Researchers find ways to minimize power grid disruptions from wind power

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Researchers from North Carolina State University and Johns Hopkins University have found that an increase in the use of wind power generation can make the power grid more fragile and susceptible to disruptions. But the researchers didn't just identify the problem – they have also devised a technique for coordinating wind power generation and energy storage in order to minimize the potential for such power disruptions.

Typically, the power flowing through the transmission lines of a power grid suffers from small "oscillations," or deviations from the norm, after a disturbance. Generally, these oscillations are mitigated by means of controllers inside the power generators. However, if the controls are not strong enough, the oscillations may be "sustained," reducing the efficiency of power transfer and posing a threat to the stability of the grid. If not controlled properly, these oscillations can even lead to widespread power outages – such as the 1996 blackout that hit the West Coast of the U.S.

The researchers found that, under certain circumstances, wind power generators can make these oscillations worse. This is because wind farms produce power erratically. After all, the amount of power being produced by wind farms depends on how hard the wind is blowing. Furthermore, the nature of these oscillations strongly depends on where the wind farms are located in the grid.

"To counteract this problem, we have designed a technique that

coordinates the activity of controllers inside the wind turbines and battery management systems to even out the flow of power from wind farms into the grid," says Dr. Aranya Chakrabortty, an assistant professor of electrical engineering at NC State and senior author of a paper describing the work.

Specifically, the research team developed several algorithms that match control efforts between wind farms and energy storage facilities. If the power output for the wind farm increases, the surplus can be siphoned off to charge batteries at the storage facility, instead of being dumped directly onto the power grid. Similarly, if the power output at a wind farm declines, the batteries can compensate for the loss and provide power to the grid.

"By matching the behavior of the two controllers, we can produce the desired damping effect on the power flow and restore stable grid behavior," Chakrabortty says.

This issue is particularly important because wind energy is one of the fastest growing sources of renewable energy. In the U.S., the rapid increase in wind farm installations is being accelerated by government mandates and the goal of providing 20 percent of the nation's power needs through wind power by 2020.

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