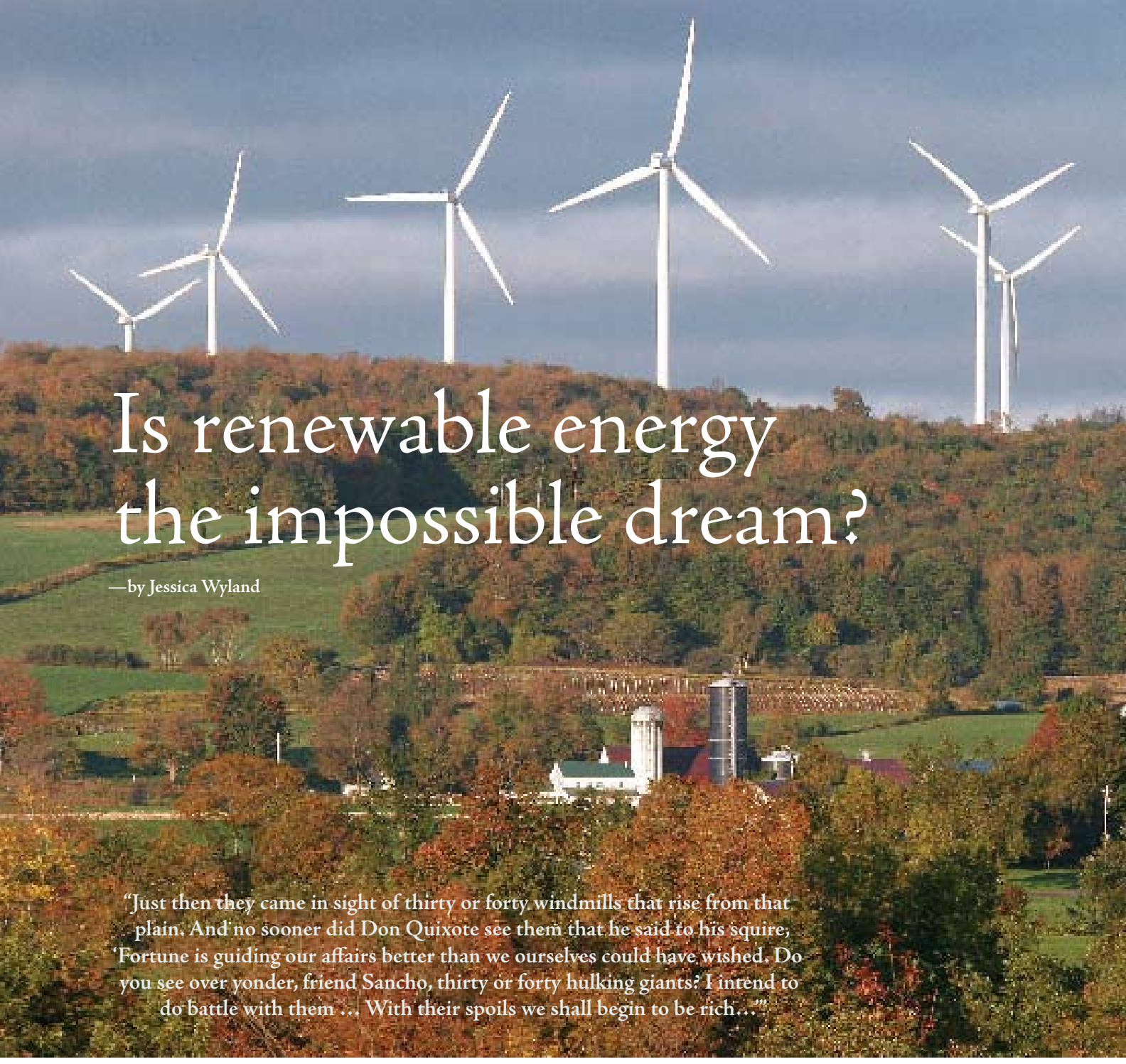


Is renewable energy the impossible dream?

