maximum credit allowed was $1000. Consumers could claim the credit only once between January 1, 1976 and December 31, 1980.

In September 1977, this tax credit was eliminated in favor of a new credit set at 55%, with a limit of $3000 for solar equipment on single family dwellings. Conservation measures taken as part of the installation of solar equipment also became eligible under the bill. Commercial or industrial structures as well as multifamily dwellings were also eligible for the 55% credit, but the credit applied to investments totaling $12,000. Over that amount, a 25% credit was applicable, and there was no upper limit. It was set to expire on December 31, 1980.

About a year later, new legislation passed (AB 3623) which amended the solar credit program "to allow the builder or developer of a new dwelling to claim the credit at the time of construction or to pass on the tax credit to the original purchaser of a new dwelling" (Quigley quoted in Gilbert, 1991, p. 294). The bill also made the cost of obtaining a solar easement easier and allowed wind energy systems to be eligible for the tax credit.

In 1980, the California state legislature again amended the tax credit by broadening the eligibility requirements to include all residential applications not just single family dwellings. The expiration date of the tax credit was also extended to December 31, 1983. Recreational and therapeutic equipment also became eligible for the tax credit.
In 1980, the state legislature passed California's first conservation tax credit (AB 2030), which enabled tax payers who installed energy conserving equipment to claim a credit of 40% on investment, with a limit of $1500. A 25% credit was made available to those who invested in equipment costing more than $6000 that was installed on non-dwelling premises. This credit had no upper limit. The effective date for the conservation credit was set for January 1, 1981, but the expiration date varied with the particular application and the property in question.

The last important tax credit that Brown signed into law was one which provided a tax credit for experimental uses of solar (SB 1687) (See SEIR, Sept. 29, 1980, p. 384). This credit was aimed at stimulating the introduction of new and innovative technologies to be used in both residential and commercial applications.

3.2.2. Governor Deukmejian

Like President Reagan, George Deukmejian, a Republican, began to attack tax credits soon after assuming office. Governor Deukmejian was elected to office in 1982, on a "Reagan-type platform of reducing tax burdens and other government involvement in people's lives" (Barkovich, p. 81). He did not pursue an aggressive campaign against continued government involvement in promoting renewable energy as President Reagan did. However, he did not lend support to the renewables industry because of the perceived revenue loss, which the state was more sensitive to because of the recession. At best he was apathetic about promoting renewable energy. As long as he received the expenditure reductions that he wanted, he did not veto legislation promoting renewable use, i.e., quid pro quo (SEIR, June 17, 1985, p. 200).

Despite this, as early as 1983, Deukmejian sought to repeal the solar energy credit and the energy conservation tax credit provisions, arguing that such action would save the state $110 million (UPI, Feb. 13, 1983). In a state assembly hearing on these tax credits, strong opposition was voiced against their elimination. Some insisted that the tax credits were beneficial to the local governments in that they stimulated economic activity where there otherwise would not have been any. Despite pleas like this, Deukmejian sought to eliminate the credits. He did not succeed in removing them from the state budget in 1983, but he did manage to decrease their level from 55% to 50%. Contrary to what he desired, the solar and wind tax credits were
extended to December 1986 and the conservation tax credit was extended to December 1985. The credit for recreational and therapeutic equipment was eliminated. The conservation credit of 40% was reduced to 35%. Although Deukmejian was not able to remove them, he made the first strides at whittling them down.

Even those in favor of repealing the tax credits admitted that a stable operating environment was essential for the continued existence of a solar industry. Jim Kennedy of the California Chamber of Commerce pointed out that it was "very important that the state maintain a good business climate, stable taxes and a predictable tax structure...although [they] advocated the repeal of the tax credits" (Assembly Hearing on the Governor's 83-84 budget proposals, April 12, 1983, p. 7). Deukmejian argued that the credits were "too expensive for the state" in the face of a large budget deficit (SEIR, May 16, 1983, p. 160). Assemblyman Tom Hayden rose in impassioned opposition to the repeal of the tax credits on the grounds that it would destroy an industry that depended on their continued provision. Each argument had some validity, depending upon which variables one took into consideration. The differences resulted from the varied perceptions of the contribution of renewable energy activity to the state's economy and whether it was necessary to support the technology to allow its long-term viability.

Two other bills were signed into law in 1983 by Deukmejian which adversely affected the renewables industry. In the first, SB 298, the tax credit for builders and developers, who elected not to pass the benefit onto the original home buyer, was reduced from 25% to 15%. Solar energy systems eligible for the federal tax credit, were now only eligible for a 15% state tax credit. Non-dwelling property became eligible only for the 25% state tax credit. The one positive change from this bill for renewables was an expansion of the tax credit for leased solar systems. The second bill, AB 2158, removed the requirement to have a home energy audit before being able to install energy conservation measures.

Two years later, in 1985, taxpayers were no longer able to claim as large a tax credit. Bills SB 125 and SB 1079 severed the tie between state credits and eligibility for federal credits, and the residential solar tax credit was limited to 10% with a maximum claim of $1000. This was only applicable to single family dwellings. For multifamily dwellings the tax credit was
reduced to 5% of total costs. Another change brought by these bills was that only 25% could be claimed for system costs for installation of equipment on commercial and industrial property (BNA, Aug 6, 1985). As at the federal level, the tax credit for wind systems was also set to expire at the end of 1985. The rest of the California energy tax credit programs were slated to expire as of December 31, 1986.

Even though approval was given by the state Senate and the state Assembly to extend all the credits to the end of 1986, the message was sent to the renewables industry that it could not count on continued state support. Governor Deukmejian continued to oppose solar tax credits generally, but never succeeded in eliminating them from the state's budget. State energy tax credits continued through 1987, but at a slightly pared down level. Some were optimistic about Deukmejian's inability to eliminate the credits altogether. As Sue DeWitt, executive director of the California Solar Energy Industries Association remarked, symbolically the signature of the governor on the extension of the tax credits "mean[1] stability for California renewable energy companies" (SEIR, July 8, 1985, p. 234). The renewables industry did not take this too much to heart.

Although not a tax credit, the state of California had enacted a property tax exemption in 1975 (ACA 30), which Deukmejian also tried to eliminate. This exemption excluded solar firm locations from local property taxes (Nemetz and Hankey, 1984, p. 106). The property tax exemption sought to reduce the selling price of renewable facilities and technology by reducing company tax burdens. The exemption was extended by the legislature in 1990, but vetoed by Deukmejian. As with the tax credits, the Deukmejian administration perceived the property tax exemption as a revenue drain. Again, proponents of this benefit to the renewables industry argued that it would facilitate economic activity that otherwise would not occur. Deukmejian did not take into account revenue from jobs, income tax from the business activities generated and other benefits to the state from such energy companies. The numbers of certain advocates accounted for this. They considered employment, production levels, and business profits. It boiled down to what the "difference was between methodologies and assumptions"(Interview with Jan Hamrin of IEP).
3.2.3. Governor Wilson

California's next governor, Pete Wilson, also a Republican, was confronted with the extension or elimination of the property tax exemption as well. He did not veto it outright, but stalled for nearly three months before signing it into law again. Assistants to governor Wilson argued that the property tax exemption resulted in a net loss of revenue to the locality. Since the state was faced with a budget deficit in 1991, Wilson was led to reevaluate the Legislature's proposed extension (See UPI, Feb. 28, 1991). Wilson was the target of additional pressure by local reporters critical of the legislation as a one company tax give-away -- that being Luz International. Governor Wilson, like his predecessor, was indifferent to the promotion of renewable energy use. Unless it concerned a loss to state revenue, the governor was relatively apathetic to the continued provision of tax credits or the property tax exemption, although he ended up extending both.

3.2. The California Public Utilities Commission and PURPA

The most important regulatory change under Brown was the state's implementation of PURPA. As noted in the previous chapter, PURPA's implementation was left up to individual state PUCs. Brown had placed individuals in key positions on the CPUC who were ideologically in line with his stance advocating renewable energy development. A very favorable regulatory environment for the renewable energy industry arose. Brown was the catalyst for promoting the renewable energy industry. Although there were a couple of states with better climates for solar applications (e.g. Hawaii and Arizona), California had the best business operating environment (Peck, Amicus Journal, Spring 90, p. 32). This is why companies like Luz International and U.S. Windpower, and a host of others, came to California to set up their operations. As an Office of Technology Assessment report noted, the regulatory environment in California is unique. "In no other state has the public utility commission participated so actively in capacity and resource planning" (OTA 1983, p. 91).

The California Public Utilities Commission (CPUC) is the state's regulatory body assigned the task of setting electricity rates and the levels of service to be provided by utility companies. It also determines the "capital and operating costs of regulated utilities" to determine
prices (CPUC Dec. 86-07-004, July 2, 1986, p. 3). The CPUC is a constitutionally established state commission. According to Section 701 of the California Public Utilities Code, "the commission may supervise and regulate every public utility (90% of all utilities) in the State and may do all things, whether specifically designated in this part or in addition thereto, which are necessary and convenient in the exercise of such power and jurisdiction" (See Nemetz and Hankey, 1984, p. 104).

One of the objectives of PURPA was "more efficient energy production through cogeneration and the use of renewable resources" (Hallaron, Power Engineering, Sept. 1985, p. 44). California was among those in the front of the pack in pursuing this aim. By mid-1984, California had granted "qualifying facilities" status to 286 facilities which was over twice as many as the next closest state, Oklahoma with 139 facilities (Hallaron, Power Engineering, Sept.1985, p. 44).

After obtaining QF status, a company could begin to negotiate for contracts with utility companies. The QFs were essentially competing not only against each other, but also against the anticipated costs the utility would incur if they were to build another facility using conventional energy, i.e., the avoided cost. The avoided cost that the QF would receive for sale of electricity to the utility would be equivalent to the price. In California, utilities were required to enter long-term contracts with the QFs (Gunn, 1984, p. 357). This supply side strategy led to a flood of QF filings in California. The utilities in California contended that the flood was too great, that is, beyond the needed capacity of the state, thus leading to higher rates for utility customers (Interview with Jan Hamrin). The CPUC "aggressively pushed development of attractive rate packages that [small, independent producers] could enjoy" (Hirsh, p. 7). This created animosity initially between the utilities and the renewables industry.

Small power producers established contracts with the utilities through Standard Offers. At the start, Standard Offer 4 (SO #4) was used to determine the buy-back rate for the independent producers. This is what led to the flood of filings in California. Utilities were locked into a ten-year contract to buy electricity from the independent producer at an escalating rate based on oil prices forecast by the California Energy Commission (CEC) in 1983. In the case of wind and solar power companies, this made the process of finding investors and
collecting the necessary funds a little easier. The steady flow of income removed some of the risk associated with investing in a new technology. As a result of the phenomenal response under SO#4 and the falling energy prices during the mid-1980s, the CPUC suspended SO#4 and implemented Standard Offer 2 (SO#2). The forecasts could not foretell "the slump in oil and gas prices in 1986" (Waltan & Hall, 1990, p. 252). Under SO#2 investors were no longer free of risk for the first ten years, they were now subject to immediate price risk (Lotker, 1991, p. 14). SO#2 still offered long-term contracts. The major difference was that avoided cost was recalculated every year such that the rate paid to the independent power producer was comparable to the going market rate. Consequently, obtaining adequate financing became more difficult without a guaranteed windfall.

Richard Gilbert has suggested that there were other problems with PURPA as it was implemented in California besides the trouble of securing financing. In his assessment, there are several inherent problems with the way PURPA is currently structured. First, there are "size and technology restrictions [that] aggravate the current bias against large scale facilities." Second, PURPA does not "encourage investment in the most cost-effective alternatives." Third, it unnecessarily restricts power for resale only. QFs cannot "compete in the general energy market for electric power." As mentioned earlier they compete only with other QFs and the utility’s avoided cost. Fourth, utilities have no incentive to invest in large scale projects because the associated risk is too high for them (See Gilbert, 1991, p. 75-7).

