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Seeking Wind Energy, Some Consider the Sea

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LAST June in a fjord in southwestern Norway, a 213-foot-tall wind turbine did something large wind turbines normally don't do: it headed out to sea.

Multimedia

Graphic

A Floating Wind Turbine

Towed by tugboats, the newly built turbine, with three 139-foot rotor blades and a 2.3-megawatt generator atop the tower, which itself was bolted to a ballasted steel cylinder extending more than 300 feet below the waterline, made its way to a spot six miles off the coast. Once in position it was moored with cables to the seafloor, about 700 feet below.

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The project, called Hywind and owned by Statoil, the giant oil and gas company based in Stavanger, Norway, is the world's first full-scale floating wind turbine. After being hooked up to a transmission cable, it began supplying electricity to the Norwegian power grid on Sept. 21.

"We've been baby-sitting the turbine so far," said Sjur Bratland, asset manager for the project. "The main point for us is not to produce as much power as possible."

Rather, Mr. Bratland said, over the next two years Hywind will test the feasibility of what some people think may be the next big idea in alternative energy: generating power from the winds over the open ocean, far from land.

"Our real opportunity for ocean energy is deepwater wind," said Habib J. Dagher, director of the Advanced Structures and Composites Center at the University of Maine, who with an $8 million grant from the federal Department of Energy is organizing a consortium of universities, companies, government agencies and nonprofit groups to develop floating wind turbines in the United States.

Dr. Dagher hopes to have prototypes for testing off the coast of Maine in 2011, including one from an American company, Principle Power, which is based in Seattle. And Blue H USA, a subsidiary of a Dutch company that deployed a two-thirds scale prototype off Italy in 2007, has applied to the Army Corps of Engineers for a permit to place a test platform,

without a turbine, 23 miles south of Martha's Vineyard to gather engineering and environmental data. "This would start the learning curve in the United States," said Ray Dackerman, general manager for Blue H USA.

Deepwater turbines are meant to solve some of the problems of existing land-based turbines and those that are built on foundations in shallow water, like large turbine farms in the North Sea and the Cape Wind project proposed for Nantucket Sound in Massachusetts.

Floating turbines can be located over the horizon, out of sight of land, eliminating aesthetic and noise concerns that have delayed projects, including Cape Wind. Deepwater farms can be established far from shipping lanes, aircraft flight paths, commercial or sport fishing grounds, and known migratory paths of birds and marine animals, potentially easing the process of obtaining the necessary approvals and permits.

And farther offshore, winds are stronger and more consistent, with no surface obstructions to slow the air down. This better-quality wind is also closer to population centers on both coasts. Why pay to transmit power from large wind farms on the Great Plains to the coasts, deepwater proponents argue, when better sources of wind are sitting just a dozen miles or so offshore?

But the concept of floating wind turbines has its own problems, not the least of which is cost. Maine officials, for example, say that a 5-gigawatt deepwater wind farm would require about $20 billion in investment.

More than $70 million has been spent on the Statoil project since a couple of employees came up with the idea while out sailing eight years ago. As Mr. Bratland tells the story, they noticed floating navigational buoys of the kind that mark harbor entrances, "and they said, why not put a turbine on top of such a construction?"

Because it relies on a long ballasted cylinder to keep it stable, the Hywind design has to be assembled in deep water, using floating cranes and large barges. Other designs, like that of Principle Power, which uses a semi-submerged platform with adjustable buoyancy, can be built on or near shore, but even so, with turbines at 10 miles or more from land, the costs of installation, maintenance and repair would be high. And transmitting power through undersea cables would be expensive as well, particularly if newer, more efficient methods like high-voltage direct current technology are used.

Aside from costs, there are many technical unknowns about the performance of wind turbines at sea. "By going 20 miles offshore we're eliminating visual issues, noise issues," Dr. Dagher said. "But we're creating more complicated engineering issues."

Most of the structural technology is borrowed from the offshore oil and gas industry, which has been building floating platforms for decades. But no platform can be made completely stable, and movement caused by ocean swells and storms can create unique stresses on the turbines, said Jason Jonkman of the National Renewable Energy Laboratory in Golden, Colo., who analyzes different offshore designs.

As an example, he noted that if a platform pitches in rough seas, the turbine's spinning rotor can induce a gyroscopic load on the rest of the system. "That's never really been an issue on a land-based machine," he said.

"There's no technical reason why you can't take a platform, put a turbine on it and get it to work," Mr. Jonkman said. "The only question is, can you do it at a reasonable cost?"

"We think with the right design we can get costs down to a reasonable amount so it will be comparable to conventional technology," he added.

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No one knows what the best design will be, but Mr. Bratland said that having a full-scale prototype in the water had helped his company's cause. "My task as asset manager has not only been to build a floating turbine, but to try to develop a market," he said. "Hywind is an opener. It's a kind of mindset."

Statoil's reputation in the oil and gas industry, he added, may help it attract other companies to develop different turbines, assembly ships and the other specialty equipment needed for the technology to develop, he said. "If this is going to be a large industry, we need lots of players."

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