Policy Options for Promoting Wind Energy Development in California:

A Report to the Governor and State Legislature

Frank Harris and Peter Navarro

University of California-Irvine
Graduate School of Management
Irvine, CA 92697

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Additional information about this report may be found at http://gsm.uci.edu/~navarro or by calling 949-824-6225.

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Executive Summary

Introduction

From both a national and global perspective, California has been the king of wind energy. Indeed, the Golden State's more than 13,000 wind turbines account for almost 30% of the *world's* wind-generated electricity.

California's leadership in developing the cheapest and most efficient source of renewable energy has been laudable. Wind energy not only rids our air of millions of tons of pollutants. It also creates thousand of jobs, diversifies our fuel mix, and generates substantial income and property tax revenues. Now, however, because of a complex confluence of regulatory, legislative, and political events, wind energy development is on the wane.

In this report, we examine various policy options to re-stimulate the wind industry. We conclude that a comprehensive policy response should include both cost-side and demand-side actions as well as a concerted lobbying effort at the Federal level. The overriding goal should be to create a stable, long run market for wind and other renewables in a way which minimizes economic costs to the state treasury while capturing the indirect environmental and economic benefits of an increased reliance on renewable energy.

Suggested Policy Responses

The three "Big Three" policy responses suggested by this report include the following:

1. A "Buy Green" Commitment by the State

Commit state government to purchasing a significant share of its electricity from *new* renewable sources. This "buy green" policy is perhaps the most important single action that the governor and legislature can take at this time to boost renewable energy demand; and it can be done with minimum fiscal impact.

2. A Comprehensive Loan Program to Assist Renewable Developers

Our cost-side policy simulations indicate that a large-scale loan program offering lower interest rates and longer debt maturities can help significantly lower the cost of capital intensive renewables projects at minimal cost and risk to taxpayers. Such a program could be administered by the California Energy Commission, which currently administers the Renewable Energy Funding program. It could also be assisted by the California Infrastructure and Economic Development Bank.

3. Lobby for Reinstitution of the Federal Production Tax Credit (PTC)

The loss of the PTC has had the single largest negative effect on the economic cost of wind power. The governor and legislature have a golden opportunity to work with the

state Congressional delegation to significantly raise the profile of what is an otherwise a very obscure issue on Capitol Hill by lobbying both Congress and the Clinton Administration for its reinstitution.

Other Policy Responses

Beyond these three major policy responses, there are a number of other actions that might form part of a broader renewables strategy.

1. Extend the Renewable Energy Trust Fund

A Renewable Energy Trust Fund was established as part of the state's electricity restructuring, and it has been reasonably successful in promoting renewable energy. However, this program is scheduled to expire in 2001, and it may be useful to consider an extension.

Note, however, there will likely be significant opposition to such an extension from the state's major utilities as well as from fossil fuel generating interests. In addition, from a fiscal point of view, ratepayers bear much of the burden of this renewables "tax," and this must be taken into the political calculus.

2. Lobby for Non-discriminatory Transmission Pricing Rules

At the state level, pricing protocols in California's administered electricity market currently discriminate against intermittent energy resources such as wind. While this is an admittedly arcane issue, it is nonetheless worth the attention of both the governor and the legislature.

3. Continue Support for Green Marketing and Certification Efforts

To date, green marketing and green certification programs have yielded only modest benefits in promoting increased renewable energy development. It remains an open question as to whether or not such programs can work over the longer term once consumers acclimate to the new electricity market environment. Nonetheless, unless support is continued for green marketing, that open question may never be answered. Accordingly, within prudent fiscal constraints, it may be useful for the state to continue its support for its green marketing efforts.

4. Consider a Renewable Portfolio Standard

It may well be time for the governor and state legislature to seriously consider establishing a Renewable Portfolio Standard. Note, however, that of all the major policies that seek to promote renewable energy, this may well be the most politically contentious.

In this regard, a low risk political strategy would be to simply wait for pending Federal legislation to lead the way on an RPS. On the other hand, California has traditionally been a leader on such issues so that more bold action may be warranted – as Republican Governor Christine Todd Whitman has recently demonstrated in her embrace of an RPS in New Jersey.

Chapter 1: Introduction

> "*Alone among the alternative energy technologies, wind power offers utilities pollution-free electricity that is nearly cost-competitive with today's conventional sources."*
>
> Electric Power Research Institute

From both a national and global perspective, California has been the king of wind energy. Globally, the Golden State's more than 13,000[1] wind turbines account for almost 30%[2] of wind-generated electricity. Nationally, California's more than 1,600 megawatts[3] of capacity far outdistance Minnesota, which finishes a distant second with 275 megawatts.[4]

About 95 percent of California's wind capacity is located in three areas: the Altamont Pass, east of San Francisco; Tehachapi, southeast of Bakersfield, and San Gorgonio, which is near Palm Springs and east of Los Angeles.[5] For more than a decade, these wind turbines have helped generate roughly 1.5% of the state's electricity production.[6] This is enough electricity to provide for the residential needs of a city the size of San Francisco. At the same time, wind power reduces California's emissions of air pollutants and greenhouse gases by hundreds of thousands of tons annually.[7]

Despite the role wind power has played in California's energy and environmental picture, the industry's future is uncertain. This is because of a complex confluence of regulatory, legislative, and political events that have led to a waning of the growth in wind power development. This is unfortunate because wind power has the potential to provide tremendous economic and environmental benefits at the state, national and global levels.

At the state level, wind power results in both cleaner air and water while creating well-paying jobs.[8] For every 10 million kWh of output, seven jobs are created.[9] At the national level, wind power helps cut our trade deficit by lowering our foreign petroleum imports at the same time that it improves national security by reducing foreign petroleum dependence. At the global level, wind power helps reduce greenhouse gas emissions and the attendant threat of global warming.

Within the context of these foregone benefits, the purpose of this paper is to analyze various policy options to re-stimulate wind energy development in the state. In the course of this analysis, we shall see that a significant increase in California's reliance on wind energy is both economically desirable and feasible. We shall also see that wind power currently faces a difficult market environment, an uncertain regulatory environment, and an indifferent public policy climate – even as public support for wind power remains high among the broader electorate.

Chapter 2 discusses the benefits of wind power from a state, national, and global perspective. Chapter 3 provides a brief policy history of wind development in California that illustrates both the rise – and sharp decline -- of the growth in wind power in the state. Chapter 4 discusses the structure and economics of the wind power industry as a prelude to Chapter 5, which examines various cost-side policy options available to promote wind energy development. In this chapter, we conduct a set of simulations designed to assess the financial impact of each of the various cost-side policy options. In Chapter 6, we examine similar policy options on the demand-side. The report concludes with a summary and set of policy recommendations.

Chapter 2: The Benefits of Wind Power

Wind power represents an abundant, renewable, non-depletable energy resource. It ranks second only to hydroelectricity as the cheapest source of renewable electricity generation and is significantly less expensive than other renewables, ranging from solar and biomass to geothermal. For example, wind energy can be generated at around 5 cents per kilowatt hour (kWh) while solar costs about 16 cents/kWh, geothermal about 11 cents/kWh, and biomass about 7 cents/kWh.[10]

In California, it is economically feasible to significantly increase wind power generation. With such an increase would come important environmental and economic benefits to the state. These benefits include reduced air pollution, a greater diversity of the fuel and generation mix, additional income and property tax revenues, and job creation. Additional economic benefits involve creating new export markets and generating emissions credits which can be sold or traded.

A. Reducing Air Pollution

The most important contribution that wind power can make to California is to help clean its air. Making electricity is the largest industrial source of air pollution in the United States. Renewable generation sources are dramatically cleaner than non-renewable system power, with wind power leading the way. Although California has made significant progress in this environmental area, substantial air pollution problems remain.

1. The Scope of the Problem

Seven of the nation's top ten smoggiest cities are in California;[11] and more than 90 percent of all Californians live in areas with polluted air.[12] This is despite the fact that California has led the nation in requiring strict emission standards.

In some cities, the problem is particularly acute. For example, living in Los Angeles has the same effect on human lungs as smoking half a pack of cigarettes a day while 12 million southern California residents are regularly exposed to levels of pollution that can cause nausea, headaches, eye irritation, and dizziness.

Moreover, because of the state's topography, California's air pollution problem is not confined to urban areas. Mountains that surround the state's valleys form basins that trap and hold air, and much of California's agricultural land is located in these basins.

According to the California Air Resources Board, air pollution aggravates heart and lung disease and contributes to bronchitis, emphysema, and cancer. Both children and senior citizens are particularly prone to polluted air – the young because their lungs are still developing, the elderly because their immune systems have begun to weaken. Such air pollution costs Californians billions of dollars each year.[13] These costs come in the form of increased health care costs, decreased worker productivity, and premature mortality as

well as lost business due to regulatory controls, property damage, and foregone production and income caused by poor health.

2. The Role of Wind Energy

Increased wind energy development can play in an important role in a broader strategy to reduce the state's air pollution by displacing electricity generation from fossil fuels such as coal, oil, and natural gas, as well as nuclear energy. In a typical year, California's utility plants emit 64 million tons of carbon dioxide, 69,000 tons of sulfur dioxide, 162,000 tons of nitrogen oxides, and 1,876 tons of particulates.[14] Nationally, emissions exceed 5,420 million tons of carbon dioxide, 9.3 million tons of sulfur dioxide, and 21 million tons of nitrogen oxides.[15]

Carbon dioxide is the most important of the so-called "greenhouse gases" that many experts now believe is contributing to global warming. Sulfur dioxide is the primary cause of both photochemical smog and acid rain. Nitrogen oxides are also a major component of photochemical smog and a major contributor to the formation of ozone. As for particulates, as the American Lung Association has reported, air pollution from particulates alone causes thousands of deaths and costs the national economy some $11 billion each year.[16] The risk of premature death is 17% higher in cities with high fine particulate levels when compared with cities with cleaner air.[17]

Wind energy can play a crucial role in reducing the emissions of these pollutants because electricity generated from wind is completely pollutant free. Indeed, every additional 500 megawatts of wind capacity has the potential to reduce as much as 588,697 tons of carbon dioxide, 637 tons of sulfur dioxide, 1,496 tons of nitrogen oxides, and 17 tons of particulates.[18]

Such emissions offsets from increasing reliance on wind power would help clean up our air. They would also contribute to the broader Federal policy of reducing greenhouse gases – a policy dictated by the Kyoto Treaty on Global Warming signed by President Clinton. This Treaty specifies that the U.S. must reduce its emissions by 7 percent below 1990 levels within the next decade. As the producer of one fourth of the world's greenhouse gases, the United States is the world's largest polluter. In meeting the ambitious Kyoto goals, California can make a significant contribution, due to its abundant wind resources and positive political climate toward environmental responsibility.

In this regard, global climate change resulting from the widespread burning of fossil fuels has the potential to be the most important environmental problem of our time. By the year 2100, some experts predict that the Earth's average temperature can be expected to warm by 1 to 4 degrees Celsius. This is a modest increase, but likely consequences include: the spread of tropical diseases; disruption of agriculture due to drought and changes in rainfall patterns; elimination of many now endangered species; increasing

numbers of deaths during summer heat waves; increasingly severe tropical storms; and melting polar icecaps, leading to rising ocean levels and coastal flooding.[19]

B. Diversity of the Fuel and Generation Mix

A second major benefit of wind power is to help diversify the state's fuel and generation mix. In this regard, both coal and natural gas prices are low by today's standards. Historically, however, they have often been subject to rapid price fluctuations and supply problems. This is a significant issue around the world because many countries (including the United States) are rushing to install gas-fired electric generating capacity because of its low capital and fuel costs – the so-called "dash to gas."

