Proposed wind power grid to make wind power more reliable

April 5 2010

Researchers analyzed hypothetical power output from five-megawatt offshore turbines similar to the one shown here off the coast of Belgium. Credit: Hans Hillewaert

The energy needs of the entire human population could potentially be met by converting wind energy to electricity by means of wind turbines. While offshore wind power resources are abundant, wind turbines are currently unable to provide steady power due to natural fluctuations in wind direction and strength. However, offshore wind power output can

be made more consistent by choosing project development locations that take advantage of regional weather patterns and by connecting wind power generators with a shared power line, according to a paper by researchers from the University of Delaware and Stony Brook University that is published in the April 5 issue of the *Proceedings of the National Academy of Sciences*.

"Making wind-generated electricity more steady will enable wind power to become a much larger fraction of our electric sources," said the paper's lead author Willett Kempton, UD professor of marine policy in UD's College of Earth, Ocean, and Environment and director of its Center for Carbon-free Power Integration.

The research team — which also included UD alumnus Felipe Pimenta, UD research faculty member Dana Veron, and Brian Colle, associate professor in the School of Marine and Atmospheric Sciences at Stony Brook University — demonstrated that thoughtful design of offshore wind power projects can minimize the impacts of local weather on power fluctuations.

The researchers analyzed five years of wind observations from 11 monitoring stations along the U.S. East Coast from Florida to Maine. Based on wind speeds at each location, they estimated electrical power output from a hypothetical five-megawatt offshore turbine. After analyzing the patterns of wind energy among the stations along the coast, the team explored the seasonal effects on power output.

"Our analysis shows that when transmission systems will carry power from renewable sources, such as wind, they should be designed to consider large-scale meteorology, including the prevailing movement of high- and low-pressure systems," said Dr. Kempton.

Dr. Colle explained the ideal configuration. "A north-south transmission

geometry fits nicely with the storm track that shifts northward or southward along the U.S. East Coast on a weekly or seasonal time scale," he said. "Because then at any one time a high or low pressure system is likely to be producing wind (and thus power) somewhere along the coast."

The researchers found that each hypothetical power generation site exhibited the expected ups and downs, but when they simulated a power line connecting them, the overall power output was smoothed so that maximum or minimum output was rare. In the particular five-year period studied, the power output of the simulated grid never stopped completely.

No wind turbines are presently located in U.S. waters, although projects have been proposed off the coasts of several Atlantic states. This research could prove useful as project sites are selected and developed.

Reducing the severity of wind power fluctuations would allow sufficient time for power suppliers to ramp up or down power production from other energy sources as needed. Solutions that reduce power fluctuations also are important if wind is to displace significant amounts of carbon-emitting energy sources, the researchers said.

Provided by Stony Brook University