3.3. The Utilities

Under PURPA, utilities like California’s Pacific Gas & Electric (PG&E) and Southern California Edison (SCE) have been required to purchase electricity from small, independent power producers. However, utilities have been limited in the extent to which they could invest in small power production facilities. When utilities were first required to purchase electricity, most did not enter willingly into contracts with small, independent power producers. Many utilities argued that the SO#4 contracts were biased against the consumer in that they would potentially have to pay rates in excess of the current price of electricity. That turned out to be true in some cases. PG&E vehemently opposed having to purchase electricity from these
unregulated producers, or "PURPA machines." They claimed that the contracts were neither "just nor reasonable to electric consumers" and were not in the "public's interest" as ordered in the California code (See 16 USC 824a-3, Sec. 210(b)).

Both wind and solar companies sought long-term standard offer contracts that provided for fixed capacity payments for as long as the contract was valid. Obviously, utilities did not find this arrangement attractive. "In California, the utilities immediate reaction to having to purchase energy from small, independent producers was to use short run marginal utility costs instead of avoided cost. Utilities eventually got the message that QF's would be paid avoided cost, but it was only after their rate of return was threatened by the CPUC that they got the hint" (Interview with David Mcrse of the CPUC).

When the political support was most needed from the utilities, however, it was not there. The utilities did not willingly participate in the promotion of renewable energy in California. As Ronald Luxa of SCE put it, "if we had our druthers, we wouldn't have signed the contract[s]. We just don't need the capacity." (Electric Utility Week, Sept. 29, 1986 [in response to being asked about the contracts with Luz International]). The dilemma has been that they might not need the capacity now but they will in the future (according to state energy demand forecasts). The CEC sought to prepare the state for the future by diversifying California's energy supply now. The State was attempting to look long-term, at the same time that utilities were trying to preserve as much control over their future as they could. They have continued to do this, but now incorporate the contribution of small, independent producers into that future.

Some have argued that the utilities could play a much larger role in promoting the renewable energy industry. Jan Hamrin, the former director of Independent Energy Producers Association remarked that "there is no incentive for utilities right now to encourage them. What is absent, for example, is a regulatory structure that allows utilities to purchase facilities. The utilities role should be expanded even more than it already is" (Interview with Jan Hamrin). The House and the Senate have each passed a bill that would redefine what a utility is and who can operate in the electricity generating market. If approved by the President, major changes will occur in the PUHCA provisions that would limit the extent to which utilities can invest in other projects. A proposal for the change should be introduced in late 1992.
3.4. Implications of the California Experience

Although few would disagree that California has been the most aggressive and successful state in diversifying its energy supply and promoting the use of renewable energy, a number of issues remain to be reckoned with that may stifle the further growth of renewable energy there. The following is a brief description of some of the larger barriers confronting renewable growth.

The first issue concerns the price of natural gas. Since its deregulation, the price of natural gas in California has dropped substantially. Natural gas is one of the cleanest burning fossil fuels and is also now one of the cheapest for generating electricity. As Sam Rashkin of the CEC has noted, "the price of gas in California is so low that it is unlikely that anything will be able to compete with it in the near future" (Interview with Sam Rashkin). This is a reality that the renewables industry is going to have to face for some time. It may also mean that renewables will not be able to increase their contribution substantially until their costs go down or the price of natural gas goes up or both. This highlights another concern - the cost of generating electricity from renewables.

Current production from large scale RET operations, except wind power farms, are not capable of producing electricity at a competitive rate without government intervention (Nathan Assoc., 1985). However, some residential heating applications are competitive already. California has come a long way in creating an environment in which the renewables industry could begin operations and bring its operating and power generating costs down. Some of the more efficient companies have reduced their costs and become more competitive. However, many of these companies admittedly have been dependent on the continued provision of tax incentives, such as tax credits and property tax exemptions, to make their operations profitable (See Sandia Rep. 91-7014). They say that they need more time and more support to reduce costs further. The question remains whether or not it is the responsibility of government to provide support of the kind that they have in the past? Regardless of one's ideological perspective, the simple fact seems to be that if government is concerned with promoting the use
of renewable energy at the state level, it must be involved in a role that goes beyond information provision.

Rashkin pointed out that reducing the costs of RETs and broadening their market access when he said that the most important lesson to take from past experience is that the industry must be allowed to develop along a certain curve. The state also "must ensure that the industries have guaranteed markets out there for them given that they meet certain performance and cost objectives and as long as they continue to meet these, they must be guaranteed certain quantities of capacity for them to sell and to commit to their product. That is the key thing." This, he says, "can be achieved by providing tax incentives, making outright purchases of technology, or providing rebates. At the state level, firm capacity markets are essential" (Interview with Sam Rashkin).

One of the first steps for making electricity markets more amenable to the renewables industry would be to provide, what David Goldstein of the Natural Resources Defense Council says is "more utility exposure to the renewable technologies" (Interview with David Goldstein of NRDC). This is happening now, but it is important that it continue and that the "problem of having suppliers develop something that the users don't want is avoided" (Interview of Edgar DeMeo of EPRI by R. Hirsh). This calls for better channels of communication between the utilities, the CPUC, the CEC and the small, independent producers. More importantly, the lack of competitiveness or apparent near-term need are very large obstacles.

During the Brown years, California demonstrated that it was committed to promoting the renewables industry. After Brown's term, consistent support of the renewables industry was not to exist. As at the federal level, state government has not offered the industry consistent support. In the tradition of federalism, California has served as a laboratory for experimenting in energy diversity, illustrating both the positive and negative consequences of promoting renewable energy. "Renewable energy has greatly reduced California's consumption of oil and natural gas. These results stem not just from California's abundant resources but from a concerted state effort to encourage renewable energy development" for the sake of long-term energy diversity (Challenge Nov/Dec, Flavin, p. 9, 1990).
This is where the federal government can play a big part. The federal government could play its largest role in disseminating information about various state successes and failures in developing, or opening, markets for renewable energy. According to a 1982 study by the Solar Lobby and the Center for Renewable Resources, "the larger questions surrounding the future of solar energy are not technical, but rather concern "the availability of capital, access to information and political support." (Inside Energy/with Federal Lands, May 7, 1982, p. 9).

A particular issue that might warrant greater attention is the manner in which prices paid to small power producers were determined. CEC now employs an arcane formula to calculate avoided cost payments. Some have pointed out that calculating avoided cost is one of the largest problems with PURPA around the country, not just California. They have recommended that "there needs to be some method of ensuring that avoided costs are real. One simple way that might work is to limit cost recovery from utility sponsored projects to the level consistent with their avoided cost estimates. The avoided costs could resemble the actual long-run avoided costs" (Interview with David Goldstein of NRDC). This would at least remove some of the disincentive for utilities to participate. A reevaluation of the current method of calculating avoided cost would reveal some of the biases of energy pricing toward conventional energy use. Where to begin this reevaluation though is the tricky part. It might not be as simple as Goldstein makes it seem.

One of the last issues to be addressed is the need for a stable and reliable operating environment. California has come close to establishing this. The path for renewables in California has not been without its rough points. If tax incentives are to still be provided they ought to be consistent and reliable. If they are not to be offered, a firm position must be taken that renewable energy must make it on its own in the market place. The renewables industry cannot have continual uncertainty over whether or not they can operate on a competitive basis depending upon the ebb and flow of government support.

3.5. Conclusion

Three general lessons can be drawn from this analysis. First, the California experience demonstrates that given the right kind of leadership and resources, states can diversify their
energy supplies by including some forms of renewable energy. Governor Brown aggressively promoted the goal of energy diversity and included energy from renewables as an important ingredient of that goal. His next two successors did not aggressively promote renewable energy nor urge many policy initiatives to diversify further California's energy supply. Brown entered office with an agenda that included renewable energy, the others did not. It was part timing, but largely tone setting of the direction of energy policy by Brown that thrust the renewable energy industry forward in California.

The California experience also suggests that state governments may play a crucial role in promoting renewable energy. Without concerted government support, in either the creation of a stable regulatory environment or policy initiatives, the renewables industry potential will continue just to flicker in many states. California has demonstrated how renewable energy can be promoted effectively. It at least has set an example for other states to study or to follow.

The third lesson is that inconsistent and unstable policy support for renewable energy at the state level will hinder the progress of the renewables industry. As at the federal level, this kind of support will not allow a new viable renewables industry to survive, or even emerge. The industry cannot effectively plan its future operations and contracts if they are not sure that their business will be profitable regardless of technological improvements and management savvy. At the same time, policy should avoid promoting those renewables which are not yet ready for the market and would depend on continuous provision of government incentives. Once committed, however, the government should be consistent in its support, if a viable renewables industry is desired.
Chapter 4 - Luz International: a case study

4.1. Introduction

This chapter describes in detail the rise and fall of Luz International. This study illustrates the effect that federal and state policy had on one particular renewable energy company. Emphasis is placed on the contributive role played by government policies and programs intended to affect the way energy is managed and used. Luz was selected because it allows examination of the effect of government intervention in the development of new and innovative energy technologies, such as RETs. This is also an excellent case for study because of the richness of the company's experience. Tracing government involvement in Luz's growth reveals the options that government may exercise (or fail to exercise) to create a healthy operating environment for the renewables industry as technology evolves.

The first section looks at the background of those who started Luz and what projects and ideas preceded the actual creation of the company. The discussion next examines the technology used by Luz in its solar electric generating plants. The following three sections address the policies and programs implemented by the federal government and the state government in California affecting the start of Luz in the early 1980's and its continued operations throughout the decade. While laying out the path that Luz followed to commercialize its renewable technology, many of the ideas in the previous chapters about R&D and investment incentives are recapitulated in order to clarify the tie between government action (inaction) and RET commercialization. The financing scheme used by Luz to fund its projects is then described briefly before relating the events leading to Luz's bankruptcy in the latter part of 1991. The last section suggests the important lessons to be drawn from the Luz experience for future government involvement.

4.2. Background

Luz International was founded in 1979 by two principal individuals. The first, Arnold Goldman, is an electrical engineer who had the original vision of forming a company to generate electricity from solar energy. After receiving a masters degree from the University of Southern
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<th>Capacity (net MW)</th>
<th>Location</th>
<th>Status</th>
<th>In-Service Date</th>
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<tbody>
<tr>
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<td>14 Daggett, CA</td>
<td>Operating</td>
<td>1984</td>
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<tr>
<td>SEGS II</td>
<td>30 Daggett, CA</td>
<td>Operating</td>
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<td>SEGS III</td>
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<td>SEGS IV</td>
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<td>SEGS V</td>
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<td>SEGS VI</td>
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<td>SEGS VIII</td>
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<td>SEGS IX</td>
<td>80 Harper Lake, CA</td>
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California, he started his career with Litton Industries. In 1969, at the age of 26, he helped to form Lexitron, one of the first companies to develop a word processor. After Lexitron was acquired by Raytheon in 1977, Goldman moved to Israel and formed his own company which he called Independent House Products. This company eventually became Luz International (N.Y. Times Magazine, September 24, 1989, p. 65).

In 1979, Goldman met Patrick Francois, a French private consultant to individuals and groups interested in investing in Israel. Despite some hesitation initially, Francois decided to join Goldman in implementing a business plan for Luz International. Together they raised nearly $1 million for the base equity in the company. Late in 1979, they incorporated in California and began targeting small textile manufacturing companies around the country. Luz offered solar electricity generating systems which were to be located at the manufacturing site. This first venture proved to be unsuccessful due to a lack of demand for it in the marketplace. During its first four years of operation, Luz incurred losses of $13.5 million (N.Y. Times Magazine, September 24, 1989, p. 65). Luz regrouped and decided to concentrate its efforts on another market for its parabolic trough technology and a different type of investor to fund its projects. Since Goldman was a staunch advocate of solar energy, they decided not to abandon the idea of selling solar electricity generating systems.

