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DOE Report Tracks Maturation of U.S. Wind Industry

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Tracking the Growth of the U.S. Wind Industry

The U.S. Department of Energy’s inaugural “Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006” summarizes key trends in the U.S. wind industry, in many cases using previously unavailable data, making it a valuable reference for the U.S. wind sector.

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The wind power industry is in an era of substantial growth in the United States, and keeping up with trends in the marketplace has become increasingly difficult. Yet, the need for timely, objective information on the industry and its progress has never been greater. This article provides a brief synopsis of a recently completed report from the U.S. Department of Energy – the first in what is envisioned to be an ongoing annual series – that attempts to fill this need by providing a detailed overview of developments in the U.S. wind power market, with a particular focus on 2006. This report, and its subsequent updates, will hopefully serve a useful role in keeping wind industry stakeholders regularly informed of key trends.

Wind Installations

As widely reported earlier in the year, the U.S. wind power market continued its rapid recent expansion in 2006, with 2,454 MW of new capacity added, for a cumulative total of 11,575 MW. As shown Figure 1, leading states in terms of 2006 additions include Texas, Washington, California, New York, and Minnesota.

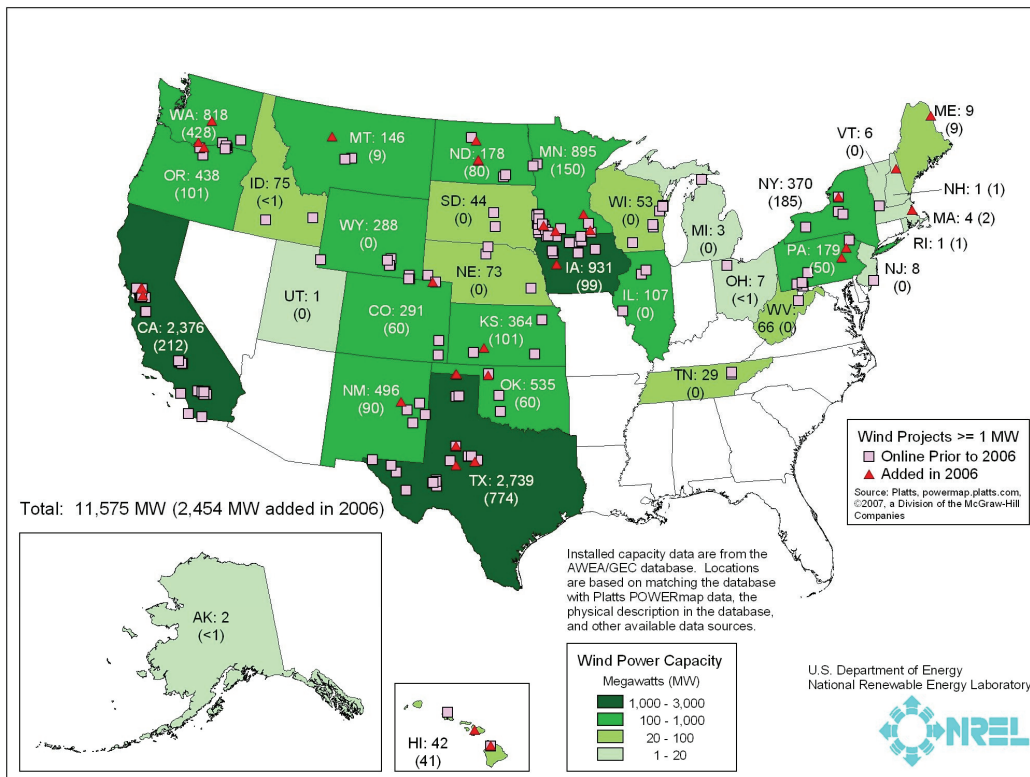


Figure 1. Size and Location of Wind Power Development in the U.S.

This growth translates into more than \$3.7 billion invested in wind project installation in 2006, for a cumulative total of more than \$18 billion since the 1980s. Impressively, for the second consecutive year, wind power was the second-largest new resource added to the U.S. electrical grid in terms of nameplate capacity – new wind plants contributed roughly 19% of the new nameplate capacity added in 2006, compared to 13% in 2005.

