The U.S. Regulatory and Innovatory Processes for the Wind Energy Industry

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Working Paper

March 12, 2003

I. Regulation of the Wind Power Industry

A. The Federal Energy Policy Act (1992)

There exists very little in the way of federal regulation of the wind power industry in the United States. Most innovation comes from financial subsidies, incentives, and research partnerships. As wind power is virtually non-polluting, there has been little regulation of it. Most regulations from the EPA come from environmental and health risks, and as there are no true risks associated with wind power, there has been a scarcity of regulation.

The federal government provides a tax credit of 1.5 cents per kWh (adjusted for inflation, 1.8 cents today) for electricity generated by a wind plant during its first 10 years of operation. This credit is intended to "level the playing field" for wind, which must compete with other energy industries that receive billions of dollars in federal subsidies each year. The wind energy credit will expire at the end of this year unless Congress extends it.

1. The Renewables Portfolio Standard (RPS)

The federal government created the Renewables Portfolio Standard which is a "minimum content requirement", which specifies that a certain minimum percentage of electric power must be generated from renewable energy sources (wind, solar, and others). Typically, RPS legislation provides that the minimum percentage increase gradually over time to encourage the sustained, orderly development of the renewable energy industries.

Renewable Energy Credits ("RECs") are central to the RPS. A REC is a tradable certificate of proof that one kWh of electricity has been generated by a renewable-fueled source and sold to an end-user in the state. RECs are denominated in kilowatt-hours (kWh) and are a separate product from the power itself. Each credit is proof of actual generation and sale of renewable electricity-not merely proof of capacity. The RPS boils down to a requirement that every generator possess a number of RECs equivalent to a determined percentage of its total annual kWh generation (or sales). For example, if the

RPS is set at 5%, and a generator sells 100,000 kWhs in a given year, then it would need to possess 5,000 RECs at the end of that year.

For generators that fall short of the required number of credits at the end of the reporting period, an automatic penalty for non-compliance is assessed. The amount of the penalty is three times what it would have cost to purchase each REC that the generator should have acquired. This penalty is estimated to be about 3¢ to 5¢ per REC-high enough to encourage full compliance, yet not so high as to encourage litigation. The high penalty level is intended to make the policy self-enforcing by avoiding the need to resort to costly administrative and enforcement measures.

B. The State Level

A significant number of state policies have been implemented to support renewable energy development, specifically wind power. The policies identified, described and evaluated here do not represent an exhaustive list of these policies, they do cover most of the basic strategies that have been used or considered at the state level. Many variations and combinations of these policies are possible. We have created three main categories of state incentives: tax incentives, direct cash incentives and low-cost capital programs.

1. Tax incentives

a. Production tax credits

A production tax credit (PTC) provides the investor or owner of qualifying property with an annual tax credit based upon the amount of electricity generated by that qualifying facility. By focusing on energy produced, not capital invested, this type of tax incentive encourages projects that perform adequately. For this reason, PTCs now are widely considered to be a more effective support mechanism than investment tax credits (ITCs), especially for large installations of relatively mature technologies.

Tax credits have been a traditional government approach to supporting social or economic policy objectives. Renewable energy tax credits can enhance after-tax cash flows and, therefore, support investment. Specifically state production tax credits could be used to stimulate wind development by reducing state income taxes. Although

production tax credits traditionally have been popular than investment tax credits, the Energy Policy Act of 1992 established PTCs (many have opted instead for investment atx credits), but state legislatures have the authority to implement PTCs.

b. Investment Tax Credits

Tax credits for renewable energy projects can support investment by enhancing after-tax cash flow. Historically investment tax credit (ITC) have been one of the predominant approaches taken at the state and federal levels to stimulate renewable energy development. Specifically state ITCs can be used to increase wind development by reducing the state income tax burden of wind project. The tax credit can be used in the first year of production, or it can be spread over a number of years.

c. Sales Tax Reductions

Reductions in state sales taxes can be used to support wind development by decreasing the tax burden (i.e., the tax payment per KWh of electric production) associated with owning a wind power facility, in general due to their high capital costs and low operational costs, the per-KWh sales tax burden on renewable energy facilities is high relative to fossil fuel fired facilities. This is because the fossil fuel inputs to generation facilities generally are exempt from sales taxes, whereas sales tax is paid on wind turbines and other equipment.

