

Hywind Scotland – status and plans

EERA DeepWind' 2015, Trondheim

Rune Yttervik, Statoil

Building the Portfolio:

Material positions in fixed offshore wind

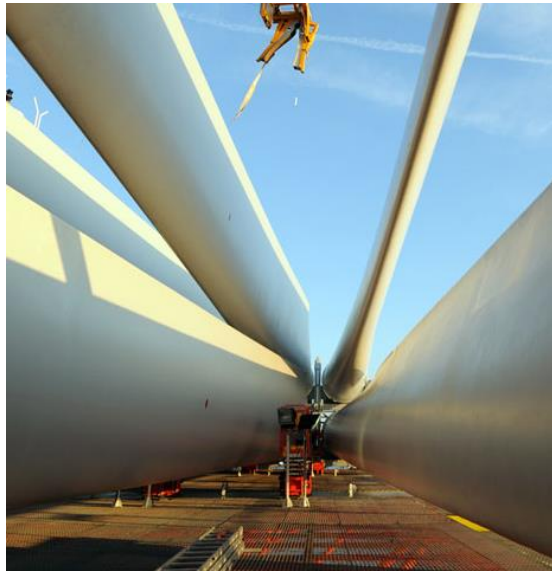
Project execution to
operations:
Sheringham Shoal, UK

317 MW
In operation, 2012



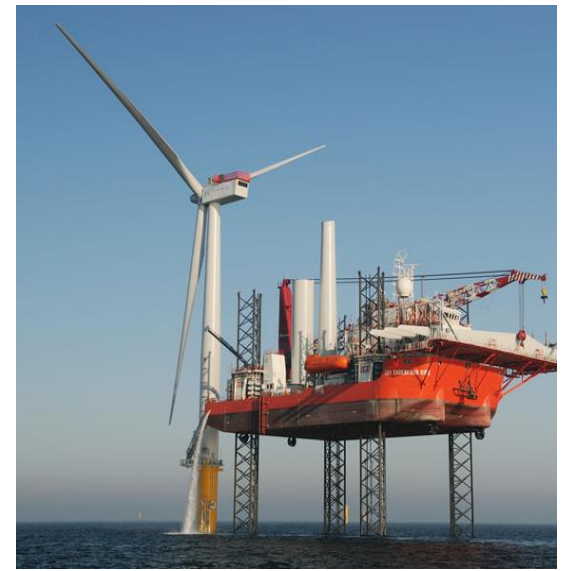
Working to bring technology
costs down:
Dudgeon Offshore, UK