Nonetheless, as world demand for natural gas grows, the prospect of supply interruptions and volatile price fluctuations will likewise grow. Indeed, if present economic and oil industry trends continue, future price shocks have been forecast as early as the year 2000, with the world facing permanent increases in the price of oil and gas.[20] Such forecasts make further reliance on natural gas unwise and greatly increase the value of fuel and generation mix diversity. It would appear, then, to be in the strong economic interest of the State of California to promote a diverse electricity generation mix as "portfolio insurance" against fossil fuel price increases and/or petroleum supply disruptions.[21]

C. Job Creation, Tax Revenues, and Economic Diversity

Wind power generates more than just electricity. It also generates more jobs per unit of energy produced than most other forms of energy. As one utility executive has put it, "wind power pays for people, not fuel."[22] This is due to the source of operating expenses in a wind farm as compared to a fossil fuel facility. In gas-fired plants, fuel costs account for much of the operating expenses. These expenses may not remain in the state but instead are directed to the source of the gas. However, with a wind facility, the majority of the operating expenses will remain in the state in the form of wages. Moreover, much of the employment occurs in economically disadvantaged rural areas where employment opportunities are both scarce and low paying.

In California, the wind energy industry presently supports more than 50 businesses. 1200 people are employed directly in these businesses and another 4300 jobs have been created indirectly. Nearly all jobs are related to operating, maintaining, and servicing wind turbines.[23]

Wind power can also create a valuable use for land that is not otherwise economically viable. Additionally, land currently used for other activities such as farming or ranching can simultaneously be used as a wind farm. Additional benefits to the state flow from the incremental property and income tax revenues generated.

An excellent example of the positive economic and environmental impacts of wind power to California is provided by Kern County, home to 4600 installed wind turbines and 650 megawatts of capacity. These wind resources employ over 3000 people, generate almost $4 million in annual property tax revenues and offset over a million pounds of pollutants while providing electricity to a half a million people.[24]

Chapter 3: A Brief Policy History of Wind Development in California

Within the context of the economic and environmental benefits provided by wind energy, it is useful to discuss both the rapid rise and the current waning of wind power development in California.[25] In fact, the rapid rise of wind power in California between 1982 and 1991 represents one of the most incredible booms in the state's long history of economic growth. During this time, over 1500 megawatts of wind capacity were put into place – well over 10% of the *world's* total capacity.

Figure One documents this boom between 1982 and 1991.[26] The bars in the chart illustrate the annual increase in wind power capacity measured in megawatts installed. The upward sloping dotted line traces the increase in cumulative capacity measured by total megawatts installed. As is evident from the figure, the rapid rise of wind power in California began in 1982, peaked in 1985 with almost 400 megawatts of capacity installed, and virtually ground to a halt by 1992. Since that time, almost as much capacity has been retired as installed so that total capacity today is now roughly the same as it was in 1991.[27]

FIGURE ONE: WIND DEVELOPMENT IN CALIFORNIA, 1982-1991

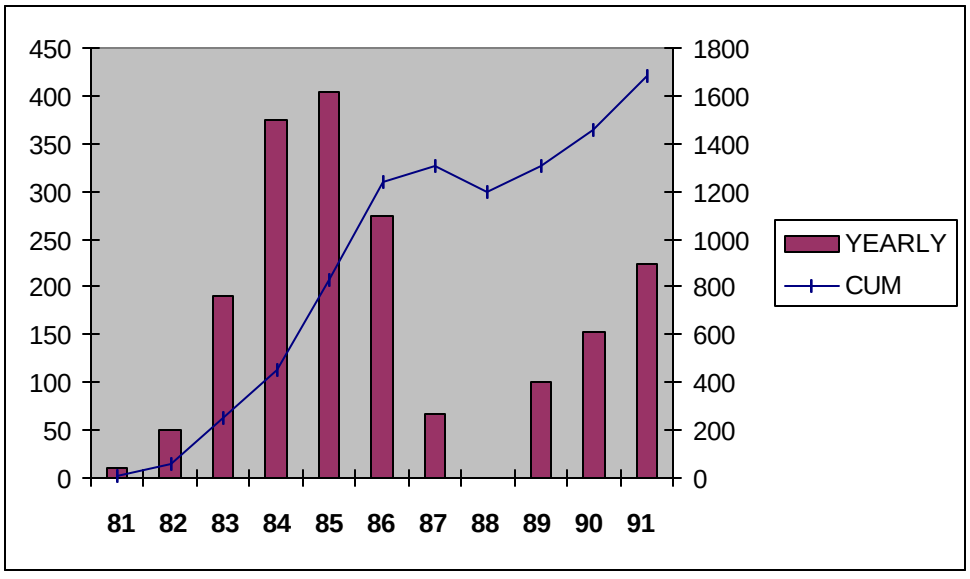

TABLE ONE: THE RISE OF WIND DEVELOPMENT

YEAR	EVENT	EXPLANATION
1977	The California Energy Commission begins program to map state's wind resources	The identification of viable wind resources significantly improved ability for developers to obtain project financing.
1978	Congress passes the National Energy Act and the Public Utility Regulatory Policies Act (PURPA)	• Opens the electricity market to non-utility generators • Guarantees a market for electricity generated by independent power producers by requiring utilities to buy electricity at a "fair" price • Establishes a 10% Federal Energy tax credit and accelerated depreciation
1979	California Public Utilities Commission fines Pacific Gas & Electric $15 million for not considering conservation and renewable energy in their future generation mix.	Action increases pressure to develop renewables among executives at California's three major electric utilities
1980	Governor Jerry Brown organizes a conference to attract financial interest in commercial wind development	Leads to the first set of wind turbines installed in two of the three windiest passes on California
1980	Congress passes the Crude Oil Windfall Profits Tax Act	Increases the business energy tax credit to 15%, thereby boosting the total investment tax credit for wind turbines to 25% when combined with the Federal Investment Tax Credit. Also extends applicability through 1985
1980	The California Legislature passes a 25% state investment tax credit	Combined with Federal ITC, the total ITC approaches 50%
1983	The California PUC fines Southern California Edison $8 million for failing to follow orders to accelerate the development of alternative energy.	Action helps serve as a catalyst for negotiations over establishing an "Interim Standard Offer Contract

1983	The California PUC brokers a deal between independent energy produces and two of the state's major utilities to establish an "Interim Standard Offer Contract"	The deal establishes standard, long term contracts with guaranteed high prices for wind producers

A. The Rise of Wind Power

The rapid rise of wind power in California may be directly traced to the public policy history documented in Table One.

In 1977, the California Energy Commission began to map the state's wind energy resources. This effort led to the identification of three mountain passes which have proven to have some of the best wind resources in the world -- Altamont, Tehachapi, and San Gorgonio. This mapping proved to be a crucial ingredient in the coming California wind boom. This is because it helped provide crucial information to investors about the viability of wind projects once attractive subsidies were put into place.

In 1978, in response to a perceived "energy crisis" and growing concerns over air pollution, President Jimmy Carter signed the National Energy Act (NEA) and the Public Utilities Regulatory Policy Act (PURPA). The purpose of these watershed laws was to encourage energy conservation and the development of national energy resources, including renewables such as wind and solar.

The NEA opened the electricity market to independent power producers and non-utility generators while PURPA established a framework to guarantee a renewables market. It did so by requiring utilities to buy all electricity generated from renewables and to do so at a "fair" price – the so-called "must take" provision.

It would take four more years for these laws to have their full effect on wind energy in California, during which time the California Public Utilities Commission (CPUC) came to fully interpret and implement them. However, in the meantime, in 1979, the CPUC fined Pacific Gas & Electric – the state's second largest utility -- $15 million for not considering conservation and renewable energy in their future generation mix. This unprecedented fine helped soften the hitherto seemingly hostile attitudes of the big utilities to "alternative energy."

The following year Congress passed the Crude Oil Windfall Profits Tax Act. This increased the business energy tax credit to 15% and combined with the 10% Federal Investment Tax Credit, the total investment tax credit for wind turbines became 25%. It also established a 5-year, accelerated depreciation for wind projects.

In this same year, the California State Legislature passed a 25% state investment tax credit and extended its applicability through 1985 so that the combined state and federal ITC approached 50%.[28]

In this changing financial and political climate, Governor Jerry Brown organized a conference to stimulate financial interest in commercial wind development. By the following year, the first set of major wind turbines was installed in two of California's three windiest passes.

Nonetheless, despite all of the various federal and state tax incentives, investment in wind energy still lagged. It wasn't until 1983 that the final portion of the economic stimulus puzzle was put into place. In that year, the California PUC once again levied a major fine against a large utility. This time it was the state's largest utility, Southern California Edison; and the fine was $8 million for failing to follow orders to accelerate the development of alternative energy. This regulatory action put further pressure on the utilities to cooperate; and one important by-product was a landmark negotiation involving the utilities themselves, independent power producers, and the California PUC.

The negotiation revolved around how the "must take" provision of PURPA would be implemented and involved the establishment of an Interim Standard Offer Contract or ISO4. This ISO4, unique to California, adopted a shorthand method of calculating the price that utilities would have to pay for PURPA power and created a standard long-term contract. The price was based on the cost that a utility would be able to "avoid" if it did not have to build a new coal or nuclear power plant but instead bought electricity from independent power producers.

The result was an "avoided cost" ISO4 price that ranged from six cents per kilowatt-hour to as high as 10 and 14 cents per kWh. These higher prices[29] were well above the cost of generating electricity from wind. Moreover, any wind power developer entering into an ISO4 with a utility was guaranteed the forecast ISO4 price at the time for at least 10 years.[30]

Accordingly, these standard offer contracts in combination with the various Federal and state tax incentives created a huge boom in wind power investment. More than $2 billion in investment from more than 50,000 individual investors[31] flowed into California as installed wind capacity quadrupled from 1983 to 1984, tripled from 1984 to 1985, and nearly doubled from 1985 to 1986. But even as this boom was reaching its peak, a complex set of events was unfolding that would stop wind energy's development almost in its tracks.

B. A Wind Development Slowdown

Table Two documents the major events that helped lead to a significant slow down in the development of new wind power capacity in California.

TABLE TWO: A WIND DEVELOPMENT SLOWDOWN

	EVENT	EXPLANATION
1980s	Natural gas combustion turbines begin to emerge as the generation capacity of economic choice	Lower fuel prices and improved technology spark a boom in gas-fired generation.
1985	The federal energy tax credit expires and is not renewed	
1986	Congress passes the Tax Reform Act of 1986 which eliminates the 10% federal investment tax credit while California's state tax credit is reduced to 15% for 1986 and then expires.	
Mid-1990s	The fixed price portion of many ISO4 contracts expire	Prices specified by these long-term contracts plummet, leading many wind turbine projects to be shut down.
1996	The California State Legislature "restructures" the electric utility industry	It becomes more difficult for regulators and legislators to mandate a price or quantity for renewables, but a $540 million fund to promote renewable technologies is established.
1996	The Federal Energy Regulatory Commission issues Order 888 governing transmission pricing	This Order establishes a set of rules for transmission pricing that discriminate against intermittent renewable energy sources like wind and solar.
1999	The "Production Tax Credit" for wind projects is allowed to expire	This leads to as much as a 30 percent increase in the price of wind energy.

To set the policy stage for the significant slowdown of wind power development, oil and natural gas prices began to stabilize in the 1980s and then actually started to significantly decline. During this same period, an important technological breakthrough led to the emergence of relatively small, modular, natural gas-fired combustion turbines as the cheapest available source of new electricity generating capacity. These new, smaller facilities replaced large, central station coal plants as the capacity of choice. This improved technology, coupled with lower natural gas prices and significant subsidies to the petroleum industry,[32] allowed gas-fired turbines to produce electricity for as low as 3.5 cents/kWh. This was well below that of any non-hydro renewable technology, including wind that generates power for approximately 5 cents per kWh.

The problem this new generation of natural gas combustion turbines created for wind energy and other renewable technologies was that gas represented a very low-cost electricity generation option. This was in direct contradiction to the expectations created in the 1970s over soaring oil and gas prices. One important result was that the favorable policy climate for renewable energy disappeared; and in fact, it was the emergence of a low-cost natural gas alternative that partially motivated "tax reforms" in the mid-1980s that took away many of the wind industry's subsidies.