As the price of energy continued to rise, solar energy became more attractive to utility companies. Hoping that this trend would continue in their favor, they set out to devise a financing plan that would allow them to attract the interest and money of a utility company. In July of 1982 they were able to land a contract with one such utility, the Southern California Edison Company (SCE), a utility which provides power to over 2 million people in the Los Angeles basin. At the signing of the 30 year contract, the SCE Vice President stated that "more than 250 MWe [from solar] are expected to be serving Edison's customers by the end of the decade" with Luz's assistance (SEIR, July 19, 1982, p. 237).

The first Luz solar electric-generating system, SEGS I, was designed to provide 13.8 megawatts electric (MWe) (See Table 4-1). In December of 1984, after 13 months and $62 million, SEGS I began delivering electricity to the SCE power grid at a cost of 24 cents per kilowatt hour (kWh). This marked the beginning of what would be nearly eight years of growth.
and development for Luz's solar energy technology, which culminated with a capacity of 354 MWe in 1991. They had begun plans for raising that number to close to 1000 MWe by the year 2000, with the newest facility, SEGS IX, generating electricity at 8¢/kWh (See Figure A). Government incentives and regulation which were favorable to Luz still existed, though not as favorable as when the company had first started. Construction had begun on their tenth plant, and their market seemed to be expanding. In November of 1991 company declared bankruptcy.

In the months following the company's collapse, analysts, industry representatives, and Luz officials voiced their opinions about why Luz had failed. Some company officials pointed to government policy (or lack of it) and low energy prices as reasons for the fall. A few analysts argued that Luz made some bad business decisions and should not have advanced with its corporate plans as blindly as it did. Still others insisted that Luz was a victim of circumstances, sacrificed not out of malice but due to inadvertent government ignorance of the consequences of public action. A source at the Department of Energy likened the circumstances of Luz's failure to a "slow moving steamroller unknowingly crushing everything in its path." The more comprehensive reports suggested that a combination of factors had led to Luz's demise.

Both skeptics and proponents of renewable energy agree that none of Luz's success would have been possible without government incentives. This case study examines the role of federal and California policies in facilitating Luz's development and demise. The following sections address the importance of government involvement and the impact of each of the financial incentives on Luz's operations. The final section draws some lessons concerning the politics of energy as they affected the company throughout the past decade and the legacy that Luz leaves behind for the rest of the renewable energy industry. Three specific questions will be addressed:

- what set the stage for the solar thermal industry to enter the energy market;
- what were the assumptions on the part of both government and business that underlay the promotion of renewable energy;
- how did government contribute to Luz's fall. As background, the first section describes the technology used by Luz.
Figure A

Levelized Cost of Power From SEGS

1988 Cents per kWh

4.3. The Technology

Broadly, the systems used by Luz to generate electricity are known as solar electric generating stations (SEGS) (See Figure B). (See EPRI document GS-6573s for further information, December 1989). The type of solar-thermal electric technology collects solar energy as heat, which is then converted into useful energy by means of conventional thermal power plant technology, that is, through a generating system. The heat collection element (HCE) itself is a complex device (See figure C). Inside, there is a steel pipe covered with an absorptive coating. Within this pipe are chemical sponges known as getters. These are connected to a central computer that allows workers to monitor the temperature and flow of oil. Around the steel pipe is a glass envelope which is separated from the pipe by a vacuum. (Popular Science, May 1990). Each tube extends across the entire face of the mirror, and is approximately 13 feet in length and 4 inches in diameter. Oil is pumped through the internal pipes and heated to a temperature of 371°C (735°F) (Independent Power Report, Nov. 17, 1989). The pipes are connected to one another, thus, allowing the fluid to flow through a series of heat exchangers bringing the fluid to the desired temperature. By using vacuum tubes the system minimizes thermal energy loss while increasing efficiency.

The mirrors themselves are in the shape of parabolic troughs. The mirrors are composed of white glass, not window glass which has a green tinge to it because of its iron composition. The higher transparency afforded by this glass allows more of the light passing through the glass to be reflected onto the HCEs (Popular Science, May 1990). The silver glassed mirrors are what capture the sunlight and focus it precisely on the HCE. Each assembly, or reflector unit, is mounted separately with an independent Luz-patented sensor that tracks the sun. The sensors are all linked to a central computer which "monitors, and controls the position of each collector, the temperature, the flow of heat-transfer fluid, and the thermal output of the field" (ENR, Jan 15, 1987).

The solar collector assembly (SCA) was the basic element of the solar fields which Luz constructed (See figures D & E). The parabolic trough solar collector on each assembly focuses the sunlight directly on the tubes which are positioned at the focal point of the parabolic mirror.
Figure 8

THE LUZ SYSTEM

Figure C

Heat Collection Element

- Evacuation Nozzle
- Vacuum between glass envelope and metal tube
- Glass-to-metal seals
- Flange
- Internal Steel Pipe, covered with absorptive coating
- Glass Envelope
- Chemical Spacers (Gaskets) to maintain and indicate states of vacuum
- Bellows

Not to scale: Tube is about 13 feet long and 4 inches in diameter.

LS-3 Solar Collector Assembly

- Solar Collector Assembly (SCA) is the discrete, individually controllable unit within the solar field. Each SCA has its own sun-sensor, drive motor and local controller to track the sun.
- Each LS-3 (third generation) SCA has:
  - 224 collector segments
  - 24 Heat Collection Elements
  - 545 Square Meters of Collection Area
  - Total length of 330 feet
- SCAs are connected to each other by flexible hoses.
- SEGS VIII Solar Field consists of 852 SCAs, in 142 loops.

Each SCA is 330 feet in length, consisting of 24 HCEs. At the end of the SCA is a flexible hose which enables the SCAs to be connected to each other. This set of loops provides for a continuous flow of oil through the entire system (Lotker, Sept. 1991).

After the oil is heated by passing through the HCEs, it then flows through a solar super heater and through a steam generator, then back through the solar collector field (See figure B). Most of the super heated steam is directed to the turbine generator which produces electric power to be sent to the electricity grid of a local utility. A small amount of the steam is diverted to keep the turbine generator moving, which moves the oil through the HCEs. A natural gas unit is used by the plant to supplement electricity production during the summer months at peak energy consumption times when the weather is not favorable and during times when the sun is not shining (Power Eng. Rev., Aug 1989). Nevertheless, FERC allows only 25% of the electricity to be produced by the burning of natural gas (FERC rule implementing the Public Utilities Regulatory Policies Act (PURPA)) (L.A. Times, Jan 9, 1989).

The solar panel fields vary in size. SEGS I is the smallest, generating 14 MW of electricity. SEGS II through VII, built between 1985 and 1988, have a net capacity of 30 MW each. SEGS VIII and IX, completed in 1989 and 1990, respectively, generate 80 MW each (See Table 4-1) (Electric Light and Power, March 1990). As of November 1991, the total generating capacity of the SEGS was 354 MWe. These sites cover a total land area of approximately 1000 acres, and are configured along a horizontal north-south axis. This type of orientation allows for a greater percentage of on-peak electricity production to be generated by solar during the summer (Power Engineering Review, p. 6, A 1989). The acknowledged drawback is that electricity generation during the non-summer months declines sharply. According to Michael Lotker, there is plenty of space available to expand the operations further. He claimed that just 1% (about 250 sq mi) of the available land in the Mojave Desert, where the plants are located, could deliver as much electricity to Southern California Edison as they use (ENR, Jan 26, 1989; World Book Encyclopedia, 1990, Vol M).

Understanding Luz's technology and the progress the company achieved in making the technology more efficient is the first step in determining the impact the corporation had on the solar industry. Luz was able to do what none of its competitors could -- build a device that
could generate electricity that could closely compete with power from conventional sources. Luz chose what they claimed were the highest quality materials and combined that with innovative design to create a device that captured sunlight and transformed it into usable electricity. By the time it completed its final project, Luz had been able to reduce the cost of electricity generation to about 8¢/kWh, but this was still not low enough to compete with natural gas or coal, at least not on a cost-for-cost basis (L.A. Times, Nov. 27, 1991). Government assistance was the linchpin that not only helped get Luz started, but kept its operation going.

4.4. The Government's Role and the Rise of Luz

This section examines the federal and state governments' role in promoting solar thermal technology and thereby illustrates what government did that was beneficial for the industry and allowed Luz to contribute what it did to energy diversity in California.

Government incentives consisted of tax credits, both state and federal, a state property tax exemption, favorable utility standard offer power generating contracts under PURPA, and exemption from other strict regulatory requirements under PURPA. In addition to reducing costs for independent power generators to enter the market and extensive research and development, government developed a regulatory environment that was conducive to the growth of the solar energy industry. In spite of all this support, Luz was unable to continue constructing plants.

In 1974, the Energy Research and Development Administration and the Department of Energy began a program to transform the physical principles it had come to understand about parabolic trough technology into commercializable process heat. The goal of this program was to improve the technology's efficiency and decrease the cost of generating power with it. The idea was that if the government could demonstrate its potential and bring down start-up costs, private industry would adopt the technology and apply it in the commercial sector.

A combination of factors led Luz to adopt parabolic trough technology and try to market it. R&D at Sandia National Laboratories had brought the costs of electricity generation down substantially, but it was still not to the point of commercialization without other incentives (Mitchener, 1982). Goldman took the government design and upgraded it using higher quality
materials. Previous government R&D brought parabolic troughs to the point of commercialization, but Luz was first to mass produce the technology. As mentioned earlier Luz began by selling the technology to individual manufacturers. After this proved to be a money losing application for the technology, the company changed direction. The venture that really brought the technology to a higher level of efficiency was the construction of solar fields.

In the late 1970's and early 1980's, the price of energy in the marketplace was relatively high and was projected to be even higher in the future. Based on this projection, in addition to concerns over national security and energy dependence, President Jimmy Carter embarked on his campaign to promote renewable energy. Before Congress passed his National Energy Act, the role of the government in promoting renewable energy, had largely been limited to minimal R&D and information provision. After the passage of NEA, the government assumed a more interventionist position, providing investment incentives and creating a favorable regulatory environment for small producers to enter the market.

These last two elements, combined with high energy prices, made parabolic trough technology an attractive investment opportunity, the details of which will be explained below. The important thing to realize is that the timing of government R&D and the changes in the market along with the increased contribution of government in other forms encouraged companies to pursue commercialization of the technology. At the risk of oversimplification, it is apparent that Goldman perceived this technology to be the best suited for the applications he had in mind, and once he was committed he clearly intended to seek commercialization until it was achieved.

The goal of federal incentives and regulatory modifications was to make the transition to the marketplace for new technologies more attractive to private industry. The role government R&D played was in getting that technology to the point that someone like Goldman could refine it and bring it to market in an efficient and profitable manner. Essentially, without the progress having been made in trough technology at the government level, it most likely would not have been brought to market (more about this later). This is important to keep in mind because many of the new, alternative technologies will have to follow the same path as the parabolic troughs.
Government's involvement at this stage of development is critical in determining which technologies enter the market and when.

Although government assistance at the early stage of technology development is important, the scope of government activity can extend beyond R&D. "Governmental actions which influence the commercialization of new technologies are not limited to R&D, but include stabilization of the business environment, financing and taxation policies, outreach and education, and guaranteeing sufficient distributional equity to maintain the system's legitimacy" (Worthington, p. 369). This statement highlights the role President Carter envisioned for the government. When President Reagan took office, R&D funding for renewables dropped, but solar trough technology was not really affected by the drop in R&D because it was already developed (See Table 4-2). The more damaging element was the loss of earnest government support.

