



Statoil's Hywind concept – expanding the reach of offshore wind

by Sebastian Bringsværd, Head of Hywind Development, Statoil

By overcoming depth limitations, floating offshore wind greatly expands available areas and markets for the offshore wind sector. In 2017, Statoil is opening the world's first floating offshore wind farm – Hywind Scotland.



Sebastian Bringsværd
Head of Hywind Development
sebri@statoil.com

Positioning for the next wave in offshore wind

There are several factors that make the floating wind market particularly attractive. While bottom-fixed offshore wind is generally constrained to water depths of ~50 m, floating wind can be installed at water depths from over 50 to 500 meters or more. According to the UN, around 3 billion people live within 100km of the coast. As urbanization grows within developing megacities – offshore wind can provide clean, sustainable power solutions close to demand centers and provide huge opportunities for economic development.

A rising tide lifts all boats

The cost of offshore wind has been declining for some time. Rapid deployment has enabled innovation and enhanced learning, a competitive supply chain and ever larger turbines. Volume matters in this business. Europe now has a total installed capacity of 12,631 MW from 3,589 grid-connected wind turbines in 10 countries, and is providing more than 10 million households with clean energy in Europe every year. On a levelised cost of energy basis (a comparative calculation comparing net unit energy costs) offshore wind is now approaching grid parity in Europe. In effect, this business is rapidly becoming subsidy free and a real alternative to conventional power sources – all without the carbon and the radio-

active waste. We expect costs to continue to decline and this development will also contribute to lower costs for floating offshore wind. If we can build a larger pipeline of floating wind projects, we can capture economies of scale, globalise the supply chain and apply innovation and the next stage in the evolution of the offshore wind industry.

The world's most mature floating wind Concept

Hywind is Statoil's brand within floating wind and complements our portfolio within traditional, bottom fixed offshore wind. Hywind is the most mature of all floating concepts. Our first pilot, a single 2.3Mw turbine in 95-100 meters water depths off the coast of Norway, has been in operation since 2009 and has experienced hurricane wind speeds and 19 meter wave heights. Our next phase, Hywind Scotland in the Buchan Deep off the coast of Peterhead, Aberdeenshire is a full scale 30Mw windfarm which will power approximately 20,000 households when production starts in late 2017.

Statoil is already a substantial player in the European market for offshore wind, and is now expanding in the growing US market. By demonstrating cost efficient and low risk solutions for future commercial-scale floating wind farms, Hywind Scotland can further



enhance the attractiveness of floating wind to markets like California, Hawaii, France and Japan.

Leveraging our competitive advantages

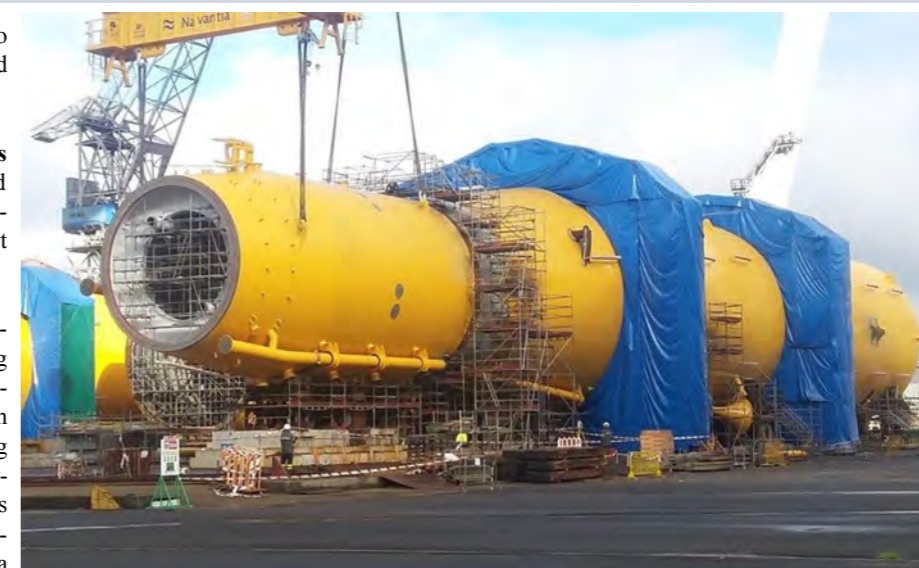
Through the development of the Hywind concept, Statoil has positioned itself as a leading player within FOW. Hywind is the most mature and derisked of all FOW concepts.

