

Policies and market factors driving wind power development in the United States

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Abstract

In the United States, there has been substantial recent growth in wind energy generating capacity, with growth averaging 24 percent annually during the past five years. About 1700 MW of wind energy capacity was installed in 2001, while another 410 MW became operational in 2002. During 2003, development activity has remained strong, with an estimated 1600 MW of capacity installed. With this growth, an increasing number of States are experiencing investment in wind energy projects: currently about half of all States host at least one wind power project. This paper explores the key factors at play in the 12 States in which a substantial amount of wind energy capacity has been developed or planned. Some of the factors that are examined include policy drivers, such as Renewable Portfolio Standards (RPS), Federal and State financial incentives; as well as market drivers, such as consumer demand for green power, natural gas price volatility, and wholesale market rules.

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1. Introduction

Installed wind power capacity in the United States has accelerated in recent times, with an average annual growth rate of 24 percent during the past five years.¹ By the end of 2002, total installations reached 4685 MW (see Fig. 1), which placed the United States third in wind power capacity globally, following Germany and Spain (which reported 12,000 MW and 4830 MW, respectively). Growth in the US wind industry continued during 2003, with an estimated 1600 MW installed (AWEA, 2003). With this growth, an increasing number

of States are experiencing investment in wind energy projects. Current installations are spread among more than 25 States, although the vast majority of capacity is concentrated in fewer than half of those States.

This paper explores the policies and market factors that have been driving wind energy development in the United States, particularly in the States that have achieved a substantial amount of wind energy investment in recent years. Although there are Federal policies and overarching market issues that are encouraging investment nationally, recent activity has also been spurred by State-level policies or localized market drivers.

Some of the policy drivers of wind development in the United States that are discussed in this paper also exist in other countries, particularly those in Europe, while others do not. For example, the so-called “feed-in tariffs” that have provided a stable profitable market for wind generators in Denmark and Sweden historically, and Germany and Spain currently, no longer exist in the United States (Haas, 2000). Other forms of support, such as the Renewables Obligation in the UK, as well as similar quotas in Austria, Belgium, and Italy (and

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¹For comparison purposes, between 1997 and 2002, natural gas-fired generating capacity in the United States increased at an average annual rate of 18 percent, while coal-fired, hydroelectric, and nuclear capacity showed no growth over this period, and oil-fired generation capacity declined by an average annual rate of 2 percent (EIA, 2003).

Nomenclature

Integrated Resource Planning (IRP)

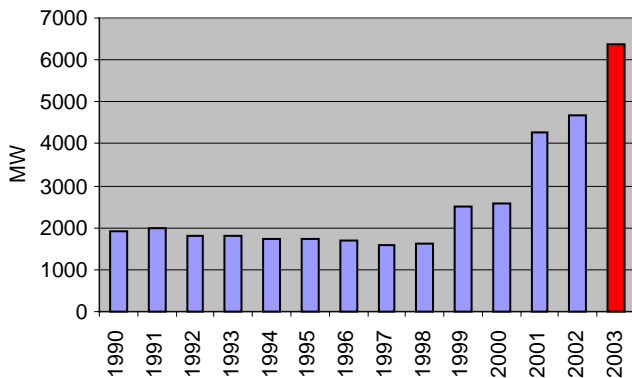
IRP is an electric-system planning process that requires utilities to forecast demand for power and examine alternative resource scenarios to meet that demand. The least expensive combination of resources is then chosen to meet the utilities' needs, considering environmental constraints, risks, and other factors.

Renewable Portfolio Standard (RPS)

Similar to the Renewables Obligation in the United Kingdom, an RPS is a policy that requires electricity providers to include in their resource portfolios a specified amount of electricity generated from renewable sources.

System Benefits Fund

A system benefits fund is a policy that has been adopted primarily in restructured electricity markets, whereby a small surcharge is imposed on electricity customers and placed into a fund used to support renewable energy, energy efficiency, and other system benefits that might not otherwise be funded in a competitive electricity market.



Sources: 1990–1996 data from EIA Renewable Energy Annual; 1998–2003 data from American Wind Energy Association. 2003 data is estimated.

Fig. 1. Cumulative US wind energy capacity.

planned for Denmark and Sweden) closely resemble the renewables portfolio standard (RPS) that has taken hold at the State level in the United States (Reiche and Bechberger, 2004). Finally, Europe's aggressive targets for renewables deployment are driven in large part by its strong stance on carbon abatement and adoption of the Kyoto protocol, whereas the United States, which at the Federal level has opted to encourage voluntary emissions reductions rather than to ratify the Kyoto protocol, has so far not explicitly linked policy support for renewables with carbon policy (though some State governments are beginning to move in this direction, and consumers who voluntarily purchase renewable energy often do so out of concern for carbon emissions).