State and local sales taxes apply to the transfer or exchange of energy, material and land assets (although wind development land is leased in most cases, not purchased). These taxes vary by states and country, but the total tax rate typically ranges between 4 and 8 percent. Sales tax incentives can be in the form of full exemptions of reductions in tax rates and could be applied to utility scale and small-scale residential wind systems. Exempting renewable energy facilities from sales taxes or reducing the tax rates can decrease the installed and levelized cost of wind power. State legislatures have the authority to implement these policies. The enactment, implementation and enforcement of such policies may occur independent of electric industry structure and regulation.

d. Property Tax reductions

Reductions in property taxes can also be used to support wind development by decreasing the tax burden (i.e., the tax payment per KWh of electric production) associated with owning a wind power facility. In the case of a California hybrid gas/solar-thermal facility, the difference amounted to the solar plant paying more than four times the level of taxes paid by a 100 percent gas-fired plant. The impact would be less for a wind facility today, given its lower cost relative to solar thermal plants. Still, property taxes can represent a more significant cost than sales taxes, depending upon the relative tax rates and assessment methods.

2. Direct Cash Incentives

a. Direct Production Incentives

Direct cash payments could take the form of investment or production incentives, similar in nature to investment tax credit (ITC) and production tax credits (PTCs), but without a tax basis. Production incentives supply project owners with a direct cash subsidy or price support payment based upon electric production, not capital investment, and therefore provide the correct incentives for project performance. For this reason, production incentives typically are considered to be a more effective support mechanism than investment incentives, especially for more mature technologies such a wind. State production incentives can be used to encourage wind development by reducing the levelized cost of a wind power project.

Although analogous to the PTCs discussed earlier, providing payment through a direct cash incentive rather than through equivalent sized reductions income taxes provides three primary benefits:

1 First, the inability of investors to absorb the full value of a production tax credit is an important barrier to the effective use of tax incentives to support renewable energy development. A direct cash payment has no similar.

2 Second, due to the nature of tax credits, they are a benefit to equity investors only, and do not help projects sustain debt. A direct cash incentive, on the other hand , would increase revenue directly, allowing more low-cost debt in the capital

structure and making equivalent direct cash incentives more powerful than income tax credits.

3 Third, unlike PTCs, direct cash payments could be provided to taxable and nontaxable entities (e.g. municipal utilities), therefore ensuring some degree of competitive neutrality.

b. Direct Investment Incentives

Although tax incentives for renewable energy projects can enhance after-tax cash flows and therefore support investment, a more direct cash payment would give project developers and owners additional benefits compared to an equivalently sized tax incentive. First, the inability of investors to absorb the full value of a tax credit is a substantial barrier to the effective use of tax incentives to support renewable energy development. A direct cash payment has no similar problems. Second, unlike tax incentives direct cash payments could be provided to taxable and nontaxable entities, therefore ensuring some degree of competitive neutrality. Third, direct cash payments can be made even more powerful through cost sharing, where the government pays part of plant costs directly, because the private investors would not pay taxes on the cost-shared portion.

3. Low-Cost Capital Programs

a. Government-Subsidized Loans

Debt costs significantly affect the cost of energy from wind power systems. Utility-scale wind system debt interest rates are frequently one to two percentage points higher than rates for gas-fired projects, and projects without a secure revenues stream typically are incapable of obtaining debt financing. Smaller-scale (residential, agricultural or commercial) renewable energy facilities can be affected even more by loan terms and conditions because of the higher installed cost per unit of capacity of smaller systems. Private bank loan terms and conditions for these smaller renewable facilities are likely to be even more costly and restrictive than for larger-scale systems.

State governments provide low-cost capital to renewable energy projects to

support their development. This can be done directly through a state agency or by making arrangements with private lending institutions, local authorities or electric utilities. Direct loan programs have taken and can take many shapes, including economic development programs and green bonds. These programs can be used to support renewables by providing lower cost debt than is available in the private markets (i.e., lower interest rates or terms that are more favorable). For smaller-scale systems, these programs also may reduce the transaction costs of arranging a private loan.