Up to 560 MW
Under development

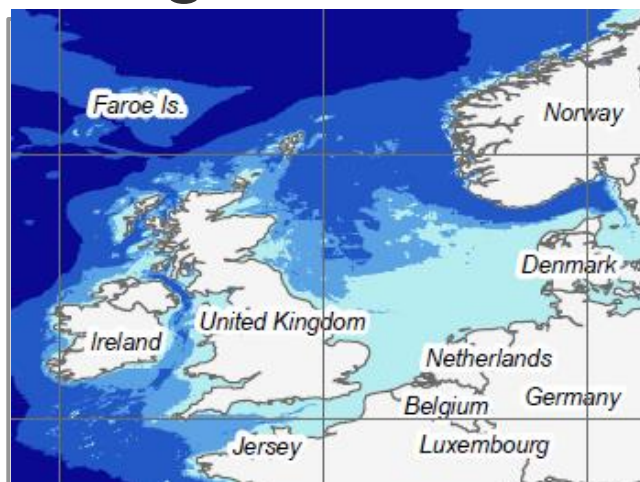


Larger projects, deeper
waters, further from shore:
Doggerbank, UK

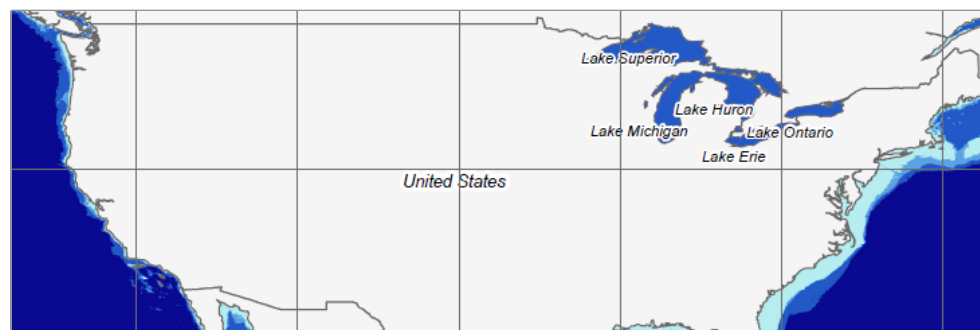
Up to 9 GW
Under consent



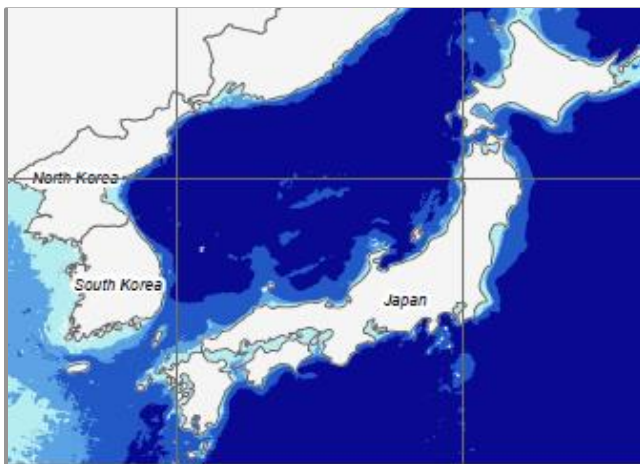
Floating wind - *Potential markets*



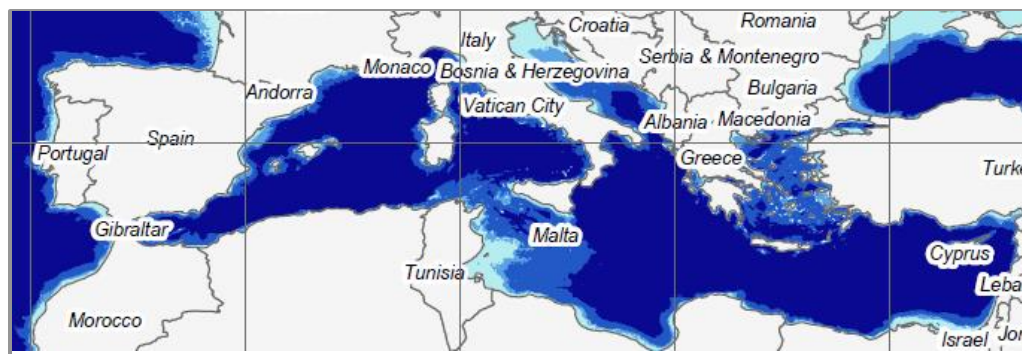
North sea – Norway and UK



US, Atlantic and Pacific coast – and Great Lakes



Japan and Korea

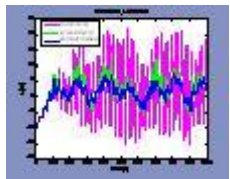
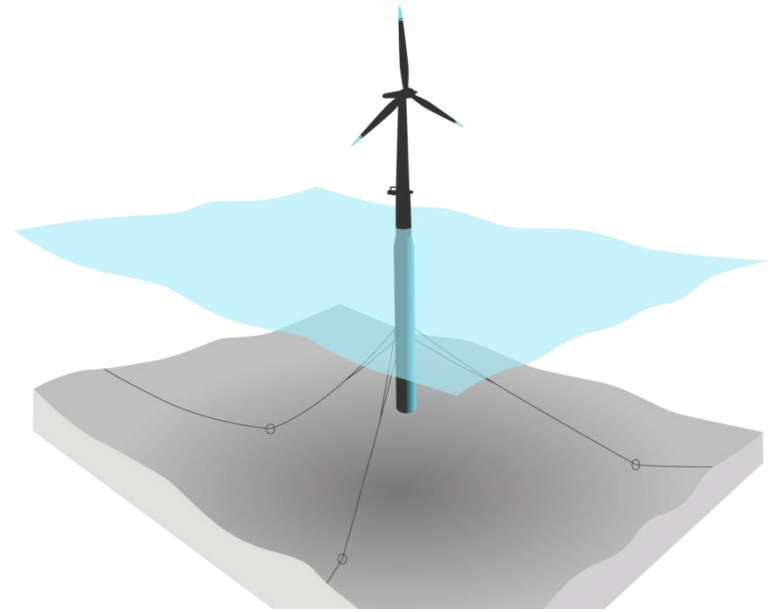