4.4.1. Tax Credits

Energy tax credits were first introduced successfully at the federal level in 1978 to encourage the development and use of solar and other renewable energy. The manager for external affairs at ARCO Industries has argued that "the tax credits provide a critical link in the development of how you do business with this new technology" (CA Hearing, April 12, 1983, p. 23). Combined, the federal and state tax credits yielded Luz almost a 40% tax credit benefit. Luz first took advantage of the two tax credits in 1983 as it prepared financing for the SEGS I project, which was completed in December of that same year. The financing schemes devised by Luz, which are discussed in a later section, were integral to the company's success. Being a private company, and not being self-sufficient, outside investors had to be obtained who would be willing to invest capital in a company, using a new commercial technology. Investors were attracted to Luz based on the high rate of return on investment and the steady flow of money to the company as a result of the guaranteed price contracts under SO#4.

The California tax credits like the federal energy credits were not intended to last indefinitely. Jan Hamrin, who was the executive director of the Independent Energy Producers Association, acknowledged that the tax credits were "intended to give the industry the boost it
### Table 4-2: R&D Spending for Solar Energy 1975-1991

Solar Funding, FY 1975-1991 (millions current $)

<table>
<thead>
<tr>
<th>ERDA</th>
<th>Solar Thermal ($ in millions)</th>
<th>Solar Funding Total in million:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1975</td>
<td>13.2</td>
<td>$48.00</td>
</tr>
<tr>
<td>1976</td>
<td>33.3</td>
<td>$158.70</td>
</tr>
<tr>
<td>1977</td>
<td>67.1</td>
<td>$282.20</td>
</tr>
<tr>
<td><strong>DOE</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carter</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1978</td>
<td>104.1</td>
<td>$408.80</td>
</tr>
<tr>
<td>1979</td>
<td>109.3</td>
<td>$484.30</td>
</tr>
<tr>
<td>1980</td>
<td>117.3</td>
<td>$548.40</td>
</tr>
<tr>
<td>1981</td>
<td>134.6</td>
<td>$548.90</td>
</tr>
<tr>
<td><strong>Reagan</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1982</td>
<td>42.4</td>
<td>$221.30</td>
</tr>
<tr>
<td>1983</td>
<td>48.5</td>
<td>$197.00</td>
</tr>
<tr>
<td>1984</td>
<td>38.7</td>
<td>$176.50</td>
</tr>
<tr>
<td>1985</td>
<td>33.9</td>
<td>$169.80</td>
</tr>
<tr>
<td>1986</td>
<td>25.5</td>
<td>$143.20</td>
</tr>
<tr>
<td>1987</td>
<td>22.6</td>
<td>$122.50</td>
</tr>
<tr>
<td>1988</td>
<td>17</td>
<td>$96.90</td>
</tr>
<tr>
<td>1989</td>
<td>14.8</td>
<td>$91.50</td>
</tr>
<tr>
<td><strong>Bush</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1990</td>
<td>15</td>
<td>$92.40</td>
</tr>
<tr>
<td>1991</td>
<td>19.3</td>
<td>$129.50</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>856.6</td>
<td><strong>$3,919.90</strong></td>
</tr>
</tbody>
</table>

need[ed] to get started and then as economies of scale and other things develop in the industry then it could be stepped down or ended" (CA Hearing, April 12, 1983, p. 37). "The expectation was that rising traditional fuel prices and decreasing renewable energy equipment costs (as a result of technical improvements and economies of scale) would soon eliminate the need for subsidies" (Rich & Roessner, p. 186).

In addition to these tax incentives, Luz received a property tax exemption. Each of the Luz's SEGS plants was exempted from taxation. Normally, being a piece of real property, the SEGS would pay a property tax. The exemption removed this cost to the company, making it easier to raise funding, attract investors, and reduce overhead costs. The idea behind the property tax exemption was that companies contemplating the development of renewable energy would be encouraged to construct their facilities given that they did not have to pay that tax. The effect on the economy was perceived by some to be a net gain because it would stimulate business activity that otherwise would not have occurred. The benefit would be seen in generated employment, business activity taxes, and other multiplier effects.

In 1981, Luz officials believed that their plants would be competitive with fossil fueled facilities by the time the federal tax incentives expired in 1986 (UPI, Aug 26, 1981). They were not. In 1989, Luz officials again claimed that their system would be able to compete in pure economic terms by 1990 with conventional energy plants "without any tax breaks" (Forbes, Feb. 20, 1989, p. 70). This too proved not to be the case either.

Tax incentives, along with the favorable regulatory environment created under PURPA, facilitated Luz's entrance into the energy market. During the first half of the 1980's, it looked as if Luz would be here to stay. It had negotiated numerous lucrative contracts with California utilities, it had plans for nearly 1000 MWe by the year 2000, and was engaged in talks with other organizations in both the domestic and international markets to apply its technology. Government support however began to wane under President Reagan. Changes in the economy coupled with this dissipating support for renewables at the federal level turned the tables on Luz.

Luz's continued existence became dependent upon government assistance in one form or another. Although the hope was that government assistance would steadily decline as cost
efficiency improvements were made, it did not always turn out that way. In Luz's case, it could not make the necessary improvements in its technology to keep pace with the falling price of energy. A more important shift was in the ideological position of the federal government toward the continued provision of tax credits.

Without tax credits, Luz could not attract investors, and without investors it could not continue constructing facilities. The facts were simple, no incentives, no investors, no projects, no more Luz. Given the turn of events, "Luz [had become] depend[ent] on incentives to make its privately financed units profitable" (ENR, Jan 26, 1989). Two years before they were set to expire in 1985, President Reagan began his campaign to eliminate the tax credits. This was done in an effort to purge the government of its involvement in the market. From then on the tax credits would continually come under attack by some in the Congress and the President.

In the Tax Reform Act of 1986, the federal business investment tax credit was eliminated and the energy tax credit was reduced and renewed for just one year. By 1988, the federal energy tax credits had dropped to 10%, a level at which it has remained since. The California state tax credit has dropped to 6.6% (Sand 91-7014). The state failed to renew the credit for fiscal year 1988, but it was reinstated in the following year. Since 1986, federal tax credits have been renewed on an annual basis. Thus, by 1987 the credits were providing just over half of the incentive they had provided in the early part of the decade. The industry, investors, and lobbyists were never quite sure that credits would be renewed by the December 31st deadline, which was usually set when they were renewed. The tax credits were set to be phased out, but they were not. Solar advocates were left with few alternatives when the price of energy did not turn up. All Luz could do was hold onto the few vestiges of government assistance it could. The tax credits worked in getting companies such as Luz started, but they also contributed to Luz's demise by creating an environment which was characterized by transitory support. Luz confronted inconsistent and unreliable government responses during the past decade.

It is surprising that Luz was able to continue its operations in such an environment for as long as it did. With credits being renewed on an annual basis, it could neither plan internal corporate operations with certainty, nor guarantee its investors a favorable rate of return. Luz
and other renewable energy producers were left with an investment incentive which was a mere 25% of what it had originally been. Despite all the confidence the corporate and executive leaders had in their systems and their marked cost-cutting improvements over time, Luz was still unable to compete against conventional plants without some sort of tax incentive. Was it because of cheap natural gas prices? What about inefficient government regulations based on outdated assumptions? Or, could it be that these systems simply were not ready for the marketplace given the current price of energy?

"In 1978 the tax credits were expected to nurture an embryonic industry in the face of $14-a-barrel oil and 30¢-a-cubic-foot natural gas. They were to build an industry 10 years before normal market forces would" (Morris, p. 12). Although improvements were made in the technology, energy prices actually dropped and then remained low until the time of the Persian Gulf crisis. As a result, Luz became dependent on the continued existence of those credits. Luz had not anticipated such a scenario: "With oil and other energy prices unable to rise to anything like the levels feared during the crises of the '70s - and even collapsing of late - solar had to be much cheaper than anyone ever imagined" (ISEIR, June 15, 1990).

As energy prices dropped over the last decade, Luz was unable to bring its technology to a point that would have allowed it to compete in the market absent government incentives. The tax credits became the primary factor maintaining the attractiveness of their projects to investors. However, these tax incentives were not intended to be permanent. They were designed as temporary incentives to stimulate investment activity initially where there otherwise would not have been any. The property tax exemption was another mechanism designed to encourage economic activity.

The way that the property tax exemption contributed to Luz's demise was two-fold. First, when the property tax exemption expired in 1990, Governor Deukmejian vetoed its extension. A year later, with a new Governor, the legislature again sought a property tax exemption (L.A. Times, Aug. 24, 1991). Amidst the possibility of catching some flack from the press over the passage of this legislation, Governor Wilson balked on signing the bill into law immediately, which would have given Luz an $8 million annual savings (UPI, April 23, 1991). Not until May 15, 1991 did he sign the property tax exemption. In conjunction with the stall
over the signing of the bill, San Bernardino County, where the SEGS are located, had brought a case against Luz, demanding that the company provide compensation to the county. Only after Luz offered to pay the County a substantial amount of money every year did the County back off. The County's concern with Luz's tax exemption arose from the fact that it stood to lose thousands of property tax dollars that would otherwise be available. Nevertheless, since Luz was not sure if it was going to get the property tax exemption it could not begin construction of what would be its final project.

Second, when the exemption was finally passed the company had nine months in which to complete its project before the energy tax credit expired at the end of the year. According to the revised standard offer contracts, Luz could not receive any payments from the utility until it started generating electricity from that facility. Consequently, it had to spend most of its cash reserves and pay high premiums for its construction materials. Investors did not foresee Luz being able to complete the projects on time so they backed out, and Luz was left in a precarious situation. Instead of reorganizing and putting its plans on hold temporarily, it went ahead and attempted to complete the project before the tax credit deadline, due to uncertainty over whether the tax credits would be renewed. In basic economic terms, "without [the] various tax benefits, investment in the projects would not make much economic sense" (Forbes, Feb. 20, 1989). They were renewed a few weeks after Luz declared bankruptcy.

Tax issues were not the only factors that brought about the fall of Luz, a favorable yet immature regulatory environment contributed as well. PURPA and other regulatory policies affected the kind of fiscal environment Luz operated in with both its investors and the utilities, sometimes these being one and the same.

4.4.2. PURPA

The Public Utilities Regulatory Policies Act (PURPA) was considered by some to be "a watershed event for the regulation of electric power" (Gilbert, p. 73). PURPA, was not intended to decentralize the energy industry, but rather to stimulate other producers to enter the market and to encourage investment. Both goals were sought by creating a propitious environment in which to operate. Independent, small producers of electric power could enter the
electricity generating market and be exempted from the more stringent regulations to which utilities are held, such as PUHCA. In short, PURPA removed institutional obstacles and mitigated the impact that they had on the development of the small power production industry including those independent energy producers using renewable resources (like Luz). For Luz, PURPA offered a golden window of opportunity.

In general, there were four major obstacles which stood between small power producers and the electricity market. First, many utilities refused to buy electricity from such producers. Second, the prices paid for the electricity were very low. They were so low that the revenue gained by independent energy producers was usually below the price paid by the utilities for that electricity. Third, back-up power rates were excessive to the point of making it prohibitive to attempt to generate electricity. Fourth, independent energy producers were restricted by the same regulations that utilities were required to follow, which were extremely burdensome on the small producers (Gunn, p. 354).

PURPA was designed to remove some of these barriers and create a favorable environment for small power producers who used renewable energy technologies as well as cogenerators. The following is a list of the elements of PURPA in California that contributed to Luz's rise. First, utilities were required to purchase electricity from small power producers. In California, this requirement translated into a guaranteed market for a small producer's energy. Second, utilities were required to offer small power producers contracts for their electricity based on an avoided cost rule. In addition, these contracts were set for a minimum of ten years, thus, effectively removing price risk for investors.