b. Project Loan Guarantees

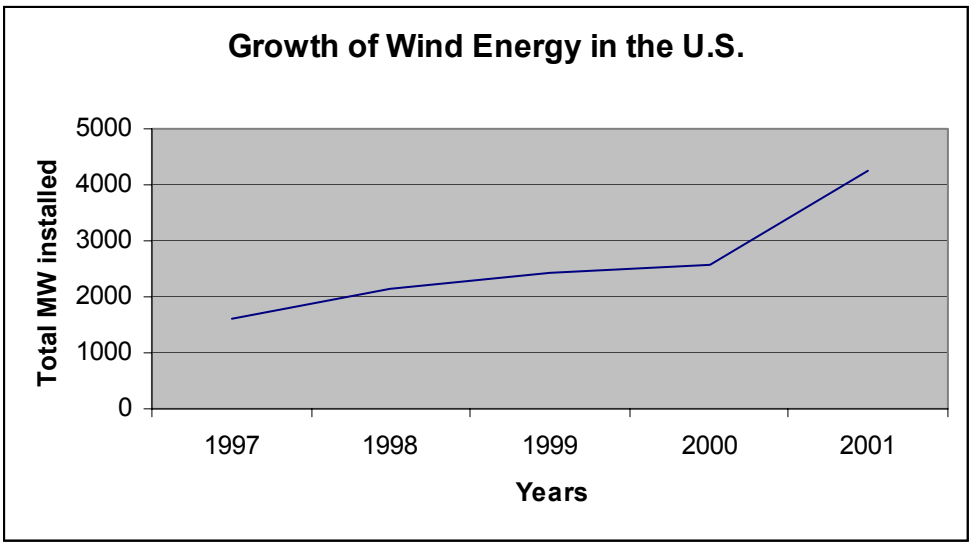
Financing costs for renewable energy facilities are substantially higher than those for traditional gas- and coal-fired generation stations. Specifically, utility-scale wind power debt interest rates are often one to two percentage points higher than for gas-fired projects. Additionally, projects without a stable revenue stream guaranteed through contracts often are incapable of obtaining financing. Past unsuccesful projects, poor information about improvements in technology and the markets assessment of fuel and technology risk all are the factors in the higher financing costs of renewable energy projects. Small-scale residential, agricultural and commercial projects, typically financed through bank loans, often are subjected to even higher interest rates.

Project loan guarantees are provided by state governments to reduce the debt costs of wind power developers through an indirect interest rate buy-down. A program of this type guarantees loan repayment to lenders (banks or institutions) and, therefore, shields the creditors from project risks. In the extreme case, loans simply may not be available without a guarantee for some types of risky wind projects. In this case, loan guarantees provide the assurance lenders need to consider a loan. The cost to the state government of such a program come from payouts to lenders in the event of project defaults. As security for these guarantees, the guarantor (the state government) would require either a cash pool or explicitly provide security through the government's taxing authority. These guarantees could provide risk insurance for all or a portion of project risks.

II. Development of Wind Power

A. Wind power growth and geographical development in the U.S.

In 2001, wind power nearly doubled in capacity in the United States to reach 4,100 MW. Close to 2,000 megawatts of electricity were added, up from 53 MW in 2000 and 732 MW in 1999, according to the American Wind Energy Association. The dramatic increase is largely attributed to a 1.8 cent-per-kilowatt-hour tax credit that wind farm owners and operators can receive.



Expanded wind capacity has also brought lower costs. Technical improvements in blade design, generator design, and site location continue and the cost of generating a kW-hour of wind power continues to decline. In 1981, the cost of a kW-hour from a new wind turbine was over $0.35. By 2000, it reached about $0.04, nearly a ninety (90) percent reduction.

Following are the top-ten states for wind power installments in 2002:

1) California (1,603.95 MW)
2) Minnesota (273.16 MW)
3) Iowa (242.39 MW)
4) Texas (187.22 MW)
5) Wyoming (73.835 MW)
6) Oregon (25.1 MW)
7) Wisconsin (22.98 MW)

8) Colorado (21.6 MW)
9) Hawaii (21.06 MW)
10) New-York (18.15 MW)

III. Regulation and Innovation

A. Making Wind a Federal Case

The federal government's involvement in wind energy research and development began in earnest within two years after the so-called "Arab Oil Crisis" of 1973. Despite the speed with which it was initiated and began to show results, this program ultimately proved to be largely ineffective because of the interference of political factors and the withdrawal of financial support before success could be achieved.

B. Wind Energy Today

The U.S. Department of Energy's (DOE's) Office of Energy Efficiency and Renewable Energy manages the federal wind energy program in accordance with national energy policy. Wind energy diversifies the nation's energy supply, takes advantage of a domestic resource, and helps the nation meet its commitments to curb emissions of greenhouse gases, which threaten the stability of global climates. There is federal support for a comprehensive wind energy research, wind turbine research and development, and for utilities, industry, and international wind energy projects. The U.S. Department of Energy's (DOE's) Wind Energy Program is directed by the Office of Wind and Hydropower Technologies under the Assistant Secretary for Energy Efficiency and Renewable Energy. The Wind Energy Program supports this mission by working with members of the wind industry to research and develop advanced, low wind speed turbines that will reduce the cost of wind energy in broader regions of the United States.

C. The Program goals

1) By 2002 - Develop advanced wind turbine technologies capable of reducing the cost of energy from wind to 2.5 cents per kilowatt-hour (in 15 mile per hour winds) 2 - Develop advanced wind turbine technologies capable of reducing the cost of energy from wind to 2.5 cents per kilowatt-hour (in 15 mile per hour winds)
2) By 2005 - Establish the U.S. wind industry as an international technology leader capturing 25% of world markets
3) By 2010 - Achieve 10,000 megawatts of installed wind-powered generating capacity in the United States.

