

# White Paper

*A clean technology white paper from Brodeur Partners and Beaupre*

## Big winds and gentle breezes merge into a promising outlook for wind power technology

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*by Mike McGrail*

The iconic image of a prairie farm windmill has given way to the contemporary image of large-scale wind farms where hundreds of sleek turbines pump megawatts of clean power onto the grid. On its face, this shift in imagery could represent the changing nature of wind power in the U.S. and the rest of the world – from small to large. In reality, however, both images represent wind power's future.

Large and small wind ventures are tackling the same problem using the same resource, but approach the problem from very different directions. Large wind ventures are developing industrial-scale wind farms that can replace fossil-fuel-fired power plants at the regional and national levels. Small wind, by contrast, is opportunistic, employing less powerful turbines to create power intermittently from the less consistent winds in residential, urban and commercial areas.

Technology will play a significant role in the development of large and small wind power, but not so much in the actual power production because the basic process of turning a turbine to produce electricity doesn't require any breakthrough technology. The U.S. Department of Energy predicts that wind power can generate 20 percent of U.S. electricity by 2030 using existing wind turbine technology. Even so, the Belgian energy consultancy Sia Conseil, on its "Energy Outlook" blog (<http://energy.sia-conseil.com/?p=149>), predicts that wind power needs better supporting technologies to realize its full potential:

Technological progress will also take part in the management of wind power. Heavy incentives regarding, for instance, energy storage, help R&D in the sector. A real-time knowledge of energy flows on the grid and optimization of energy use are keys in grid improvement and are currently being developed. Also, auto-adjust devices will support automation of voltage, frequency and harmonic filtering in the future.

Technologies like these will help wind power emulate some of fossil fuels' reliability, making both big and small wind a credible component in the future energy equation, and an increasingly attractive option for investors as the industry attempts to expand.

### **Big wind, big challenges, big payoff**

Big wind is a reality today. The technology exists and the power production's economics – helped in the U.S. by a federal tax credit – make wind-generated electricity competitive with fossil fuel-generated electricity. The challenge is where to build wind farms. Many of the best spots are:

- Scenic vistas like mountain ridges and ocean tracts jealously guarded by environmentalists and local tourism interests. The Cape Wind project in Massachusetts ran into a maelstrom of private and public opposition when it announced plans to build a 130-turbine wind farm on Nantucket Sound – within sight of some of the most expensive real estate on the East Coast. Similar proposals in Maine and Vermont have met cool responses as well.
- Open prairies in flat, lightly populated states. Isolated areas of the Dakotas, Wyoming, Minnesota, Kansas and Texas have the most reliable wind currents, but they're also located far from the population centers that actually need the power.

Whether the wind farms are located on mountain ridges or lonely prairies, the electricity has to get from the wind farms to consumers, which involves more than just building more power lines. National electric grids have to get smarter to handle wind power's variability. Managers need visibility into the grid's operations based on the kind of real-time data collection that doesn't exist in today's grid management technology. The Swiss power and automation technology company ABB group wrote in a 2007 white paper:

As grids transmit more and more energy from renewable sources, they must adapt not only their transmission structures, but also their response to greater and faster changes in load flow caused by intermittent generation. Effective grid management will be achieved only by improving data collection and communication procedures, providing operators with up-to-date information on the status of grid components. New wide-area monitoring systems can provide such a service, using time-synchronized phasor measuring units (PMUs) at strategic positions in the network. The units capture real-time data on the status of the grid, allowing operators to identify and deal with faults before they develop into wide-spread disturbances.  
(<http://www.abb.com/cawp/db0003db002698/55622466a2d2c488c12572c700568a95.aspx>)

Data collection, communication procedures, network monitoring ... these terms are straight out of the classic high tech glossary. They give tech an entrée into wind power that's easy to miss at first glance, but a critical piece of its long-term success. As *The Economist* wrote in July 2008 ([http://www.economist.com/specialreports/displaystory.cfm?story\\_id=11565667](http://www.economist.com/specialreports/displaystory.cfm?story_id=11565667)), there is plenty

of room in big wind for technologists who can apply data networking concepts to power grid management. Today's electric grid cannot manage large volumes of wind-generated power, the magazine writes, but a future "smart grid" with embedded intelligence will be up to the challenge:

A smart grid will constantly monitor its load and (this is the smart bit) take particular consumers offline, with their prior agreement and in exchange for a lower price, if that load surges beyond a preset level. For this purpose, a consumer may not necessarily be the same as a customer. The grid's software would be able to identify particular circuits, or even particular appliances, in a home, office or factory. Their owners would decide in what circumstances they should shut down or boost up, and the smart grid's software would then do the job. Water heaters and air-conditioners might stock up on heat or cold in anticipation of such shutdowns. Fridges would know how long they could manage without power before they had to switch on again.

### **Growing power in small wind**

The small wind market will look a lot more familiar to high technology executives and investors than the big wind market. Big wind is dominated by large corporations and mature technologies. Small wind is more entrepreneurial, with flocks of early-stage companies developing new turbine and wind blade designs, storage and efficiency products. Skeptics doubt the viability of many of these ideas, but nevertheless the creative energy in the small wind market is staggering.

Engineers are basing new turbine blade designs on everything from the DNA double-helix to humpback whale flippers. A Michigan-based startup, backed by a state investment program, is prototyping a lightweight residential "wind turbine in a box" with a target price of less than \$2,000, compared to the \$12,000 to \$60,000 most residential turbines cost today. The London-based "Stormblade" research team is developing an enclosed turbine resembling a jet engine. The team claims it will be quieter than a conventional turbine, making it more acceptable in populated areas, and produce electricity from weaker, sporadic winds.

All of this entrepreneurial energy is moving toward the same goal: to make small wind's lower productivity more economically viable. Right now, small wind is as much a social movement as a serious answer to national energy consumption needs – a way to make a statement, but not to solve the larger problem. Homeowners and institutions like the Brooklyn Navy Yard in New York, Logan International Airport and Harvard University in the Boston area have erected small wind turbines on their buildings to show support for the concept, but critics say they'll have little real impact on power production. A recent British study of wind on home roofs, quoted in the *New York Times*, reported that turbines generate less power than installers projected because of lower-than-expected wind speeds.

[http://www.nytimes.com/2008/09/04/business/04wind.html?\\_r=3&pagewanted=2&oref=slogin&oref=slogin&oref=slogin](http://www.nytimes.com/2008/09/04/business/04wind.html?_r=3&pagewanted=2&oref=slogin&oref=slogin&oref=slogin)),

“Rooftop wind economics are abysmal, since the resource just isn’t there,” Ian Woofenden, a senior editor at *Home Power* magazine, told the *Times*.

Small wind advocates, predictably, have a different view. They point out that small wind sales grew 170 percent from 2000 to 2006 even though small wind lacks the tax credits supporting other renewable resources such as big wind and solar. The capacity of “on-grid” residential turbines tripled from 2006 to 2007, according to the American Wind Energy Association (AWEA). As turbine and energy storage technology improve, small wind will join big wind as a major component in national energy production strategies.

Whether it’s big or small, the future for wind power and supporting technologies appears bright. The Renewable Energy Policy Project estimates that boosting U.S. wind energy installations could attract as much as \$50 billion in new investment and create 150,000 jobs. Demand for wind turbines exceeds manufacturing capacity, according to the AWEA. The U.S. Congress affirmed the government’s support for wind power when it renewed the wind power tax credit in 2008. Wind power, and the other renewable energy sources developing alongside it, promises to re-write the energy market’s rules as environmental consciousness and the reality of scarcer fossil fuels grow.

“The energy future belongs to wind,” wrote *Electricity Forum News* (<http://www.electricityforum.com/news/aug03/windenergy.html> ). “The world energy economy became progressively more global during the 20th century as the world turned to oil. It promises to reverse direction and become more local during the 21st century as the world turns to wind, wind-generated hydrogen and solar cells.”

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