According to Mike Lotker, the former Vice President for Business Development at Luz, "guaranteed utility purchase provisions and [the] attractive avoided cost approach to pricing" stimulated activity among small power producers constructing qualifying facilities (QF) (Lotker, Sandia, p. 32). These requirements were established in conjunction with the federal tax credits. Together they spurred the development of the SEGS facilities. The idea behind this scheme was that investment in renewable energy would be made more attractive than without them (Gunn, p. 355). Investors were very attracted to the Luz projects because of the rate of return given their investment and the relative stability of that investment.
The third element was exemption from state and federal energy regulation. Under PURPA, Luz avoided limitations that utility companies were held to. For example, its facilities could be owned primarily by third party investors. This was a benefit to Luz because it provided for a relatively quick decision making process and rapid execution of those decisions. Luz was also exempted from the prohibition on natural gas use in their electricity generating facilities. They could use up to 25% natural gas in their facilities to maintain generation levels during off peak hours and cloudy days. Because of this favorable regulatory environment Luz was able to negotiate very lucrative 30-year contracts with the utilities like SCE (L.A. Times, Jan. 9, 1989, p. D8). In turn, it could entice investors with a secure investment once contracts had been obtained from utilities. This was made possible through the standard offer contracts (SO#4 and most recently SO#2), which were based on avoided energy price forecasts.

In California, the general response to the stimulation of small power production was overwhelming. The number of such facilities generating power for California utilities jumped to over 600 by 1990. These facilities generated almost six and a half million kilowatt hours of electricity that year (FERC QF Report, p. xix). Luz began generating electricity for SCE in 1984, with a 13.8 MWe plant. This was the first of several contracts with SCE.

The decision to require utilities to purchase electricity did not pass without contention. Two major utilities, SCE and PG&E in particular, vehemently opposed the requirement to purchase electricity from such independent producers. The utilities were further bothered by the standard offer contracts (SO#4) for the purchase of power from small power producers. These contracts allowed companies like Luz to negotiate power purchase agreements with utilities that offered a guaranteed price for 10 years. This meant that Luz could sign a contract with a company like SCE and demonstrate to its investors or a lending institution that they would have a steady flow of income. Utilities argued such standards were not fair to the rate payer in that fluctuation in the actual price of energy would not affect the price paid for electricity generated by Luz: nevertheless, "the Standard Offer contract system was important because it provided renewable energy systems an energy pricing structure that allowed the financing of such capital-intensive technologies in a relatively stable and secure regulatory and contractual structure" (Lotker, Sandia, p. 3).
In 1987 PURPA was amended to allow plants to qualify as an acceptable facility, but generate more electricity. Originally, small power producers were limited to facilities generating only 30 MWe. In raising that level to 80 MWe, Luz was able to cut its costs from 24¢/kWh to 8¢/kWh, which was important in keeping Luz's costs down and remaining competitive with conventional facilities costing between four and five cents a kilowatt hour. Increasing the size limit from 30 MWe to 80 MWe "allowed [Luz] to really start bringing [their] technology to maturity" (House Hearing, James Bazor, June 14, 1990). An interesting note about the original size limit of 30 MWe is that neither the industry nor government representatives interviewed for this study could indicate why it was set at that level (Ind. Power Rep, Nov. 17, 1989). When asked about why the size limit had been set at 30 MWe, officials at FERC indicated that it was "made on a whim" (Interview with Sissine). Since the price of energy had dropped over the decade, the reduction of overhead costs everywhere it could was key to its survival. Luz officials were quick to point out that because "the viability of the Luz system is [based on] econom[ies] of scale, if PURPA were [to be] changed" it would allow single plants as large as 150 MWe to be constructed. This could drop the cost to as low as 5 cents/kWh (Energy User News, Nov. 1989).

When the size limit was debated in October of 1987 in the House, a number of the representatives pointed out the need to change regulations to keep pace with advances in technology. As Congressman Berman from California argued, "increasing the size of solar facilities...is absolutely critical to making solar power a competitive alternative energy source in the immediate future. [Raising the size limit] would allow Luz to increase the size of its facilities, and thereby gain the benefit from the economies of scale associated with operating at 80 megawatts" (Congressional Record, October 27, 1987). In one case, Senator Pete Domenici unsuccessfully attempted to amend Senator Timothy Wirth's global warming bill by attaching an amendment to lift the limit. This bill would have allowed solar generating plants "to qualify for benefits under PURPA and allow developers to scale their systems to the optimum for their technologies." (ISEIR, May 18, 1990).

The Assistant Secretary for Conservation and Renewable Energy, Mike Davis, told a Senate Energy Committee in 1991 that "the limit [under PURPA] should be waived for all
renewable energy plants" (IE/w FL, May 21, 1991). For Luz, the rationale was that for the company to compete with energy from more conventional energy sources, it had to be able to cut its life-cycle costs by at least 2¢/kWh. Luz argued that if the size limit was removed, the corporation would be able to reduce its dependence on federal and state tax incentives. This is something that it sorely needed to do because of the uncertainty over their continued provision. Anything it could do to reduce its costs and move closer to being competitive with conventional energy plants was of great importance to the company's future.

As will be discussed in greater detail in the next section, financing of Luz's projects was one of the most important elements to its success; attracting the right investors and enough of them was crucial to the company's continued progress. Without the economy of scale, or of manufacturing, operation and maintenance costs would be so high as to make the projects only marginally profitable, while at the same time forcing them to be dependent on the tax credits. In testimony before a House energy subcommittee, Representative Edward Markey (D. Mass.) stressed that removing the size limit altogether would "help make the renewable technologies respectable in the eyes of Wall Street" (Inside Energy/ with Federal Lands, June 18, 1990). When asked about the barriers to further penetration of renewables into the energy market, the majority of interviewees indicated that cost would be the biggest stumbling block. Taking this as true, it would follow that any measures the government could take in helping the renewable energy industry to reduce its costs would greatly enhance that industry's market position and competitiveness.

Luz was able to construct nine sites before it had to declare bankruptcy. As discussed above, the regulatory environment created by PURPA was important in opening the door for Luz. It was incumbent upon Luz though to improve its technology along a cost curve and create opportunities for itself through greater efficiency. By not allowing Luz to develop facilities which would bring them to an economy of manufacturing it could only bring its costs down a certain amount, an amount which was not allowing them to operate at the most efficient level. Not until 1990 was PURPA amended to allow Luz to construct a facility of an unlimited size. It could not immediately begin construction of a site, because there was a long negotiation process that had to be followed, as had been done with all of its previous facilities. It still had several
SEGS of an 80 MWe size to construct before it could begin new ones. The removal of the cap was made effective for only four years. It is forecasted by some that this gesture will have little or no impact on the solar industry, since Luz collapsed and there are no other plans on the horizon for new construction in the commercial sector. The willingness of government to commit to supporting renewable energy growth and development cannot continue to come in the form of piecemeal changes that arrive too late, which is how this amendment to PURPA might be characterized. As Lotker argues, policymakers and proponents must have foresight to understand what the future ramifications are from formulating renewable energy policy now.

4.4.3. Luz’s financing scheme

Until July of 1991 it looked as if Luz would be one of those companies which would lead the country toward the goals of greater energy diversity, energy conservation, and increased environmental consideration. The corporation developed a financing scheme that offered investors a 13-16% rate of return. Government incentives, however, were a cornerstone of this financing scheme. Favorable federal and state R&D and tax policies continued to encourage energy production from renewable resources. When these policies were jeopardized, however, investors became leery and creditors became hesitant of providing continued support, which came in the form of venture capital: high risk financing.

When Luz started out with its financing schemes, third party participation was considered an asset. Reliance on private funding enabled the company to move quickly to adjust to shifts in demand in the marketplace and make major decisions rapidly as they arose (Lotker, Sandia document, p. 9). Luz planning was geared toward attracting the individual investor who did not have to go through a board of executors to make an investment decision. Most importantly, as Goldman noted, "if some individual investors balk[ed], it [was] simply a matter of finding replacements" (Chemical Week, Jan 20, 1982). This was to be easier said than done. Goldman was overly optimistic about the ease of finding investors, especially when the continuation of public investment incentives became questionable. In fact, reliance on third party investors would prove to be one of the biggest chinks in Luz’s armor. If utilities, for
example had been allowed to own more than 50% of a qualifying facility, this might not have been the case.

Luz’s financing arm managed the pool of prospective and present investors in Luz stock. Investors were attracted to Luz projects because of their relatively high rate of return and the investment and energy credits, they yielded. This does not ignore the possibility that some investors were attracted by the social and long-term good of investing in renewable energy. Nevertheless, what made these projects viable in economic terms were the government incentives. Without this government assistance, most investors would not have sunk money into a project that would not yield a financial gain.

Each investor contributed capital to the company which in turn was used to construct facilities and conduct research and development. Most of the early projects, 30 MW and under, took from between 14-16 months to complete and cost a little over $100 million each. The latter projects, such as SEGS IX, an 80 MW plant, were completed in less than a year and cost approximately $212 million (Independent Power, Feb 1989, p. 49). Goldman was able to introduce the technology successfully into the marketplace by 1982.

To recapitulate, several important developments occurred prior to Luz beginning its operations in the Mojave Desert that set the stage for the corporation to enter the energy market: one, the provision of tax credits and other tax incentives; two, the regulatory environment established under PURPA; and three, the financing scheme developed by Goldman. Despite these positive factors, several developments that worked against Luz’s continued success. The next section addresses the events that led to the demise of Luz.

4.5. The Fall of Luz

On November 25, 1991, Luz International Ltd. and four of its subsidiaries filed for bankruptcy under Chapter 7 of the U.S. Bankruptcy Code. Two of its subsidiaries, Luz Partnership Management Inc. and Luz Engineering Corp, filed under Chapter 11, allowing them to reorganize. Control of the nine existing solar energy generating stations (SEGS) would be retained by these two organizations, but all future stations and plans would be discontinued. So marked the end of a decade of development by the largest solar energy producer in the world.
Luz had been able to make substantial strides in technological efficiency and sign several long-term contracts with major Southern California utility companies. Since the construction of its first plant, it had been able to reduce the cost for its most recent plant, and was planning to reduce it even further in upcoming projects (See Figure A). Utilities had lately begun to encourage Luz. A one-time opponent, PG&E, had begun to review contracts for power generation with Luz. There had been talk of plants in Nevada, New Mexico, Arizona, and even as far away as Spain. All of these plans came to an abrupt halt early in 1991, as Luz struggled simply to keep on top of its present and future projects.

By almost anybody's estimates, Luz had become the most successful solar energy producer in the world. In 1989, Luz was providing over 90% of the world's solar electricity (ENR, Oct. 19, 1989, p. 21). Although the company generated only 354 MWe, less than 1% of Southern California Edison's electricity demands, it was lauded as a significant achievement by both skeptics and proponents. The contribution that Luz made to the diversity of our energy supply was not substantial, but it was significant. It was significant in that it demonstrated that a firm could compete, with incentives, in the marketplace as a producer of electricity using a renewable resource, the sun. Certainly, Luz was dependent on government incentives, and it did ultimately fail, but it was able to make a contribution to the energy supply in California and might have been able to go further had the commitment to promoting renewable energy been consistent over the past decade. In retrospect one could say that anything might have happened, but it is clear that the solar industry cannot operate with inconsistent policy support.

The tax credits, for example, were not consistently implemented. After they expired at the end of 1985, they were renewed on an annual basis. Sometimes they were renewed for 3 months, 9 months, or a year at a time, but never more than that. The uncertainty over their continued existence made it difficult for Luz to plan future projects and guarantee potential investors a rate of return on their investment. Each year, solar advocacy groups had to mount large campaigns to ensure an extension of the credits, arguing that solar firms could not continue to produce electricity without operating at a loss if the credits expired. Free market advocates argued that the government should have no role in nurturing an industry which was not ready for the marketplace. The reality of low natural gas prices meant that no matter how far Luz was
able to come down the cost curve with its technology, it would not be able to compete cost for cost without tax credits. The issue boiled down to what role government should play now that the energy market was so different than what most forecasters had anticipated. Was it up to the government to continue promoting a technology through incentives which were designed to be temporary?

