HARNESSING THE WIND

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In recent years, the use of wind power has grown rapidly in the United States—and is poised for greater growth if transmission and political challenges can be met.

NEW WIND POWER INSTALLATION in the United States set a record in 2008 for the fourth consecutive year. The wind energy industry installed 8,545 megawatts (MW) of wind power capacity last year, more than 3,000 MW greater than the previous annual record set in 2007, according to the Washington, D.C.–based American Wind Energy Association (AWEA). Total U.S. wind power capacity is 28,206 MW as of the second quarter of 2009 and AWEA estimates that wind will generate about 1.25 percent of the nation's electricity needs, enough to power more than 8 million average homes. The AWEA projects about 5,000 MW in new capacity to be installed by the end of the year.

The American Recovery and Reinvestment Act of 2009, signed by President Obama in February, includes provisions to encourage wind and other alternative energy technologies. The production tax credit (PTC)—a key wind industry priority that provides a 2.1-cent per kilowatt-hour generated tax credit for ten years for wind and other renewable energy projects—has been renewed through December 31, 2012. The legislation also allows wind energy developers to choose between the PTC and a 30 percent investment tax credit, convertible to a grant from the U.S. Treasury, enhancing the ability to monetize renewable energy tax credits. Other provisions include financing for planning and building new transmission lines.

PPM ENERGY

The Maple Ridge Wind Farm northeast of Syracuse is the largest wind farm in the state of New York, providing up to 322 MW of electricity toward the state's goal of obtaining 25 percent of its power from renewable energy by 2013.

Both the public and private sectors have been promoting renewable energy. Some 28 states and the District of Columbia have enacted renewable energy standards (RES), requiring that some percentage of electricity be supplied from renewable sources, usually in the next five to 15 years. The Obama Administration called for a national RES of 25 percent by 2025. The American Clean Energy and Security Act of 2009 (also referred to as the Waxman-Markey bill), passed by the House of Representatives 219–212 on June 26, calls for a national RES of 6 percent in 2012, increasing to 20 percent by 2020; up to 40 percent of which can be met by utilities increasing energy efficiency. The Senate is working on its own RES legislation. Further action is expected in the fall.

Many private companies have set voluntary goals for using or developing green energy. In July, the U.S. Envrionmental Protection Agency recognized 58 Fortune 500 companies (and universities, governments, and others) for their purchases of green energy, totaling more than 8 billion kilowatt-hours annually. For example, Mountain View, California–based Goggle, Inc., launched in November 2007 an investment and research effort to develop electricity from renewable sources that would cost less than coal. Round Rock, Texas–based computer maker Dell, Inc., announced in February that 35 percent of its U.S. energy consumption was from green sources.

A U.S. Department of Energy (DoE) study concluded in 2007 that wind power is competitive at the wholesale price level and has been consistently priced, including all rebates and credits, at or below the price of electricity produced at fossil-fuel or nuclear power plants. Moreover, wind project performance has been increasing due to improved project siting, larger turbines, and technological advances, and average prices have been declining for many years, though they increased in 2006 due to increasing costs for turbines. Prices vary by region and are the lowest in Texas and the Plains states, which the DoE defined as North and South Dakota, Nebraska, Kansas, Oklahoma, Minnesota, Iowa, Missouri, and Arkansas.

As of the end of June, 35 states had utility-scale (generally defined as designed to be hooked to the commercial grid rather than providing power to a single user such as a business or home) wind generation facilities. Texas, the leading state by far in total installed wind power capacity, again led the country in new installations in 2008, adding 2,671 MW (see table above). Iowa vaulted past California into second place in 2008. Minnesota and Iowa rely most on wind-generated electricity, obtaining about 7.5 and 7.1 percent, respectively, of their electricity from wind, followed by Colorado, North Dakota, and New Mexico.

TOP TEN STATES' TOTAL INSTALLED WIND POWER CAPACITY (MW) (AS OF JUNE 27)

State Ranked by Existing Capacity	Existing	Under Construction
Texas	7,907	1,102
Iowa	2,883	210
California	2,653	125
Minnesota	1,803	0
Washington	1,479	0
Oregon	1,363	126
New York	1,261	21
Colorado	1,068	0
Kansas	1,014	0
Illinois	915	312

Source: AWEA.

Only three of the top ten states in installed wind energy capacity are among the top ten for wind energy *potential*: Texas (2), Minnesota (9), and Iowa (10). The other top ten states for annual wind energy potential are as follows: North Dakota (1), Kansas (3), South Dakota (4), Montana (5), Nebraska (6), Wyoming (7), and Oklahoma (8).