This paper proceeds as follows. We first look briefly at Federal policies and broad market issues driving wind development in the United States, and then focus more narrowly on State-specific experience. We provide brief discussions of the drivers for wind development in a

dozen leading States—California, Colorado, Iowa, Kansas, Minnesota, New York, Oregon, Pennsylvania, Texas, Washington, West Virginia, and Wyoming. Finally, we conclude with a discussion of the key lessons that may be transferable to other States, regions, or countries.

2. Federal policies

Federal tax and financial incentives have played an important role in encouraging wind power development. The most notable and effective of these incentives has been the Federal Production Tax Credit, which is an inflation-adjusted per-kWh credit applied to the output of a qualifying facility during the first 10 years of its operation. During calendar year 2002, qualifying wind generators earned an inflation-adjusted production tax credit of 1.8¢/kWh. Originally created under the 1992 Energy Policy Act, the Federal Production Tax Credit was initially available for projects installed between 1994 and June 30, 1999 (Gielecki et al., 2001). The credit was subsequently extended to December 2001 and then again to December 2003. As of the time of writing, Congress has failed to adopt new energy legislation to extend the credit. The impact of the tax credit on the wind energy industry is evident in the boom-bust cycle of development in recent years. Wind energy installations have peaked in years when the credit was scheduled to expire (i.e., 1999, 2001, and 2003) as developers rushed to complete projects in time to take advantage of the credit. In the off years, development has lagged because of the uncertainty surrounding the Production Tax Credit extension and the lead-time necessary to plan and complete projects (see Fig. 2).

The Renewable Energy Production Incentive, also created under the 1992 Energy Policy Act, provides an

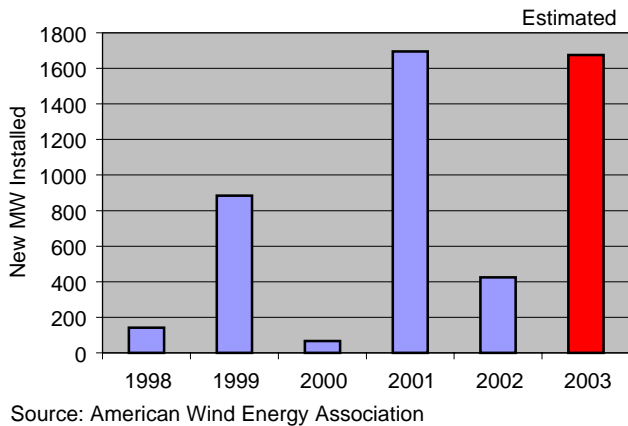


Fig. 2. US wind energy capacity additions.

inflation-adjusted cash production incentive (also currently at 1.8¢/kWh) to wind (and other renewable energy) projects owned by publicly owned utilities and cooperatives that do not have Federal tax liabilities, and therefore are unable to take advantage of the Federal Production Tax Credit. However, funding for the Renewable Energy Production Incentive is subject to Congressional appropriations each year, so there is significant uncertainty regarding the annual availability of the incentive. This has limited its effectiveness as a driver of wind power development because eligible public utilities cannot rely on this revenue stream when financing projects.

Other Federal policy incentives that contributed primarily to the early development of the wind energy industry, particularly in California, have included the Public Utility Regulatory Policies Act (PURPA, which in California provided a “feed-in tariff” of sorts), investment tax credits, and accelerated depreciation (Gielecki et al., 2001). Of these, the five-year accelerated depreciation schedule for wind energy investments is still available and most relevant today. The Job Creation and Worker Assistance Act of 2002 expanded depreciation incentives by allowing owners of wind (and other) projects to take an additional 30 percent depreciation in the first year for assets purchased after September 10, 2001, and before September 11, 2004, and placed in service by January 1, 2005. In May 2003, the Job Creation and Tax Relief Reconciliation Act of 2003 increased the first year depreciation bonus from 30 to 50 percent for qualifying projects placed in service between May 6, 2003 and January 1, 2005.

3. Broad market drivers

Recently, market forces have also played a role in increasing the cost-effectiveness of wind generation. During the past several years, natural gas prices have

experienced unprecedented volatility, which has driven up the cost of electricity from natural gas-fired generators and helped to close the gap between the cost of power from wind and conventional sources. During the 1990s, prices for natural gas averaged about \$2/thousand cubic feet (Mcf) (\$0.07/cubic meter) at the wellhead and varied by about 35 percent during seasonal peaks. Then in the winter of 2000/2001, wellhead prices reached a new peak of more than \$8/Mcf (\$0.28/cubic meter) and climbed even higher during the winter of 2002/2003 (EIA, 2001). In good wind regimes, wind energy generation has been shown to be cost-effective with natural gas at prices of \$3.50/Mcf (\$0.12/cubic meter) (Lehr et al., 2001).