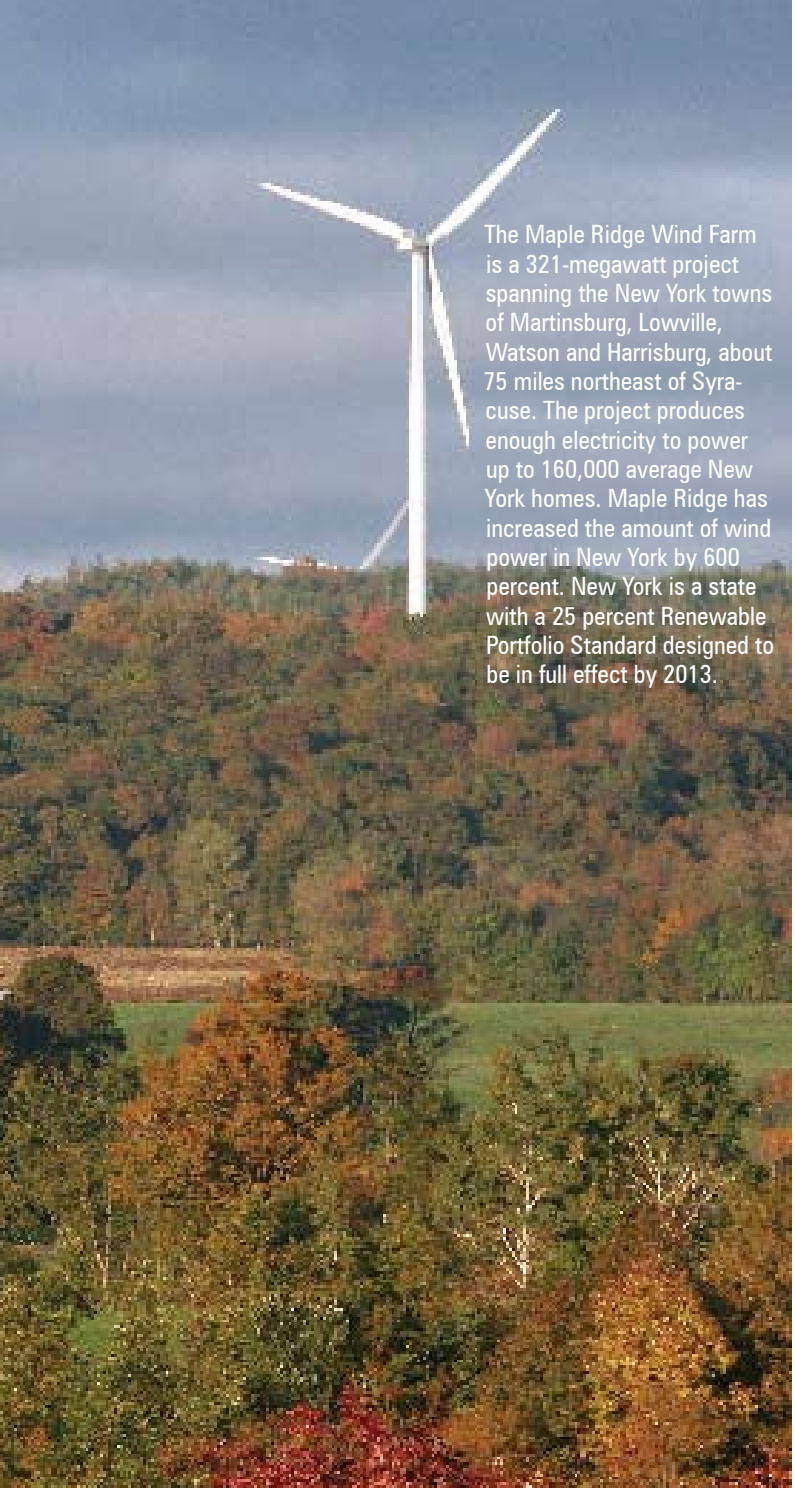
—by Jessica Wyland

"Just then they came in sight of thirty or forty windmills that rise from that plain. And no sooner did Don Quixote see them that he said to his squire, 'Fortune is guiding our affairs better than we ourselves could have wished. Do you see over yonder, friend Sancho, thirty or forty hulking giants? I intend to do battle with them … With their spoils we shall begin to be rich…'"

When Miguel de Cervantes wrote of the impetuous and noble hero Don Quixote 400 years ago, he could not have imagined that one day, environmental scientists and energy analysts would dream the impossible dream of stocking the electric grid with the power of the wind. Nor could he have envisioned the hulking giants that now line many a horizon, the 400-foot-tall wind turbines each wielding three 130-foot steel blades and weighing 8.5 tons. When he talked of tilting at windmills, the Spanish literary master did not know that public utilities, private companies, and investors would someday look to the wind to beat the unbeatable foes of waning fossil fuel supply and deleterious carbon emissions.

