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## HARNESSING THE POWER OF THE WIND

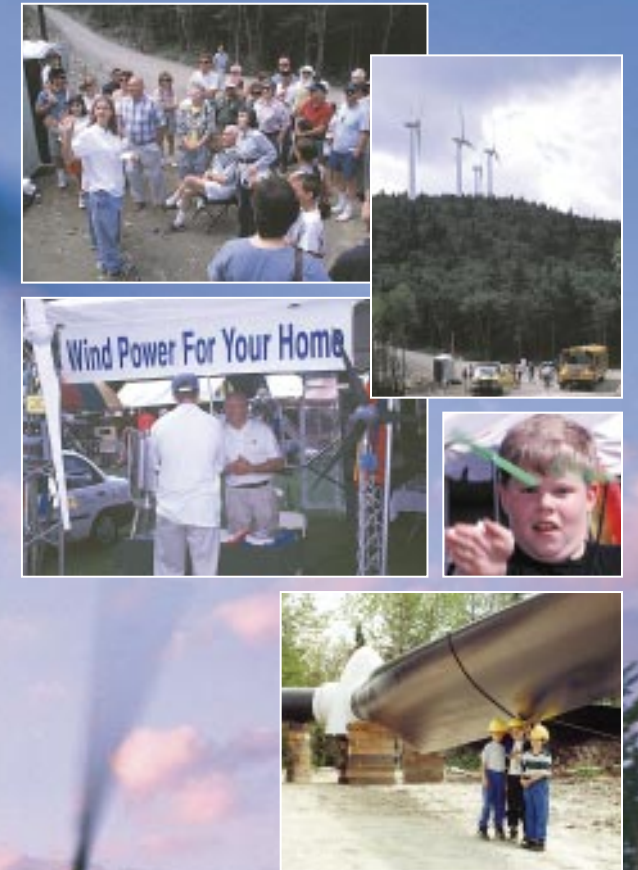
Green Mountain  
Power's Searsburg  
Wind Power Facility



GREEN  
MOUNTAIN  
POWER  
CORPORATION

As the largest in the east, this wind power facility offers a valuable opportunity to share information about the costs and benefits of generating electricity from the power in the wind, including environmental and societal impacts. Lessons learned in developing and operating the wind generating station are being shared with educators, industry representatives and other organizations from around the country.

Searsburg's 6 megawatt power plant provides emission-free, renewable energy to over 2,000 average Vermont households and serves as an education resource for wind generation in cold climates and environmentally sensitive regions.



**G**reen Mountain Power began “prospecting” for wind turbine sites in the late 1970s. Knowing that higher elevations have better wind, but are more environmentally sensitive, the challenge from the start was to find a windy site that would be environmentally acceptable and still be economically feasible. After screening hundreds of potential sites in Vermont and Massachusetts, GMP selected the Searsburg site because of its strong and persistent winds and its proximity to existing access roads and transmission lines. In addition, the area was away from population centers, yet was not in an area of unique environmental concern.

When completed in 1997, the Searsburg project became the largest wind power facility in the eastern part of the country. After initial research and development work by GMP, this project became feasible when it was selected by the U.S. Department of Energy (DOE) and the Electric Power Research Institute (EPRI) for participation in their Utility Wind Turbine Verification Program. GMP’s commitment to and experience with wind generation fit well with the program’s objectives of utility involvement in wind power and the evaluation and commercialization of advanced wind turbines.