Wind energy proponents tout its economic impact. Wind farms provide income for rural landowners, ranging from $3,000 to $5,000 per turbine, according to the AWEA, while allowing farming or ranching to continue, and create construction and maintenance jobs. Since the turbines do not require water for steam to produce electricity, as do fossil-fuel and nuclear plants, they suit the often-arid Plains. Windmill component manufacturers announced more than 55 new or expanded facilities in 24 states last year.

In May 2008, a DoE report, "20 percent Wind Energy by 2030: Increasing Wind Energy's Contribution to U.S. Electricity Supply," concluded that wind energy could provide 20 percent of U.S. electricity without major technological breakthroughs, though it would require significant capital and transmission investment. (Denmark and parts of Spain and Germany already get 20 percent of their electricity from wind.) While there is opportunity for growth, there also are barriers.

First, a potential wind farm site has to be windy. Generally, wind speed of 15.7 to 16.8 miles per hour (25.1 to 26.9 km per hour) 164 feet (50 m) above ground (class 4 on a 1-to-7 scale) or higher is necessary for viable commercial-scale wind farms with current technology. Preferred sites are hilltops, ridge crests, mountain summits, large clearings, and other locations free of local obstruction and with less surface roughness.

Windmills are tall—rotor diameters can be 262 to 295 feet (80 to 90 m) and towers can be just as tall—and getting taller, and wind farms sprawl as individual towers are spaced to avoid each other's wind shadows. Wind is stronger higher up, and the energy output of wind increases proportionally to the cube of wind speed; e.g., doubling wind speed increases energy potential eightfold. Offshore windmills are bigger still, in part because it is easier to transport larger blades over water. While it is difficult to cite average wind farm size since some cover flat rectangular sites and others follow mountain ridge-tops, they are getting bigger. The 137-turbine Fenton Wind Project in southwest Minnesota, for instance, covers a seven-by-seven-mile (11-by-11-km) span of farm fields in two counties. It takes about 18 to 24 months to develop a wind farm, with six months for construction and the rest for approvals.

Wind alone is not enough for an ideal site, however. Environmental issues, protecting migrating birds and endangered species, avoiding radar interference, and concerns about noise and aesthetics all factor into site selection, but perhaps the biggest barrier is access to the electrical grid. The DoE notes: "While access to nearby transmission lines is a key requirement for large renewable power facilities, the first step for developing many renewable resources is for someone to actually build a transmission line." Wind farms in wide-open spaces, where there are few conflicting uses or few residents to raise objections, also are often far from the demand for electricity and from transmission lines. The

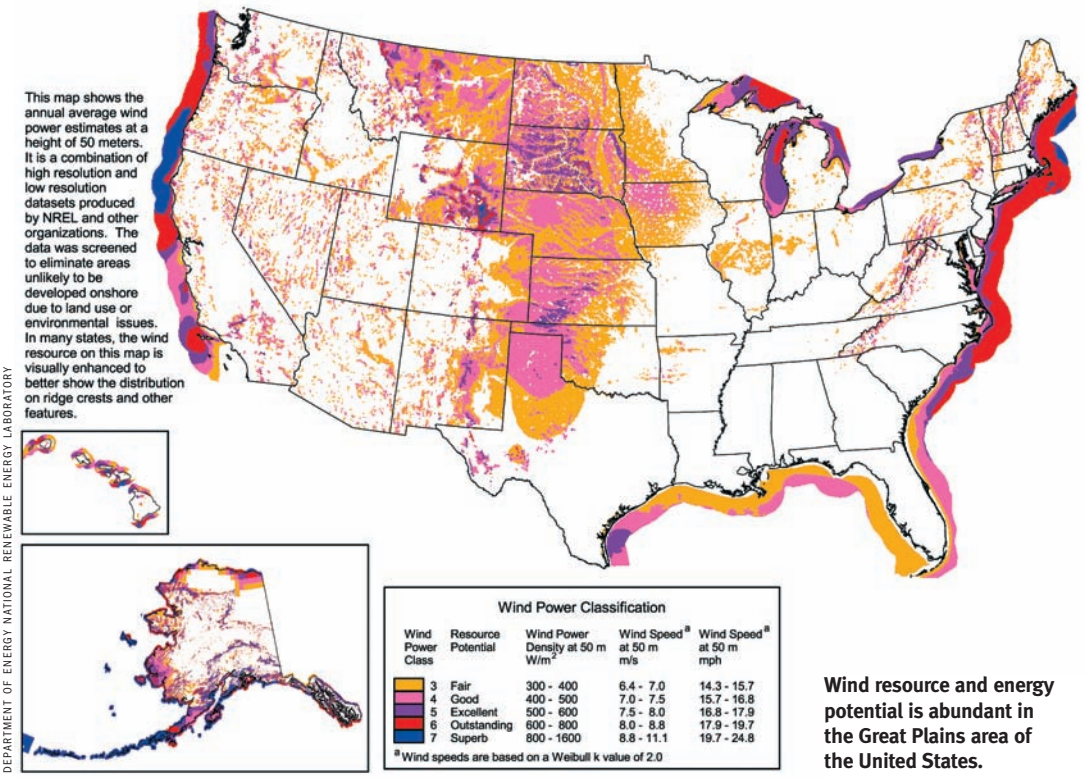
Peetz Table Wind Energy Center in northeast Colorado, built in 2007, required a 78-mile (125-km) transmission line to connect to the grid.