Wind energy generation costs have also dropped with the movement toward larger, more efficient turbines. Since 1995, generating efficiencies have improved by more than 15 percent; current efficiencies are approximately 1050 annual net kilowatt-hours (kWh) per square meter (Cohen, 2003). Further, high wholesale electricity prices—resulting not only from high natural gas prices but also from supply demand imbalances associated with the Western energy crisis—have improved the relative competitiveness of wind energy generation.

With the recent downturn in the US economy, and the energy sector in particular, growth in the wind industry has been tempered to some degree. Access to capital has become restricted because many energy companies are already burdened with excessive amounts of debt and have sub-par credit ratings. The slowdown in the economy has also reduced demand for electricity, causing many developers to shelve plans for new power plants of all types. On the other hand, low interest rates have prevailed in the sluggish economy, reducing the cost of financing for project developers who are able to obtain it.

4. State-level drivers

Installed wind power capacity in the United States has historically been concentrated in California and, to a lesser extent, in a few other States. More recent development, however, has spread among a broader cross-section of the country. As of December 2002, the 12 States listed in Table 1 collectively hosted 98 percent of the installed capacity in the United States. In addition to Federal incentives, improved economics, and the broad market drivers discussed above, the key factors that have been driving development in these States include renewable portfolio standards (RPS) and other forms of renewable energy mandates, State tax and financial incentives, voluntary purchases of green power by consumers, and wholesale market rules that are favorable to wind. Table 2 summarizes the State-level

Table 1
Cumulative wind energy capacity by state, 1998–2002 (Megawatts)

State	1998	1999	2000	2001	2002	Percent of total (%)
California	1395	1646	1646	1714	1822	39
Texas	41	180	180	1096	1096	23
Iowa	5	243	243	324	423	9
Minnesota	135	272	290	319	336	7
Washington	0	0	0	178	228	5
Oregon	25	25	25	158	218	5
Wyoming	1	73	91	141	141	3
Kansas	0	2	2	114	114	2
West Virginia	0	0	0	0	66	1
Colorado	0	22	22	61	61	1
New York	0	0	18	49	49	1
Pennsylvania	0	0	11	35	35	1
Total 12 States	1602	2463	2528	4189	4589	98
Total 50 States	1616	2500	2566	4261	4685	100

Source: American Wind Energy Association (AWEA) wind project database <http://www.awea.org/projects/index.html>.

Table 2
Comparison of state wind energy incentives

	State	RPS/Mandate	Retail green power products	Financial incentives
1	CA	20% by 2017	6*	System benefits fund
2	TX	2000 MW by 2009	4*	Property tax, franchise tax exemption
3	IA	105 aMW	8	Property tax, sales tax, loan fund
4	MN	425 MW by 2002, 400 MW by 2012; 10% by 2015 goal	63	Fund, property tax, production incentive, accelerated depreciation
5	WA	—	14*	Corporate tax, sales tax incentive
6	OR	—	10*	System benefits fund, business tax credit, property tax exemption
7	WY	—	2*	Sales tax exemption
8	KS	—	*	Property tax exemption
9	WV	—	*	Property tax abatement
10	CO	—	20*	
11	NY	25% by 2013 planned		System benefits fund
12	PA	—		System benefits funds

*Wholesale green power products available.

incentives available to support wind energy development in these States.

Of course, investment in wind power projects is dependent upon the quality of the wind resource, access to transmission, the cost of conventional generation, the need for new electricity supplies, the willingness of power companies to integrate wind into their systems, and the ease of siting and permitting wind facilities. Fig. 3 presents potential wind energy resources in the United States. In addition, Table 3 compares the technical wind resource potential in each of the 12 States, based on a study conducted by the Pacific Northwest National Laboratory (Elliott et al., 1991). Since technical potential reflects a combination of the quantity as well as the quality of the wind resource, Table 3 also includes an additional column targeted more specifically at relative wind resource quality by providing representative capacity factors of existing or planned wind projects in each State. For example, Table 3 shows that

California has the technical potential to generate 59 terawatt-hours (TWh) of wind energy annually (placing it 17th among all 50 States on this basis), and that recently constructed wind projects in California expect to achieve capacity factors in the high-30 percent range (e.g., 38 percent).

In the following sections, we examine the drivers of increased wind energy investment in the 12 States that, as of the end of 2002, hosted the vast majority of US wind energy capacity.²

²In 2003, a number of states previously without significant amounts of installed wind capacity (and therefore not covered in this paper) have seen large projects built within their borders. These states include New Mexico (204 MW in 2003), Oklahoma (102 MW so far in 2003), and North and South Dakota (61.5 and 41 MW in 2003, respectively). Though not covered here, the drivers of this new wind development resemble those covered in this paper for other states—i.e., a combination of strong wind resource, Federal and state tax incentives and, at least in New Mexico, the possibility of an RPS.