Iberian Peninsula and Mediterranean Sea

HYWIND

What is Hywind?

- Floating wind turbine (FWT)
- A standard offshore wind turbine placed on a ballasted vertical steel cylinder, anchored to the seabed
- Active motion controller
- Statoil-owned technology



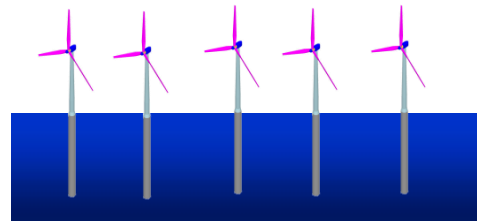
Concept
2001



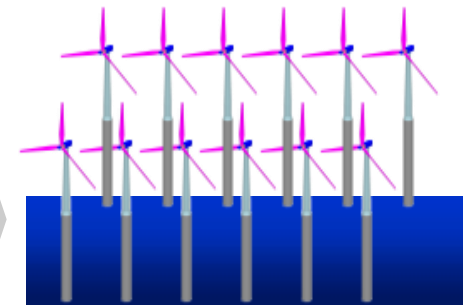
Model test
2005



Full-scale
prototype
2009



Pilot Park, 3-6 turbines
<5 years



Large Parks, 500-1000MW
<10 years

HYWIND DEMO

Hywind Demo – the World's first full scale prototype

10 km offshore Norway
at 200 meter depth:

Conventional technology used in a new way

slender floating cylinder (simple sub-structure)

conventional 3-line mooring system

use of standard offshore wind turbine

In operation from September 2009

produced ~40 GWh since start-up

capacity factor 50% in 2011 (overall 40%)

experienced wind speed of 40 m/s and
maximum wave height of 19 m

Blade pitch control to dampen out motions

Floater motions have no negative impact on turbine
performance

Concept verified



Hywind Demo - assembly and installation - 2009

- Simple and safe assembly and installation



HYWIND SCOTLAND

Commercialisation of Hywind

Status:

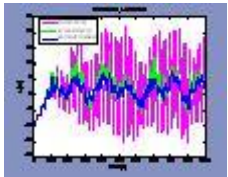
- The technical concept is considered proven

Next step:

- Pilot park to demonstrate improvements and cost reductions

End goal:

- Commercial scale parks of 500-1000 MW
- Cost competitive with bottom fixed



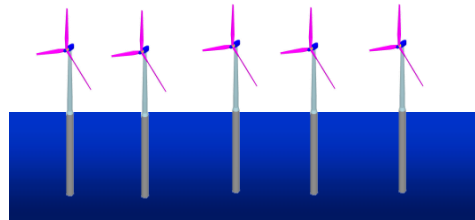
Concept
2001



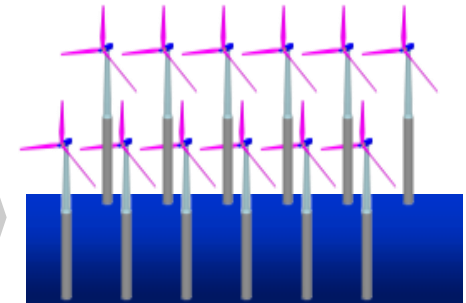
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Full-scale
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Pilot Park, 3-6 turbines
<5 years



