



Oil & Energy



HYDRO

Floating windmills



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Hydro has developed a new concept for producing power at sea – using known floating concrete structure technology used in the North Sea oil industry as the base for offshore windmills. This way we can utilize the wind where it blows most – far out at sea. After successful model testing the next step is a full-scale demonstration project. If successful, floating windmills can contribute to the world's future energy supply.

A prototype of Hydro's floating windmill has for the first time been thoroughly tested at Marintek's Ocean Basin laboratory in Trondheim. The results are promising. Our goal is now to place a floating windmill in the North Sea – to demonstrate that it's possible to build offshore wind farms at water depths beyond 200 meters.

The development of wind power technology has given us large wind turbines that have so far only been installed on land and in shallow waters offshore. Windmills at sea are a good solution because they won't bother people on land. In addition to steadier breezes and higher annual mean wind, we achieve better energy efficiency at sea. There are challenges in shallow waters. Modern windmills have become so large that establishing foundations and installation are demanding.

Using floating concrete structures allows us to build on land and tow to sea – just as we've done for many decades with offshore oil platforms. The hulls will not be larger than regular tug-boats can tow. Hydro's concept entails mounting a regular offshore

wind turbine atop a 120 meter high floating concrete cylinder with ballast and which will be fastened to the sea floor with three sturdy anchor lines. The electrical power generated by the wind turbine will be transported by cable to shore or possibly to offshore oil platforms.

The windmills will be designed for water depths from 200–700 meters. Hydro has plans to start a demonstration project in 2007 and build an offshore wind farm using this type of windmill in 10–15 years.

In the beginning, it's relevant to use windmills with standard wind turbine equipment for use at sea. The demonstration project is based on a wind turbine with a power generation capacity of 3 MW. The windmill will reach 80 meters above the sea's surface and will have a rotor diameter of about 90 meters. The windmill tower will be fastened to the concrete structure at about 12 meters beneath the sea.

We eventually envision wind turbines with a power capacity of 5 MW and a rotor diameter of approximately 120 meters. For the

concept to work, it is crucial that the wind turbines be light, requiring further technological development to realize the goal of establishing offshore wind farms at greater sea depths. If we succeed, it's feasible to imagine offshore wind farms with up to 200 turbines and a combined power capacity of 1,000 MW. Steady winds in our part of the world could mean wind farms producing more than 4 TWh per year.

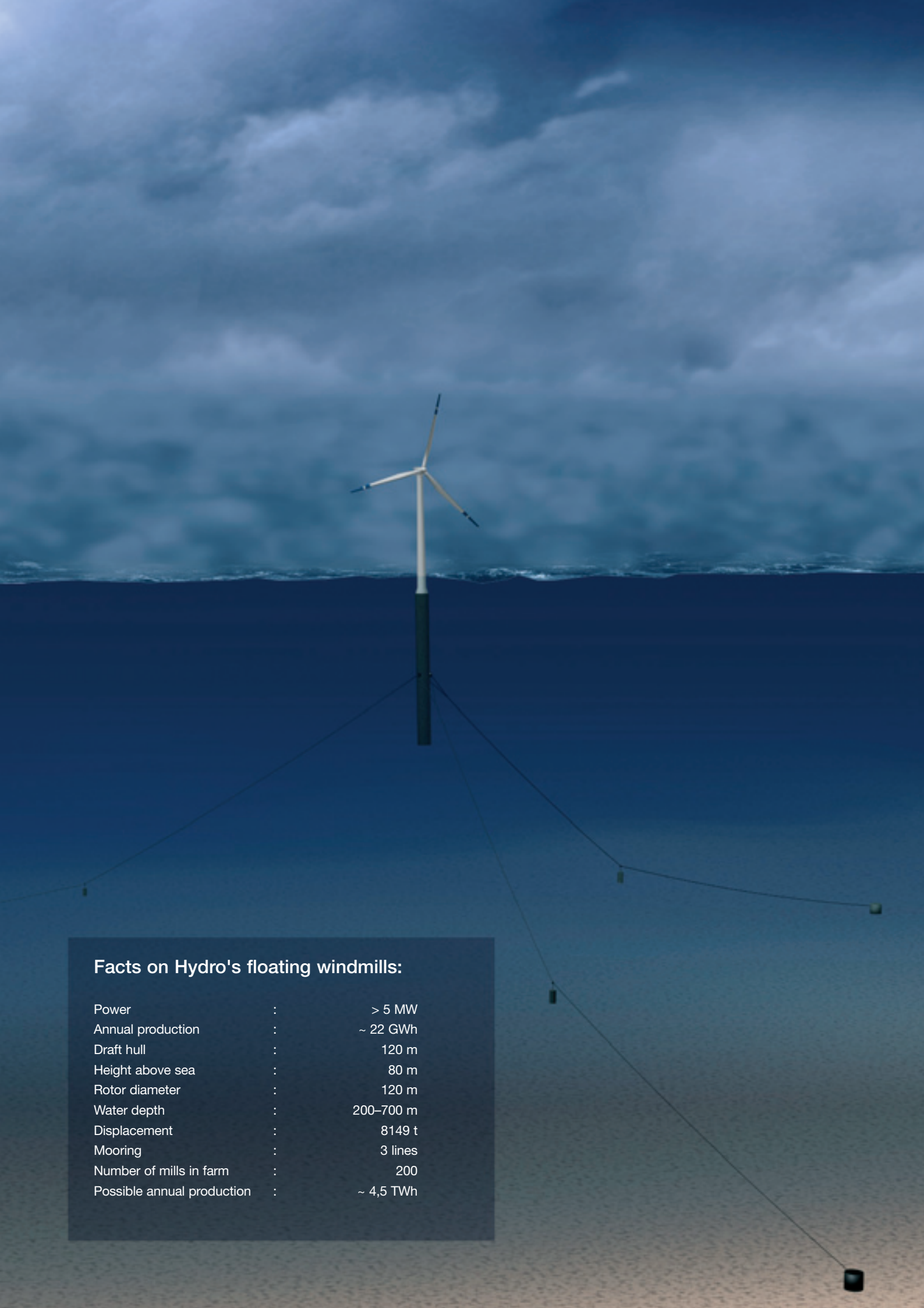
Hydro has faith that the windmills can compete economically with existing solutions for offshore wind power. The concept can additionally open up new areas of energy utilization and an international market for this type of technology. In Norway, there are many well-suited sites for construction and assembly of these wind turbines. By combining our long-time power production experience with our extensive experience developing offshore oil and gas fields, Hydro can become a major player in the development of energy supply at sea. Hydro's mission is creating a more viable society by developing natural resources and products in innovative and efficient ways – just like we're doing with floating windmills.

This is how an offshore floating wind turbine could look like.



The wind turbine is mounted to a 120 m high floating concrete substructure.





Facts on Hydro's floating windmills:

Power	:	> 5 MW
Annual production	:	~ 22 GWh
Draft hull	:	120 m
Height above sea	:	80 m
Rotor diameter	:	120 m
Water depth	:	200–700 m
Displacement	:	8149 t
Mooring	:	3 lines
Number of mills in farm	:	200
Possible annual production	:	~ 4,5 TWh

Hydro is a Fortune 500 energy and aluminium supplier founded in 1905, with 36,000 employees in nearly 40 countries. We are a leading offshore producer of oil and gas, the world's third-largest integrated aluminium supplier and a pioneer in renewable energy and energy-efficient solutions. As we look forward to our next 100 years, we celebrate a century of creating value by strengthening the viability of the customers and communities we serve.

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