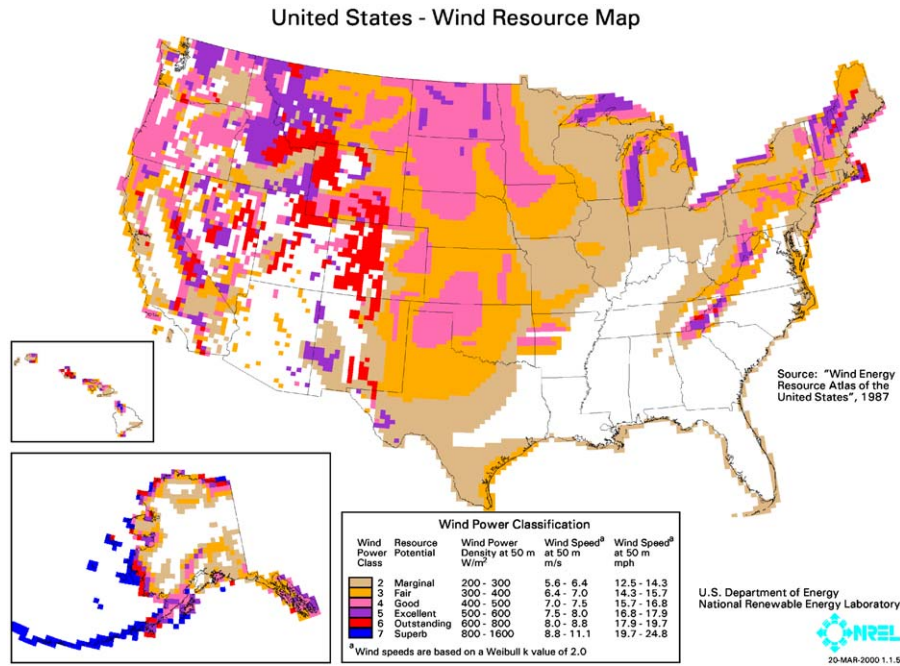


Fig. 3. US wind resource potential.

Table 3
Comparison of state wind resource technical potential

	State	Wind energy technical potential (annual TWh)	Wind capacity technical potential (average MW) ^a	Resource rank	Representative capacity factors (percent) ^b
1	California	59	6770	17	High 30s
2	Texas	1190	136,000	2	High 30s
3	Iowa	551	62,900	10	Low 30s
4	Minnesota	657	75,000	9	Mid 30s
5	Washington	33	3740	24	Mid 30s
6	Oregon	43	4870	23	Mid 30s
7	Wyoming	747	85,000	7	High 30s
8	Kansas	1070	121,900	3	High 30s
9	West Virginia	5	594	32	Low 30s
10	Colorado	481	54,900	11	Mid 30s
11	New York	62	7080	15	Low 30s
12	Pennsylvania	45	5120	22	Low 30s

Source: [14]Elliott et al. (1991).

^aAn average megawatt (aMW) is a megawatt of capacity at 100 percent capacity factor. One aMW of wind capacity is roughly equal to about 3 MW of nameplate wind turbine capacity.

^bHigh 30s refers to capacity factors in the range of 37 to 39 percent, mid 30s refers to capacity factors in the range of 34–36 percent, while low 30s refers to capacity factors in the range of 30–33 percent. These estimated capacity factors are based on data from 34 operating or planned wind energy projects in these states with a combined capacity in excess of 2000 MW.

4.1. California

California has been the historic leader in wind energy development, both in the United States and internationally. Wind energy investment began in earnest in the early 1980's and the industry grew substantially throughout that decade, resulting in a total installed capacity of about 1880 MW by 1990 (EIA, 2000). Although development slowed greatly in the 1990's

and some existing projects ceased operation, California still has the most wind energy capacity in the United States, with 1822 MW installed by the end of 2002. Initially, California's wind energy industry emerged as a result of State and Federal tax incentives and the 1978 Public Utility Regulatory Policies Act (PURPA), combined with strong implementation of PURPA by the State's public utility commission (Gielecki et al., 2001). More recently, new and existing projects have

been supported by production incentives and other financial incentives funded through a systems benefits charge on electricity sales created under California's electric industry restructuring law. Although these funds were originally expected to support the development of about 1000 MW of new wind, only about 100 MW have become operational because of difficulties in financing projects as a result of the State's electricity crisis (California Energy Commission, 2003a).

In the near term, growth will be facilitated by the extension of the system benefits funds through 2012 and, more importantly, the creation of an RPS. The new system benefits funds, starting at \$135 million annually in 2002, are to be primarily allocated to support new renewable sources—although about 20 percent of the funds can be used to support existing renewables (California Energy Commission, 2003b). Because utilities will be allowed to tap a portion of the funds to cover any above-market costs of procuring renewable power to meet the State's new RPS, the funds will likely not support much new development beyond that mandated under the standard.