The attractiveness of Hywind is both its simplicity and maturity. Essentially, everything below the water is tested oil and gas technology which you find all over the world – from the spar buoy foundation, to the mooring lines, to the suction anchors. Above the surface, we utilise regular offshore wind turbines and towers. In essence, we are marrying renewables with oil and gas – which puts us in a unique position to accelerate the industrialization of floating wind. There's an 'x-factor' here too, our patented motion control system which ensured stability and higher production. There are several factors that make the FOW market particularly attractive for Statoil. Statoil is already a substantial player in the European market for offshore wind, with assets also in the growing US market. Through the Hywind Scotland pilot farm, Statoil is a leader in technology development and industrialization of floating offshore wind farms. By demonstrating cost efficient and low risk solutions for future commercial-scale floating wind farms, Hywind Scotland can further enhance the attractiveness of FOW.

Through continuous simplification of the Hywind concept, the use of standardised industrial components and broadening the supply chain, Statoil aims to significantly reduce costs, accelerate our project pipeline and remain the leading player within floating wind.

More in store — Batwind

The innovation does not stop at floating wind farms. Statoil is developing storage solutions linked to offshore wind (Batwind), with a battery and converter onshore that will become an integrated part of the Hywind concept. The battery storage capacity will hold excess electricity for sale when capacity is



1st Substructure (HS 3) in full length at Assembly Area

free, mitigate intermittency and optimize output through a power management system developed in-house.

This will improve efficiency and lower costs for offshore wind when it comes to exporting power. Linking up batteries with offshore wind highlights how innovation is overcoming traditional obstacles associated with variability in wind power. This lays the ground work for future projects which have the potential to store additional batteries within the structure of the turbines offshore.

Offering nuanced new energy solutions

Our main aim is to successfully develop full scale commercial parks in countries with a high potential for floating wind, such as Japan, France, US and the UK. Such parks may have a capacity of up to 500 MW or more. However, we also see more nuanced markets developing which will require tailor made engineering to give stakeholders and customers new energy solutions fit for their own purpose:

- 1) **Big Coastal City Markets:** Large cities with congested power supplies and pollution challenges with a desire and means to provide clean power. Examples for this may be New York or Los Angeles with

one-off opportunities for developing high-profile utility scale wind farms.

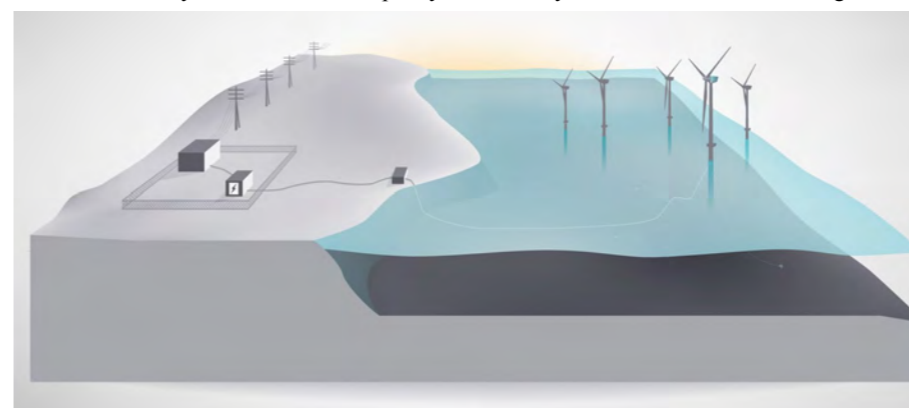
- 2) **Island States:** Populated islands with deep waters relying on expensive diesel generation with limited potential for on-shore renewables. This segment could consist of several one off opportunities for developing wind farms on different locations. Hawaii is the most prominent example where companies have started lease processes for floating wind in deep waters.

3) Offshore Oil & Gas Installations:

Hywind could be a competitive option to power solutions based on diesel, gas or power from shore, particularly in locations with advantageous regulatory frameworks. Several near term opportunities have been identified in Statoil's own oil and gas portfolio. The market size is small due to the limited size of wind farms needed to serve the power needs (typically 50-100 MW). This may represent an important bridge market and a potential of multiple installations around the world could be targeted.

Our strategic intent – and an invitation for change

Whilst Statoil has developed much if Hywind in-house, we are looking to develop broader partnerships and facilitate new market opportunities across the globe for floating wind. We are open for new partnerships and business models. The Hywind concept is the most mature concept on floating, but we recognise that we will need new sites and areas opened, and for the Hywind concept to succeed the supplier industry needs to go hand in hand with the developers and the technology owners. There is no reason that FW should not follow the path of OW (reaching grid parity this year), or even lower, as FW can be standardised even more than OW. It is just a question of time and the timing is now!



Hywind including Batwind