Wind Industry Trends

GE Wind remained the dominant manufacturer of wind turbines supplying the U.S. market in 2006, with 47% of newly installed capacity. Siemens and Vestas also had significant U.S. installations, with Mitsubishi, Suzlon, and Gamesa playing lesser roles (Figure 2). Siemens' move to the number two wind turbine supplier is particularly noteworthy, given that it delivered no turbines to the U.S. market the previous year. The average size of wind turbines installed in the U.S. in 2006 was roughly 1.6 MW, more than double the 0.7 MW average turbine size seen in projects installed in 1998 and 1999.

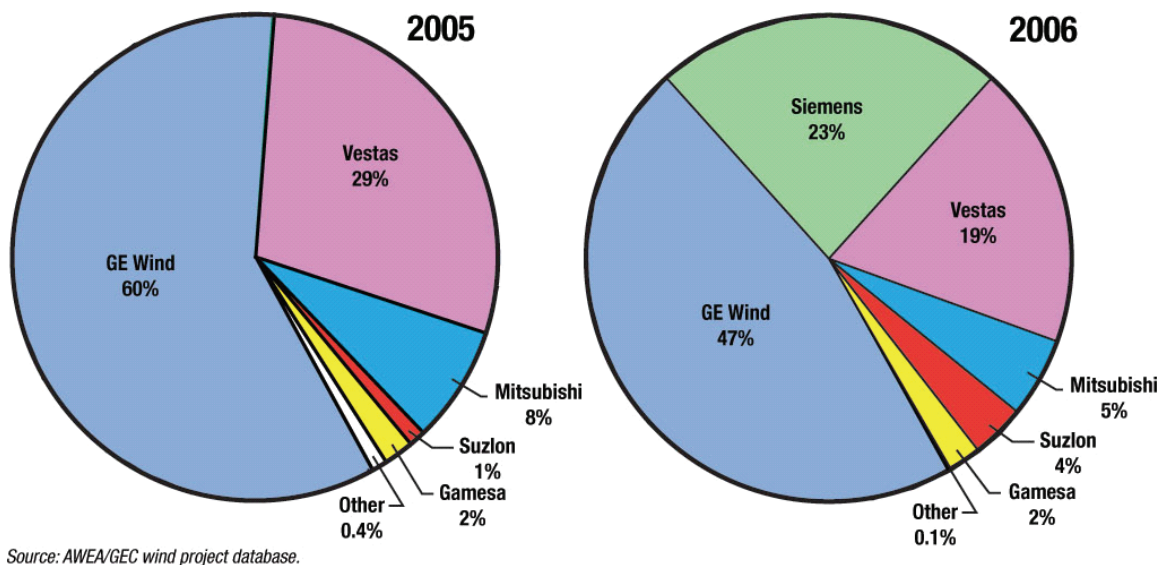
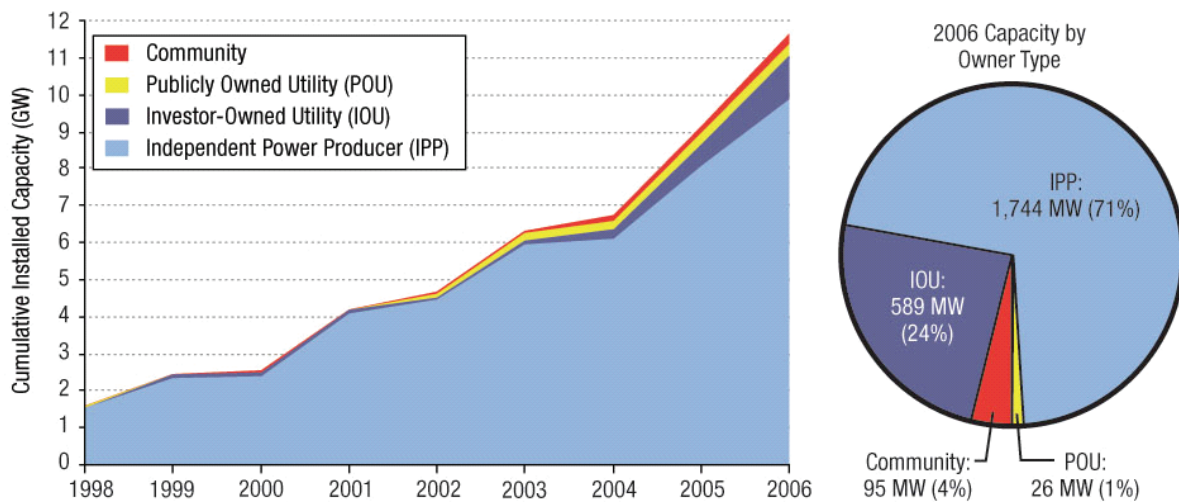


