Reaping From the Wild Wind

By John Gartner

A 77-acre property may have fertile soil, a stocked creek and wooded glen, but an increasingly important question is, "How much wind does it get?"

The rise in demand for clean electricity has created a parallel need for accurate data describing a location's wind-energy potential. Supercomputers running complex algorithms are now providing unprecedented detail about wind patterns in small areas in a matter of weeks.

During the past five years, the amount of wind energy produced in the United States has increased at an average rate of 28 percent, according to Kathy Belyeu, a spokeswoman for the American Wind Energy Association. Belyeu said commercial wind turbines will produce 16.7 billion kilowatt-hours of electricity in 2004, or enough power for 1.6 million U.S. households.

New modeling software means wind-farm developers no longer have to wait a year to find out the wind-energy potential of their property, according to Lee Alnes, vice president of marketing for wind-analysis firm WindLogics.

Before computers became powerful enough to create the models (about five years ago), Alnes said wind-farm developers had to install wind-measurement devices called anemometers and record data through all four seasons to get an estimate of a site's wind-energy potential. Anemometers provide information about one spot, but "they cannot estimate how much wind is present at higher altitudes where wind turbines would reside," according to Alnes.

Wind-farm developers need accurate information because a slight difference in average wind speed greatly affects energy potential, according to data from the American Wind Energy Association. For example, an increase in wind speed from 12 to 18 miles per hour yields more than three times the wind energy.

WindLogics and competitor AWS Truewind have developed algorithms that analyze weather data from the National Weather Service and other sources to estimate the wind patterns in specific locations.

WindLogics CEO Mark Ahlstrom said the weather data from satellite and terrestrial sources provides wind information at 20-kilometer intervals. His company's model, which is based on 15 years of data, can estimate wind patterns in sections as small as 30 meters.

Ahlstrom said companies hoping to borrow money for wind turbines have hired WindLogics to provide data to help assess the viability of the venture. "We integrate the

information so that it can be used in an actionable business decision," Ahlstrom said, adding that wind analysis for one area would cost about $10,000.

"Organizations looking to find the wind-energy potential of a property don't want to wait a year to study the wind patterns," said Dennis Elliot, a principal scientist at the National Renewable Energy Laboratory.

Elliot is working on a Department of Energy project to create wind-energy estimations for all 50 states. The Wind Powering America project will estimate the wind-energy potential for areas as small as 400 meters, Elliot said. He said trying to be more precise is not possible given the budget and available computing resources.

Individual states share the cost of the research, and Elliot said that by the end of this year estimates for 30 states will be completed, with an average cost of $100,000 per state. Elliot said companies including AWS Truewind perform the modeling, and his agency validates that the models are accurate by comparing the results with actual wind data.

Bruce Bailey, president of AWS Truewind, said his company's model is accurate within 5 to 7 percent, and it will improve as more data becomes available. "If you give models plenty of information, then they will give you very accurate wind predictions. When they don't work well, it's because there's not enough information," Bailey said.

Bailey said the height and density of the surrounding vegetation and whether the area is wet or dry affect wind-speed data. "Having all those details enables you to do a better job of predicting." AWS Truewind has 94 processors working together as a virtual supercomputer to perform the calculations, Bailey said.

Commercial wind plants generally need a minimum average wind speed of 16 mph for a wind turbine to be cost-effective, Bailey said, while small turbines can be economical with 14-mph average winds.

Wind energy companies are also becoming interested in wind forecasting, which predicts the strength of the wind during the coming hours, Bailey said. Because wind is an intermittent energy supply, the operators need to know when they will have supply available to sell. "For wind to participate fully (in the energy market), producers have to schedule their output," Bailey said.

The U.S. military is also interested in knowing which way and how fast the wind blows. The Army has hired WindLogics to develop a system for forecasting the wind to be used as part of its Future Combat Systems, according to WindLogics' Ahlstrom.

The goal is to allow soldiers in the field to use WindLogics' software to project the wind at a given location, Ahlstrom said. This would enable them to determine the direction of wind prior to a mission during which they might encounter chemical weapons. "We want to get it down to a battalion level so that they can forecast on an hourly basis," Ahlstrom said.