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21
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Exciting technologies to push windfarms away from coastal waters into deep ocean are the next step in renewable energy generation. Heath Reidy explains.

Like ocean waves building up to a storm at sea, offshore technology is changing shape and becoming more powerful.

Wind turbines are already contributing hugely to the targets that the European Union has set for 20% of all energy across Europe - 15% for Britain - to come from renewables by 2020. It is also estimated that Britain generates about 3GW of energy from windfarms. And this figure is set to increase after news this month that the Crown Estate had announced awards for the development of 10 offshore turbines in Scottish waters.

Duncan Ayling, head of offshore at the British Wind Energy Association (BWEA), says the biggest contribution to UK renewable energy will be from offshore wind. "That is undeniable," he says. "It's where we have got the largest resource and the largest potential."

But with costly offshore windfarms filling up space close to coastlines and proving expensive to install, engineers are looking at ways to get turbines further out to sea as quickly and cheaply as possible.

Ayling says that using certain structures, such as the monopole foundation, the most economical construction to support an offshore turbine, at a depth of more than 25 metres is "unrealistic". Stronger steel jacket structures or gravity bases, he says, are needed instead and they are more expensive. "If you are going deeper than 50 metres, you are really struggling to find a physical foundation that is going to be economical for a wind turbine," says Ayling.

This is where floating turbines come into play. They need only to be anchored to the seabed by strong cables or wires, rather than embedded in costly metal architecture, allowing the turbine to be put into much deeper waters. "The biggest advantage is (floating turbines) open up other areas of the sea to offshore wind generation, areas that are considered too deep for other foundations," he says.

Technical and installation staff do not need to spend as long working at sea to place the floating turbines so are not so restricted by weather. The turbines can be towed out with most of the engineering and assembly work carried out onshore, which cuts costs considerably.

"The less time you spend working at sea the better because it is so expensive," says Ayling. "If a floating turbine can be fully assembled in a harbour and then towed out and moored to the seabed that could be a big advantage."

Two companies developing floating wind turbines are StatoilHydro and **Blue H** Technologies. Both hope their turbines will create the next step towards cheaper and more efficient offshore technology.

Norwegian energy firm StatoilHydro is developing what it claims will be the world's first full-scale floating turbine. The HyWind, a 65-metre carbon steel turbine, will be installed in the summer and producing power for the Norwegian grid from 1 October. The 2.3MW turbine, powered by 80-metre diameter rotor

blades, is being designed for depths of between 120 metres and 700 metres - a far cry from the 25-metre limit of fixed structures.

It will be fitted to a 100-metre steel flotation structure anchored by three marine wires and chains to the seabed, which will allow it to float, keep it upright and, to a certain extent, stop it drifting too far, even in large waves. Sjur Bratland, asset manager of the HyWind project, says: "The technology prevents it from excessive movement."

The flotation element consists of a slender steel cylinder, which has some similarities to a spar buoy. This hollow structure sits 100 metres below sea level. Filled with water and olivine rock and weighing 3,000 tonnes, it acts as a ballast for the 138-tonne turbine.

StatoilHydro aims to assemble and commission the turbine onshore. Bratland says: "It is up to us to do all the commissioning and all testing in protected waters so that when we finally venture offshore there is very little work to do.

"(Cost) is a question that needs to be answered but we don't see any reason why this should be more expensive than other marine renewable energy technology," he adds.

A 3-metre model has been successfully tested in a wave simulator and the team hopes to repeat the results with the full-scale structure.

Bratland says: "Offshore floating wind power has the potential to contribute a large quantity (to renewable energy). We have a lot of experience from marine operations, harsh environments and large projects and we believe we have something to contribute."

Project Deepwater Turbine is another example of work in floating wind turbines. It is one of the first four projects to receive funding from the Energy Technologies Institute (ETI), a partnership between industry and the UK government to meet Britain's targets in reducing greenhouse gas emissions.

Deepwater, which aims to develop a floating windfarm of 5MW turbines, is backed by a consortium led by **Blue H** Technologies. The consortium includes defence firm BAE Systems, which will provide its engineering expertise.

Blue H installed the prototype floating wind turbine last summer. The twin-bladed device has been deployed in waters 113 metres deep. The company is building the first operational 2MW unit, expected to be deployed off the coast of southern Italy later this year.

Now the firm wants to develop a fully operational turbine that could lead to a floating windfarm. The target is to develop turbines that could operate in depths of up to 300 metres.

Rather than replicate floating turbines already under construction, **Blue H** says Deepwater will look at new designs to "reduce the cost of electricity generation to a level that is competitive with other forms of energy".

Jon Mills, head of strategy at integrated system technologies for BAE Systems, says ideas include reducing the weight by, for example, replacing steel with concrete, and reducing the complexity of the system to make installation quicker and easier. Cutting maintenance costs will also be explored.

"We are trying to combine the turbine, the power and the foundations into one unit," he says. "Because this is likely to be something that will be further out to sea there is potential to use something that is slightly different from current turbine designs."

Floating turbine technology is still only in its infancy and Ayling says it has yet to prove itself, particularly in saving money.

Deepwater is a long way from proving itself and it will be a few years before HyWind can provide accurate data on the benefits of floating wind turbines. Ayling is confident about the technology and believes it has a future in contributing to offshore wind energy generation.

"We have yet to find out the real economics of floating turbines," he says. "But they have a place and a role to play."

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