Powering the U.S. East Coast with offshore wind energy: A possibility?

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The report should act as a guide for placing wind farms in the most rewarding locations, said Mark Z. Jacobson, a professor of civil and environmental engineering at Stanford who directed the research.

(Phys.org)—A new analysis by Stanford researchers reveals that there is enough offshore wind along the U.S. East Coast to meet the electricity demands of at least one-third of the country.

The scientists paid special attention to the Maine-to-Virginia corridor;

the historical lack of strong hurricanes in the region makes it a favorable site for offshore wind turbines. They found that turbines placed there could satisfy the peak-time power needs of these states for three seasons of the year (summer is the exception).

"We knew there was a lot of wind out there, but this is the first actual quantification of the total resource and the time of day that the resource peaks," said Mark Z. Jacobson, a professor of civil and environmental engineering at Stanford who directed the research. "This provides practical information to wind farm developers about the best areas to place turbines."

Some breezes are better than others; wind energy that peaks during times of high electricity demand is more valuable and can offset dirtier generation that runs only a few hours a day.

The researchers used a weather model to generate five years of hourly wind speeds at 90 meters above sea surface – the standard height of offshore wind turbines (the projection was validated against real data from offshore buoys and towers).

The team inserted about 140,000 wind turbines into their computer model, each capable of generating 5 megawatts of electricity – similar to windmills used in offshore wind farms in Europe – at various ocean depths and distances from shore, from Florida to Maine.

After factoring in standard transmission losses and turbine array inefficiencies, the U.S. East Coast offshore winds were found to produce from 965 to 1,372 terawatt hours of electricity annually, enough to satisfy the demands of one-third of the United States, or all of the East Coast, from Florida to Maine. What's really important, the scientists say, is the time of day that electricity can be delivered.

"People mistakenly think that wind energy is not useful because output from most land-based turbines peaks in the late evening/early morning, when electricity demand is low," said Mike Dvorak, a recent graduate of Stanford's Atmosphere/Energy PhD program who was part of the research team. "The real value of offshore wind energy is that it often peaks when we need the most electricity – during the middle of the day."

Tapping this vast resource shouldn't come at the expense of ocean views, nor should it seriously impact wildlife or recreational and commercial water use, according to the researchers. Many of the turbines would be sited so far offshore that they could not be seen. In fact, the analysis assumed the use of only one-third of available shallow water locations out to 30 meters depth of water, and two-thirds of remaining sites out to 200 meters depth.

Jacobson doesn't expect the country to convert completely to wind energy; in practice, he said, we wouldn't want more than 40 to 50 percent of electricity production to be tied up in any one energy source, to ensure power demands could be met in extreme cases.

The report, he said, should act as a guide for placing wind farms in the most rewarding locations. For example, there is a substantial amount of peak-time wind energy near the East Coast's largest population centers.

"This study enables the planning and development of very large wind farms offshore of New York City or Boston. Connecting the power to the grid would be technically as easy as laying a cable in the sand and hooking it directly into the grid without the need to build often controversial transmission lines on the land," Dvorak said.

Both scientists acknowledge that it could take years before developers begin to tap this resource to the extent that it is needed – the country's first offshore wind farm, the Cape Wind Project, was proposed in 2001

and is still not operational – but they believe that if pilot projects are successful, bigger wind farms will follow.

Although wind energy currently costs more than natural gas – and installation offshore currently costs two to three times as much as land-based turbines – both the short- and long-range economics of offshore wind power make it attractive. In the near term, the construction would create jobs in states that don't currently have a large energy industry, and it would further wean consumers off fossil fuels.

Long term, a greater shift to wind energy would offset pollution, and thereby reduce the associated health and environmental costs.

"But the real advantage of wind versus natural gas or coal is that, even though there's a higher cost now for offshore wind, it results in price stability," Jacobson said. "There's zero fuel costs once they're in the water. Coal and gas are depletable resources, so their cost will inevitably go up over time. The cost of wind energy will remain stable, and the wind resource is infinite."

The paper, "U.S. East Coast Offshore Wind Energy Resources and Their Relationship to Peak-Time Electricity Demand" is available here.

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