In particular, in 1985, the federal energy tax credit expired and was not renewed. Shortly thereafter, the Tax Reform Act of 1986 ended the 10% federal investment tax credit even as California's state tax credit was reduced to 15% in that same year and then likewise was allowed to expire. These weren't the only problems for wind development, however.

More recently, wind energy has faced a difficult market, an uncertain policy environment, and the expiration of favorable "standard offer contracts" that had once been so important to the flourishing of wind power. Indeed, by the end of 1998, less than a third of California's wind plants were still eligible to collect the higher ISO4 prices, and by 2002, virtually all the ISO4 contracts will have expired.[33]

1. Utility Restructuring

Most broadly, the uncertain market for wind energy has been significantly affected by "utility restructuring" in the 1990s. In 1996, California became one of the first states in the nation to pass a comprehensive restructuring bill. This law deregulated electricity generation and set up an independent power exchange where electricity can be bought and sold. In doing so, it has made it much more difficult for regulators and legislators to directly mandate a price or quantity for renewables.

To address this issue, and as part of its restructuring bill, the California Legislature has established a "Renewables Funding" program administered by the California Energy Commission (CEC). One purpose of this fund is to provide financial support that will allow renewable projects currently in operation to more effectively compete in the new

deregulated market for electricity generation. The other major purpose is to stimulate the development of new renewable energy projects.

Towards these ends, $540 million is being collected from ratepayers between 1998 and 2001 using a "system benefit charge." 13% of the fund is dedicated towards wind energy with
the remainder spread out over technologies ranging from solar and geothermal to biomass and hydro. To date, this program has had some modest success in preserving and stimulating both wind and other renewable projects.

In particular, $70 million of the fund for *existing* technologies has been made available to wind power redevelopment. As a result, a total of 69 wind facilities representing 93 megawatts of capacity have been determined to be eligible for this funding and are receiving from a fourth to a half cent per kWh in subsidies.[34]

At the same time, an additional $162 million – 30% of the total funds -- has been earmarked for *new* renewables projects. These funds are capped at no more than 1.5 cents per kWh, with the subsidy to be paid out over the first five years of operation of each project. To date, wind projects totaling 300 megawatts have been funded.[35]

It is perhaps worth noting at this point that it is unlikely that this program will lead to a net increase in renewable energy as a *percentage* of total electricity generation in the state. It is a modest program that, at best, might help maintain the *share* of renewables in the total overall market. Nonetheless, it should be a topic of further discussion below as to whether or not it would be prudent to extend this Renewables Funding program beyond 2001 as a means to continue stimulating renewable energy development.

2. Discriminatory Transmission Pricing

a. The Federal Problem of Capacity-Usage Pricing

A second problem with utility restructuring relates to how transmission services are priced in a deregulated electricity generation market.[36] The major *underlying* problem is that like solar energy, wind energy is an "*intermittent,*" low-capacity power source. This means that wind generation is not available all the time. Rather, such generation is available only when the wind is blowing within certain speeds and conditions; and this is determined by both the geographical and meteorological region the wind farm is located in as well as any characteristics unique to the project site.

In fact, for a given wind farm, the "capacity factor" – which is based on the available wind resources and measures how much the turbines are actually used -- is likely to be only between 20% and 40%. It is worth repeating here that despite its low capacity factors, wind energy is the lowest cost of all the non-hydro renewables.

Unfortunately for intermittent power sources like wind and solar, transmission services have historically been sold on a "take-or-pay" *capacity-usage* basis rather than upon an *"energy-usage"* basis. Under this take-or-pay system, in order to be assured of available transmission capacity, a wind project operator must reserve transmission services in advance and pay for the capacity reserved – regardless of *whether the capacity is actually used*

or not. This reliance on capacity-based charges, in turn, causes intermittent technologies like wind and solar to have a high transmission cost per kWh generated, further disadvantaging them relative to competitors like natural gas.

One might think that in an era of utility deregulation and restructuring -- in which it is essential to have fair competition among all competitors in the electricity generation market -- that the inequitable transmission pricing structure might have been more fairly structured. In fact, just the opposite has happened.

In 1996, the Federal Energy Regulatory Commission (FERC), which regulates transmission pricing, issued Order 888 to establish a set of rules for transmission pricing in an era of restructuring. This order essentially reinforced the industry practice of take-or-pay, capacity-based charges. Moreover, despite proposals from wind and solar energy advocates to move to an "energy-based" transmission pricing structure tied to the actual utilization of transmission services system, FERC has refused to speak further on this issue.

b. The State Problem of "Uninstructed Deviations" Penalties

Before leaving the issue of transmission pricing, it is also useful to address the rather arcane, but nonetheless important, issue of "*uninstructed deviations*" that has arisen at the state level. Some background here may be useful.

The California Independent System Operator (Cal-ISO) was established in 1996 as a non-profit corporation to administer the state's power grid in an era of electricity deregulation. Its governing board includes representatives from private and public utilities as well as consumers and electricity marketers. The stated mission of the Cal-ISO is "to ensure the power grid is safe and reliable and that there is a competitive market for electricity in California"; and the Cal-ISO serves, in essence, as the "traffic control center" of California's "electron highway."

In fulfilling its role, the Cal-ISO has established a number of protocols, including one on "uninstructed deviations." Under the current protocol, generators deviating from their schedules by producing either too much or too little power for the grid can incur a significant financial penalty. For intermittent resources such as wind, this protocol basically shifts risk from the Cal-ISO to the generator. In doing so, it acts to discourage the development of intermittent sources.

3. Expiration of the Federal Production Tax Credit

Perhaps the biggest problem facing the wind industry at the Federal level is its loss of the so-called Production Tax Credit. The PTC was established by the National Energy Act of 1992 as a means to stimulate wind development. It was initially set at 1.5 cents/kWh and indexed to inflation. It allows any wind developer to take this PTC for the first ten years of operation of its plant. Most recently, the PTC was worth fully 1.7 cents per kWh.

Unfortunately, as of July of 1999, Congress allowed the PTC to expire; and, as we shall see shortly, the loss of this credit will significantly raise the price of wind power.

In this regard, it is perhaps worth noting here that it is in the strong interest of both the Governor and the California Congressional delegation to lobby for a renewal of the PTC for an additional five years or more.

Chapter 4: The Structure and Economics of the Wind Industry

There is a compelling argument based on a wide range of economic and environmental benefits that California policymakers should strongly encourage the expansion of wind energy development in the state. It is equally clear that wind energy development faces a difficult market environment, considerable regulatory and legislative uncertainty, and an indifferent policy climate -- even as public support for wind power remains high among the broader electorate. In this regard, public opinion surveys from around the country continue to view renewable energy as an important response to our environmental problems.

For example, in a Sustainable Energy Coalition survey, 60 percent of more than 1,000 registered voters cited renewable energy as worthy of the highest priority in energy research funding. More broadly, the National Renewable Energy Laboratory has concluded from a review of about 20 years of opinion polls that 56 to 80 percent of Americans are willing to pay more for renewable energy while a study by the Edison Electric Institute concluded that 60 percent of households are willing to pay $6 or more per month for green power and about 40 percent would pay more than $ 11.[37]

The obvious policy question for California's Governor and State Legislature is this: How might wind development be further encouraged in a fiscally responsible way? Before we can address this policy question, it will be useful to first understand three things: (1) how the wind industry is structured; (2) how the "project economics" of wind energy are in large part driven by this industry structure; and (3) what the relative economics of wind generation are versus its chief competitor, natural gas. Let's start with industry structure.

A. Industry Structure and the Economics of Project Financing

During the last decade, most wind projects were financed by limited partnerships or third-party individual investors seeking to take advantage of a wide range of tax benefits. This led to wide-scale abuses, as investors were often more interested in the tax benefits from *construction* than any revenue benefits from *operating* the wind farms. Indeed, these perverse investment incentives quite literally left the California landscape littered in the 1980s with hundreds of non-performing, broken down turbines in the so-called "junkyard phenomenon."[38]

Today, however, "*project financing*" is the norm for most large wind projects. With project financing, a wind developer borrows some of the money – the "debt capital" -- typically from a bank or major financial institution. The remainder of project funds is then provided by equity investors who stand to benefit from both the cash flow of the project as well as from any stream of available tax advantages.

A key ingredient of project financing is a "purchase power agreement" (PPA). A PPA is typically signed with a utility which agrees to purchase the power at a specified

price for a period of time such as 10 or 12 years; and such agreements are essential to attract both debt and equity capital.

1. Key Financial Parameters in the Wind Industry

Because wind turbine projects are capital-intensive and use virtually no fuel,[39] the cost of wind energy is largely determined by the project financing terms, specifically, the cost of debt, the loan maturity, the cost of equity, and the project's capital structure which measures the ratio of debt and equity to total capital. Because these four financial parameters are absolutely critical in understanding how various public policy options might be used to promote wind development, it is useful to briefly discuss each of them in more detail.

The cost of debt is simply the interest rate project developers must pay on the requisite loans while the cost of equity is measured by the return required to attract investors. In general, equity capital is much more expensive than debt because it is viewed as more risky. This is because equity investors are last in line behind lenders and other lien holders when it comes to any claims on a project's revenue stream and assets.

As for loan maturity, it is important because as the term of the loan increases, the price of energy will fall. This is because, with a longer-term loan, the amount of the loan can increase, thus reducing dependence on more costly equity financing. The required rate of return on equity is substantially more than the cost of debt capital. It follows that the higher the debt-to-capital ratio a project can use, the lower will be the costs of generating electricity. Historically, wind project loans have been limited to the length of the purchase power agreement that is entered into.[40] Typically, the loan maturity is 12 years and rarely more than 15 years.[41]

As a practical matter, the most important constraint on the amount of debt used is the "debt service coverage ratio" or DSCR. The DSCR is defined as the minimum ratio of operating cash flow to total yearly debt service required by a lender, where "operating cash flow" equals total revenues less cash expenses and total yearly debt service includes both principal and interest payments. Thus, if the debt service is $1 million in a given year and the DSCR is 1.4, a project developer must generate $1.4 million of operating cash flow to service the debt, with the extra $400,000 providing a cushion in the event of operating under-performance.

Table Three illustrates representative values for the key financial parameters of a typical wind project and compares these parameters to those available to wind's chief competitor in the generation market -- natural gas combustion turbines.[42]

TABLE THREE:
KEY FINANCIAL PARAMETERS FOR WIND AND NATURAL GAS

	Natural Gas CT	Wind Project
Interest rate on debt	LIBOR + 25 basis points	LIBOR + 175 basis points
Loan maturity	15 – 18 years	12-15 years

Minimum DSCR	1.25	1.4
Post-tax Equity Return	8%	14%

From the table, you can see that natural gas projects enjoy significantly more favorable financing terms. Looking at the "interest rate on debt," we see that natural gas project developers pay about 25 basis points above the LIBOR interest rate index[43] while wind projects developers must pay about 175 points above the LIBOR.

Natural gas project developers also only have to provide a rate of return on equity of 8%-- as compared to 14% for wind developers -- while enjoying both longer loan maturities and lower debt service coverage ratios. The obvious question is "why"? The more subtle and important question is: What impact do these less favorable financing terms have on the cost of a wind project? The answers to both of these questions lie in understanding the greater perceived financial risks of a wind energy project.

2. The Perceived Financial Risks of Wind Energy

The perceived financial risks of energy projects include cost over-runs and construction or operation delays. Additionally, wind projects face the possibility of wind turbine failure or under-performance, less available wind than forecast, and environmental disputes involving noise or bird mortality, either of which may lead to construction delays or operational problems. Note, however, that while these risks represent a legitimate concern to investors, much of today's perceived financial risk may be traced back to the early days of wind energy when the industry faced significant problems.