Figure 2. Annual U.S. Market Share of Wind Manufacturers by MW, 2005 and 2006

Consolidation on the development end of the business continued the strong trend that began in 2005, with a large number of significant acquisitions, mergers, and investments among U.S. wind developers. By our count, 13 such transactions totaling roughly 35,000 MW of in-development wind projects were announced in 2006, up from nine transactions totaling nearly 12,000 MW in 2005, and only four transactions totaling less than 4,000 MW from 2002 through 2004.

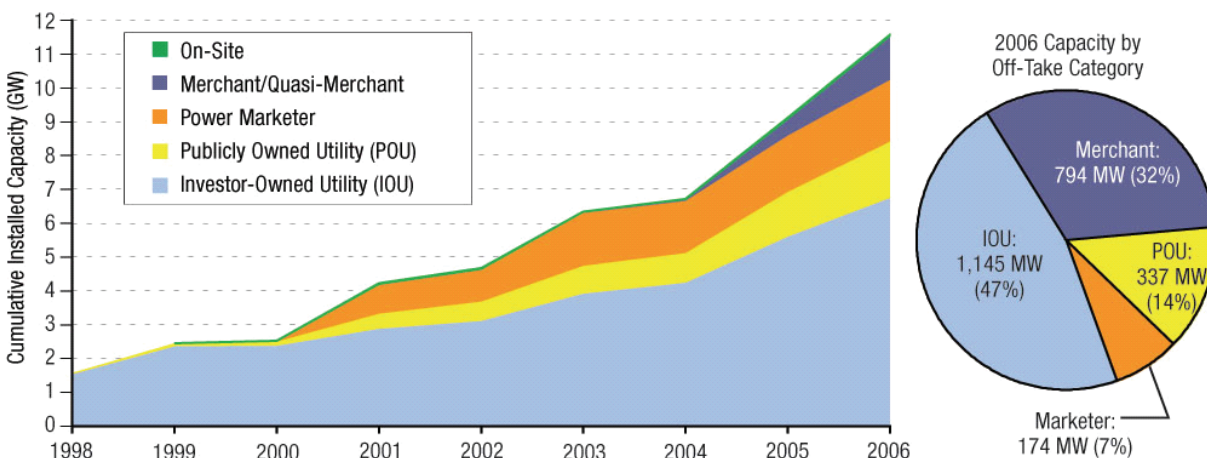
Another sign of the maturation of the wind sector is that electric utilities have begun to express greater interest in owning wind projects (Figure 3). Although private independent power producers continue to dominate the U.S. wind industry, owning 71% of all new wind capacity added in 2006, local electric utilities put in a strong showing, owning 25% of all new wind capacity added last year. Community wind power projects – defined here as projects owned by towns, schools, commercial customers, and farmers, but excluding publicly owned utilities – constitute the remaining 4% of 2006 projects.



Source: Berkeley Lab estimates based on AWEA/GEC wind project database.