Those who strongly advocate that government should only intervene in the marketplace in the case of a market failure have argued that the government's role should be limited to research and development and information provision. According to the skeptics, government has no place in creating long-term investment incentives to promote one source of energy over another. The market will determine this. They insist that Luz collapsed because it was using a technology that simply was not ready to compete in the marketplace, especially given the price of energy this last decade. The question they ask is why should the government promote a source of technology which is not mature enough to compete in the market absent substantial government assistance? Admittedly, Luz became heavily dependent on government sponsored tax incentives. When it began its operations in the early 1980's, the price of energy was forecast to be much higher than it is today, and the policies enacted during that time were based on the assumption that energy prices were only going to go up, not down as they did: "the solar energy tax credit was intended to...create incentives to accelerate commercial investment in, and consumer adoption of, renewable energy technologies" (Rich & Roessner, Energy Policy, Mar. 1990, p. 186).

Advocates of the free market approach point out that such policies as the tax credits were not aimed at improving environmental quality, but were designed to stimulate investment where there otherwise would not have been any. They adamantly insist that the government should not continue promoting something regardless of what the intention was unless you modify the assumptions upon which the policy is based. The energy market changed quite a bit after 1981, substantially reducing the impact that renewable energy could have without continued government support in the form of incentives. Based on the circumstances, they say that the government should have discontinued support because the opportunity cost was simply too high. The tax credits could not be supported on the grounds of cost-effectiveness as
concluded by early studies of the tax credits (See Sawyer & Lancaster in Sawyer & Armstrong State Energy Policy, p. 172; Salvatore Lazzari, CRS Report #82-204; U.S. GAO, Studies on Effectiveness of Energy Tax Incentives are Inconclusive, 1982). Some analysts have argued that the "policy issue is whether tax credits constitute an appropriate, viable and cost-effective component of federal government policy aimed at promoting solar technology commercialization" (Rich & Roessner, Energy Policy, Mar. 1990, p. 198). Luz officials would disagree and argue that this is not the real issue to be reckoned with, unless environmental externalities are considered.

Some of those who advocated continued government support of renewable energy insisted that the government has got to have a firm commitment to renewable energy for some of the reasons mentioned above. Cost-effectiveness without considering environmental costs is not one of them (Interview with Heede). Some would even argue that the government should have intervened to prevent the collapse of Luz. The dominant position among advocates is that the government should not have intervened with a short term measure, but rather should have implemented policy which was consistent and reliable in the long-term; a policy which was flexible to shifts in the economy. Lack of such a policy contributed substantially to Luz's demise. "On-again, off-again renewal of federal solar tax credits...made financing difficult" (IPR, Dec. 6, 1991, p. 1; see also PR Newswire, Nov. 27, 1991).

The property tax exemption extension also contributed to Luz's demise in a similar way that the tax credits did - it was uncertain. With this uncertainty over the government's willingness to continue exempting Luz from property taxes, the company found it very difficult to convince its investors that it could complete the project in the absence of the exemption. That is why when Deukmejian vetoed a five-year extension, investors in the Luz projects became skeptical about continuing their investment. Some argued that his decision was based on inaccurate information (Solar Today, Jan/Feb 1991, p. 25). Others insisted that the perception of a one company tax benefit was difficult politically. Some journalists embraced this view at the time Governor Wilson was presented with a property tax exemption bill (Solar Today, Jan/Feb 1991, p. 26). Certain investors decided at the last minute not to participate. This
caused further problems because Luz then had to search frantically for other investors willing to fund its project. It was unsuccessful in finding substitutes.

As mentioned earlier, government assistance in the form of regulation and policy made Luz's contribution possible. Policy took the form of tax credits and property tax exemptions and regulation came in the form of state implementation of PURPA. In California, the size of QFs was at first limited to 30 MWe, was raised to 80 MWe in 1987, and then removed for four years in 1990. These limitations prevented Luz from reaching the point of maximum efficiency with its projects, although the technology to build larger plants, which would reduce costs, had already been developed. In this sense, government regulation of small power producers like Luz was very inefficient. These ceilings set under PURPA did not allow Luz to decrease its costs, and possibly prevented it from being competitive with natural gas facilities operating at 5¢/kWh.

4.6. The Lessons

What lessons can policy makers learn from the experience Luz had? The one who was best situated to comment is Mike Lotker, Luz's Vice-President of Business Development until the corporation's liquidation. His Sandia report is very helpful in shedding light on the ways that government can effectively promote renewable energy development, if they so choose. This assumption though, he points out, may not be a reasonable one. Past policy experience demonstrates that many believe we as a nation can put renewables on the shelf until they are called upon to serve as sources of domestic energy: "the Luz experience demonstrates that this may not be the case. A company must have the room to grow if it is to survive, including a stable regulatory environment, a marketplace that values solar technologies' mitigation of fuel price risk, and an overall tax structure that is both stable and equitable to all energy technologies" (Lotker, Sandia Report, p. 41). This highlights an economic problem, an ideological problem, a strategy question, and several political impediments. Notice that advocates of renewable energy such as Lotker are not arguing that renewables receive greater incentives than conventional energy. They are insisting that different energy sources receive the same policy support and development incentives. It amounts to what many today call a "level playing field."

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By equalizing incentives and financial support, the market could be left to determine which sources of energy we use. As long as conventional energy continues to receive significant incentives and subsidies, renewable advocates will insist parity be established. Favoritism toward one energy source over another does not allow for fair competition or for market mechanisms to function properly. To have survived, Luz did not need to be coddled, but it needed continued stable, government support in one form or another, similar to that which is given to competing conventional sources of energy. "You can't expect to put us on a shelf for 10 years and in the year 2000 pull us off and expect our costs to have gone down and our technology to develop" (L.A. Times, Oct. 18, 1990, p. A30).

A second important lesson is that government policy promoting renewable energy cannot be based solely on economic criteria. The social and environmental good associated with renewable energy must also be taken into account when formulating policy. Unfortunately, these are very difficult to quantify, although strides are being made in our methods of accounting for these benefits and the corresponding costs of conventional energy. Nevertheless, it may be some time until policy can be formulated which incorporates these elements. As past policy experience demonstrates, the market has not attributed any value to social and environmental benefits. If renewable energy is to be promoted, government policy will have to recognize the magnitude of the market failure that it is designed to rectify.

A third lesson is one of basic corporate finance. Large-scale, high start-up cost projects, like the SEGS, require a substantial amount of capital. Government policy over the last decade has prevented very suitable investors, the utilities, from investing in solar technology to the extent that they could have. Utilities have the experience and the organizations, not to mention the financial resources, to facilitate increased use of renewables. However, until the 1970's the utility industry showed itself to be very uninterested in innovative technologies while it continued building nuclear power plants. Policy that recognizes the potential relationship that can be cultivated between the solar industry and utilities could have a positive effect. If we continue to limit the extent to which they can invest in such facilities, the potential of renewables will be realized much later rather than sooner. Until this regulatory obstacle is removed, the renewables contribution to national energy requirements will remain small.
The fourth lesson is that the status of renewable energy technology must be closely monitored to allow maximum efficiency. Renewable energy companies must do a better job than Luz did in making the government aware of the improvements made in their technology which could allow them to increase the size of their operations. In Luz's case, regulatory reform was very slow in coming, thus, Luz had to operate at levels which were below its potential and its point of manufacturing efficiency. This hints at the larger issue of information provision which goes hand in hand with the process of monitoring progress in the industry. This does not call for a marriage between government and business in promoting renewable energy, but it does call for better cooperation.

Over the past decade, few would characterize the relationship between the federal government and the solar industry as entirely cooperative. Support has been intermittent. The energy tax credits are still around, but their existence has been continually threatened. They helped Luz by stimulating investment, and they also hurt Luz by not being consistently available each year. If the renewables industry is able to demonstrate in a strong unified voice that it is ready to contribute to our domestic energy supply, the government has to demonstrate a firm commitment either to support or not support their existence. Policy analysts must also determine whether or not government subsidies are necessary and appropriate, if not efficient. Without these elements being met, renewables will continue to endure a very bumpy ride to commercialization.
Chapter 5 - Conclusion

5.1. Renewable Energy Policy at the Federal Level

During the Carter administration, energy policy was supportive of the renewables industry. The federal government increased funding for renewable energy research and development to almost a billion dollars. Policies such as the energy tax credit were making the energy market more attractive to companies generating power from wind and solar. By 1982, the hopes of the renewables industry were beginning to fade. Reagan was involved full swing in his campaign to bring in the reigns on government spending and intervention in the marketplace. The Reagan administration's renewable energy policy represented an about face from that pursued by his predecessors. The rationale behind this change was that government intervention in the energy market created more problems than it solved. By expunging those elements which he deemed to be drains on the federal budget, Reagan essentially removed incentives to develop innovative technologies. Coupled with this effort was an ideological shift in government priorities. This shift manifested itself in a refocusing of the DOE budget from applied research and demonstration under Carter to basic research under Reagan. This exemplified a shift in the perception of what stage of technology development "the federal role should end and private efforts commence" (The Energy Journal, Jan. 1989, p. 44).

Through incentives, regulation, and increased research and development the Carter administration started something that was not continued in the succeeding administration. The provision of investment incentives is just one example of the measures that came under attack by Reagan. As Sklar has observed, "the solar industry, for example, can't hope to get on its feet if incentives are whittled away and allowed to expire" (Reuters, Oct. 25, 1989). Luz International found this to be quite true in its case. Luz had to invest heavily in lobbying efforts to preserve investment incentives at both the state and federal level.

By decreasing support, as the Reagan administration did, renewable technologies were not able to evolve as fast as they could have. "The Administration's 'constant assaults' on the energy tax credits severely damaged the viability of proposed projects, even though the economics of the projects were sound," John Wilson, executive director of the Renewable Energy
Institute has argued, because Wall Street views the attacks on tax provisions as tantamount to their actual repeal." (Daily Report for Executives, July 15, 1982). Philip M. Huyck of the FBC has argued similarly that: "because the existing credits appeared under continual attack, and because the expiration dates in most cases were too early to be factored into the investment decision in a meaningful way" investors would not find investment in these ventures to be sound. "The 'ambiguous and uncertain character' of the credits may well have made the situation worse than if they had never existed in the first place." (Daily Report for Executives, July 15, 1982).

Another point to understand is that the conventional energy industries are heavily subsidized and have been for many years (Heede, 1985). The infrastructure which has arisen over the last century is balanced in favor of conventional energy production and consumption. Changing this trend and moving towards energy efficiency and a greater reliance on renewable energy will take time. Based on the experience of the 1980's, however, many analysts have concluded that renewables are competing on an uneven playing field. When asked how they would level this playing field they respond that renewables should be given the same amount of support as conventional energy. As Thomas Anton has warned, government and business have been bound together for a long time, and in some cases strong bonds have developed among the beneficiaries, the bureaucrats, and the legislators. Changing these traditional patterns of behavior at the federal level will not occur without tremendous conflict.

Below are the general lessons drawn from the experience of the federal government in promoting renewable energy:

- without consistent government support, the renewables industry will not be able to increase its contribution substantially to the domestic energy supply in the near term
- the issue specific nature of the political system continues to frustrate attempts at formulating substantive renewable energy policy
- the federal government can play an integral role in stimulating the renewable energy industry. However, there are factors inherent in our political system that make efforts at increasing the government's role problematic.
5.2. California and Renewable Energy

One state which has made significant progress in attempting to quantify the externalities and alter the trend of overreliance on conventional energy is California. Even before President Carter took office, California was well on its way to diminishing its reliance on conventional energy and promoting renewable energy use. When Brown left office, the aggressive support of energy efficiency measures and renewable energy polices was quickly abandoned. Neither Deukmejian nor Wilson assumed the same vigorous approach as the Brown administration in encouraging the renewables industry to contribute more energy to the state's supply. The residential solar heating and cooling market collapsed, the strength of the wind farm industry faded, and the world's largest solar electric manufacturer went bankrupt. In the meantime, however, a couple of the utilities, Pacific Gas and Electric and Southern California Edison, picked up their promotional activities encouraging both demand-side management and renewable energy projects.