Part of the problem was the technology itself. Many of the early wind turbine designs were simply not reliable, and in these early days, capacity factors, which measure the utilization of wind, averaged below 20%. Part of the problem was the aforementioned "junkyard phenomenon" that occurred because of lucrative tax breaks which fueled the growth of new power development in the wind industry but lacked any incentives for ongoing operations and maintenance. Part of the problem was that, as with any economic boom, inept developers jumped into the fray, proceeded to manage their projects poorly, and then went bankrupt -- leaving their investors with large losses.

Today, however, new turbine designs have cut operating costs by as much as 80 percent compared to just 15 years ago. The newest wind turbines start producing power at lower wind speeds, keep operating at higher wind speeds, and generate more energy from all velocities in between. Additionally, this new technology is highly reliable. New projects utilize higher wind resources with capacity factors that have exceeded 40%.

Perhaps most importantly, the industry has sorted itself out into a smaller number of stronger, more experienced developers, with long-term track records of successful wind power development. Nonetheless, despite a dramatic reduction in the *real* financial risk of building a wind project, there remains a significant gap between this real risk and the *perceived* risk of such a project by the capital markets.

This perceived risk manifests itself in the capital markets as a substantial "risk premium" that wind developers must pay relative to natural gas turbine project developers. To see the impact of this risk premium, take a look at Table Four. It shows by how much the cost of wind energy would fall on a kilowatt hour basis, holding other things constant, if

each of the financial parameters for a typical wind project were set at the more favorable values of a natural gas project (as indicated in Table Three above).[44]

TABLE FOUR: FINANCIAL RISK AND THE COST OF WIND ENERGY

	Change Financial Parameters to Those Of Gas Projects	Levelized Cost of Wind Project	% Impact On Levelized Costs
Benchmark "Base Case"	----------	6.81 cents/kWh	--
Interest rate on debt	Reduce by 150 basis points	6.43 cents/kWh	- 6%
Increase Loan maturity	Increase from 15 to 18 years	6.31 cents/kWh	- 7%
Lower Minimum DSCR	Lower from 1.40 to 1.25	6.62 cents/kWh	- 3%
Reduce Equity Cost	Reduce from 14%to 8%	6.06 cents/kWh	- 11%
Total Impact	Change All	5.29 cents/kWh	- 22%

From the table, we start out with a benchmark levelized cost[45] of wind energy of 6.81 cents/kWh. It is perhaps useful to note here that while a levelized cost of 6.81 cents/kWh may seem high relative to other estimates that informed readers may have seen for the cost of wind power, it is important to remember that we are assuming no Federal Production Tax Credit in this analysis. This is because the Federal PTC has been allowed to expire as of 1999.

However, as we shall discuss further below, if the PTC were in effect, the levelized cost of the benchmark case above would fall by more than 25% to 5.17 cents/kWh – well within the range of typical wind power estimates. *This fact both underscores the importance of the Federal PTC as well as the importance of a swift policy response by the State of California to help wind developers offset the loss of this important policy option* – points that we shall return to in a subsequent chapter.

For now, however, we see in row two of Table Four that if the interest rate were reduced by 150 basis points to that paid by gas projects, the cost per kilowatt hour of wind energy would fall by 6% to 6.43 cents/kWh while extending the loan maturity from 15 to 18 years reduces the cost by 7% to 6.31 cents/kWh. Similarly, lowering the debt service coverage ratio, holding other things constant, reduces the cost to 6.62 cents/kWh or by 3% while the biggest impact of all, lowering the cost of equity by 600 basis points, reduces the generating costs to 6.06 cents/kWh or by 11%. Finally, in the last row of the table, we see that if all four parameters are changed to reflect all the favorable financing terms of a gas project, the cost would fall by 22% to 5.29 cents/kWh.

The lessons of Tables Three and Four are that financing terms are critical in determining the cost of wind energy. The question that this discussion leads us to ultimately is the most important question addressed by this paper: What kind of policy options might be adopted to change these financial parameters to better promote wind project development in the State of California. It is to this task we now turn.

Chapter 5: Cost-Side Policy Options to Promote Wind Development

The major economic problem facing wind power may be summarized as follows: Wind energy costs more in the marketplace than its chief competitor, natural gas largely because of: (1) a greater perceived financial risk, (2) a set of unfavorable transmission pricing rules because of wind energy's intermittent, low-capacity nature; and (3) a discriminatory tax environment at both the state and federal level that favors fuel-intensive generation sources like gas rather than capital-intensive sources like wind.

In thinking about the various policy options available to the Governor and the State Legislature, it is useful to separate these options into three categories. These include: (1) policies such as loan programs and tax exemptions that primarily affect the *cost* side of the wind power equation; (2) policies like "green marketing" and a "renewable portfolio standard" that address the *demand* side of the equation; and (3) broader regulatory and institutional changes such as a change in transmission pricing rules.

A comprehensive policy response should include a balance of both cost-side and demand-side responses as well as institutional and regulatory changes. The overriding *long* term goal should be to create a stable, long run market for wind and other renewables in a way which minimizes economic costs to the state treasury while capturing the indirect environmental and economic benefits of an increased reliance on renewable energy. The *short* term goal should be to re-stimulate the development of the most economic wind energy sites available in a timely manner.

In this chapter, we discuss the various cost-side policy options and then conduct policy simulations to assess their impact on the levelized cost of wind energy. In the next chapter, we take a similar look at demand-side options. Table Five lists the major cost-side policy options.

TABLE FIVE: MAJOR COST-SIDE POLICY OPTIONS

LOAN OPTIONS

- Low-interest government loans
- Tax-free bonds
- Government loan guarantees

TAX CREDITS AND EXEMPTIONS

- State sales tax exemption
- Local property tax exemption
- State investment tax credit

PRODUCTION SUBSIDIES

- Direct production subsidies (e.g., the Renewable Energy Funding program)

In the loan category, options include low-interest government loans, tax-free bonds, loan guarantees, and industrial revenue bonds. In the tax credit and exemption category, policy options include a state sales tax exemption, a local property tax exemption, and a state investment tax credit. In the production subsidy category, options include direct subsidies such as those offered in the Renewable Energy Funding program and preservation of the Federal Production Tax Credit or PTC.

Each of these policy options in Table Five are discussed below with regard to their mechanics, likely impact on the key financial parameters of the wind's cost-side equation, and, where possible, the estimated cost to the California treasury. *This discussion is then followed by a set of policy simulations that illustrate the impact of each policy (and sets of policies) on the levelized cost of wind energy.*

As we shall discuss below, in many cases, the direct costs associated with a policy option are likely to be more than offset by an increase in sales tax revenues, increased job creation, and associated income tax revenues from new projects as well as by the reduced social costs associated with a lower level of air pollution.

A. Loan Options

In this category, policy options include low-interest government loans, tax-free bonds, and government loan guarantees.

1. Low-interest government loans

The state of California currently offers a variety of low-interest loan programs. These include programs to promote agriculture, small business, pollution control, and renewable energy programs. The rates on these loans are typically several hundred basis points or more below the prime rate.[46]

A low-interest government loan program for wind or renewable energy development could be established within, and administered by, the California Energy Commission, which currently administers the Renewable Energy Funding program (as discussed above). Such a program could also be assisted by the California Infrastructure and Economic Development Bank, which was established in 1994 with the enactment of AB1495 and SB 101. This bank has been given broad authority to provide capital to finance infrastructure projects with an economic development impact;[47] and Governor Gray Davis has already strongly supported an increase in the bank's capitalization for the state's infrastructure needs.

In the interest of fairness, such a loan program could be open to all renewable energy producers. However, to minimize costs to the California treasury, funds might be allocated in a process in which the available loans are allocated to the lowest cost producers, as determined in an auction or bidding process.[48]

In terms of how low-interest loans would affect the cost side of the wind equation, developers would, of course, pay a lower interest rate. However, in addition to this direct

interest rate effect, the terms of such loans might also be written to include a lower debt service coverage ratio and a longer debt maturity. These provisions collectively would, in turn, allow for more debt relative to equity in the capital structure and further help lower costs.

Assuming that such a program would have no impact on the credit rating of California and further assuming a low default rate on the loans, the cost of such a program would be minimal and limited primarily to its administrative costs and covering any defaults.

2. Tax-free bonds

The availability of tax-free bonds to wind developers would have a similar favorable impact on wind project financing as low-interest loans, allowing for both a lower interest rate and more debt in the capital structure as well as perhaps a lower DSCR and a longer debt maturity.

The interest rate itself could be as much as 300 basis points or more below prime. From a theoretical standpoint, it is determined roughly by the formula $i_{ntb} = (1-t)*i_{tb}$, where i_{ntb} is the interest rate on the non-taxable bond, t is the marginal tax rate, and i_{tb} is the interest rate on a taxable bond. Thus, for example, if the taxable bond rate is 8.00% and the assumed state and federal tax rate is 40%, then the interest rate on the non-taxable bond would be 4.8%, or 320 basis points lower.[49]

The State of California, as well as numerous municipalities, currently offer a variety of tax-free bonds to fund various types of infrastructure and services. These include programs to promote energy development, control pollution, eliminate solid waste, and encourage the development of enterprise zones.

One important tax-free instrument is the "Industrial Revenue Bond." Such IRBs are employed by both the State of California and various municipalities to stimulate development in energy development and recycling projects as well as in industrial projects such as fabrication or manufacturing. These bonds are issued through the California Industrial Development Financing Authority, which is a division within the state treasurer's office and their primary goal is job creations. To date, over $500 million in bonds have been issued.[50]

Another example of a tax-free bond program is the one administered by the California Pollution Control Financing Authority. Bonds issued through this authority must be used for a project that abates or eliminates pollution or solid waste.

The cost of a tax-free bond program to the California treasury comes primarily in the form of so-called "tax expenditures." These are defined as tax revenues that the state foregoes by virtue of the tax credits. A rough estimate of the cost to the treasury of adding each additional 100 megawatts of wind capacity using this option is about $800,000 per year in foregone taxes.

3. Loan Guarantees

The State of California likewise offers a variety of loan guarantee programs for various public purposes including small business growth and pollution control. Under a loan guarantee program, the state would agree to underwrite all or some portion of the debt load of a wind project. In the event of under-performance or default, the state would reimburse the lender.

A model for such a loan guarantee program is offered by the California Export Program, which is administered by the California Trade and Commerce Agency. This program operates as a bank loan guarantor for exporting firms, the agency evaluating a firm's eligibility and acting as guarantor for up to 90% of a loan for working capital. Through this program, the California Trade and Commerce Agency claims to have added $1.5 billion in export sales to California's economy on $254 million in loan guarantees.[51]

Interestingly, the default rate for this program is extremely low -- less than 2% -- so that the cost of this program to the treasury is minimal. Several of the restrictions are equally interesting. For example, the firm must have a positive net worth and have been in operation for at least one year with no start-ups allowed.

In this regard, the key to using loan guarantees in the wind industry may be to design the eligibility program in such as a way as to minimize the government's risk from actual repayment of a loan in default. The obvious problem is that a loan guarantee may provide an inappropriate disincentive for the wind developer to under-perform.

The best way to reduce the risk of such "moral hazard" might be to limit such programs to established project developers with a proven financial track record. A second way to reduce default risk might be to use only *partial* loan guarantees so the developers shares part of the risk. Still a third way currently used by the California Capital Access Program is to have each borrower in the loan guarantee program pay an "insurance premium" into a common pool.[52] In the event of a default, these funds are then used to pay off the loan.

From a fiscal perspective, a wind power loan guarantee program has the potential to have one of the smallest impacts on the state budget – if it features appropriate safeguards. This is because no government funds would have to be used for other than the administration of the program *unless* a project failed.

Regarding the impact of such a program on wind's cost equation, loan guarantees offer wind project developers a variety of both direct and indirect benefits. With the government assuming some or all of the financial risk, the interest rate would fall by 150 basis points or more and the amount of debt in the capital structure would increase, lowering levelized costs. As with other loan programs, a loan guarantee program could likewise include provisions for a lower DSCR and a longer loan maturity.

B. Tax Credits and Exemptions

In this category, policy options include a state sales tax exemption, a local property tax exemption, and a state investment tax credit.

