

Siemens Goes Direct Drive

Siemens Energy's first direct-drive wind turbine, developed by a group of engineers in Denmark, could turn into a game-changing product in the robustly growing wind market.

By Stefan Nicola

The final 10 meters are testing my vertigo. Dressed in a white jumpsuit, I am climbing up a narrow ladder leading into the nacelle of Siemens' first direct-drive wind turbine, which towers over a lush green field in the Danish countryside. I'm hooked to the ladder via a steel rope, and I'm inside the tower, but the platform below me seems far away – too far for my stomach. I pretend that all is well and take the last rungs. “Well done,” says Morten, the Siemens engineer who accompanied me on my trip up the turbine, as I finally reach through a small opening into the nacelle. Morten smiles and says: “Well, this is our baby.” The “baby” is a 90-meter turbine with a 3-MW capacity and a rotor blade diameter of 101 meters – Siemens' first-ever direct-drive turbine. It has only half the parts of a geared machine, thus requiring less maintenance. Driven by a new permanent-magnet generator, it's also shorter and weighs

less than Siemens' 2.3-MW gearbox machine. The compact design means that it's easier to transport and erect. “We are taking a genuine quantum leap with this new turbine,” said Henrik Stiesdal, Chief Technology Officer of the Siemens Wind Power Business Unit in Brande, Denmark. “We are reducing the cost and the complexity of wind power while at the same time increasing the efficiency.” Stiesdal is used to inventing things. More than 80 patents are linked to his name, and some say he is the true inventor of modern wind turbines. Back in the 1970s, as a high school graduate concerned with the implications of the oil crisis, Stiesdal collected scrap steel and wood to build one of Denmark's first wind turbines in the backyard of his father's farm. Today, he is one of Europe's most renowned turbine engineers. During the past two years, Stiesdal and a team of around 20 engineers

The new direct-drive wind turbine by Siemens is lighter and more compact than earlier models.

Photo: Erik Krüger



“We are taking a genuine quantum leap with this new turbine.” Henrik Stiesdal, Chief Technology Officer of the Siemens Wind Power Business Unit.

have set out to develop a direct-drive turbine that would not cost or weigh more than a similarly sized machine with a gearbox.

Game Changer

In December 2009, after countless hours perfecting a test turbine, the first prototype was erected near Brande. It performed so well that it was unveiled at the European Wind Energy Association (EWEA) conference in March. Analysts from the HIS Emerging Energy

Research said the new turbine changes the game in the quickly growing wind market.

“Siemens seems to have finally swung the balance in favor of direct-drive technology,” the analysts wrote in May. “Siemens’ peers are forced to accelerate direct-drive product development.” Apart from Siemens, only a limited number of companies offer direct-drive turbines, but this number is set to increase as the technology “will improve the overall cost of energy,”

Stiesdal said. Moreover, the wind power market is booming: Some 10 GW worth of wind power was installed in Europe in 2009 – more than any other energy source, according to the EWEA.

Green Initiatives

Europe’s traditional onshore markets – such as Germany, Denmark, and Spain – are largely saturated, but fresh growth in Eastern Europe as well as bold green initiatives in the USA and Asia will most likely fuel significant additional growth, Stiesdal said.

“This may go in a way where we cannot make as many direct-drive machines as people would like to buy from us,” Stiesdal said.

Meanwhile, Siemens is already adapting the direct-drive technology to supply the emerging offshore wind market, which needs powerful turbines that require as little maintenance as possible.

While the 3-MW direct-drive wind turbine is also suited for offshore projects, Stiesdal said his team is working on a “larger brother” for large future offshore wind farms. Asked when the new turbine will be ready, Stiesdal looked at me and smiled. “Sorry, that’s a secret,” he said.

Strong Forecast for Wind

Jos Beurskens, one of Europe’s leading wind power experts, talks to *Living Energy* about the trends and challenges affecting the global wind power market.

Jos Beurskens, a soft-spoken analyst, is known as “Mr. Wind” in the Netherlands. However, it was in Africa that he made his first experiences with the technology. As a university student, Beurskens worked on water-pumping windmills in Tanzania and Cap Verde. When he returned to the Netherlands in 1980, Beurskens joined the country’s first national research program

for wind energy. Today, the award-winning scientist is the chief wind expert at the Energy Research Center of the Netherlands, or ECN. Wind power has come a long way since Beurskens’ days in Africa. Today, it is Europe’s dominant renewable energy technology. He says he is convinced that “for the next decade or two, this won’t change.”

Close to 80,000 MW worth of wind power – the equivalent of 25 nuclear power plants in terms of energy output – are installed in Europe, most of them in Germany, Denmark, Spain, and the Netherlands. While these markets show signs of saturation, there is room for further onshore growth in the rest of Europe, Beurskens says, citing countries now waking up to

Photos: Siemens, Erik Krüger

The low-maintenance turbine has only half the parts of a geared machine.





Wind energy analyst Jos Beurskens thinks the number of wind power initiatives is still limited compared to the full potential of the technology.

renewables – such as Italy and France – and those trying to reduce their CO₂ emissions to meet EU climate protection targets – such as Poland, Romania, or the Baltic states. “These nations have great potential to develop wind energy; but unfortunately, the number of initiatives is still limited compared to the full potential.”