The California experience offers three general lessons for future efforts promoting the renewable energy industry in all states not just California

- states can stimulate renewable energy consumption and production given aggressive programs and policies, but it is up to each state to determine what energy mix would best meet the demand. Renewable energy can play a role now. The sources of energy adopted will be determined by regional resources and price of energy within that area.
- states must work closely with the utilities, the state utility boards, state energy offices and those planning to operate in the independent energy market. This is essential for increasing the familiarity that the utilities have with the RETs and demonstrating how, in some cases, using energy from renewables can reduce operating costs and enhance general operations
- the regulatory environment created at the state level is one of the most important elements determining the extent to which the private sector will undertake construction of new renewable energy facilities relative to federal policy.
Institutional factors (barriers) must be closely examined prior to the implementation of regulatory reform.

5.3. Future of Renewable Energy in the United States?

Some argue that the possibility of altering the direction of energy policy is slim unless environmental externalities are taken into account in the pricing of energy sources (Interview with Ken Sheinkopf and Heede; Bohi & Darnstadter, 1991). Others argue that indeed renewable energy will continue to face an upward battle because of the historic preference for oil, coal, and natural gas and the accompanying industrial and governmental infrastructures which facilitate their consumption (Rosenbaum 1987; Anton, 1989). The relationship between government and the conventional energy industry for the majority of the century was quite propitious. With the surge in consumerism and environmentalism in the 1970's, that relationship became less firm, but did not disappear. A policy window was created for renewables to go through during that time and they did, but that window quickly shut as the 1980’s came around and the price of energy fell (Kingdon, 1984). In a sense, renewable energy lost its salience as the fear of $50/barrel oil prices withered away. The end of crisis quickly swept the solar energy movement back into the shadows of the counterculture.

Although oil is not used much today for the generation of electricity there is a perception in the public's eye of a connection between decreasing oil use and the use of solar energy. Interest in other renewable energy sources also rises as general energy prices increase, or, more accurately, the steady flow of cheap energy is threatened. For example, most recently, the Persian Gulf crisis gave the solar industry a strong boost, in some cases a 400% increase in sales of renewable energy technologies was experienced (Miller, Industry Week, Feb. 4, 1991, p. 52). The point to be drawn from this example is that economic and political events can have a very strong effect on the future contribution to be made by renewables. This effect will be seen in the extent to which renewables can displace present and future energy demands and in the time that it takes for certain technologies to reach the point of commercialization and for others to compete free of government incentives or subsidies. Much of the success or failure of the renewables industry can be attributed to the role played by government.
5.3.1. Role of Government

Over the past two decades the role assumed by the government has not been consistent. Should it be expected that the government be consistent in its energy policy given the changes which occur in the legislature and the executive branches not to mention the built in incrementalism which seems to characterize all energy policy, as Rosenbaum points out? During the past twenty years the number of participants in the policy process has vastly increased, thus further confounding efforts to formulate substantive policy. As a result of this change in the participants, the relationship between government and the private sector has also been altered. Much debate surrounds discussion of the appropriate roles to be played by the government and the private sector in developing renewable energy technologies. Some have insisted that the government has a minimal role, while others have argued government has a substantial role. The reasons for each argument vary widely, but what is important to realize is that agreement is not easily arrived at how to promote renewable energy effectively.

5.3.2. Role of the Renewable Energy Industry

The private sector has been expected in the past decade to shoulder the burden of bringing particular RETs to commercialization, while the government continues to invest in projects the private sector does not find attractive (Interview with Heede). Some argue that the reason for this is that there is poor communication between the national laboratories and the private sector. Claims like this are not well founded because there is a lack of research on the processes used by the federal government to distribute information to domestic industries. However, it is apparent that there are significant differences in the direction that the private sector is going with renewable research and where the federal government spends the majority of its funding dollars. A case in point is solar thermal technology. Sigmund Gronich at the DOE insisted that central receiver systems are the most promising application for solar thermal, while the only large scale application in the private sector has been a dispersed unit system. The government seems to have other intentions beyond just helping to bring to commercialization particular technologies. What those intentions are are a bit vague.
5.3.3. The Future and the Cost of Energy

The major point to conclude from this analysis of the factors affecting renewable energy promotion is that the future is still very uncertain. The factors to weigh in determining what role renewables will have in our energy future are too numerous to examine in this short paper. Unless serious consideration is given to the various options available to government, and renewables are able to improve their level of economic efficiency markedly, it is doubtful that their contribution will rise to over 10% of our domestic energy supply before the year 2000. As Hans Landsberg of Resources for the Future wrote, "despite continuing advances in technology, the diffusion of renewable energy sources will be years in coming" (Landsberg, Spring 1990, p. 7). Those who are contemplating future energy policy prospects must bear in mind that there are "powerful and established constituencies oriented toward the maintenance of established conditions and the perpetuation of energy growth" (Burton, 1980, p. 24). Those who benefit from this environment will not let it be replaced by one that restructures the energy market in favor of other industries. Oftentimes, it is in the interest of legislators and other public officials to maintain the current distribution of benefits.

The difficulty of quantifying environmental externalities will continue to confound the solicitation of greater renewable energy support. For the renewable energy industry to increase its contribution, policy promoting renewable energy should not be based solely on investment factors, but must also take into account environmental externalities. Current pricing of energy perpetuates certain patterns of use and a continued dependence on traditional supplies of energy. "The abundance of low-cost oil well into the next century is a reality that policy must deal with" (Behrens & Bamberger, CRS Review, Mar-Apr 1991, p. 2).

If the general price of energy remains low, renewable energy will not be able to increase its market share. As Christopher Flavin of the World Watch Institute remarked, "you would need sustained, very high oil prices to really encourage the development of so-called alternative fuels. The only way we are going to see such a development is through a concerted program to do it, but we're not going to see this during the next 20-30 years if ...oil prices are not high enough to provoke their development" (Cooper, p. 596, Oct. 12, 1990).
Another stumbling block for RET development is that there is really no economic weight given to their relatively benign environmental effects. Until environmental externalities become more weighty, the playing field will continue to be uneven. "As evidence of the environmental harm caused by burning fossil fuels mounts and controversy continues to surround the issue of nuclear power, energy experts point to renewable energy sources as the only acceptable, long-term solution to the country's energy needs." There are two reasons. "First, they depend upon a virtually inexhaustible supply of domestic fuel." Second, they "release few or no harmful emissions into the atmosphere" (Cooper, Oct. 12, 1990, p. 595). "A variety of renewable technologies are available today, and with relatively minor technical improvements and the benefit of mass production, they could be competitive with. . .fossil fuel technologies (particularly if environmental impacts are included)" (PUB FORT, Nov. 8, 1990, p. 5).

Currently, research is being done on quantifying environmental externalities, but there is still much debate which surrounds the methods being used. Some argue that until positive and negative environmental externalities are taken into consideration, renewables will not be able to compete on a large scale. "If the oil companies were taxed for some of the costs of keeping shipping lanes open or oil spills, it would at least level the playing field and make it easier for us to compete. . .," said Mike Eiliston, a co-owner of the Carrizo Plain solar plant in California. "Right now there's no financial advantage for us to produce energy that has no thermal pollution, no noise pollution, and no air pollution." (L.A. Times, July 26, 1991, p. A3). As Carl Weinberg, Pacific Gas & Electric's research and development manager, said, "if fuel and social costs were included in the projections for fossil fuel systems, those costs would be much higher" (PUB FORT, Jan. 15, 1991, P. 13).

"Upon reflection of the past decades experience with renewable energy, the biggest question [that remains] is whether we as a nation have the political will to make a bold but guaranteed investment in our country's future" (Green Report, p. 10). As this thesis has attempted to demonstrate, certain barriers will continue to impede the pursuit of that goal. We have yet to see a comprehensive energy policy at the federal level, let alone one that aggressively promotes long-term solutions which include renewable energy. Although our political system is
designed to inhibit progressive policy from being formulated, policy makers should continue striving to implement substantive policy. There are a variety of options that policy makers can select to promote renewable energy. However, the political environment will determine which options are actually implemented. Political leaders at the state and national level will continue to have a considerable influence on the general direction of energy policy. At the same time, the public will maintain the responsibility for being informed about energy related issues and encouraging change, if that is so desired. An essential place to begin shaping the future of renewable energy is in informing and educating the public about energy. The public must be made aware of the costs and benefits associated with using particular sources of energy. By changing the public's perception and attitude toward energy consumption and production, the renewable energy industry could begin to make greater social and economic gains while contributing to our energy supply.
Epilogue

Since the writing of this thesis, comprehensive energy legislation was enacted by Congress and signed by President Bush. The lessons drawn from my research shed light on the manner in which policy was formulated at the federal level. As past policy formulation efforts illustrated, a final bill is usually a very watered down version of its original form. When Kuwait was invaded on August 9, 1990, over two years ago, it was believed that Congress was going to put together a bill that would reduce our dependence on foreign oil. The National Energy Security Act seemed like the vehicle to bring about this change. However, after two years of battle among environmental groups, automobile manufacturers, and oil companies, many of the key principles of the original bill have been all but changed in the legislation signed in October of 1992.

A delicate coalition of House and Senate leaders held the bill together. The differences between the House and Senate bills were wide enough that they could have led to the unraveling of the coalition underpinning the legislation. Numerous problems erupted that could have caused the death of this legislation. One such problem was even sparked by a Senate bill's co-sponsor, Republican Senator Malcolm Wallop. Until compromise was reached on a coal tax proposal, he held up the legislation by threatening to not support it and by using obstructionist tactics such as filibustering. Despite such attempts to block the legislation, the coalition was able to hold the bill together with an 84 to 8 vote. What ended up not being included in the legislation were two of the more controversial issues - drilling in the Arctic National Wildlife Refuge and fuel efficiency standards for cars.

The following is a list of provisions that the new law calls for in supporting renewable energy sources. First, the law calls for a change of the ways in which the electric utilities are regulated under PUHCA. It calls for the easing of regulations to allow independent power producers to buy and sell on the wholesale electric market. In addition, another provision aims to open transmission access. This would allow companies like Luz to sell the power they generate directly to a different utility, not just the one in whose service area that power is generated. The result of this change will be increased competition and more efficient producers.
Another measure is the purchase of fleet vehicles using natural gas, ethanol, and other alternative fuels. Federal fleets of such vehicles will be expanded as a result of this provision.

There is a federal production incentive for public utilities that build or purchase new facilities that generate electricity from renewable energy sources. Renewable energy developers receive up to 1.5 cents per KWH they produce. The incentives financed through appropriations applies to electricity from wind, solar-generated steam, photovoltaics, geothermal heat, and biomass material. Other provisions for renewable energy development include:

- federal government-private enterprise joint ventures to develop renewable technologies and applications ($3 million will be allocated each year for the joint development program using renewable energy sources);
- buying down or subsidization of part of the interest on commercial loans for joint-venture developers of renewable energy facilities;
- studying whether rate-making and taxation practices bias for/against renewable energy power plants;
- exporting renewable energy technology such as a database to the Pacific Rim
- and, providing for the licensing of hydroelectric power projects on federal lands.

Although President Bush signed this energy act, it is still very uncertain what its impact will be on the renewables energy industry. No money has actually been appropriated for any of the programs presented in the national energy bill. However, the fact that an energy policy was formulated is a small achievement in itself, given that it has been over ten years since a comprehensive energy bill was passed. The bill, which took more than two years to assemble, "finally passed in the tail end of the 102nd Congress because it was non-partisan and largely non-controversial" (TEJ, Nov. 1992, p. 6). As noted above there are substantial provisions which are being made to encourage the use and development of renewable energy. Many deals and compromises were made to pass the legislation, and it is likely that these will come to light in the months ahead. Until then, renewable advocates will watch with cautious optimism as the federal government attempts to modify long-existing structures in the energy industry to accommodate new participants.
Appendix A

Organization:

Address:

Interviewee:

Job Title:

Date:

Time:

**Interview Objectives and Questions**

1. To determine both the positive and negative effects of PURPA on the independent energy industry and the resulting relationships between utilities and non-utility producers.