The RPS, which was signed into law (SB 1078) by Governor Gray Davis in the fall of 2002, requires California's three investor-owned utilities to obtain 20 percent of their power from renewable sources by 2017. Each utility must increase its renewable portfolio percentage by at least 1 percent per year until the 20 percent standard (RPS) is met (NREL, 2002). Although rules for implementing the RPS are still under development, it is one of the most aggressive RPS policies in the United States, ultimately requiring on the order of 2400 average MW of new renewable energy generation (California Energy Commission, 2003c). The requirement may be scaled back, however, if the State's system benefits funds are found to be insufficient to support this level of capacity. Nevertheless, wind is likely to be used to meet a significant portion of the standard, and thus, the RPS is expected to be the most significant driver of new wind power development in the State and perhaps nationally.

4.2. Texas

Texas has 1096 MW of installed wind energy capacity, which places it second (behind California) among all States. Most of the development has occurred during the past few years, with the vast majority installed in 2001. The main factors that have driven wind energy development in Texas are the State's RPS requirement; a strong wind resource; and, to a lesser extent, the willingness of consumers to voluntarily purchase renewable energy. Compliance with the RPS—which requires the installation of 2000 MW of new renewable capacity by 2009—is significantly ahead of schedule. About 750 MW of wind generation have been installed ostensibly to meet the standard since 1999. The success

of the RPS is due in part to the State's high-quality wind resource, effective implementation, and strong support from the Legislature and the Public Utility Commission (PUC).

The RPS will continue to drive wind power development in Texas in the long term. However, transmission constraints could slow the rate of development in coming years. With the rapid growth of the wind industry during the past three to four years, existing transmission capacity between windy parts of the State and more populated load centers has been insufficient to handle the wind energy output; and, in fact, wind farms in West Texas have at times been curtailed due to transmission constraints. The Electric Reliability Council of Texas (ERCOT) has approved plans to alleviate this congestion, but it will take time to do so. Voluntary purchases of green energy by in-state and out-of-state consumers may also continue to drive some development, given that Texas has abundant wind resources and a Renewable Energy Credit (REC) tracking system in place to facilitate verification.

4.3. Iowa

Iowa was an early pioneer in wind development. Although the State's wind resource ranks tenth nationally (see Table 3), Iowa ranks third in installed wind capacity (see Table 1). Iowa's Alternative Energy Production Law, its version of an RPS, led to the initial development of wind energy resources in the State. Under the law, the State's two investor-owned utilities were required to secure a combination of 105 average MW (aMW) of renewable energy, with each utility's portion based on its percentage of the total retail electricity supplied in 1982. About 250 MW of Iowa-based wind capacity has been installed to meet the requirement. In addition, about 50 MW of Iowa's total 423 MW of installed wind capacity is used to meet the RPS requirement in neighboring Wisconsin (Dunlop, 2003). Iowa also has property tax and sales tax exemptions that lower the cost of wind generation and have contributed to recent development.

In the future, factors that may influence wind energy development in Iowa include political support from the Governor and a State law requiring all utilities to implement green pricing programs by 2004. Governor Tom Vilsack recently established a goal of reaching 1000 MW of wind energy capacity. One utility has responded by announcing plans to add about 300 MW of wind generation in Iowa by 2006, which would nearly double the State's current wind generating capacity.

4.4. Minnesota

Minnesota has a strong wind resource and ranks fourth nationally in installed wind power capacity, with

336 MW on line at the end of 2002. The main driver for wind development has been a regulatory settlement requiring the State's largest investor-owned utility, Xcel Energy, to develop or purchase 825 MW of wind power by 2012 in exchange for the right to store nuclear waste from its Prairie Island power plant on site. Of this, about 300 MW is installed. Although this requirement has been driving most large-scale wind energy development in the State, Minnesota also has a number of policies and incentives that encourage wind energy investment, including a production incentive for small wind, a sales tax exemption, a requirement that all utilities offer green power options to their customers, and a renewable energy fund.

In the future, State mandates will continue to drive wind energy development in Minnesota. By the end of 2003, another 160 MW of wind generation is expected to be operational. In addition, the timeline for the installation of the remaining 400 MW originally required by 2012 to satisfy the conditions of the nuclear waste settlement agreement may be accelerated as a result of a recent transmission-related decision by the Minnesota PUC (Dunlop, 2003). In the longer term, Xcel will need to install additional capacity, including at least 300 MW of wind energy, to meet the recently adopted Legislative requirement (HF 9) that 10 percent of its supplies come from renewable sources. While other utilities are not specifically required to meet the standard, they must develop plans for meeting the goal, and some have taken preliminary action to develop new renewables. To a lesser extent, consumer participation in utility green power programs may continue to drive some wind energy development.

4.5. Oregon

At the end of 2002, 218 MW of wind power capacity was installed in Oregon. A variety of factors have encouraged wind power development, including high wholesale market prices resulting from the California restructuring debacle and natural gas shortages in recent years, strong wind regimes in some parts of the State, open areas and land use that can accommodate large-scale projects, interest among utilities in supporting the development of cleaner energy sources, and interest among consumers in purchasing green power. The lack of sales tax in Oregon and, to some extent, property tax incentives have also helped to lower the cost of wind energy generation. Settlement agreements were an initial driver for wind energy investment.