Figure 3. Wind Capacity Categorized by Owner Type

Electric utilities (primarily investor-owned, though increasingly publicly owned as well) continue to be the dominant purchasers of wind power (Figure 4). However, the role of power marketers – defined here as corporate intermediaries that purchase wind power under contract and then re-sell that power to others – has increased dramatically since 2000. Moreover, as a sign that wind investors are increasingly willing to take some merchant risk, more than 30% of the wind capacity installed in the U.S. in 2006 was sold at least in part on a quasi-merchant basis.



Source: Berkeley Lab estimates based on AWEA/GEC wind project database.

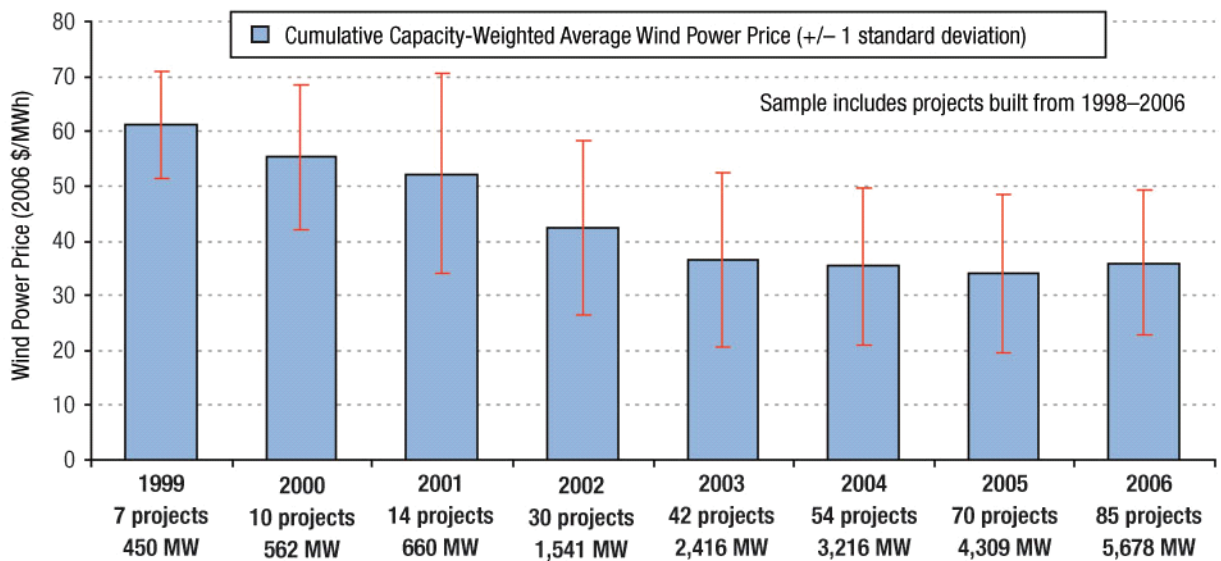
Figure 4. Wind Capacity Categorized by Power Off-Take Arrangement

Wind Power Prices Are Up in 2006

Although the wind industry appears to be on solid footing, the weakness of the dollar, rising materials costs, a concerted movement towards increased manufacturer profitability, and a shortage of components and turbines has put upward pressure wind power prices.

Berkeley Lab maintains a database of wind power sales prices, which currently contains price data for 85 projects installed in the U.S. between 1998 and the end of 2006. These wind projects total 5,678 MW, or 58% of the incremental wind capacity in the U.S. over the 1998-2006 period. The prices in this database reflect the price of electricity as sold by the project owner, and might typically be considered busbar energy prices.

