Gudmund Olsen

Floating offshore wind in Statoil

Content

- Renewable Energy in:
  - Statoil's Strategy
  - Statoil's climate roadmap

- Statoil position in offshore wind
- Floating offshore wind
- The Hywind development
  - Hywind demo
  - Hywind Scotland

Content

- Renewable Energy in:
  - Statoil's Strategy
  - Statoil's climate roadmap
- Statoil position in offshore wind
- Floating offshore wind
- The Hywind development
  - Hywind demo
  - Hywind Scotland

Statoil

Sharpened strategy for enhanced value creation

Cash generation

- Low cost
- Low break-evens
- Long-life assets

Capex flexibility

- Operated positions
- Flexible onshore assets
- Cycle time efficiency

Value from cyclicality

- Portfolio management
- Supply chain efficiency
- Financial capacity

Low carbon advantage

- New energy business
- Carbon efficiency
- O&G portfolio shape

Statoil

Developing a distinct and competitive portfolio

Norwegian continental shelf

Build on unique position

- Highly cost competitive
- Attractive project pipeline
- Exploration potential

International oil & gas

Deepen core areas

- Enhance Brazil portfolio
- Flexible US position
- New growth options

High value, low carbon

Midstream and marketing

Access premium markets

- Flow assurance
- Asset backed trading
- Capital light

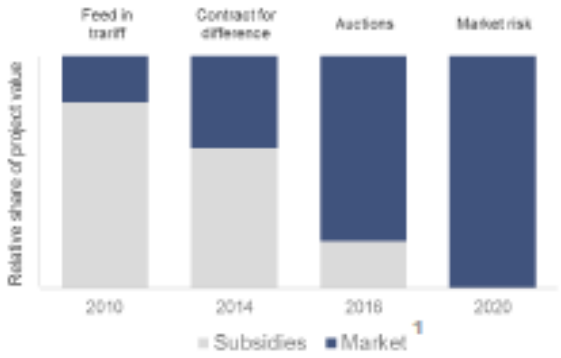
New energy solutions

Industrial approach

- Offshore wind focus
- Low-carbon solutions
- Ventures, R&D

Statoil

Building a profitable new energy business



Industrial approach

- Leverage core competence
- Scale & technology reduce costs
- Access to long-term projects

Value driven

- From subsidies to markets
- 9-11% return range (real)
- Cash flow resilience

Growth opportunities

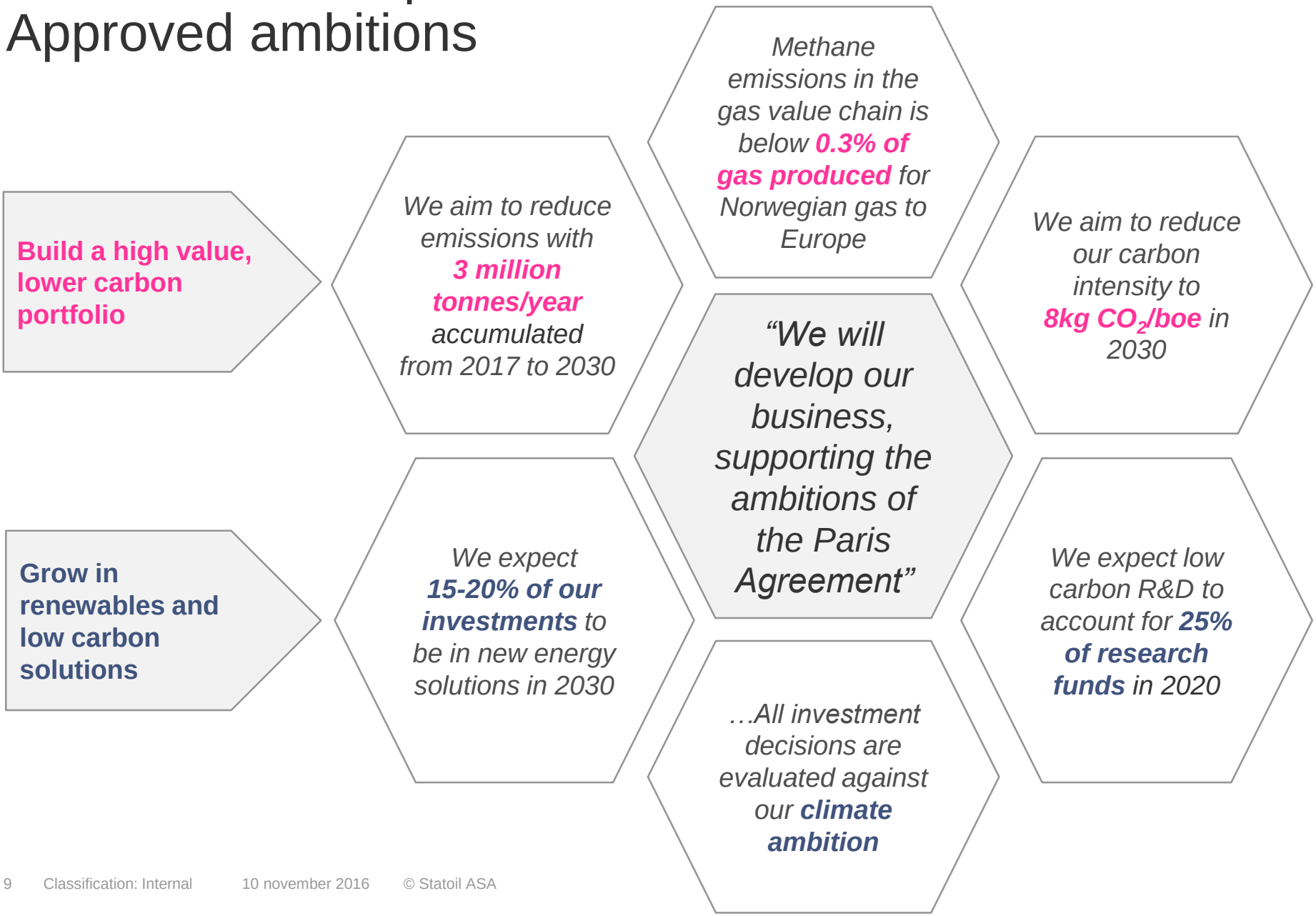
- 15-20% of capex in 2030[2]
- Offshore wind and other options
- Low-carbon solutions