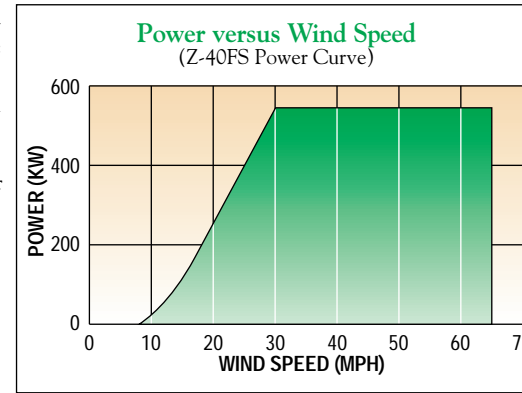
Generating energy from wind in Vermont’s harsh winter environment poses a unique set of challenges. Learning

how to meet these challenges is an important research goal at this facility. Lessons learned provide valuable information for land use and energy planners in determining to what extent wind energy will be used to meet the region’s electrical needs. The research focuses on the performance of wind turbines in cold, northern climates, the level of public acceptance of wind energy facilities, and the potential effects on birds and wildlife.

### Winter’s Influence

Vermont is well known for its beautiful and very cold winters. Unlike most states, Vermont uses more electricity in the winter than in any other season. But the winter season also brings the strongest and most persistent winds. This gives the plant the ability to generate more electricity at the time it is most needed. In part because of that and the research funding, the cost per kilowatt-hour of energy generated at Searsburg will be comparable to alternative sources over the 25-year life of the plant. The plant reduces the need to burn fossil fuels in other parts of New England, reducing air emissions by approximately 22 million pounds a year.

The turbines’ design incorporates several features that allow them to perform better in cold climates. For example, the rotor blades are black to absorb solar energy on sunny winter days, warming them enough to shed ice. The gearboxes use synthetic lubricants and heaters to assure reliable operation in cold temperatures.



### Operating Characteristics

A computer-based controller in the base of each tower controls each turbine, which is in turn connected to a central control computer in the building at the base of the mountain. The automated control circuitry permits largely unattended operation and the monitoring and control of critical functions

from a remote location. Turbines respond to changing wind and weather conditions automatically. For example, wind sensors atop each turbine continually monitor wind speed and direction for that particular turbine. When the wind direction changes, the turbines automatically respond by turning to face into the wind.

The turbines begin producing power in relatively light winds of 10 miles per hour (mph). Between 10 mph and the 29-mph “rated speed” for the turbines, the power output increases with the wind speed. Once the winds go above 29 mph the turbines continue to produce their maximum output of 550 kilowatts as the rotor blades are pitched to deflect the excess power in the faster wind speeds. In winds over 65 mph the turbines completely turn their blades parallel with the winds which stops the rotors and protects them from possible damage.

Over 10 years of wind measurements at this site indicate the average wind speeds along this ridge are between 15 and 17 mph. In these conditions, the turbines produce power over 80% of the time.



### Searsburg Wind Power Facility Statistics

The diagram shows a wind turbine with a 132 ft. (40m) rotor diameter and a 132 ft. (40m) hub height. The nacelle is mounted on a 24-sided tubular tower. The rotor blades are shown in a pitch position. The tower is supported by a 36 ft. square, 3 ft. thick foundation. The nacelle is mounted on a 2 ft. of rock covering foundation. The diagram also shows the approximate tree canopy height.

Component	Weight (lbs)
Rotor	18,700
Nacelle	36,600
Tower	64,400
Total	119,700

Installed capacity	6 megawatts
Turbine type	Zond Z-40FS
Number of turbines	11
Equivalent horsepower	8,113 horsepower
Name plate rating of each turbine	550 kilowatts
Interconnection voltage	69 kilovolts
Cleared land area required	35 acres
Estimated annual energy production	14,000,000 kWh
Equivalent households	2,000+ households
Equivalent oil saved	23,400 barrels/year
Estimated total plant cost	\$11 million
Funding from EPRI & DOE	\$4.0 million
Projected levelized cost/kWh	5.8 to 6.2¢/kWh

### Thanks to our neighbors

The interest and support of the people of Searsburg and the surrounding communities were essential for the success of this project. We thank them for welcoming us into their communities.



The nacelle provides a weather protected, enclosed and spacious environment for field personnel to perform service and maintenance work.

Photo courtesy of Zond Energy Systems