Scottish Government positive to floating wind



Scottish First Minister Alex Salmond visits Statoil, August 2010



Recharge article, August 2010

- Scottish consultation regarding introduction of a separate band for «experimental offshore wind»
- The European Commission has granted state aid approval for the introduction of an enhanced ROC (i.e. 3.5 ROC/MWh) for floating wind in Scotland
- 3.5 ROC and 18 months grace period was approved by the Scottish Parliament in 2014

Hywind Scotland - project objectives

Demonstrate cost-efficient and low risk solutions for commercial scale parks

- Test multiple units in park-configuration
- Verify up-scaled design
- Verify reliability and availability of optimised multi-turbine concept
- Mobilise supply chain



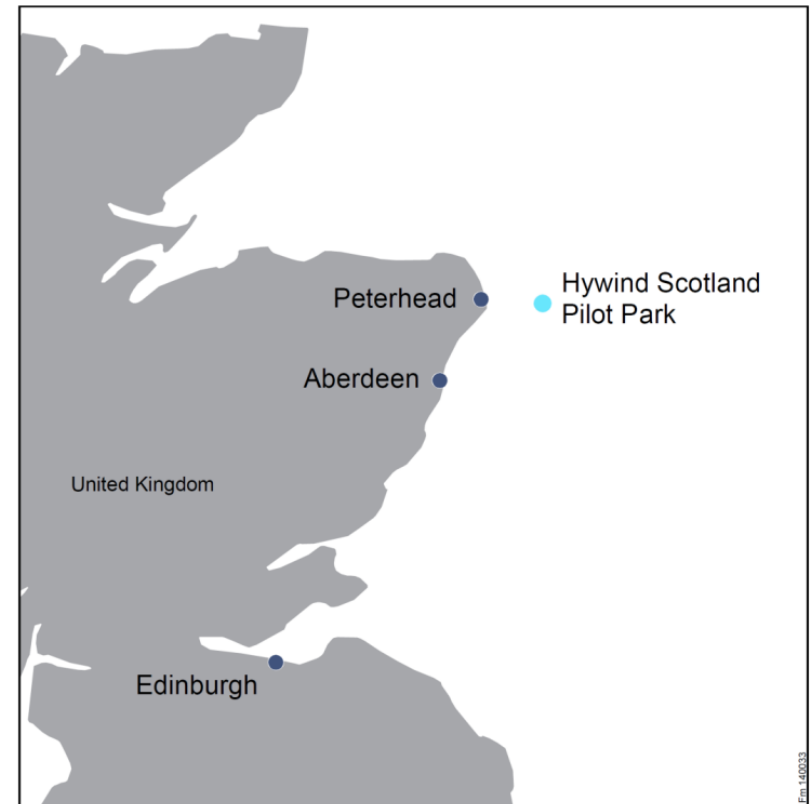
Hywind Demo

Hywind Scotland

Hywind Scotland Pilot Park

Project introduction

	Hywind Scotland
Installed capacity (5 WTGs)	30 MW
Area (sea level)	~4 km ²
Water depth	95-120 m
Average wind speed (@100 m)	~10 m/s
Mean waves, Hs	1.8 m
Offshore export cable length	Ca.30 km
Onshore cable length	Ca.2-3 km
Transmission voltage	33 kV
Mooring	Pre-laid chains
Anchor	Suction



Pilot park area and export cable corridor



Upscaling from Demo 2009 to Hywind Scotland 2014

Dimension	Hywind Demo	Hywind Scotland
Mass	5300 tons	~11500 tons
Hub height	~65 m	~100 m
Draught	100 m	~75 - 80 m
Diameter of sub-structure	8.3 m	~14 - 15 m
Water depth	220 m	~95 - 120 m
Rotor diameter	~85 m	154 m
Capacity	2.3 MW	6.0 MW



Upscaling effects

- Fabrication
 - Increased diameter of the substructure is an important challenge for the fabrication
- Marine operations, assembly site
 - Lifting height increased significantly
 - Available vessels to install under floating conditions very limited
 - The operation related to lifting from a floating installation to another floating installation is very challenging with regards to load transfer