1. State Sales Tax Exemption

The state sales tax rate is 7.75%, and currently, there is a very diverse set of goods and services that are exempted from paying this tax. These activities range from the distribution of free or weekly newspapers, snacks and candy, and perennial plants to commercial space launch activity at Vandenberg Air Force Base[53] and selected equipment for movie producers.

In addition, there are several programs that *indirectly* provide sales tax relief. For example, the state's Enterprise Zone Program provides tax credits for sales or use taxes paid on up to $20 million of qualified machinery purchased per year. California also provides "new" or start up companies the option of a 5 percent partial sales or use tax exemption on all qualifying manufacturing property purchased or leased generally during the company's first three years of operation. The partial sales tax exemption is available as an option to the current investment tax credit on an item- by-item basis.

In the context of wind development, California's state sales tax raises the up-front cost of 100 megawatts of wind turbine capacity by roughly $7.5 million. These taxes are paid primarily on the purchase of turbines and substation and interconnection hardware. With a full sales tax exemption, this $7.5 million represents the approximate cost of such an exemption per 100 megawatts to the state. Unlike the foregone tax revenues in a tax-free bond program which must be paid annually, this cost would be a one-time event.

2. Local Property Tax Exemption

Property tax exemptions have been used in California to subsidize activities ranging from enterprise zone development to solar energy development. For example, property tax reductions of up to 100% can be offered to firms willing to locate in economically stressed enterprise zones.

Similarly, Senate Bill 1775, which was signed into law by Governor Pete Wilson in 1998, reinstated former property tax exemptions for homeowners and businesses that install new solar energy systems. Under this program, which had expired several years previously, the installation of a residential or commercial solar system *cannot* result in the reassessment of the property or higher property taxes.

In terms of how a property tax exemption might benefit a wind project, property tax rates vary by location in the state of California so that the property tax burden is at least partially location-dependent. However, a reasonable estimate is that property taxes add roughly a half a million dollars per year to the cost of every 100 megawatts of wind capacity; and this would roughly be the annual cost to the treasury of exempting new projects from the tax.

In evaluating this policy option, it may be useful to note at this point that California has already had at least one major problem with its implementation in the context of renewable energy. In the early 1990s, the state agreed to a $9 million property tax

exemption for the Luz Corporation, a solar energy development. This was so Luz could build a utility-scale solar energy plant in the Mojave Desert. However, opposition to this exemption was significant, and the resultant delays in extending the exemption created problems with both the financing and construction of Luz's plants.[54] These problems helped to eventually force Luz into bankruptcy.[55]

3. State Investment Tax Credit

California currently provides investment tax credits for activities ranging from basic manufacturing and research and development to targeted uses in the pharmaceutical, semiconductor, satellite, and electronic industries. For example, manufacturers operating in California currently are eligible for a 6 percent manufacturers' investment credit (MIC). This unlimited tax credit can be used to offset income tax based on the purchase or lease of manufacturing equipment that is depreciable.

In a more targeted manner, so-called "clean rooms" for certain electronic manufacturers, semiconductor equipment manufacturers, commercial space satellite manufacturers and property related to specified pharmaceutical activity are likewise eligible for this credit. Still another investment tax credit is available for basic research and development activities. This ITC allows companies to receive a credit of 11 percent for qualifying research expenses (research done in-house) and 24 percent for basic research payments (payments to an outside company.)

Despite the proliferation of investment tax credits in the state, *these instruments are not recommended for wind energy development*. As noted earlier, the state has, in the past, used a 25% investment tax credit to stimulate wind energy development. Re-imposition of such a 25% state ITC would cost the state approximately $3.75 million in foregone tax revenues for every additional 100 megawatts of new wind capacity. But such a revenue loss may not be the major consideration.

Rather, the broader problem is that ITCs provide perverse, unwanted incentives to the wind industry. This is a harsh lesson that was learned in the boom years of the wind industry in the 1980s. The problem is that while investment tax credits provide strong incentives to *build* projects, they offer no incentives to *run* projects well or at all. In fact, the investment tax credits of the 1980s can be rightly blamed for many of the failed wind farms that at one time littered the California landscape and tarnished the industry's name.

C. Production Subsidies

In the production subsidy category, the two main options include an expansion of the direct subsidies currently offered in the Renewable Energy Funding Program and the preservation of the Federal production tax credit.

1. Direct Subsidies

As we discussed in Chapter 3, the California Legislature has established a Renewables Funding program, which is administered by the California Energy Commission. Such a program, which is funded by ratepayers and scheduled to expire in 2001, already offers direct subsidies to wind and other renewable developers on a limited basis

For new projects, these funds are capped at no more than 1.5 cents per kWh, with funds paid out only for the first five years of the project. Note, however, that in this program, awards are allocated by a low bid process, with the winning bids going to the projects that ask for the lowest amount of subsidy below the 1.5 cents/kWh cap. This bidding process helps to minimize the costs of subsidizing additional projects. To date, 300 megawatts of wind capacity have been funded.

In terms of the impact of such a direct subsidy on wind energy costs, the subsidy will always be worth more to the project on a kWh basis than the subsidy itself. This is because the subsidy allows developers to reduce the amount of more expensive equity relative to debt in the capital structure; and this reduces financing costs.

As for the impact of such a program on the treasury or ratepayers, a direct subsidy program is likely to be one of the most expensive policy options. For example, assuming a one-cent subsidy per kWh over the life of the project, it would cost roughly $3.1 million annually for every 100 megawatts of new capacity.

2. Preservation of the Federal Production Tax Credit

As noted earlier, the Federal Production Tax Credit provides wind developers with a federal subsidy of more than 1.5 cents per kWh; and it is currently, far and away, the single most important policy stimulus to wind energy development. Unfortunately, Congress allowed this law to expire in July of 1999; but it important to note that negotiations on Capitol Hill regarding an extension of the PTC for from 30 to 60 additional months are ongoing. As shall be reinforced below, this means that a lobbying effort by the Governor, State Legislature, and Congressional delegation may be fruitful.

In this regard, in a policy simulation below, we will demonstrate how the 1.5 cent PTC subsidy translates into an actual reduction in levelized costs of more than 1.5 cents/kWh. This is because of a complex interaction between the tax credit, the passive income to which it applies, and the earned return on equity yielded by the wind project.

D. Cost-Side Policy Simulations

Having reviewed the various cost-side policy options, it is useful to answer this question: what impact would implementing each (or some combination) of these options have in reducing the cost of wind energy?

1. Model and Base Case Assumptions

This question can be answered by using a simulation model currently in use in the wind industry to calculate the change in levelized costs for a typical project under alternative policy scenarios. Our approach will be to change key financial parameters per our discussions above regarding the impact of each policy option on these parameters.

For example, as we discussed above, a low-interest loan or loan guarantee option most obviously would be characterized by a lower rate of interest. This lower interest rate would not only lower the cost of debt. It would allow wind developers to increase the debt to equity ratio and thereby indirectly further lower costs. At the same time, a low-interest loan or a loan guarantee program might also be structured to include a lower debt service coverage ratio (DSCR) and a longer debt maturity. These provisions likewise would allow for the model to increase debt relative to equity in the capital structure and similarly lower costs. Accordingly, these assumptions can be entered into the model and a new levelized cost relative to a "base case" can be calculated.

By the same token, to model options such as the state tax exemption or a local property tax exemption, these costs can simply be "zeroed out" in the model while both a direct subsidy and re-implementation of the Federal PTC can likewise be accommodated by the model.

Table Six presents the project characteristics, financial parameters, and operating cost assumptions used in our policy simulations.[56] These "base case" assumptions are for a typical 40 megawatt wind farm that would be built in California and are reflective of current industry conditions.[57]

TABLE SIX: BASE CASE ASSUMPTIONS

PROJECT CHARACTERISTICS	
• **Project Size**	**40 MW**
• **Project Cost**	**$60 million**
• **Capacity Factor**	**35%**
FINANCIAL PARAMETERS	
• **Interest Rate**	**8%**
• **Post-Tax Cost of Equity**	**14%**
• **Debt to Total Capital Ratio**	**65%**
• **Debt Service Coverage Ratio**	**1.4**
• **Loan Maturity**	**15 years**
TAX AND INFLATION ASSUMPTIONS	
• **Inflation rate**	**3.0%**
• **Combined Federal and State Income Tax Rate**	**40%**
• **State Sales Tax Rate**	**7.75%**
• **Property taxes**	**1%**

Note that a project built using these "base case" assumptions can produce power at a levelized cost of 6.81 cents/kWh. Thus, 6.81 cents/kWh will serve as our benchmark of comparison for the policy simulations.

2. Policy Simulation Results

Table Seven reports the results of our policy simulations. The first column specifies the policy option, the second column provides the specific assumptions used to model the policy option, the third column illustrates the new levelized cost of wind energy, and the last column indicates the percentage change.

TABLE SEVEN: SINGLE POLICY SIMULATIONS

	Simulation Assumptions	Cents/kWh	% Change
BASE CASE ASSUMPTIONS		6.81	0%
LOAN OPTIONS			
• Low-interest government loans	200 basis point interest rate reduction only	6.24	-8.4%
	Plus lower DSCR and longer debt maturity	5.37	-21.1%
• Tax-free bonds	Reduced interest rate according to formula	6.03	-11.5%
	Plus lower DSCR and longer debt maturity	5.14	-24.5%
• Government Loan Guarantees	150 basis point interest rate deduction	6.43	-5.6%
	Plus lower DSCR and longer debt maturity	5.52	-18.9%
TAX CREDITS & EXEMPTIONS			
• State sales tax exemption	"Zero Out" sales tax	6.50	-4.5%
• Local property tax exemption	"Zero Out" property tax	6.56	-3.7%
PRODUCTION SUBSIDIES			
• Direct subsidy	One cent/kWh	5.14	-24.5%

• Re-imposition of Federal production tax credit (PTC)	1.5 c/kWh PTC	5.17	-24.1%

From the table, it should be clear that for the loan options, the biggest benefit will come not from a lower interest rate *per se* but rather from a reduced DSCR and a longer debt maturity. For example, with the low-interest loan program, levelized costs fall only 8.4% to 6.24 cents. However, if such a program also includes a reduced DSCR of 1.25 and an additional three years debt maturity, we get a 21.1% reduction.

From the table, it should be equally clear that some policy options have a much smaller impact than other policies. For example, a state sales tax exemption reduces levelized costs by only 4.5% while a local property tax exemption would reduce costs by only 3.7%. On the other hand, re-imposition of the Federal PTC clearly reduces levelized costs by a massive 24.1% while a similar impact is achieved by implementing a one-cent per kWh subsidy program.

Perhaps most importantly, from the table, it is also clear that no *single* policy – even re-imposition of the Federal PTC -- is sufficient to reduce the levelized cost of wind power down near to the point where it is competitive with natural gas (about 3.5 cents/kWh). Thus, it is useful to explore how several *combinations* of policies might impact wind power economics. This is illustrated in Table Eight, where column one of the table describes the policy package and column two details the assumptions. Note below that for each cell in columns three and four, the top portion of the cell assumes no re-imposition of the Federal PTC while the lower portion of the box assumes that there the PTC is reinstated.

From the table, we see that the first package is referred to as a "low budget" option. This is because it entails relatively minimal costs to the state treasury. The package includes a loan guarantee program, where loans are offered with a 150 basis point reduction in the interest rate, a DSCR of 1.25 and a loan maturity of 18 years. It also includes a sales tax exemption. As you can see, the package yields a levelized price of 5.28 cents/kWh with no PTC and a levelized price of 4.05 cents per kWh with a PTC. These numbers represent a reduction from the base case of 22.4% and 40.5%, respectively. They also once again underscore the importance of the PTC in helping to make wind energy competitive with natural gas.

The second policy package is a "mid budget" option. It not only includes a low interest government loan program (with a 200 basis point reduction and a lower DSCR and higher loan maturity). It also includes both sales and property tax exemptions. You can see that this option provides a 27.6% reduction in price relative to the base case assuming no PTC and a 44.6% reduction with the PTC, with levelized prices of 4.90 and 3.77 cents per kWh.

