

### 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



Japan and Korea



US, Atlantic and Pacific coast - and Great Lakes



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







<10 years



### HYWIND DEMO



### Hywind Demo – the World's first full scale prototype

Conventional technology used in a new way

slender floating cylinder (simple substructure)

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

10 km offshore Norway at 200 meter depth:







#### **Concept verified**

### Hywind Demo - assembly and installation - 2009

• Simple and safe assembly and installation





### HYWIND SCOTLAND



# **Commercialisation of Hywind**





Concept 2001



Model test 2005



Full-scale prototype **2009** 



Pilot Park, 3-6 turbines

<5 years



Statoil

2015-02-06

## Scottish Government positive to floating wind



Scottish First Minister Alex Salmond visits Statoil, August 2010

UK Offshore			dan Rich
		wants St	
Seel		WARE ST	
		Walls SL	
2000			
		and the second	
First Minister want	s to increase subsid	ies to entice Norwegian giant to build f	loating wir
ANDERS BJARTNES	wind farm based on Hywind		offshore renewa
ANDERS BJARTNES	technology. Statoil is looking at	CONTRACTOR OF THE OWNER OF	predecessors". In
0500	siting a test farm with three to	All of the second se	port from the Euro
cotland wants to increase	five turbines in 2011 either off		sion's programme
the subsidies it can pay to	Scotland, the US (off the coast of		renewable techn
attract floating offshore	Maine), or Norway.	A STATE OF S	also be possible. Salmond's visio
wind projects, First Minister Alex	Statoil has identified two possi-		land - in co-oper
Salmond tells Recharge. It is an	ble locations off Scotland for the		way - can delive
effort to attract Norway's Statoll	Hywind demonstration. One is		to the European n
to build the world's first floating	off Aberdeenshire and the other is near the Hebrides islands.		parable to today's
wind farm with its Hywind tur- bines in Scottish waters.	The ROC system creates a		oil and gas in the
Salmond says Scotland wants	predictable revenue stream for		"In 20-30 years
to extend its support system,	investors, and the UK policy		could produce mo
which gives an extra bonus for	framework is often presented as		of power from t
immature technologies such as	a best-case model when Statoil		That's a realistic
wave and tidal to help the de-	bosses give presentations about		mate. We could
velopment of floating offshore	renewables.		than enough to p of Germany," Sah
wind.	Statoil spokesman Øistein Jo-	And and a second s	Salmond hope
Tidal power gets three renewa-	hannessen says: "The ROC sys-	and the second se	bines can make
ble obligation certificates (ROCs)	tem is working very well." Scotland was given permission	AND DESCRIPTION OF A DE	velop deepwater
per MWh and wave power five ROCs/MWh. Each ROC gives	by Westminster and Brussels to	AND DESCRIPTION OF A DE	which is abundan
about £50 (\$78) per MWh of rev-	create a subsidy system that is	and the second sec	way and Scotlan
enue above the price paid for the	better than the rest of the UK for		interconnector be
power. Offshore wind farms cur-	wave and tidal, but it is unclear if		and Scotland, wh
rently under construction will	it will get the go-ahead to extend	and the second se	be connected to a
get two ROCs/MWh if they are	It to floating offshore wind.		pergrid, was also during Salmond
built by March 2014.	A new support scheme would	VISION: Alex Salmond believes the North Sea has great potential	during Salmond and Stavanger.
"This is a matter we are con-	have to comply with European competition rules.	VISION: Alex Salmond believes the North Sea has great potential	ners over dilger.
sidering. This is one option, but we have not made any decisions."	The UK government is review-		Street and street and street
Salmond tells Recharge.	ing the future of ROCs as it at-	and the second secon	
On a visit to Norway, Salmond	tempts to cut spending across	MASTER MARINE WILL ON BEHA	LF OF ST
discussed the Hywind project	the board, but Salmond is confi-	AND STATKRAFT INSTALL 88 W	IND TURE
with Statoil.	dent the system will survive - or	AND 2 SUBSTATIONS FOR THE	SHERING
He says the Scottish govern-	even be improved.	AND 2 SUBSTATIONS FOR THE	Shening
ment is investigating ways to	He says Energy Minister Chris	SHOAL WIND FARM PROJECT	
convince Statoil to choose it as	Huhne has a "better understand-		
the location for the first floating	ing of the potential in marine		

#### 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 Scotland Pilot Park Project introduction

	Hywind Scotland
Installed capacity (5 WTGs)	30 MW
Area (sea level)	~4 km <sup>2</sup>
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 heigth 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



### THANK YOU FOR YOUR ATTENTION.

Rune Yttervik Statoil ASA www.statoil.com