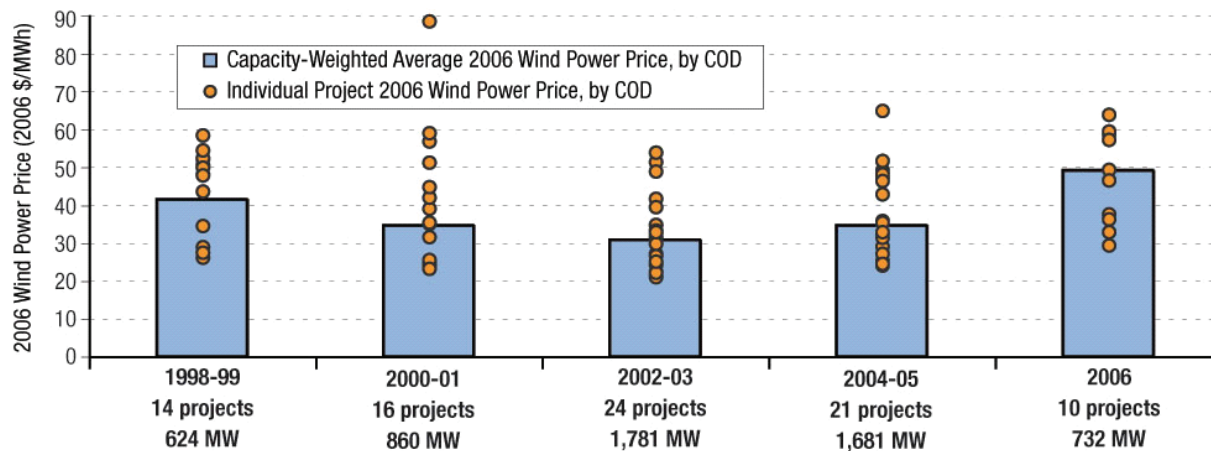
Based on this database, the cumulative capacity-weighted average power sales price from our sample of post-1997 wind projects remains low by historical standards. Figure 5 shows the cumulative capacity-weighted average wind power price in each year from 1999 through 2006. For example, based on our limited sample of 7 projects built in 1998 or 1999 and totaling 450 MW, the weighted-average price of wind in 1999 was just under \$61/MWh (expressed in 2006 dollars). By 2006, in contrast, our cumulative sample of projects built from 1998 through 2006 had grown to 85 projects totaling 5,678 MW, with an average price of \$36/MWh. Although Figure 5 does show a slight increase in wind power prices in 2006, reflecting rising prices from projects built in 2006, the cumulative nature of the graphic mutes the degree of increase.



Source: Berkeley Lab database.

Figure 5. Cumulative Capacity-Weighted Average Wind Power Price Over Time

To better illustrate the 2006 price increase, Figure 6 shows average wind power sales prices (as well as actual project-specific prices) in 2006, grouped by each project's initial commercial operation date (COD). Following a general decline since 1998, prices bottomed out for projects built in 2002 and 2003, and have since risen. Specifically, the capacity-weighted average 2006 sales price for projects in our sample built in 2006 was roughly \$49/MWh, up from an average of around \$35/MWh for our sample of projects built in 2004 and 2005, and \$31/MWh for projects built in 2002 and 2003. Moreover, because recent turbine price increases are not fully reflected in 2006 wind project prices – many of these projects had locked in turbine prices and/or negotiated power purchase agreements as much as 18 to 24 months earlier – prices from projects being built in 2007 and 2008 may well be higher still.



Source: Berkeley Lab database.

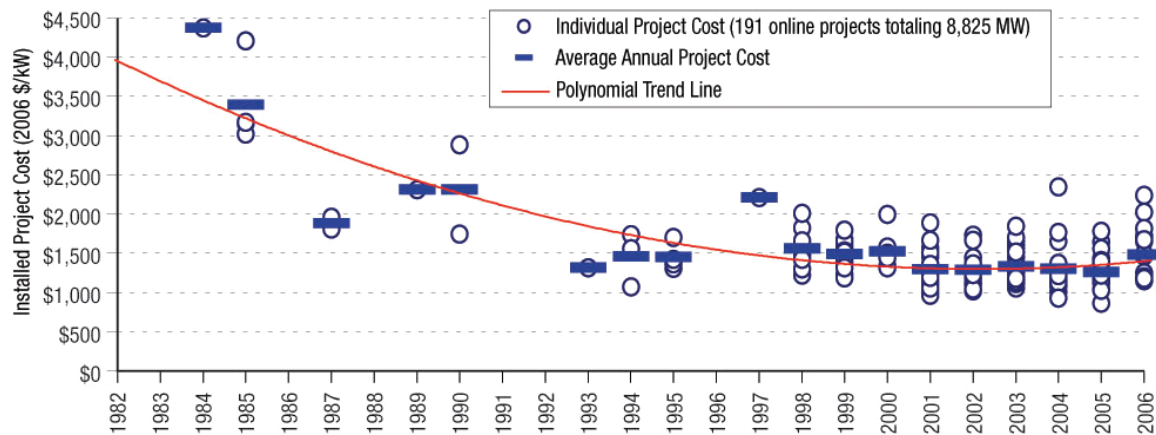
Figure 6. 2006 Wind Power Price by Commercial Operation Date (COD)