In the future, financial incentives available through the State's system benefits fund are expected to help drive new project development. Created under the State's 1999 restructuring law, the fund will collect about \$8.6 million per year for 10 years to buy down the above-market costs of renewable energy (Bolinger et al.,

2001). The first wind project to receive incentives from the fund is a 41-MW project near Pendleton, Oregon, which is to receive a total of \$3.8 million (Energy Trust of Oregon, 2002; West, 2003). The trust expects to provide additional incentives for wind energy projects in the future. The integrated resource planning (IRP) process is also likely to encourage future development. For example, PacifiCorp, a large investor-owned utility that serves electricity customers in the region, proposed in its 2003 Integrated Resource Plan to meet part of its projected load growth during the next 10 years by installing 1400 MW of new wind capacity (PacifiCorp, 2003a).

4.6. Washington

All of the wind energy development in Washington has occurred in recent years. By the end of 2002, installed wind energy capacity totaled 228 MW. As with Oregon, the primary factors driving wind energy investments have been market conditions that at least initially were favorable to wind, proactive utilities, consumer interest in purchasing green power, and municipal and utility commitments to increase their reliance on wind power. Washington also has tax incentives to encourage renewable energy development, the most important of which is a sales tax exemption.

According to AWEA, more than 400 MW of wind capacity are planned for the near term. However, more stringent siting regulations and greater concerns regarding aesthetic issues may slow or impede future development activities. As with Oregon, longer-term development may be driven in part by IRP—in addition to a proposal by PacifiCorp to install 1400 MW of new wind to meet future load growth, Puget Sound Energy has set a goal to meet at least 5 percent of customers' energy-supply needs with renewable resources by 2013 as part of its least-cost plan (Puget Sound Energy, 2003).

4.7. Wyoming

Wyoming's wind energy capacity grew from about 1 MW in 1998 to about 140 MW by the end of 2002. Generation costs have been relatively low because of the State's strong wind resources and the ability to site relatively large projects that could be expanded over time. Of the total capacity installed, about 75 MW is used to meet regional utility commitments to develop renewables, resulting from mergers or IRP requirements (Colorado Public Utility Commission, 1998; PacifiCorp, 2003b). The rest supplies customers in nearby States who voluntarily purchase green power.

In 2002, the Wyoming legislature adopted a sales tax exemption for wind energy facilities that may contribute to future development. The tax exemption helped to spur the development of a 144-MW wind project that

will be used in part to supply green power programs offered by utilities in Utah. However, transmission constraints may limit further wind energy development in Wyoming.

4.8. Colorado

At the end of 2002, Colorado had about 60 MW of operational wind generating capacity. Wind energy development has steadily expanded in recent years due to the success of early utility programs that enabled customers to voluntarily purchase renewable energy at a premium. Through the implementation of these voluntary programs, the utilities, the public utilities commission, and regional stakeholders gained experience with wind energy generation, which has facilitated additional development. There are no State policies or incentives currently in place to support wind energy development in Colorado.

Another 162 MW wind energy project, which the State Public Utilities Commission (PUC) found to be cost-effective, is being developed in southeastern Colorado. Under the IRP process, the Commission determined that this wind project would cost less than new natural gas-fired generation assuming future natural gas costs of more than \$3.50/Mcf (\$0.12/cubic meter) (Lehr et al., 2001).

4.9. Kansas

At the end of 2002, Kansas had 114 MW of installed wind energy generating capacity, with all but 2 MW located at the Gray County Wind Farm in the southwestern portion of the State. Kansas has a robust wind resource, which is ranked third nationally (see Table 3). Kansas also offers a full property tax exemption to renewable energy facilities. With the combination of strong winds, the Federal Production Tax Credit, and the State property tax exemption, existing projects have reported generation costs that are less than 3¢/kWh, making them competitive with conventional generation technologies.

In the future, Kansas' strong wind resources and the property tax incentive may continue to drive wind energy investments. Transmission issues could restrict development opportunities, but new laws facilitating transmission upgrades may help alleviate potential problems. In the short term, at least one wind project that could ultimately reach 100 MW in size is planned.

4.10. Pennsylvania

Although Pennsylvania has a modest wind resource, about 35 MW of wind energy was installed in 2002. Wind power development has been spurred by a combination of voluntary purchases of wind energy by

consumers, financial incentives available through the State's system benefits funds, and the promise of future markets for renewables in meeting regional RPS requirements, particularly, the New Jersey RPS (Freeman, 2003). Contributing to the success of the consumer market for green power have been market rules that, at least initially, favored competition; relatively high standard-offer rates in the initial stages of retail competition that have encouraged consumers to switch suppliers; wholesale market rules that are favorable to wind generators; and the willingness on the part of a large utility to commit to assuming some of the development risk by entering into long-term wind power purchase contracts. The early success of the Pennsylvania wind market has been instrumental in encouraging wind energy development throughout the region, particularly in neighboring States, such as New York and West Virginia.

