Wind Drives Growing Use of Batteries
New York Times
[In-print and Online]
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July 27, 2010

The rapid growth of wind farms, whose output is hard to schedule reliably or even predict, has the nation's electricity providers scrambling to develop energy storage to ensure stability and improve profits.

As the wind installations multiply, companies have found themselves dumping energy late at night, adjusting the blades so they do not catch the wind, because there is no demand for the power. And grid operators, accustomed to meeting demand by adjusting supplies, are now struggling to maintain stability as supplies fluctuate.

On the cutting edge of a potential solution is Hawaii, where state officials want 70 percent of energy needs to be met by renewable sources like the wind, sun or biomass by 2030. A major problem is that it is impossible for generators on the islands to export surpluses to neighboring companies or to import power when the wind towers are becalmed.

On Maui, for example, wind generating capacity over all will soon be equal to one-fourth of the island's peak demand. But peak wind and peak demand times do not coincide, raising questions about how Hawaii can reach its 70 percent goal. For now, the best option seems to be storage batteries.

In New York and California, companies are exploring electrical storage that is big enough to allow for "arbitrage," or buying power at a low price, such as in the middle of the night, and selling it hours later at a higher price. In the Midwest, a utility is demonstrating storage technology that can go from charge to discharge and back several times a minute, or even within a second, bracing the grid against the vicissitudes of wind and sun and transmission failure. And in Texas, companies are looking at ways of stabilizing voltage through battery storage in places served by just one transmission line.

Renewable goals can be met, many in the industry insist. But if the energy source is intermittent, "you can't do that without batteries of some sort," said Peter Rosegg, a spokesman for the Hawaiian Electric Company.

His company has agreed to buy electricity from a wind farm on the northern shore of Oahu, where the Boston-based power company First Wind has just broken ground.

The spot is one of Hawaii's best wind sites, Mr. Rosegg said, but the supply is gusty and erratic. What is more, it is at the farthest point on the island from the company's main load center, Honolulu, and does not even lie on its high-voltage transmission backbone.

So the 30-megawatt wind farm, which will have enough power to run about 30 Super Wal-Marts, will have Xtreme Power of Austin, Tex., install a 15-megawatt battery.

Computers will work to keep the battery exactly half-charged most hours of the day, said Carlos J. Coe, Xtreme Power's chief executive. If the wind suddenly gets stronger or falls off, the batteries will smooth out the flow so that the grid sees only a more gradual increase or decrease, no more than one megawatt per minute at some hours of the day.

The Hawaii installation is designed to succeed at a crucial but obscure function: frequency regulation. The alternating-current power system has to run at a strict 60 cycles per second, and the battery system can give and take power on a micro scale, changing directions from charge to discharge or vice versa within that 60th of a second, to keep the pace steady.

The battery system can also be used for arbitrage, storing energy at times when prices are low and delivering it when prices are high. It can hold 10 megawatt-hours, which is as much energy as a 30-megawatt wind farm will produce in 20 minutes if it is running at full capacity. That is not much time, but it is huge in terms of storage capacity.

Neither First Wind nor Xtreme Power would say what the project cost, but publicly disclosed figures put the project in the range of $130 million, with about $10 million for the battery. The Energy Department has provided a $117 million loan guarantee.

Across the country, it is proving hard to predict the cost and the value of power storage to consumers. The electricity stored in off-peak hours could be quite low in cost, and prices at peak hours could be quite high. If the reliance on renewable energy reduces the need to burn coal and natural gas, that would yield an additional advantage.

Mr. Coe estimated the battery system's round-trip efficiency — that is, the amount of electricity the batteries could deliver per megawatt-hour stored in them — at over 90 percent. If that figure is borne out, it would be a significant advance from the largest form of energy storage now in general use, pumped hydropower, whose efficiency is put at 70 to 85 percent.

At a pumped hydro plant, off-peak electricity is used to pump water from a reservoir at a low elevation to one at a higher one. At hours of peak demand the water flows back down through a turbine, creating electricity.

Electric companies are using other strategies for storage and frequency regulation. In Stephentown, N.Y., near Albany, a Massachusetts company, Beacon Power, is building a

bank of 200 one-ton flywheels that will store energy from the grid on a moment-to-moment basis to keep the alternating current system at a strict 60 cycles.

Atop each flywheel is a device that can be a motor at one moment and a generator the next, either taking energy and storing it in the flywheel or vice versa. The Energy Department provided a $43 million loan guarantee to assist in the $69 million project.

The Energy Department is also supporting storage projects that rely on compressed air. Surplus electricity is used to pump air into an underground cavity; when the electricity is needed, the air is injected into a gas turbine generator. In effect, it acts as a turbocharger that runs on wind energy captured the previous night, instead of natural gas burned at a peak hour.

The department is contributing to two projects explored by PSEG Global, an affiliate of Public Service Electric and Gas, based in New Jersey. It plans to provide $30 million of the $125 million estimated price of a 150-megawatt project envisaged in upstate New York, perhaps at an abandoned salt mine, and $25 million toward a $350 million, 300-megawatt project to be built in Northern California.

Both will be used to store power made in off-peak periods and deliver it in peak times, when prices are higher, said Paul H. Rosengren, a spokesman for P.S.E.G.

In Presidio, Tex., American Electric Power and MidAmerican Energy Holdings have just completed a four-megawatt battery system that is not tied to any particular wind farm but is intended to improve reliability in the town, served by only one major transmission line. American Electric Power already has smaller batteries working in Ohio and Indiana to provide more stability in its distribution systems there.

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