Finally, the third policy package entails the highest cost to the treasury. It includes a direct one-cent subsidy, both sales and property tax exemptions, and a tax-free government

bond program (with a lower DSCR and higher loan maturity). You can see that this package makes wind energy competitive with natural gas even in the absence of a Federal PTC. In particular, the levelized price falls 52.4% to 3.24 cents per kWh without the PTC while it falls 67.5% to 2.21 cents per kWh with the PTC.

In the next chapter, we turn to a discussion of what demand-side policy options might be used to complement any one or a package of these cost-side policy options.

TABLE EIGHT: POLICY PACKAGE SIMULATIONS

	POLICY PACKAGE CHARACTERISTICS	Levelized Price Cents/kWh	Percent Change from Base Case
Base Case Assumptions		6.81	0%
Low-Budget Policy Package	• Loan guarantee program • Sales tax exemption	5.28 4.05	-22.4%
	Low-Budget Package With Federal PTC	4.05	-40.5%
Mid-Budget Policy Package	• Low interest government loans • Sales tax exemption • Property tax exemption	4.9	-27.6%
	Mid-Budget Package With Federal PTC	3.77	-44.6%
High-Budget Policy Package	• Direct one-cent subsidy • Tax-free government bonds • Sales tax exemption • Property tax exemption	3.24	-52.4%
	High-Budget Package With Federal PTC	2.21	-67.5%

Chapter 6: Demand-Side Policy Options

In this chapter, we examine a number of major demand-side policy options to promote wind energy development, as listed in Table Nine. These options include a commitment by state government to purchase a minimum level of renewable energy, an expansion of existing green marketing and green certification programs, and implementation of a renewable portfolio standard.

TABLE NINE: DEMAND SIDE POLICY OPTIONS

- Government purchase
- Green Marketing and Pricing
- Green Certification and Labeling
- A Renewable Portfolio Standard

A. Government Purchase of Renewable Energy

One of the most direct and effective ways to boost demand for renewable energy would be for the State of California to commit to buying a minimum percentage of its electricity needs from new renewable sources. In considering such an action, it may be useful to note that a recent poll conducted by the American Solar Energy Society revealed that fully 75% of Americans favor increasing government purchases of renewable energy such as wind and solar to help reduce pollution.[58]

It is important to emphasize here that only new sources should be considered in such any "buy green" state program. Otherwise, a net increase in renewable energy is unlikely to be achieved. Instead, existing renewable generators might simply benefit from a fiscally undesirable and unnecessary windfall.

In this regard, at the Federal level, the Clinton Administration is reported to be drafting an executive order mandating federal government agencies to purchase 5 percent of their electricity from renewable sources. This order allows for the paying of a premium of up to 20 percent.[59] However, it does not specify only *new* renewable sources.

Here in California**,** a variety of local government entities have already adopted a "buy green" policy. For example, on October 12, 1998, Santa Monica became the first local government in California to commit to buying green power for all its municipal needs when its City Council voted unanimously to release a request for proposals (RFP) to supply five megawatts of renewable electricity for the city. This constitutes a $2.5 million annual purchase or the equivalent power consumed by 5,000 to 6,000 average homes.[60]

More recently, Chula Vista, El Cajon, Escondido, Oceanside, and 34 other cities, school districts, and special districts that belong to the San Diego Regional Power Pool have switched to green power.[61] What is perhaps most interesting about this switch is that Commonwealth Energy, which supplies power to the pool, is offering the green power at 3% to 5% *below* the rates of San Diego Gas & Electric.[62] Meanwhile, the Los Angeles Department of Water and Power is one of a handful of city-run utilities offering green power to its customers. It has signed up the Los Angeles Dodgers, the University of Southern California, and, as its first homeowner to switch, Mayor Richard Riordan.[63]

At the state level, with which this report is most directly concerned, the various agencies, departments, and institutions of state government collectively constitute one of the largest electricity consumers in the state. However, previous calls for California's government to make a firm commitment to green power have gone unheeded.

1. Implementation

A program commitment by the governor and/or state legislature to buy a minimum percentage of its power from new renewable energy sources could significantly boost wind energy development in at least two ways. Such a commitment by the state to increase public sector consumption of renewable energy would obviously directly increase "green demand." In addition, a government commitment to "buy green" would also likely increase demand on the *private* sector side of the market by helping to publicize the green marketing effort (discussed below). In this regard, the governor could set a fine example while once again demonstrating his commitment to cleaner air.[64]

Suppose, then, that the governor were to issue an executive order detailing a modest 10% commitment to new green power sources rising to 20% or more by the year 2005. A likely implementation scenario for acquiring this power might be for the Department of General Services to issue a Request for Proposals (RFP) from renewable producers for a given amount of electricity from new development sources. Contracts might then be awarded on the basis of low bid, irrespective of the renewable source.

In this scenario, upon winning a bid, it would be crucial for the renewable developer to enter into a long term Purchase Power Agreement with the state. This is a crucial for at least two reasons. First, as we have seen in our policy simulations above, long term PPAs help boost the economics of a given wind project by reducing financial risk and the attendant levelized costs.

Second, without firm PPAs, the government's "buy green" program would be subject to both budgetary and partisan pressures and attendant financial risk. For example, in a recession, the government might decide to tighten its belt by cutting its green power purchases. Similarly, the ascendance of a Republican governor or legislature might have the same effect for ideological reasons.

The broader point is that PPAs that lock in a firm commitment to purchase power over the life of the renewable projects are highly desirable for both wind and other

renewable developments because they allow developers to obtain adequate financing for projects while minimizing financial risks and costs.

B. Green Pricing and Marketing

A second major policy option to stimulate renewable energy on the demand-side involves an expansion of existing green pricing and marketing programs. With green pricing, customers pay a small premium for consuming power from renewable sources. Green marketing involves independent retailers competing for customers in the marketplace by publicizing the benefits of using green power. The idea behind both green pricing and marketing is simple: give electricity consumers a choice between polluting, non-renewable electricity versus cleaner, renewable electricity and then charge them a slightly higher price for the renewable power.

California's current green pricing program was established by Senate Bill 90, which implements the legislation (AB1890) that brought about restructuring of the utility industry in California. The legislation provides electricity customers with direct access to green power providers and marketers. So far, however, the results of the program have been modest. To date, less than 1% of all eligible California consumers have opted for green power. This amounts to less than 50,000 residential customers out of 9 million.[65] It is useful to understand the underlying economics of such programs to fully grasp the why green power hasn't yet been a huge success.

1. The "Free Rider" Problem

At the most general level, green power critics argue that such programs are doomed to chronically under-provide renewable energy because of what economists refer to as the "free rider" problem. This free rider problem begins with the observation that the market price for polluting, fossil fuel electricity doesn't accurately reflect the external pollution costs that these generators impose. Green marketing programs ask people to voluntarily solve this problem by paying more for cleaner green power than they otherwise would have to pay for regular electricity. This pricing premium is, however, an open invitation for people to "free ride," that is, to let other people bear the burden of paying the costs.

Indeed, if such volunteerism worked efficiently, there would be no need for pollution control legislation because enough people would voluntarily choose between clean and dirty sources of goods and services AND be willing to voluntarily pay more for the clean sources. In this regard, a real world example sheds some light on this green power conundrum while illustrating that the public at large has a very sophisticated understanding of the free rider problem.

In a public opinion poll in Oregon, people were asked whether they would be willing to pay more for renewable energy. While 75% said yes, the overwhelming majority of respondents preferred raising *everyone's* rates to pay for the program rather than each

person paying voluntarily. Clearly, such a response indicates a very sophisticated understanding of the free rider problem among the public at large.

It follows from the existence of this free rider problem, that while voluntary green marketing programs may "work" in the sense that they do elicit some response, they are also likely doomed to chronic under-performance. At least to date, this observation is bolstered by an apparent under-performance of the California market.

As noted earlier, less than 1% of all eligible California consumers have opted for green power. Moreover, this low participation rate is occurring despite the fact that the state currently subsidizes green power pricing efforts.

In particular, the California Energy Commission provides "Customer Credits" to consumers who purchase eligible Energy Commission-registered renewable power. Through this program, a consumer's electricity bill can automatically be credited for up to 1.5 cents for each kilowatt-hour of renewable electricity consumed.[66] Total funding for the program equals $75 million, and this funding is drawn from the $540 million Renewable Resource Trust Fund account. At this time, about 43,000 customers take advantage of the customer credit subsidy. Typically, the electricity provider actually receives the subsidy, but then charges customers a price net of the subsidy.

These observations about the free rider problem underscore the important leadership role that the governor and state legislature may be able to play by committing to a "buy green" policy for the state's electricity needs.

C. Green Certification and Labeling

Closely related to the concepts of green marketing and green pricing are programs that implement "green labeling" and "green certification." Green labeling typically involves some type of product disclosure in which an electricity source specifies information such as the fuel mix and/or level of emissions. Green certification programs typically involve the use of some brand or logo to "certify" that electricity has been produced with some minimum amount of renewable energy, e.g., 50%.

Such certification and labeling programs are designed to work hand in hand with green marketing and pricing. The underlying principle is that for the green power market to succeed, it will be essential that green power customers feel confident that they are getting a high-quality green energy product and that the company selling the product is reliable and ethical in their dealings with customers.

Accordingly, the purpose of labeling and certification programs is to provide consumers with a yardstick of trust. By doing so, they seek to increase consumer access to information while reducing the frequency of "greenwashing" -- the use of false or misleading advertising about alleged green products.

In fact, the electricity market in California features *both* green labeling and green certification programs. One program – labeling -- is mandatory and administered by the

government. The other program – certification – is voluntary and administered by the private sector.

1. Green Labeling and Product Disclosure

At least six states besides California -- Connecticut, Illinois, Maine, Massachusetts, Nevada, and Rhode Island -- have adopted legislation requiring the disclosure of specific information about fuel mix or emissions while another 20 states are studying or designing disclosure requirements. The fundamental principle, borne out by research, is that people will choose more environmentally friendly electricity options if they are better informed about the environmental consequences.

For example, in a 1,300-person telephone survey, 82 percent of consumers identified environmental factors as very important in choosing an electricity source. In follow-up focus groups, when given information on the fuel mix alone, consumers generally selected the electricity product that used less coal and more gas and renewable energy. However, when these same consumers were shown emissions information disclosing that the coal-based product actually had lower emissions, they changed their selection.[67]

These findings are particularly significant in California. This is because in the legislative battle over green labeling, the state legislature opted *not* to provide emissions information. Instead, under the California labeling program, only *fuel mix* is provided whereas in other states, but fuel mix *and* emissions are provided.[68] This information is posted in a "Power Content Label," a sample of which is illustrated in Table Ten below.

TABLE TEN: CALIFORNIA'S POWER CONTENT LABEL

POWER CONTENT LABEL

ENERGY RESOURCES	PRODUCT A* (projected)	1998 CA POWER MIX** (for comparison)
Eligible Renewable	**55%**	11%
-Biomass & waste	-	2%
-Geothermal	-	5%
-Small hydroelectric	-	2%
-Solar	-	<1%
-Wind	-	1%
Coal	**10%**	20%
Large Hydroelectric	**11%**	22%
Natural Gas	**16%**	31%
Nuclear	**8%**	16%
Other	**<1%**	<1%
TOTAL	**100%**	100%

* 50% of **Product A** is specifically purchased from individual suppliers.

**Percentages are estimated annually by the California Energy Commission based on the electricity sold to California consumers during the previous year.

For specific information about this electricity product, contact **Company Name**. For general information about the Power Content Label, contact the California Energy Commission at 1-800-555-7794 or www.energy.ca.gov/consumer

One column of the label identifies the breakdown of power by energy resource for the individual electricity product you are considering. For example, 55% of the green Product A might come from renewable resources such as wind and biomass and small hydro and only 10% from coal, 11% from large hydroelectric, 16% from natural gas, and 8% from nuclear.