A comparison of these prices to recent wholesale power prices throughout the United States (not provided here) demonstrates that wind power has generally provided good value in wholesale power markets over the past few years, competing well with conventional sources of power. The recent increase in wind power prices, however, is clearly eroding the strong competitive position that wind has held relative to wholesale power prices in the recent past.

Installed Project Costs Are Driving Wind Power Prices Higher

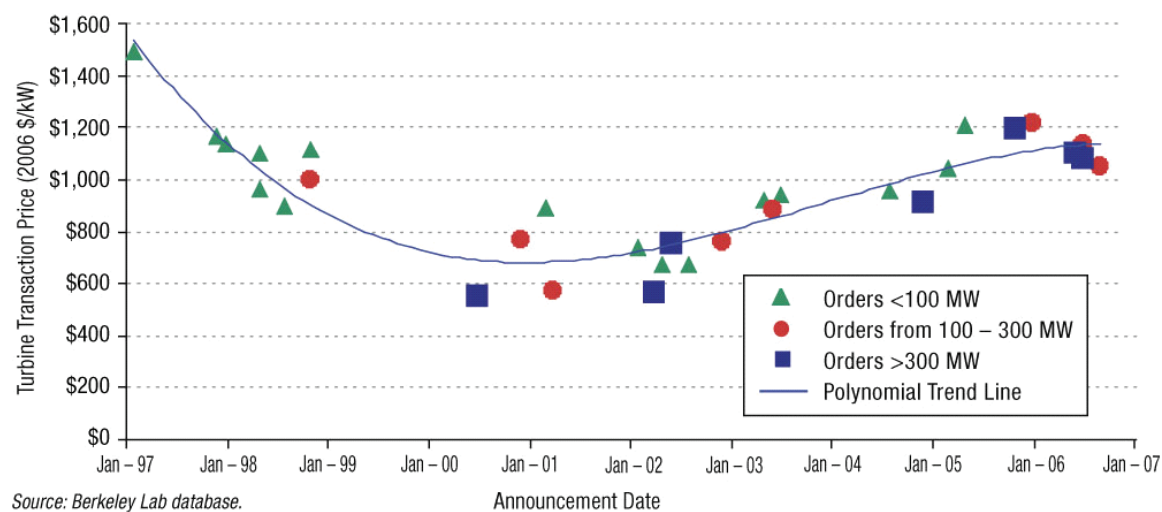
Berkeley Lab has compiled data on the installed costs of 191 completed wind projects in the continental U.S., totaling 8,825 MW. As shown in Figure 7, installed costs declined dramatically from the beginnings of the wind industry in California in the 1980s to the early 2000s, falling by roughly \$2,700/kW over this period. More recently, however, costs have increased: among our sample of projects built in 2006, reported installed costs averaged \$1,480/kW – up \$220/kW (18%) from earlier years.

Though most of this project cost increase is attributable to rising turbine costs, there is reason to believe that recent increases in turbine costs had not fully worked their way into installed project costs in 2006. First, the average cost estimate for projects under development but not completed in 2006 (not shown in Figure 7) was \$1,680/kW, or \$200/kW higher than for projects completed in 2006. Second, based on data from 32 U.S. wind turbine transactions totaling 8,986 MW and spanning the 1997-2006 period, it is clear that turbine prices have risen by more than \$400/kW (60%) on average (Figure 8). Because our sample of installed costs has risen, on average, by just over \$200/kW, further increases in project costs should be expected in the near future as the increase in turbine prices flows through more-fully to project costs.