Offshore Prospects

When it comes to the number of initiatives, it’s clear that the biggest growth will happen offshore. The governments of the North Sea, Baltic, and Irish Sea coastal states have tabled several schemes to foster the construction of turbines at sea, where winds blow stronger and steadier. “We have around 2,500 MW of offshore wind power operating today, and more than 3,000 under actual construction,”

Beurskens says. “If you add up ongoing installations and all the plans, it’s clear that we will have 30,000 MW of offshore capacity installed before 2025. That’s nearly half of what we have on land, so this is going to be a big boom.” Britain, where relatively few turbines are installed due to public opposition to wind farms on land, is leading the foray into offshore. The massive 1-GW London Array, just one of nine large-scale wind farms to be built off the island’s coastlines, is already under construction. “Britain has the best offshore potential in Europe, with lots of wind blowing and long shorelines to put the farms,” Beurskens says. Other nations are also pushing hard. In April, Germany opened its first offshore farm, Alpha Ventus, the starting

shot for several additional projects in the North and Baltic Sea.

Headwinds at Sea

But there are challenges to generating power at sea. Building the wind turbines is twice as expensive as on land. And once they’re installed, maintaining them in the rocky seas can be costly. “On land, you can access turbines immediately, change or repair the part, and then have it running again after just a few hours,” Beurskens says. “You go offshore, and sometimes you can’t access the turbine due to bad weather for several weeks. The loss of availability, which directly relates to energy output, is considerable without special access technology.” Moreover, only a handful of servicing companies own ships capable of mounting and maintaining the tur-

“Wind will remain Europe’s dominant renewable energy technology for the next decade or two.”

Jos Beurskens

bines, Beurskens says. “We are lacking maybe 80 percent of the capacity of purpose-built vessels we need when we look at all the plans.” While governments in Europe have provided lucrative support schemes for offshore wind, they have been slow to ensure that the power generated at sea will actually make it into the energy mix.

Offshore wind farms have to be connected via undersea cables to the aging European power grid, which will have trouble integrating the highly fluctuating energy source – at least once many offshore farms come online. “You have to consider that a large wind farm in the future will have the same peak capacity as a large fossil fuel or nuclear plant, with one huge difference: The output varies a lot,” Beurskens says. “So you have to plan for the same peak power, but you cannot fully control the output. This is a balancing challenge unlike any we have encountered before.”

European Smart Grid Needed

Beurskens says European governments need to ensure the swift construction of a smart transnational power grid that integrates the fluctuating renewables via electricity sharing and storage. Germany’s *Süddeutsche Zeitung* reported earlier this year that several European countries were discussing construction of such a grid in northern Europe. It would connect British and German offshore wind farms with hydrostorage facilities in Norway and wave power facilities near the Belgian and Danish coastlines.

Photo: Roel Beurskens

“But this has to happen quickly, because the grid should be in place before the wind farms,” Beurskens points out.

A Competitive Market

European wind power companies are also looking abroad, where markets are due to grow massively. “In the Americas, the USA and Brazil will lead strong onshore growth – and then, of course, there is Asia,” says Beurskens.

In 2009, China led the world in clean energy investments for the first time. The country plans to have some 100 GW of wind power installed by 2020 in a bid to feed its growing hunger for energy and reduce CO₂ emissions. Neighboring India has also launched an ambitious push into wind power. “The Asian and US markets will be similarly big by 2030, but both will be larger than the European one,” Beurskens states. Still, it won’t be easy to conquer the growing Asian market. “There are about 20 significant companies producing wind turbines in China, some of them eager to sell turbines in Europe, so for companies here, it will be a huge challenge,” Beurskens says. “But the Europeans need not fear if they stay alert: They have extensive knowledge and experience, and I would say they still understand the wind turbine and its behavior better than the Chinese companies.”

Stefan Nicola, a politics and energy journalist based in Berlin, is the Europe correspondent for United Press International (UPI). He also writes for the European Energy Review, an energy publication for decision makers.

Summary:

- Siemens’ new direct-drive turbine has half the parts and weighs less than standard machines, reducing the need for maintenance and the overall cost of energy of wind power.
- Analysts say it’s a game-changing product, forcing competitors to follow suit.
- Siemens will market the turbine in Europe and the Americas and expects demand to outgrow production.
- The company is already upscaling the turbine for the offshore market.
- Wind power will remain the dominant form of renewable energy.
- In Europe, onshore growth will happen in Italy and France as well as in Eastern Europe, while offshore farms will be mushrooming in the North and Baltic Sea.
- But generating power at sea is challenging: Construction and maintenance are challenging, Europe is lacking a smart grid infrastructure, potential supply bottlenecks are looming.
- Today, China and the USA are the world’s biggest wind markets.

Glossary

- **Direct-Drive Turbine:** In a traditional wind turbine, the rotor is connected with a generator via a gearbox to produce power. With direct-drive technology, a permanent-magnet generator is directly connected with the rotor, eliminating the need for a gearbox. This reduces friction and increases efficiency.

For further glossary terms, see: www.siemens.com/energy/living-energy

Further Information

www.siemens.com/energy/wind-power