In the future, Pennsylvania's system benefits funds are expected to continue providing financial support to encourage wind energy development. Recently, one of the State's funds negotiated \$10 million of wind production incentives with four Pennsylvania wind project developers representing nearly 150 MW of additional wind power capacity (Sanders and Clark, 2003). Other utility system benefits funds are also actively considering loans to wind project developers.

4.11. West Virginia

While only one wind project is operational to date, West Virginia has 66 MW of installed wind energy capacity, and hundreds of additional megawatts have been proposed. The drivers for wind energy development in West Virginia are similar to those for Pennsylvania, namely to meet consumer demand for green power and to supply regional RPS markets in the future (Freeman, 2003). West Virginia is one of the closest wind resource areas to Washington, DC, which positions it to serve green power demand by DC-based customers. Another key factor is that wind energy generation costs in West Virginia are relatively low compared to other areas of the region, due in part to a relatively strong wind resource, the ability to site sizable projects, and wholesale market rules that are favorable to wind. Also important was the State's ability to address punitive State tax policies, leveling the playing field for wind generators (DeWolf, 2003). As with Pennsylvania, another important element that has contributed to wind energy investment is a partnership between a large utility and a green power marketer, in which the utility assumed much of the risk by entering into a long-term contract for the wind energy output.

With respect to future development, a number of wind projects totaling upward of 600 MW have been

proposed. However, there is considerable uncertainty surrounding the probability of completion of a number of these projects, due in part to the uncertainty surrounding the extension of the Federal Production Tax Credit and potential RPS policies in the region. Local opposition and siting issues have begun to emerge, which may make it more difficult to develop proposed and future projects. Also, development will depend largely on policies and markets for wind in other States, as West Virginia does not provide any incentives for wind energy.

4.12. New York

At the end of 2002, New York had 49 MW of installed wind energy capacity, all of which was installed since 2000. The three existing large-scale projects have been developed largely through the availability of grants and financial incentives from the State's system benefits fund (Bolinger and Wiser, 2002). They are also supported in part through premiums paid by consumers interested in purchasing electricity generated from renewable sources for their own electricity needs. The system benefits fund, which was created in 1996 as part of electric industry restructuring, has also been used in a variety of ways to lay the groundwork for wind development in New York, such as identifying potential sites, creating wind resource maps, and providing incentives for green power marketers. Wholesale market and interconnection rules that allow wind to compete with traditional fuels have also facilitated wind energy development.

Future development will likely be driven by incentives available through the system benefits fund and an RPS that is being developed. System benefits funds have been awarded to planned projects totaling approximately 300 MW. In addition, Governor George Pataki recently called on the Public Service Commission to implement an RPS that would require 25 percent of the State's power to come from renewable sources, including hydroelectric, by 2012. New York currently obtains approximately 17 percent of its power from renewable sources, nearly all of which comes from hydroelectric power (NREL, 2003). If the RPS is, in fact, implemented, this could be an important driver for wind energy development over the long term. Consumer interest in purchasing green power may also continue to support new wind development. A number of retail green power marketers entered New York in 2002; and, as these early programs develop, they may create a need for new resources, particularly, in light of the State's commitment to purchase renewable energy for 20 percent of the electricity use at its facilities by 2010.³

³ Governor Pataki issued an executive order in June 2001 http://www.state.ny.us/governor/press/year01/june10_01.htm.

5. Summary of lessons from the leading states

This paper describes the factors that spur wind development in the United States. It has two fundamental messages:

- (1) State tax and financial incentives, as well as State RPS policies, can and do have an important effect on wind energy development. This impact is most pronounced when wind generation is already nearly competitive with more traditional generation resources (e.g., gas-fired generation)—for example, in States with particularly strong wind resources.
- (2) The increasing cost-competitiveness of wind generated electricity—due in part to a movement toward larger, more efficient turbines and facilitated by Federal tax incentives, but also partly attributable to high natural gas prices—is now an important driver for new wind installations. Simply said, there are some regions of the United States in which wind power is the lowest-cost resource option.

Any State policy or incentive functions in the context of other powerful drivers, such as: the quality of the wind resource, the cost of conventional generation, the need for new electricity supplies, the willingness of power companies to integrate wind into their systems, the ease of siting and permitting wind facilities, the quality of the power delivery system, and the rules that govern the transmission system.

