Seeking a Smarter Grid: Integrating Wind Energy by Linking Buildings to the Grid

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Presidential Management Fellow Pamela Sporborg is working on a project to integrate wind energy to the grid using demand response. Behind her, a computer sends electricity price signals to appliances in the house

In utility parlance, wind energy is known as a “variable load.” That’s because wind is naturally unpredictable and inconstant. What’s worse, it is more likely to blow at night, when demand for electricity is at its lowest. Because the electric grid requires that supply and demand must always be in balance, making efficient use of wind energy turns out to be no trivial matter.

Lawrence Berkeley National Laboratory has launched a new project to find more effective ways to economically integrate variable loads from renewable sources to the electrical grid. The project, led by Presidential Management Fellow Pamela Sporborg, will examine how demand

response, an area in which Berkeley Lab has been a pioneer, might help smooth out the variable loads.

The research is supported by the Pacific Gas and Electric Company (PG&E), which received $1.7 million from the California Public Utility Commission for a pilot project. Given the mandate in California to have 20 percent renewable energy in the electricity mix by 2010 and 33 percent by 2020, more efficient use of wind energy will be essential.

Sporborg is spending six months at Berkeley Lab as part of a two-year program that places recent graduate students in federal agencies. Sporborg was assigned to the Bonneville Power Administration in Portland, Oregon, in April 2008, where she has served as the load management lead; as part of her fellowship, she decided to come to Berkeley Lab for a six-month rotation to further her knowledge of demand response.

“There’s a lot of potential to solve some of the most pressing challenges facing not just our power system, but our entire economy right now, so I wanted to come here because the Lab is doing the most cutting-edge work in demand response,” said Sporborg, who earned a master’s degree in public administration from Portland State University.

To integrate a variable load to the grid, the Berkeley Lab project will explore making electricity demand more flexible by use of thermal energy storage, which entails heating up or cooling down buildings at night and storing that energy for use later in the day. For example, a refrigerated warehouse storing frozen food could be made cooler during non-peak times, thus storing energy and allowing the building to reduce refrigeration during the daytime without any danger to the food. In another example, buildings can more cheaply pre-cool at night and thus use less energy to cool during the day, when electricity is more expensive.

Such machinations are necessary because the electrical grid does not store power. “The grid must be balance on a second-by-second basis,” explained Sporborg. “When the wind blows, you have to take in that power right then.”

This challenging proposition has given headaches to even the most seasoned of pros. “At Bonneville, we’ve had grid operators who’ve taken early retirement because the wind has caused them so much stress—people who’ve been doing this for 30, 40 years and have been through every problem the Columbia River can throw at you,” said Sporborg. “The wind really creates some operational challenges.”

Sporborg is working with Sila Kiliccote of Berkeley Lab’s Demand Response Research Center, which developed a specification called Open Automated Demand Response (OpenADR) that is successfully being used by all the investor-owned utilities in California who deliver over 60 MW of demand response. Demand response allows industrial and commercial customers to reduce their energy use at peak times or when prices are high, a process that can take hours or even days and requires manual intervention. OpenADR automates the process and allows buildings to respond in less than 10 minutes.

The next step is to find ways to use OpenADR with wind energy. “As the supply side becomes more intermittent with the integration of renewables, the demand side has to be more flexible,” said Kiliccote. “There’s a need for an automated infrastructure to do this. We want to expand the OpenADR technology and infrastructure and tie it to intermittent loads, more effectively linking the grid with the building.”

After six to nine months of scoping work, the researchers will conduct a field test. As PG&E and other utilities significantly ramp up use of renewable energy, keeping the grid in balance and shifting loads to off-peak hours will become ever more important.

“There’s a lot of talk about the ‘smart grid,’” said Kiliccote. “A big component that’s missing is that customers don’t have an electronic way of receiving prices and reliability information from the grid. OpenADR is a way of delivering that, and thus making the demand-response abilities of buildings a consistent ally for wind energy.”

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