The federal wind energy program helps engineers and scientists advance the technology needed to create new wind turbine designs, better understand how to integrate wind into utility systems, and improve U.S. technology to compete in global energy markets. Researchers explore the characteristics of the wind and how wind interacts with a turbine rotor, study the physical and chemical properties of the materials used to make blades and other turbine components, and advance the fundamental scientific principles needed to improve wind technology. As research engineers acquire a deeper understanding of these principles, this knowledge becomes the foundation for computer models and other design tools used to design new technology.

Researchers envision the wind technology that will be required by industry in 10 or 15 years, then plan research projects accordingly. Then, when companies are ready to develop a new turbine, cutting-edge technologies and design tools are ready to help them go to market quickly with new products. The wind industry has neither the time nor the money to invest in long-term basic and applied research.

That is why the U.S. Department of Energy (DOE) has partnered with the U.S. industry (like with General Electric and Shell today) for more than two decades to develop efficient, reliable, cost-effective technologies. The goal of the Turbine Research conducted at NREL is to assist U.S. industry in developing competitive, high performance wind turbine technology that will compete in global energy markets. Industry partners are selected through competitive solicitations and share in the costs of the project. NWTC researchers work closely with the companies to research, design,

build, test and refine advanced large and small wind turbine designs. These public-private partnerships are developing breakthrough technologies that will significantly reduce the cost of wind-generated electricity and, ultimately, expand our domestic renewable energy supply. Wind power was the fastest-growing source of new energy in the 1990s and more reliable and higher quality wind turbines will continue that trend.

1. Tools developed by DOE to help industry build better wind turbines:

1) **Computer Models.** NREL, Sandia, and university researchers are developing a suite of design and analysis codes that will make it possible for designers to build a new turbine on the computer and refine it for commercialization without having to build and test prototype turbines.

2) **Advanced Controls.** NREL is modifying its computer models to include advanced controls. Advanced controls adjust turbine operation to maximize energy production and minimize wear and tear on the machine. In 1998, the laboratory created a new applied research team to lead an effort to develop smart controls for next-generation wind turbines.

3) **Adaptive Blades.** Adaptive blades, which change shape in response to the wind, could increase turbine performance by as much as 35%. Sandia researchers are investigating adaptive blade designs for constant- and variable-speed turbines.

4) **Advanced Research Turbines.** A 600-kilowatt wind turbine at the NWTC is the first of several machines NREL will use for experiments to elucidate the basic scientific principles underlying wind power generation. NREL will also use the research turbines to develop advanced components and test promising technologies that the wind industry is unlikely to pursue because of cost or technical complexity.

2. Government Wind Industry Programs

1) **Certification Testing.** NREL's National Wind Technology Center conducts certification testing for new wind turbines. Certification is required in Europe, India, and other major wind energy markets.

2) **Standards.** Wind turbine sales abroad depend on American technology complying with international standards. NREL, Sandia, and the American Wind Energy Association are working with international organizations to establish standards for safety, power performance, and blade testing.

3) **Technical Assistance.** DOE is bringing wind systems to areas where they are most needed by providing technical assistance in wind project planning and implementation. DOE also provides technical assistance for wind resource evaluations and technology development for international projects.

The federal wind energy program and its partners in industry and academia play a crucial role in wind energy research, in the development of innovative wind technologies, and in the dissemination of these technologies throughout the world. In recognition of the importance of these efforts, Congress appropriated $34.8 million to support the wind energy program in fiscal year 2000.

D. Results of the wind program

The U.S. Department of Energy's (DOE's) Wind Energy Program is directed by the Office of Wind and Hydropower Technologies under the Assistant Secretary for Energy Efficiency and Renewable Energy. The mission of DOE's Wind Energy Program is to enhance the level of technology development and deployment of the nation's fastest growing and most widely used renewable energy resources.

In 2001, wind power reached 4,100 MW by doubling its capacity in one year. Since 1980, research and testing sponsored by the Wind Program has helped reduce the cost of wind energy from 80 cents (current dollars) per kilowatt-hour (kWh) to between 4 and 6 cents per kWh. The goal of the Wind Energy Program is to further reduce the cost of energy produced by large wind systems to 3 cents per kWh in Class 6 wind resources (average wind speeds of 6.7 meters per second at a 10 meter height) by 2004 and to 3 cents per kWh in class 4 sites (5.8 meters per second at a 10 meter height) by 2010.

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