Source: Berkeley Lab database (some data points suppressed to protect confidentiality).

Figure 7. Installed Wind Project Costs Over Time



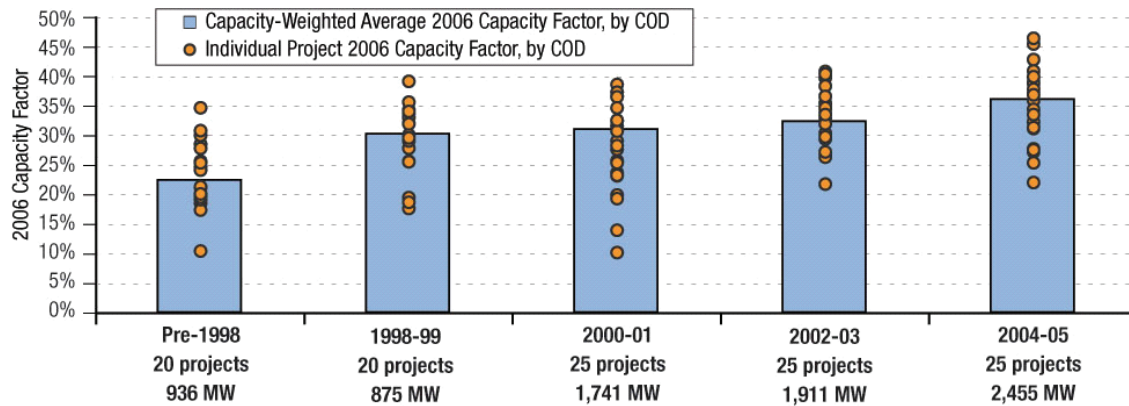
Source: Berkeley Lab database.

Figure 8. Reported U.S. Wind Turbine Transaction Prices Over Time

Wind Project Performance Is Improving, While O&M Costs Are Declining

Though project cost increases have driven wind power prices higher, improvements in wind project performance have mitigated these impacts to some degree. Figure 9 presents excerpts from a Berkeley Lab compilation of wind project capacity factor data. Our sample consists of 115 U.S. wind projects built between 1983 and 2005, totaling 7,918 MW (87% of nationwide installed wind capacity at the end of 2005).

Though capacity factors are not the ideal metric of project performance, average 2006 capacity factors in our sample increased from 22.5% for wind projects installed before 1998, to roughly 30%-32.5% for projects installed from 1998 through 2003, and to roughly 36% for projects installed in 2004 through 2005. This improvement is likely due to a combination of higher hub heights, improved micro-siting and wind turbine design, and the more recent development of windier sites in parts of the Great Plains.



Source: Berkeley Lab database.

Figure 9. 2006 Project Capacity Factors by Commercial Operation Date

Finally, based on a Berkeley Lab database of O&M cost data for 89 wind projects in the U.S. totaling 3,937 MW, there is some evidence of a decline in wind project O&M costs in recent years. Specifically, projects installed more recently (since 1998) appear to have progressively lower O&M costs, at least during the initial years of project operation.

Conclusions

With the PTC now extended through 2008, the American Wind Energy Association and BTM Consult expect robust 25-30% growth in wind power capacity in 2007, and similarly strong growth in 2008. Nevertheless, in aggregate, wind capacity in the U.S. at the end of 2006 would, in an average year, supply just 0.8% of the nation's electricity consumption. This compares poorly to wind penetration levels of roughly 20% in Denmark, 9% in Spain, and 7% in Portugal and Germany. Even higher levels of growth than seen in 2006 and projected for 2007/2008 will clearly be required if wind is to significantly contribute to U.S. electricity supply.

For More Information:

To obtain an electronic copy of the report on which this article is based, see:

<http://www1.eere.energy.gov/windandhydro/pdfs/41435.pdf>

For a printed-version of the report, email Diana Sexton at dmsexton@lbl.gov.

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