LLNL signs agreement with Siemens to improve wind energy efficiency

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Lawrence Livermore National Laboratory has signed an agreement with Siemens Energy Inc. to provide high-resolution atmospheric modeling capabilities to improve the efficiency of wind farm sites, turbine design and wind farm operations.

LLNL will provide numerical weather prediction models with resolution as fine as one-kilometer scale to predict power generated by the wind so that wind farms can operate more efficiently while providing more power to hungry grids. Predictive time frames range from an hour ahead to days ahead of time.

Under a $2 million, two-year Cooperative Research and Development Agreement (CRADA), the Livermore team will provide modeling that combines Livermore's atmospheric turbulence modeling capabilities with complex databases of topography and sea surface temperature.

Many U.S. wind parks are yielding up to 20 percent less energy than predicted because of uncertain forecasts. This loss of energy can have complicated financial consequences, such as significant penalties if operators under-produce their forecasts or no payment for extra power they generate that is more than what was estimated.

More accurate wind predictions will have a positive effect on wind farm operators and owners who can know hours or days ahead of time how wind conditions will affect power generation.

"Knowing the certainty of the forecast can be useful in a day-ahead or futures market where now there are penalties for under-performance," said Julie Lundquist, a Livermore atmospheric scientist who is heading the project. "At LLNL, we have developed improved methods for simulating the turbulent properties of the lower atmosphere, which we think will translate into a significant predictive advantage for wind energy applications."

The wind forecasting project started under a Laboratory Directed Research Development program, a principal source of internal R&D funding at Lawrence Livermore National Laboratory.

More accurate predictions also could reduce the investment risks in wind-powered projects, could improve the design of tall wind turbines to withstand the high turbulence environment higher in the atmosphere, and enable optimal bids on wind farm production.

"Accurate and timely forecasts of power availability will enable turbine owners and operators to generate optimal bids on wind turbine production and in turn maximize both financial benefit and grid support," said Henrik Stiesdal, Siemens chief technology officer for wind power generation. "We look forward to this cooperative agreement that will help us provide a clean energy source for future generations."

The Department of Energy (DOE) and Siemens recently signed a memorandum of understanding to work together on wind technology.

"Through this agreement wind manufacturers, DOE and our laboratories will enhance wind technology capability to be a competitive energy supply for America," said Steve Lindenberg, senior adviser for DOE's Renewable Energy Office. "Siemens growing presence in this country and the partnership with a national laboratory like Lawrence Livermore helps provide a new opportunity to deploy a clean source of energy."

Wind offers power with minimal carbon dioxide emission - energy production without exacerbating global climate change. Wind generation is not limited by water availability and serves a viable role in energy portfolios worldwide as economies expand beyond petroleum.

In addition to providing hourly and daily predictions, Livermore will explore impacts of global climate change on wind resources 20 years into the future.

"Estimates of climate change impact can reduce long-term investment risks," Lundquist said.

Lundquist said Siemens would translate LLNL forecasts of wind speed and wind direction at each turbine into power collected.

While the value of forecasting is hard to quantify, several studies have suggested that more accurate forecasting can render not only more clean energy but also enhanced profits for industry.

A study performed by a member of the industry of the effect of 3,300 megawatts (MW) of wind generation in New York state quantified improved forecasting to be worth $125 million a year to that region. Based on a conservative application of this figure, Stiesdal estimates that wind farm owners may be able to increase revenue by as much as 10 percent, making wind power more profitable and ultimately reducing the cost of energy.

Since 2004, Siemens has installed nearly 1,800 megawatts of power in the United States. The company ranks third among the largest U.S. turbine manufacturers, according to the most recent American Wind Energy Association's annual rankings report.

Source: Lawrence Livermore National Laboratory

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