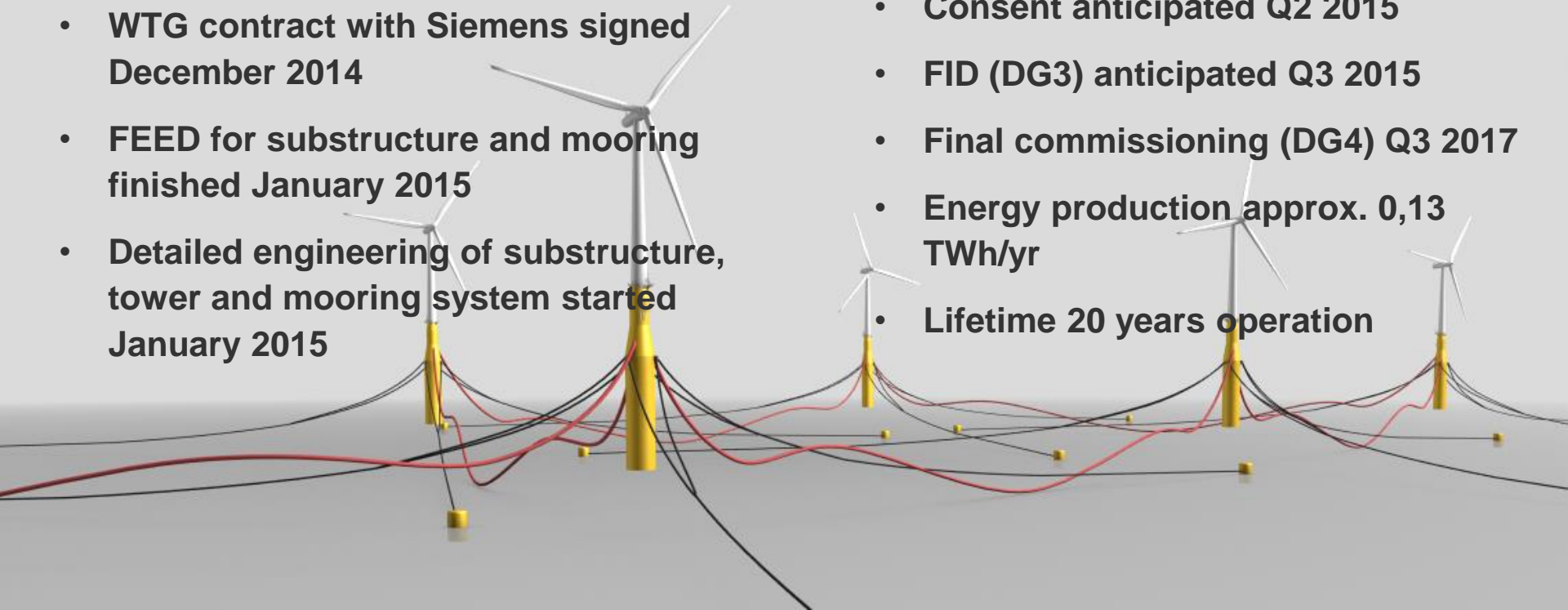


Hywind – WTG and tower assembly on shore



Hywind Scotland Pilot Park

- 3.5 ROC and grace period of 18 months
- Agreement for Lease signed Nov. 2013
- Grid offer signed December 2014
- WTG contract with Siemens signed December 2014
- FEED for substructure and mooring finished January 2015
- Detailed engineering of substructure, tower and mooring system started January 2015
- Consent application ready for submission early 2015
- Concept selection (DG2) March 2015
- Consent anticipated Q2 2015
- FID (DG3) anticipated Q3 2015
- Final commissioning (DG4) Q3 2017
- Energy production approx. 0,13 TWh/yr
- Lifetime 20 years operation



The background of the slide features a large Norwegian flag (red, white, and blue) waving in the foreground on the right side. In the background on the left, an offshore wind turbine stands in the blue sea under a clear blue sky with some light clouds.

THANK YOU FOR YOUR ATTENTION.

Rune Yttervik
Statoil ASA
www.statoil.com