**Questions regarding PURPA and utilities**

*I will begin by asking you some general questions about the Public Utilities Regulatory Policies Act (PURPA).

1. Are you familiar with the way PURPA was implemented in California and what it was intended to do? (If yes then) What do you think about the way PURPA was implemented in California? How is it different from other states in terms of encouraging the independent energy industry? Do you think this was an effective way for state governments to encourage independent energy producers? Define effectiveness for me.
2. Some analysts have argued that PURPA needs significant changes. If change is indeed necessary and desired, what facets of PURPA need be addressed first?
3. What do you see as the future of the independent energy producing market as long as PURPA remains in its current form? What about if the changes mentioned above are made?
4. What role can utilities play in promoting renewable use?
5. How important is the fact that independent energy producers can now construct facilities over 80MWe, at least for the next four years, without being ineligible for the benefits offered under PURPA?
6. Why was there opposition to allowing an amendment to PURPA lifting the size limit altogether? Which groups were concerned about raising it?

II. To determine the importance of tax credits in promoting the growth and sustenance of the solar industry.

Questions regarding tax credits
*I am now going to ask you some questions about business investment tax credits and their role in sustaining the solar energy industry.

1. What are the goals of state and federal business tax credits for energy production? Do you think they had the desired effect of helping to develop a viable renewable energy industry? Explain.
2. Are the tax credits essential to establishing a viable solar industry? How essential are they to maintaining this industry?
3. Opponents of tax credits argue that business investment tax credits do not have the desired effect and merely serve as a drain on government treasuries. Advocates of the credits point out that the tax credits merely help to level out what is already an uneven playing field. What, in your opinion, lies at the base of this controversy over tax credits?
4. How did energy and investment tax credits make solar energy more attractive? First, could you explain the difference between energy credits and investment credits? Second, could you quantify the relationship that these credits were to have on the energy producing industry?
5. There are a set of 12 tax credits which, for the past 5 years have been annually renewed. Why has the set of 12 tax credits, known as the extenders, been on an annual approval schedule instead of being approved for an extended period of time?
Additional questions for California interviewees:
a) Why was the contingency between state and federal tax credits severed by the California legislature in 1985?
b) In 1983, the SolarCal Council determined that in keeping the tax credits, significant long-term benefits would accrue to the state treasury. Advisors to Governor Deukmejian insisted that it would have the reverse effect of putting a greater strain on the state budget. What was the basis for such a wide difference in the forecasts?
c) Do you think California should continue to offer the tax credit? If yes, why? If not, why not?

III. To establish the general perception among scholars, policy analysts and industry representatives regarding how and why government policy and behavior contributed to the collapse of Luz International.

Questions regarding Luz
*This next set of questions regards the history and evolution of Luz International.

1. Which kind of government policies do you think facilitate the growth of independent energy producers like Luz?
2. Could the government have averted Luz's collapse? If so, how? Should they have averted Luz's collapse?
3. Some argue that tax credits were inconsistent and that this contributed to Luz's demise. Do you think they were inconsistent? How did they contribute to Luz's fall?
4. How did utility companies react to the requirement to purchase electricity from independent energy producers like Luz International?
5. Claims were made back in the early 1980's that Luz could become a viable electricity supplier independent of state or federal support. What happened during the 1980's to change this projection?
6. Are you familiar with the stance PG&E has taken toward independent energy producers like Luz? What made PG&E switch its position toward independent power producers, like Luz, within a few short years?
7. What lessons does the Luz experience have for the development of renewable energy? What about for government policy to promote renewable energy?
8. (Lotker only) In a 1989 article in Forbes, James Bazor, the former CEO of Luz is quoted as saying that by 1990, Luz expected their system to be competitive on pure economics without any tax breaks. Do you know what his assumptions were in making this statement?
9. (Lotker only) In a 1989 ENR news brief, it was stated that due to construction efficiencies and streamlined manufacturing procedures, a Luz plant could be built in less than a year. Could you expand on what those efficiencies were and how manufacturing was streamlined?
10. (Lotker only) Could you explain the financing scheme used by Luz to make their projects possible? When did Luz begin financing the first SEGS project?

III. To determine what role government will play in the present and the future in promoting renewable energy use.

**Questions regarding the government's role**
*This set of questions deals with the role to be played by the government in promoting renewable energy development and use.*

1. Do you think government should play a role in promoting the use of renewable energy? If so, what role?
2. Assuming that government is interested in continuing to promote renewables, at what point should renewable energy technologies be expected to vie for themselves in the market place absent government assistance or subsidization?
3. In what areas should the government allocate funding dollars for renewable energy, if they should allocate any at all?
4. How would you characterize the last decade of policy making toward the development and promotion of renewable energy? Federal? State?
5. When formulating policy for renewable energy, what technological, political, and social concerns must policy makers be sensitive to with regard to the renewable energy technologies themselves?
6. Is it important for the growth of the renewable energy industry that we have a national energy policy? If yes, what are some of the key elements that that policy must possess? If no, what kind of policy will best facilitate the industry?

IV. To determine both high and low estimates of the contribution that renewables can make to our domestic energy supply through a comparison and contrast of competing perceptions.

**Questions regarding the future of renewables**
*This last set of questions deals with the future of renewable energy*
The following is a list of possible scenarios for the future of renewable energy. What I would like you to tell me is the extent of the contribution that renewables can make given the different scenarios.

A) Assuming our government chooses to commit greater resources to the promotion of renewable energy, by the year 2000, what percentage of energy use could stem from renewables?

B) If we were to continue with current policy and funding levels, what kind of contribution do you see renewables in general making to our domestic energy supply? In specific, to what extent will solar thermal and PV energy contribute to that total?

3. What barriers, if any, will continue to exist for renewables for some time to come, assuming there are no significant changes in policy? What do you see as the largest hurdle for renewables in the short term? In the long term?

4. Would you agree or disagree with the statement that there are substantial costs to using conventional energy which are not represented in the price of that energy source? How would you propose attributing more of the so-called "hidden-costs" to the use of nonrenewable energy sources?

5. When it comes to changing the price structure of energy and fuel, we must address the issue of equity. What kind of impact do you think changing the price of energy would have on the general populous, what about specific income groups? What does this mean for making renewables more competitive with conventional energy?

6. At what government level do you see the most effective policies for renewable energy- the state or the federal? On what basis do you make this determination?

7. The Union of Concerned Scientists has forecasted that by the year 2020 renewable energy could supply as much as 45 Quads. Others, such as SERI say that 17 Quads is more likely. What are the dominant assumptions being considered in making these forecasts? What could best explain the wide difference between the two numbers?

8. What circumstances would need to arise in the economy to bring about the growth of a viable alternative energy industry which is not dependent on government subsidies, outside of research and development? For example, increases in the price of conventional energy, global warming, etc...
Other Questions
1. What do you see as the best way for preserving national security in terms of energy management and use?
2. (Lotker)Is the tax system structured so that utilities profits taxes passed on to the consumer in the form of higher prices? It has been argued that since utilities do this, alleged tax biases discriminating against solar energy utilization, turn out to actually be a bias in favor of solar energy use. What is your opinion about this?
3. What would make heat storage economically viable at solar electricity generating stations?
4. Would you call the government's current investments in nuclear power, coal, oil, and natural gas inefficient or efficient? If yes, why? If not, why not?

Questions for Capitol Hill People:
(PURPA)
1. What has proved to be the most difficult aspect of PURPA to implement?
2. Are there any changes slated for PURPA in the near future, i.e., in the form of amendments or new legislation? What are they?
3. Is (the Congress or the Senate) making any moves to enact new legislation directly supporting the development of renewable energy, outside of R&D?
4. Why has PURPA not been amended to allow independent energy producers to build facilities of an unlimited size?

(Tax Credits)
1. Do you think the tax credits have been useful in promoting renewable energy development?
2. For the past decade, much controversy has surrounded the tax credits. Some have argued about the importance of their continued existence, while others have insisted that the government should not be providing incentives in this form. If you can, could you briefly outline who it is that is aligned on both sides of the debate and what they are arguing?
3. Recently, the credits have been facing an uncertain future every year. Each year they have been extended though. What has been the rationale for keeping the credits?
4. For those who argue that the tax credits have not achieved what they were intended to do, what are the changes that they desire and what is the rationale behind that change?
5. Could you explain to me how avoided costs of buying electricity for resale played into a utilities decision making process about whether or not to purchase the electricity?
August 26, 1986  Solar pannels removed from atop the White House
October 1986  business energy investment credits retroactively
            restored to 15% in '86, 12% in '87 and 10% in '88
March 1987  PG&E continues drive against PURPA purchasing rules
October 15, 1987  Bill removing power generating limit under PURPA
                   is passed by Committee
August 1987  EPRI study sees renewable energy as more costly than
depletable power
December 1987  SEGS III and IV begin operation for Luz
September 1988  Business energy investment credit extended 6 months in
                 Senate bill
October 22, 1988  Tax credit extended through 1989
December 1988  Luz starts up SEGS VI and VII (at a cost of $116 and
               $117)
July 20, 1989  Solar tax credit extension fails in Ways and Means
               Committee vote
November 1989  BEIC extended another 9 months through measures in a
               reconciliation bill
Nov. 17, 1989  SDG&E signs 30-yr pact with with Luz for power from
               80MW station
Dec. 28, 1989  Luz begins delivering power to SCE from SEGS
               VIII 80MW station for .08/kwh
February 1990  GRI study says renewables to grow slowly through 2010
May 10, 1990  Interim NES Report comes out
May 16, 1990  NEPA of 1990 approved by Senate energy committee
June 17, 1990  House Subcommittee passes bill lifting size limits
               under PURPA
August 2, 1990  Saddam Hussein invades Kuwait
October 1990  Luz completes SEGS IX, thus bringing total to 354 MWe
October 5, 1990  Senate lifts limits under PURPA
October 7, 1990  Deukmejian vetoes 10% tax credit extension
Nov. 1, 1990  Congress votes to lift 80 MW size limit under PURPA
Feb. 21, 1991  Solar energy tax credits extended by CA state
               legislature
<table>
<thead>
<tr>
<th>Date</th>
<th>Event</th>
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<tr>
<td>July 1991</td>
<td>Luz lays off half of its work force (350 people)</td>
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<tr>
<td>August 23, 1991</td>
<td>Luz restructures in deal with Swiss firm ABB</td>
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<tr>
<td>Sept. 6, 1991</td>
<td>Accord with ABB continues to be elusive; prospects dim.</td>
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<tr>
<td>October 1991</td>
<td>Negotiations continue with ABB and other creditors</td>
</tr>
<tr>
<td>Nov. 27, 1991</td>
<td>Luz files for bankruptcy</td>
</tr>
<tr>
<td>Nov. 27, 1991</td>
<td>6 month extension of tax credit for renewable investment</td>
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VITA

A native of California, Howard Friedman attended undergraduate school at Franklin and Marshall College in Lancaster, Pennsylvania. In 1990, he received a bachelor's degree in liberal arts with a major in government. After graduation, Howard returned to California for three months and instructed students in the skills of scuba diving around the Channel Islands and Catalina. In the beginning of the fall of 1990 he began study towards a master's degree in Urban Affairs at Virginia Polytechnic Institute and State University. He graduated in the Spring of 1992 and immediately began working as a Program Planner for the Energy Bureau of the Iowa Department of Natural Resources in Des Moines, Iowa. Most recently he was promoted to the position of Fuels Data Analyst.

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