The other column allows you to compare the "green" product with the collective or average California power mix which uses only 11% renewables, 20% for coal, 22% for large hydro,[69] 31% for gas, and 16% for nuclear.

2. Certification

As a companion to the government's labeling program, California has been a pioneer in the development of a voluntary, private sector-based green certification program known as "Green-e."[70] Pilot programs allowing customers to choose their electricity in New Hampshire and Massachusetts indicated that almost a third of all consumers wanted to purchase power with environmental benefits. However, disputes over the accuracy of claims made by some companies in the Northeast raised serious concerns about "greenwashing" and interfered with the market's function.

To avoid this problem in California, a coalition of consumer, environmental, and industry stakeholders established the Green-e brand. The key requirement for branding is that the product must represent at least 50% renewable energy averaged over one year.

Other elements include: (1) a resource disclosure label, (2) a summary price and contract terms disclosure statement, (3) an information verification process, (4) a professional code of conduct for participating companies, and (5) an education campaign to inform customers about the benefits of choosing an electricity product bearing the Green-e brand.

As with the state's labeling program, Green-e has four main goals: (1) bolster customer confidence in retail electricity products containing renewable energy; (2) expand the retail market for electricity products containing renewable energy, (3) encourage the deployment of products that minimize air pollution and reduce greenhouse gas emissions; and (4) provide customers clear information about retail electricity options that enable them to make informed purchasing decisions.

With regard to Green-e financing, many environmental certification programs are at least in part funded by suppliers. This is likewise true of Green-e, with cost-based fees levied on participants. These fees include an annual, fixed, per-product fee; a cost-based verification fee; and a fee for secondary use of the brand.

D. A Renewable Portfolio Standard and Renewable Energy Credits

A Renewable Portfolio Standard has been proposed by the American Wind Energy Association, and it has been modeled after the federal sulfur-dioxide allowance trading program. Here is how such a system might work in California:

The State Legislature (or Public Utilities Commission) would first set the portfolio standard by specifying that a certain percentage of total electricity generation must be produced by renewable energy, e.g., 15%. The Legislature then requires that each retail electricity producer must comply with this standard by generating the required percentage of electricity through renewable sources or by purchasing equivalent "renewable energy credits" from renewable energy producers (or by doing some combination thereof).

For example, one "renewable energy credit" might be set equal to one kWh of renewable electricity production. Thus, if an electricity producer produces 100,000 kWh a year from fossil fuels, under the portfolio standard, the producer would be required to purchase 15,000 RECs in the marketplace from renewable producers. In this way, renewable energy production would be subsidized by non-renewable production.

As for the price of each REC credit, it would be determined in the marketplace by the forces of supply and demand. This observation leads to the primary advantage of a renewable portfolio standard approach. It is market-driven, and therefore, it is argued that it is likely to yield a much more efficient outcome than command and control type systems.

In this vein, once the standard is set, government involvement is relatively minimal. Such involvement might consist of certifying RECs and verifying that every electricity producer meets the minimum portfolio standard. To ensure compliance, electricity producers might be charged a fee for any shortfall in RECs. As long as this fee is higher than the cost of a REC, it would be sufficient incentive for compliance.

1. Implementation

At the federal level, the Clinton Administration has proposed a comprehensive electricity restructuring bill. Part of that bill would require 7.5 percent of all electricity sold in the United States to come from renewable energy sources by 2010.[71] That is significantly more aggressive than the 4 percent share called for in Rep. Dan Schaefer's (R-Colo.) well-publicized restructuring bill (H.R. 655).[72]

At the state level, six states have adopted an RPS as part of their restructuring plans: New Jersey, Maine, Nevada, Massachusetts, Connecticut and, by regulatory order, Arizona. For example, in New Jersey, the RPS requires that power marketers secure at least 3 percent of their electricity from renewable sources by 2001, gradually rising to 6.5 percent in 2012. In addition, the law defines two separate classes of renewable energy sources.

Class One renewable sources include wind, photovoltaics, solar thermal, geothermal, fuel cells, biomass, and landfill gas recovery. Class Two sources include hydropower and waste-to-energy. The law states that Class Two sources can make up no more than 2.5 percent of a utility's total RPS requirement and that the RPS can be fulfilled from sources outside the state.[73]

Here in California, state officials have been reluctant to implement an RPS. Should the state move forward on such a program, it will be important for the program to focus on eliciting new renewable resources. As we have discussed within the context of a government "buy green" policy and green marketing efforts, any renewable programs that allow existing renewable producers to benefit from new subsidies will simply provide a financial windfall rather than an increase in renewable energy production.

As a final note and as noted above, there are ongoing discussions in California policy circles about turning the temporary renewable funding program instituted by Assembly Bill 1890 into an ongoing Renewable Energy Trust Fund. As discussed earlier, under AB1890, $540 million is being collected from ratepayers between 1998 and 2001 using a "system benefits charge" as the primary funding source.

In support of extending the program, proponents note correctly that it has proved to be an effective way of creatively promoting a wide variety of renewable projects. Should this program be extended, it is important to stress that its focus should be restricted to only funding new projects.

Chapter 7: Summary and Policy Recommendations

In this report, we have seen that wind energy development in California faces a difficult market and regulatory environment and an indifferent policy environment. Yet we have also seen that a significant expansion of wind energy in the Golden State would provide important environmental and economic benefits.

It should be equally clear from the analyses in this report that there is no single "magic bullet" for appropriately stimulating the wind industry. Rather, the governor in cooperation with both the state legislature and the state Congressional delegation will have to pursue a broad ranging strategy. This strategy must address both cost-side and demand-side issues in the wind energy equation in a fiscally responsible and politically feasible way. Such a strategy must also focus on Federal issues, particularly in regard to the currently expired Production Tax Credit.

A. The "Big Three" Policy Responses

Based on the analyses and observations in this report, there are three policy responses likely to have the biggest and most immediate effect on wind energy development.

1. A "Buy Green" Commitment by the State

Commit state government to purchasing a minimum of 10% of its electricity from *new* renewable sources by the year 2002, rising to 20% or more by 2010. Obtain such electricity through a low-bid process and enter into long-term purchase power agreements to lock in the commitment and thereby minimize the financial costs of providing the power.

This "buy green" policy is perhaps the most important single action that the governor and legislature can take at this time to boost renewable energy demand. This is particularly true in light of the relatively weak response individual consumers have made in the green energy market.

From a fiscal point of view, the cost of such a green commitment to the state treasury would be relatively modest. Nonetheless, such an action is likely to be opposed politically by those directly affected. Most prominently, this would likely include both the University of California and California State University bureaucracies, which are some of the state government's largest electricity consumers. An assurance by the governor and legislature that such a green commitment will not negatively affect the budgets of these bureaucracies would be helpful.

2. A Comprehensive Loan Program to Assist Renewable Developers

Our cost-side policy simulations have indicated that some type of large-scale loan program offering lower interest rates and longer debt maturities can help significantly lower the cost of wind energy at minimal cost to tax payers. Policy options range from

low-interest loans and tax-free bonds to loan guarantees. Loan instruments that have a maturity of 18 (and perhaps even 20) years, an interest rate close to the Treasury bill rate, and a debt service coverage ratio of 1.25 should be the goal.

Of the various loan policy instruments available, loan guarantees entail the least cost from a fiscal point of view. This is true provided, however, that the loan guarantee program is structured in a way to minimize the incidence of loan default. Accordingly, only well-qualified developers should be allowed to participate in such a program, and only new renewable projects should be eligible. The second least costly option would be a low-interest loan program. Its primary advantage over loan guarantees would be to make slightly lower interest rates available.

A loan guarantee and/or low-interest loan program could be established within, and administered by, the California Energy Commission, which currently administers the Renewable Energy Funding program. Such a program could also be assisted by the California Infrastructure and Economic Development Bank that was established in 1994 with the enactment of AB1495 and SB 101. This bank has been given broad authority to provide capital to finance infrastructure projects with an economic development impact; and Governor Davis has already strongly supported an increase in the bank's capitalization for the state's infrastructure needs.

3. Lobbying for Reinstitution of the Federal Production Tax Credit

As we have seen in this report, the loss of the PTC has the single largest negative effect on the economic cost of wind power. The governor of California has an opportunity to work with the state Congressional delegation to significantly raise the profile of what is otherwise a very obscure issue on Capitol Hill by lobbying both Congress and the Clinton Administration for its reinstitution.

In this regard, a number of other states now have a major interest in wind energy development. These include Colorado, Hawaii, Iowa, Massachusetts, Minnesota, Montana, Oregon, Texas, Washington, and Wyoming. Accordingly, it may be useful to work in coalition with these states.

B. Other Policy Responses

Beyond these three major policy responses, there are a number of other policy actions on both the cost-side and demand-side that might help form part of the broader policy response. These include:

1. Extend the Renewable Energy Trust Fund

The Renewable Energy Trust Fund is raising $540 million from ratepayers to support renewable energy development. However, this fund is scheduled to expire in 2001.

It may be useful to consider an extension of this program. However, there will likely be significant opposition to such an extension from the state's major utilities as well as from fossil fuel generating interests. In addition, from a fiscal point of view, ratepayers bear much of the burden of this renewables "tax"; and there may be more cost-effective ways to achieve similar results.

2. Lobby for Non-discriminatory Transmission Pricing Rules

Wind energy, and to a lesser extent solar energy, both suffer from discriminatory transmission pricing practices. It will be difficult, however, to address this issue directly at the Federal level because transmission policies are determined in a regulatory, rather than a legislative, environment, i.e., at the Federal Energy Regulatory Commission.

Nonetheless, it will be useful for the governor and legislature to send a clear signal to the Clinton Administration that a transmission pricing policy based on energy usage rather than capacity would be a useful step in promoting wind power.

At the state level, the governor and state legislature need to speak clearly on the admittedly arcane, but nonetheless important, issue of "uninstructed deviations." As noted earlier, the current pricing policy of the California Independent System Operator on such deviations penalizes intermittent renewable energy sources such as wind and thereby acts to discourage their development.

3. Consider a Renewable Portfolio Standard

It may well be time for the governor and state legislature to seriously consider establishing a Renewable Portfolio Standard. Note, however, that of all the major policies that seek to promote renewable energy, this may well be the most politically contentious.

The problem is that a Renewable Portfolio Standard faces strong opposition by many large utilities and major fossil fuel interests as well as by ideological conservatives who oppose any such intrusions into the free market. Accordingly, the promotion of an RPS in California is likely to entail the most controversy as well as the most political risk.

In this regard, a low risk political strategy would be to simply wait for pending Federal legislation to lead the way on an RPS. On the other hand, California has traditionally been a leader on such issues so that more bold action may be warranted – as Republican Governor Christine Todd Whitman has recently demonstrated in her embrace of an RPS in New Jersey.

4. Continue Support for Green Marketing and Certification Efforts

To date, green marketing and green certification programs have yielded only modest benefits in promoting increased renewable energy development. It remains an open question as to whether or not such programs can work over the longer term once consumers acclimate to the new electricity market environment. Nonetheless, unless support is continued for green marketing, that open question may never be answered. Accordingly, within prudent fiscal constraints, it may be useful for the state to continue its support for its green marketing efforts.

ENDNOTES

[1] When the state stopped keeping records in 1995, the number of turbines in California had dropped to 13,437 from a 1991 high of 16,387. Southern California Edison, which gets power from more than half the turbines in the state, said about 5 percent were off line in August 1997. Sacramento Bee, September 14, 199, A1.

[2] Califomia Energy Commission, http://www.energy.ca.gov/wind/overview.html.

[3] California Energy Commission, http://www.energy.ca.gov/wind/windfacts.html.

[4] Texas currently has 42 mw of installed capacity. Projects planned total 144 mw. American Wind Energy Association. http://www.awea.org/projects/texas.html.