State drivers also function within the context of current Federal policies and incentives, which have played an important role in encouraging recent wind power development. The most notable and effective of these is the Federal Production Tax Credit, which has reduced the cost of wind energy and is a key policy that works in conjunction with other State or local drivers. Other important Federal policies include five-year accelerated depreciation and to a lesser extent the Renewable Energy Production Incentive, which aides wind projects owned by publicly owned utilities and cooperatives that do not have Federal tax liabilities, but is subject to annual Congressional appropriations.

Within the context of these broader market drivers and Federal incentives, State policies and markets, in many cases, have been instrumental in stimulating wind energy development. Table 2 provides a summary and comparison of policy incentives in the States examined in this paper. Based on the experience of these States, the following policies and market factors have been identified as key drivers of wind energy development at the State level.

5.1. Renewable portfolio standards

Provided they are designed and implemented effectively, RPS policies or purchase mandates are the most

powerful tool that a State can use to promote wind energy. So far, these have been particularly important for driving wind energy investment in Texas, Minnesota, and Iowa, where more than 1700 MW of new capacity has been developed to meet the requirements of just these three States. In addition, some portfolio standards, such as those in Wisconsin and New Jersey, have been directly responsible for wind development, not only within the State, but also in neighboring States. In the future, State RPS policies, such as those under development in California and New York, are expected to play a leading role in stimulating wind energy development.

5.2. System benefits funds

System benefits funds can also promote wind energy development. These funds have proven to be important for stimulating investment in wind energy facilities in States such as Pennsylvania, New York, and California, and may become increasingly important in places like Oregon. Relative to some other types of policies, system benefits funds offer the advantage of flexibility; they can be used to provide a variety of financial incentives such as debt or equity financing, production incentives, grants, or support for the development of green markets. In some cases, system benefits funds can be helpful in States with little experience in wind development by funding activities such as wind-resource mapping and site preparation.

5.3. Integrated resource planning

The IRP process has driven wind power development in some regions. For example, IRP has been important in Colorado, where the utility commission required the construction of new wind facilities totaling nearly 200 MW. The facilities were found to be cost-effective as a result of increases in natural gas prices. In Oregon, one utility issued an IRP plan that calls for 1400 MW of new wind projects to meet projected load growth.

5.4. Property tax incentives

Property tax abatements can be important incentives for wind developers, although they may not (by themselves) be capable of stimulating new wind development, except in areas with particularly good wind resources. Property tax exemptions can be significant to developers, even when the developer chooses to make smaller cash payment to the local community in lieu of the property tax. One concern regarding the use of property tax exemptions is that they reduce the local economic development benefits that would otherwise accrue from a project. This may serve to erode public support for wind projects, particularly in rural

communities, which are perhaps in greatest need of additional tax revenue and where the majority of wind development is likely to occur.

5.5. Sales tax incentives

Sales tax abatements can be important to wind developers because of the capital-intensive nature of wind energy facilities. Again, however, they may not be sufficient to stimulate new wind energy investments by themselves. Sales tax exemptions are a one-time tax benefit that developers realize at the time of equipment purchase. In a State with “very good” to “excellent” wind resources and good transmission availability, sales tax abatements may influence a developer’s decision to build a wind facility. One potential concern for States regarding the use of sales (and other) tax exemptions is that they reduce tax revenues, which can pose problems for States during tight economic conditions.

5.6. Green power markets

Voluntary purchases of green power by consumers can provide an important revenue stream to support investment in wind energy facilities. Consumer demand for green power has been a key contributor to the successful development of projects in several Mid-Atlantic States, Colorado, Wyoming, and in the Pacific Northwest, among others. In some instances, such as Colorado and Pennsylvania, green markets have provided utilities, regulators, and advocates the opportunity to gain experience with wind energy, paving the way for further development. Although premiums paid by consumers may not alone provide stable enough revenue to support large-scale development, they can be used in conjunction with other policy mechanisms. Wind energy projects have been supported through a combination of financial incentives provided by systems benefits funds and customer premiums in States such as New York and Pennsylvania. Where RPS policies are in place, green power marketing can enable developers to construct larger and more cost-effective projects, with a portion being used to meet the RPS and a portion to meet consumer demand.

5.7. Wholesale market rules

Wholesale market rules that accommodate intermittent generators can also influence wind energy development in a State or in a region. Markets that are fluid and provide real-time scheduling, capacity credit for wind, and allow schedule deviations without penalties can help to facilitate wind energy development. Nondiscriminatory market rules lower the cost of wind generation and can be particularly important for merchant wind projects that sell their output on the open market.

6. Summary

It is impossible to discern one single driver for wind power development in the United States; instead, numerous drivers function as a package and influence one another's effectiveness. It is clear from the tremendous growth in installed wind capacity that a combination of policies, vastly improved economics, and a developing market for green power are all having a sizable effect on the wind industry. Of the various State policy drivers, the RPS appears to be the most effective. But a variety of financial incentives can also wield a great deal of influence. Any State policy must, however, operate in the general context of the wind resource, transmission constraints, and market rules, which ultimately may bound any new investment in wind.

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