Wind energy now accounts for one percent of the Nation's power supply, and forecasts from the U.S. Department of Energy say that figure could reach 20 percent by 2030. As wind farms crop up across the country's windiest terrain, critics point to the need for new transmission lines and the variability of the wind. Many citizens support the idea—as long as it's "not in my backyard."

Wind power is touted as one of the cleanest, most reliable renewable resources considered so far. Given the criticism often leveled against wind energy, the question then is, "Is harness-



The Maple Ridge Wind Farm is a 321-megawatt project spanning the New York towns of Martinsburg, Lowville, Watson and Harrisburg, about 75 miles northeast of Syracuse. The project produces enough electricity to power up to 160,000 average New York homes. Maple Ridge has increased the amount of wind power in New York by 600 percent. New York is a state with a 25 percent Renewable Portfolio Standard designed to be in full effect by 2013.

ing wind power on a wide scale as quixotic as 'dreaming the impossible dream'?"

In 2008, the United States surpassed Germany as the world's biggest generator (by volume) of wind energy. The amount of wind power our country generates has doubled in the last two years, according to the American Wind Energy Association (AWEA), a trade group for wind-power developers and equipment manufacturers.

Twenty-eight U.S. states have set renewable energy mandates and are determined to woo wind developers. A Nebraska utility brochure boasts, "Nebraska has wind. In fact, the state ranks sixth in America for wind development." An energy company in Minnesota has announced plans to buy an interstate transmission line and develop wind energy to replace coal-generated electricity. One county in Montana is distributing a wind map book compilation of all necessary data to entice investors.

Harnessing the wind

Wind turbines convert the kinetic energy in moving air into rotational energy, which in turn is converted to electricity. Humans have used wind power for centuries to move boats, grind grain, and pump water. Timeless and simple as it may seem, the development of a wind power facility is much more complex than staking a pinwheel in the breeze. "Our development teams include meteorologists, engineers, environmental permitting staff, and land agents," said Tyler Hoffbuhr, a geographic information system (GIS) analyst with Iberdrola Renewables, the largest developer of wind power in the world.

Iberdrola Renewables has a flurry of wind power projects in the works as utilities aim to reduce dependence on nonrenewable energy. Modeling the feasibility of these projects requires studying location, wind speed, environmental concerns, and other variables. Wind power researchers are using GIS technology developed by the Environmental Systems Research Institute (ESRI) to organize and analyze data based on geographic location.

GIS is a familiar platform for engineers in the electric and gas industry, as well as conservation groups who use the technology to make decisions. GIS makes it possible to organize work as a series of layers or themes. One layer of a GIS built by a wind power developer may have wind density information, while another layer will have land suitability, and yet another will show bird migration patterns. The layers of information, visible as colorful "smart maps," pinpoint the best and most efficient location for a wind farm. "Locating the right site can be done quickly and accurately with publicly available data and GIS technology, said Bill Meehan, director of utility solutions at ESRI.. "This fact alone speaks well for the future of wind power and green energy."

Smart layers for smart maps

A wind farm project comes to life with a look at potential plots of land. Most developers require land within a prescribed distance of a transmission line to tie in power to the grid. If the wind is strong and steady, developers may decide to build their own transmission line. The benefits of accessing existing electric lines can be determined from utility data loaded into a GIS.

Another important consideration is land ownership. State and county land-use data in the GIS identify areas that are under development restrictions from the Bureau of Land Management and land requiring right-of-way grants. If land is privately owned, developers will have to obtain consent from individual landowners.