[5] A much smaller number of turbines have been installed in the Pacheco Pass near the San Luis Reservoir and in Solano County where the Sacramento and San Joaquin rivers converge. Paul Gipe, Wind Energy Comes of Age, John Wiley & Sons, New York, 1995, p. 34.

[6] California Energy Commission. http://www.energy.ca.gov/wind/overview.html.

[7] California wind energy reduces carbon dioxide emissions by 910,710 tons, sulfur dioxide emissions by 985 tons and nitrogen oxide emissions by 2314 tons annually. Capacity data is from the California Energy Commission: www.energy.ca.gov/electricity/system_power.html.
Emissions data is from U.S. Department of Energy, Energy Information Agency, www.eia.doe.gov/cneaf/electricity/st_profiles/california/ca.html#f6.

[8] See "Electrical Week" January 5, 1981 for a discussion of possible ground water contamination from Geothermal power generation.

[9] Energy Conservation News, December, 1996. Outlook; Vol. 19, No. 5.

[10] *See* www.energy.ca.gov/development/tax_neutrality_study/index.html. *See also* "Going Alternative: Initial High Cost Brings Gain Later" Portland Press Herald, Sept. 19, 1999, and Federal News Service, September 16, 1999, Thursday, In The News, 3219 Words Prepared Testimony Of Dallas Burtraw Senior Fellow, Resources For The Future Before The Senate Appropriations Committee Energy And Water Development Subcommittee

[11] Financial Times (London) December 3, 1998.

[12] United Press International June 17, 1998, Wednesday, BC cycle.

[13] As noted in the text, according to a report released June 22, 1995 by the American Lung Association as reported in *Wind Energy Weekly* #653, 3 July 1995, pollution from particulates alone cost the nation $11 billion.

[14] *See* www.eia.doe.gove/cheaf/electricity/st profiles/california/ca.html and http://www.epa.gov/airsweb/.

[15] See http://www.eia.doe.gov/oiaf/1605/gg98rpt/tbles1.html.

[16] According to a report released June 22, 1995 by the American Lung Association as reported in *Wind Energy Weekly* #653, 3 July 1995

[17] Dockery, et al, American Journal of Respiratory and Critical Care Medicine, March 1995. as reported in www.burningissues.org.

[18] These figures are drawn from the Department of Energy's Energy Information Agency. Figures assume that new wind capacity would displace that much capacity of non renewable power generation.

[19] *See*, for example, Intergovernmental Panel on Climate Change (IPCC).

[20] *Wind Energy Weekly*, Vol. 15, #684, 12 February 1996.

[21] Natural gas and crude oil price data indicate a positive correlation coefficient between the prices of the two commodities of .78.

[22] Carl Weinberg quoted in Gipe, p. 437.

[23] *Energy Efficiency and Job Creation: The Employment and Income Benefits from Investing in Energy Conserving Technologies*, American Council for an Energy-Efficient Economy, October 1992.

[24] "Tehachapi-Mojave Wind Resource Area Economic Impact," Kern Wind Energy Association.

[25] Parts of this chapter draw heavily on Gipe's excellent history, pp.30-36.

[26] A variation of this chart appears in Gipe, p. 35.

[27] From 1992 to 1998, 157 megawatts of capacity was retired while 154 megawatts was newly installed

[28] The credits were not strictly additive.

[29] The price established under the contracts was based on an algorithm including the utilities fuel costs, which at the time, were forecasted to increase sharply. Thus, at the time, the contracts established under the ISO4 process were not perceived as being high priced relative to market forces.

[30] The ISO4 contracts contained a 10-year fixed price portion and a 20-year period of floating prices. Thus, a wind turbine installed in 1984 would see the fixed portion of its ISO4 contract expire in 1994.

[31] Gipe, p. 31

[32] See www.energy.ca.gov/development/tax_neutrality_study/index.html. For a discussion of the tax advantages accorded natural gas, see Alec F. Jenkins, Richard A. Chapman, and Hugh E. Reilly. Tax Barriers to Four Renewable Electric Generation Technologies, Report to the Energy Technology Development Division, California Energy Commission, June 1998.

[33] Sacramento Bee, September 14, 1998.

[34] CEA web site. http://www.energy.ca.gov/renewables/existing_renewables_table.html

[35] Business Wire, August 21, 1998. New renewable projects were chosen through an auction process, and of the 56 projects that submitted bids, 55 were awarded funding. This included an additional 300 megawatts of new wind capacity, 157 megawatts of geothermal, 70 megawatts of landfill gas, 12 megawatts of biomass, 1.0 megawatt of digester gas and 1.0 megawatt of small hydro. All the bids received amounted to a total of $182 million in incentive payments, $20 million more than the amount allocated in the renewable energy program for new generation. Bids were submitted in the form of a simple cents per kilowatt hour for electricity production, not to exceed 1.5 cents per kilowatt hour, with no project eligible for more than 25% of the funds.

[36] For a more complete discussion of the complexity of this issue, see Steven Stoft, Carrie Webster, and Ryan Wiser. "*Transmission Pricing and Renewables: Issues, Options, and Recommendations.*" Lawrence Berkeley National Laboratory. Report 39845. May 1997

[37] Public Utilities Fortnightly August, 1998.

[38] Many wind projects that were built to take advantage of these lucrative tax breaks either never operated or were operated for only a very short time. There are numerous stories of turbines laying turned over on their side littered along the road and looking like a high tech junkyard. As we shall discuss further below, the obvious problem was that the financial incentives created by the government perversely rewarded construction but not actual operation of the turbines.

[39] With some turbines, some very small amount of fuel is used to start the turbines once the wind reaches a threshold wind speed.

[40] Typically, the length is the term of the PPA minus one year.

[41] With California deregulation, PPA's or being phased out. Future debt will likely be tied to long term esimates of power prices.

[42] This analysis was suggested by R. Wiser and E. Kahn, *Alternative Windpower Ownership Structures: Financing Terms and Project Costs*. Lawrence Berkeley National Laboratory, May 1996. Note that both the nominal cost of debt and equity are sensitive to the prevailing rate of inflation and level of interest rates in the economy at a given point in time. Wiser and Kahn assume higher nominal capital costs in their report for both types of projects but in real terms the two analyses are comparable.

[43] The LIBOR stands for London Inter-Bank Offered Rate. This is the rate at which the highest rated banks offer to lend to one another, and the LIBOR is a common index used in project financing.

[44] The details behind these calculations will be explained further in the next chapter of the report in our discussion of a pro forma model used to simulate the impact of policy changes on wind energy costs.

[45] Power plants are most frequently compared on the basis of their levelized electricity costs. The LEC relates the capital cost of the plant, its annual operating and maintenance costs and fuel prices to the annual production of electricity by the following formula:

$$LEC = [(CC + FCR) + O\&M + Fuel]/AkWh$$

where CC equals capital cost, FCR equals a fixed charge rate, O&M is operations and maintenance expenses including taxes and insurance, fuel is the fuel expenses adjusted for inflation, and AkWh is the annual net electricity generation in kilowatt hours.

[46] For example, at present, rates range from 3.7% and 3.3% for the Greenhouse and Dairy Farm Energy Efficiency loan programs, respectively, to 5.4% for the Energy Conservation Assistance Program.

[47] A precedent has already been set for the use of bank funds for the utility industry. In December of 1997, the California Infrastructure and Development Bank issued $6.02 billion in bonds to help the state's three major utilities finance a 10% rate reduction for residential and small commercial consumers.

[48] Such a process is currently used by the California Energy Commission to allocate the $540 million of renewable energy funding.

[49] Note that as a practical matter, financial markets may not provide this entire tax-free premium.

[50] The current industrial revenue bond program aims to create one job for every $50,000 in bond financing. However, the average has been slightly lower than that at one job for each $58,000 in bonds. Nonetheless, excluding non-performing firms, the average improves to one job created for each $38,000 in financing. Note that the figures for job creation varied tremendously by firm, ranging from one job for each $17,000 in bonds to one job for each $291,000 in bonds. Likewise, the actual impact the IDB program had on job creation varied by firm and industry. The IDB program was seen to be more effective in those industries with fewer external market factors. In particular, those industries thought to be less sensitive to general economic fluctuations showed greater success from the program than others. Dana Rivers, *The Effects of Industrial Development Revenue Bonds on Job Creation in California*, State Treasurers Office, June 1991.

[51] California Export Financing Office, http://commerce.ca.gov/international/cefo/update.html.

[52] The California Capital Access Program encourages banks and other financial institutions to make loans to small businesses that fall just outside of most banks' conventional underwriting standards. CalCAP is a form of loan portfolio insurance which may provide up to 100% coverage on certain loan defaults. By participating in CalCAP, lenders have available to them a proven financing mechanism to meet the financing needs of California's small businesses. The maximum loan amount is $2.5 million. The maximum premium CPCFA will pay is $100,000 (per loan). Lenders set all the terms and conditions of the loans and decide which loans to enroll into CalCAP. Lenders determine the premium levels to be paid by the borrower and lender. Because the borrower pays a loan guarantee premium, this program reduces the problem of moral hazard. If the loan defaults, then the program uses the premiums paid into the performance fund to reimburse the lender. This program is funded through the California Pollution Control Financing Authority.

[53] The Board of Equalization has estimated the losses in sales tax from Vandenberg at $1 million for each of the eight space launches since 1993. Los Angeles Times, April 3, 1998.

[54] For example, Luz wound up having to pay vendors premiums to meet tight construction schedules and construction overruns were the result.

[55] For discussion, see Keith Kozloff, Renewable energy technology: an urgent need, a hard sell. *Environment*, November, 1994, Vol. 36 ; No. 9 ; Pg. 4.

[56] Other key assumptions include those for land rent, insurance, management, engineering and administration fees, electrical usage and interconnection fees, and operations and maintenance expenses.

[57] Numbers are rounded off. For a detailed discussion of the literature on the values for these parameters, see generally Ryan Wiser and Ed Kahn, *"Alternative Windpower Ownership Structures: Financing Terms and Project Costs,"* Lawrence Berkeley National Laboratory, May 1996.

[58] PR Newswire, November 2, 1998. The survey reflects interviews with 1003 registered voters between September 22-28, 1998; it has a margin of error of +/-3.1%.

[59] Electric Light & Power, February, 1999.

[60] Wind Energy Weekly #819, 19 October 1998.

[61] "Chula Vista Makes the Switch to Green Power," Business Wire, June 30, 1999.

[62] "Commonwealth offers green power in So. California," Current Competition, April 26, 1999.

[63] "Now it's easy to be 'green,' Copley News Service, December 31, 1998.

[64] The recent phase-out of the gasoline additive MBTE by the governor offers another example.

[65] Sacramento Bee, October 1, 1998.

[66] Some electric service providers may reflect the value of the credit in their pricing scheme, while others may use the credit to give customers a monthly bonus. There is a limit of $1,000 in rebates for industrial customers.

[67] Lisa Prevost, "Renewable Energy: Toward a Portfolio Standard?" Public Utilities Fortnightly, August 1998, No. 15, Vol. 136.

[68] For example, the New York Public Utilities Commission has adopted an environmental labeling plan that includes both. Utility Environment Report, November 20, 1998.

[69] Large hydroelectric projects typically are not counted as "renewables." This is because of environmental concerns over issues such as the flooding of environmentally sensitive lands that often results from large hydro projects.

[70] For a detailed discussion of this program, see Karl Rbago, Ryan Wiser and Jan Hamrin, The Green-e Program: An Opportunity for Customers, Electricity Journal, January, 1998.

[71] 1999 National Journal's Congress Daily, April 15, 1999.

[72] Lisa Prevost, "Renewable Energy: Toward a Portfolio Standard?" Public Utilities Fortnightly, August 1998, No. 15, Vol. 136, Pg. 30. Several other congressional bills also contain an RPS, including S. 687, introduced by Vermont Sen. James Jeffords (R-Vt.). S. 687 calls for a 10 percent RPS in 2010. That's combined with emissions caps on carbon dioxide, sulfur dioxide and nitrogen oxide.

[73] Solar & Renewable Energy Outlook March 1, 1999.