Some states and business are taking steps to encourage transmission line building. In Texas, T. Boone Pickens, most widely known as an oil man, advocates developing wind power and plans to build transmission lines along a water pipeline right-of-way to connect wind farms in the panhandle with users in Dallas/Fort Worth, though plans have been postponed by falling natural gas prices and tight credit markets. In 2007 New Mexico established a Renewable Energy Transmission Authority, the first state-level authority, with the power to issue bonds to finance transmission lines to serve renewable energy facilities. The California independent system operator has been working with the Federal Energy Regulatory Commission to develop innovative financing for new transmission lines.

Wind's variability presents another challenge: wind generates power 65 to 80 percent of the time and on average generates at 30 to 35 percent of rated capacity annually—challenging grid operators to balance supply and demand and avoid blackouts. Traditional power plants also have downtime. Adding more wind farms to a larger grid would provide diversification and reduce variability concerns. "Improvements in wind forecasting are a key advance that can be used to better schedule wind power into the market, easing a lot of [variability-related] issues," Christine Real de Azua, AWEA's assistant director of communications, says.

Efforts to maximize energy potential from wind include collocation with other energy sources. In November 2007, Puget Sound Energy began a demonstration project producing electricity from a 450-kilowatt solar facility located within the company's Wild Horse Wind Facility in Washington. Also in 2007, a $2 million wind-to-hydrogen project was dedicated in Minot, North Dakota, to research using electricity generated by wind to separate hydrogen from water, which then could be used to power hydrogen-fueled vehicles.

Offshore wind farms are common in Europe and technically attractive for their strong and steady winds—NREL estimates that offshore wind farms could supply up to 5 percent of U.S. electricity by 2030. But in the United States they have proven particularly controversial, with residents and vacationers arguing that they mar ocean views and may interfere with fishing or navigation, notably in the proposed 130-turbine Cape Wind project in Nantucket Sound. In May, the Massachusetts Energy Facilities Siting Board granted environmental approval to the project, though federal approvals remain and opponents have vowed to appeal the commonwealth's decision.



Wind resource and energy potential is abundant in the Great Plains area of the United States.

Offshore wind may offer particular potential in the Northeast, where electricity costs are high, demand is growing, and scarce land makes onshore development expensive. In the first contract for offshore wind power in the United States, Delaware-based utility Delmarva Power signed a 25-year contract in June 2008 with wind farm developer Bluewater Wind Delaware, LLC, for up to 200 MW from Bluewater's proposed wind farm more than 11 miles (17.6 km) off Rehoboth Beach. The U.S. Minerals Management Service issued final regulations on Earth Day, April 22, guiding wind power development on the outer continental shelf, which should add predictability to the process. In a first for freshwater, also on Earth Day, the New York Power Authority asked for expressions of interest for projects in Lake Erie and Lake Ontario.

While the iconic wind farm image may be of huge pinwheel towers in rural areas, there also is potential in urban areas. Architects have designed buildings now under construction with integral wind energy generators. Mayor Michael Bloomberg of New York City advocates exploring the feasibility of installing wind turbines and other renewable energy generators on the city's bridges, buildings, and waterfront. The city of Chicago is experimenting with roof-mounted windmills designed for urban areas, where the wind is typically too turbulent for rural-style windmills, on several buildings near downtown. These compact cylindrical structures resemble the cage and blades of an old-fashioned push lawn mower and can be mounted horizontally or vertically.

In the last few years, demand for wind power has grown measurably as more states have adopted renewable standards, tax credits have become available, and prices have come down. Concern about climate change and enacting a national RES would further boost demand. The wind industry has responded by adding capacity at a record pace, but challenges remain, including building transmission capacity and access. **UL**

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