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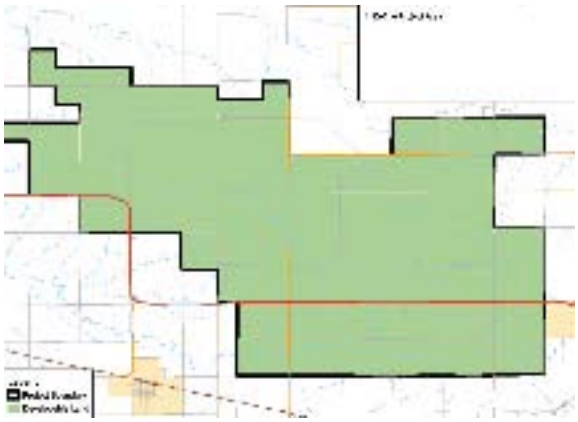

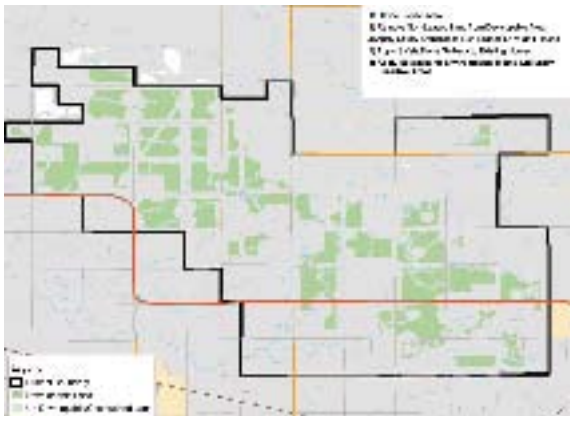

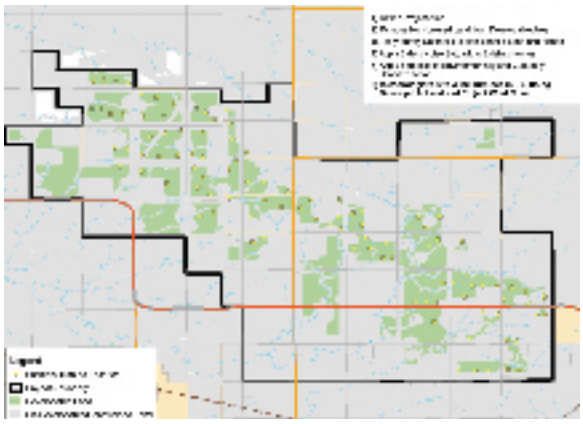

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A layer of constraints is added to the GIS, marking areas that are environmentally protected for migratory flight paths or other animal activity. Other site restrictions are military bases and airports where developers must consider radar interference and FAA regulations.

Not surprisingly, wind data are crucial when adding a resource layer to a GIS detailing wind speed and reliability. Meteorological data are continuously collected during a one-to-five- year period using tower-based anemometers and vanes mounted at several height levels up to 60 meters above ground. Based on these data, wind power can be classified into density classes ranging from one (poor) to seven (excellent). For example, a wind power class of four has an average wind speed of 15.7 to 16.8 mph at a height of 50 meters above ground.

Site scouting field trip

In addition to facilitating site research, information stored in the GIS is increasingly being used to design the layout of a wind farm. Before GIS, scientists worked from paper maps which may not have shown such things as property ownership, wetlands, county- or state-required safety setbacks, rights of way, or cultural resource sites. "Now we can stock the GIS with U.S. Geological Survey maps, property lines, aerial photography, and detailed topography data to see how the buildable area matches up with the wind data," said Hoffbuhr. Yet, the project design would not be complete without a visit or two to the field.

When development teams visit a proposed location, they collect site-based data for comparison with digital information and maps in the GIS. Using a mobile device equipped with a global positioning system (GPS) and GIS, the team can easily update data from the site and make any necessary adjustments to the facility layout.

It takes about four years to develop a wind power facility. The development stage includes site research and data collection as well as procurement of government and landowner permits, and funding. When the plans are ready, developers hand over the project to the construction team.

Operators continue to use GIS to help gather inspection and operational data. They can model and predict how well the wind will perform in the next few hours or days and accurately match energy production with demand.

But, will it work?

Government incentives are driving much of the wind power development in the country. A report led by the Department of Energy's National Renewable Technology Laboratory in Golden, Colo., reiterated predictions that wind energy will claim a 20 percent share of electricity production in the next 10 years. The report called the forecast, "ambitious," but "feasible." At the time of writing this article there were more than 20,000 wind farms operating in the U.S. and 9,000 more were under construction.