Content

- Renewable Energy in:
  - Statoil's Strategy
  - Statoil's climate roadmap

- Statoil position in offshore wind
- Floating offshore wind
- The Hywind development
  - Hywind demo
  - Hywind Scotland

Climate Roadmap: Approved ambitions



Content

- Renewable Energy in:
  - Statoil's Strategy
  - Statoil's climate roadmap

- Statoil position in offshore wind
- Floating offshore wind
- The Hywind development
  - Hywind demo
  - Hywind Scotland

Offshore wind projects to power >1M homes

Playing to Statoil's strengths

Attractive and growing market

Sheringham Shoal UK	**Dudgeon** UK	**Arkona** Germany	**Dogger Bank** UK	**Future opportunities** Europe & United States

In operation	>80% completed	Construction started	Consented
317 MW	**402 MW**	**385 MW**	**4800 MW**
2012-	**2017**	**2019**	**2020+**

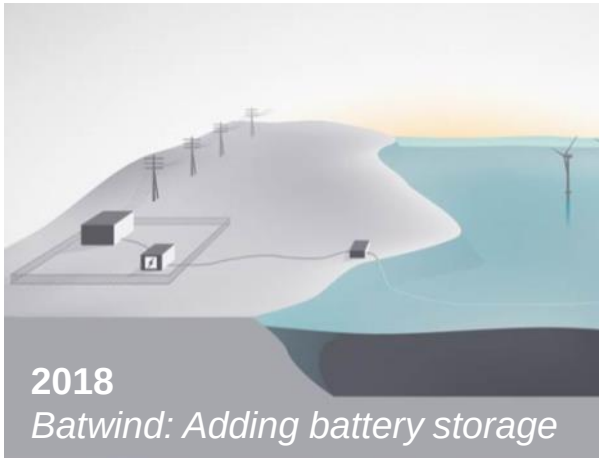
All capacity figures on 100% basis

Statoil

Floating offshore wind: Potential game-changer

2009-
Demo: Proven in the North Sea

2017
Scotland pilot park: A world's first



2018
Batwind: Adding battery storage

Statoil and offshore wind

Playing to our strengths

- Complex projects
- Marine operations
- O&M & HSE ability
- Leading floating tech.

Attractive market

- Attractive risk/return
- Predictable revenue
- OECD countries
- High entry barriers

Offshore wind projects currently in progress delivering >1100 MW

Additional 4800 MW consented / ~5 mill. homes

Hywind demo	Sheringham Shoal	Dudgeon	Hywind pilot	Arkona	Dogger Bank	Hywind large scale
In operation	In operation	In development	In development		Consented	
2.3 MW	317 MW	402 MW	30 MW	385 MW	4 x 1200 MW	
2009-	2012-	2017	2017	2019	2020-	

North West Europe

Japan

United States

** All capacity figures on 100% basis*

Statoil

Content

- Renewable Energy in:
  - Statoil's Strategy
  - Statoil's climate roadmap
- Statoil position in offshore wind
- Floating offshore wind
- The Hywind development
  - Hywind demo
  - Hywind Scotland

Where are the next floating wind opportunities?

Utilities

Why floating wind?

- Security of supply
- Limited space
- Sustainability

Big cities

Why floating wind?

- Transmission
- Electrification
- Limited space

Islands

Why floating wind?

- Cost of alternatives
- Security of supply
- Limited space

Oil and gas

Why floating wind?

- Emission taxes
- Cost of fuels
- License to operate

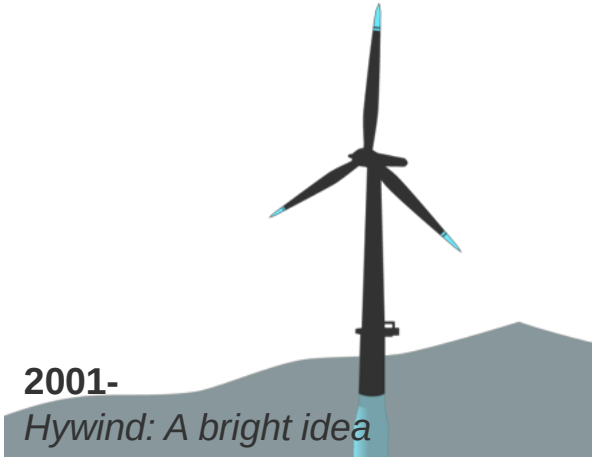
Illustration photos from Flickr.com: Moyan Brenn, Darshan Simha and Nosha. Oil and gas photo by Statoil.

Expanding the potential floating wind market

Content

- Renewable Energy in:
  - Statoil's Strategy
  - Statoil's climate roadmap
- Statoil position in offshore wind
- Floating offshore wind
- The Hywind development
  - Hywind demo
  - Hywind Scotland

Further developing the unique Hywind concept



2001-
Hywind: A bright idea

- Unique concept
- Intellectual property owned by Statoil, patented technology

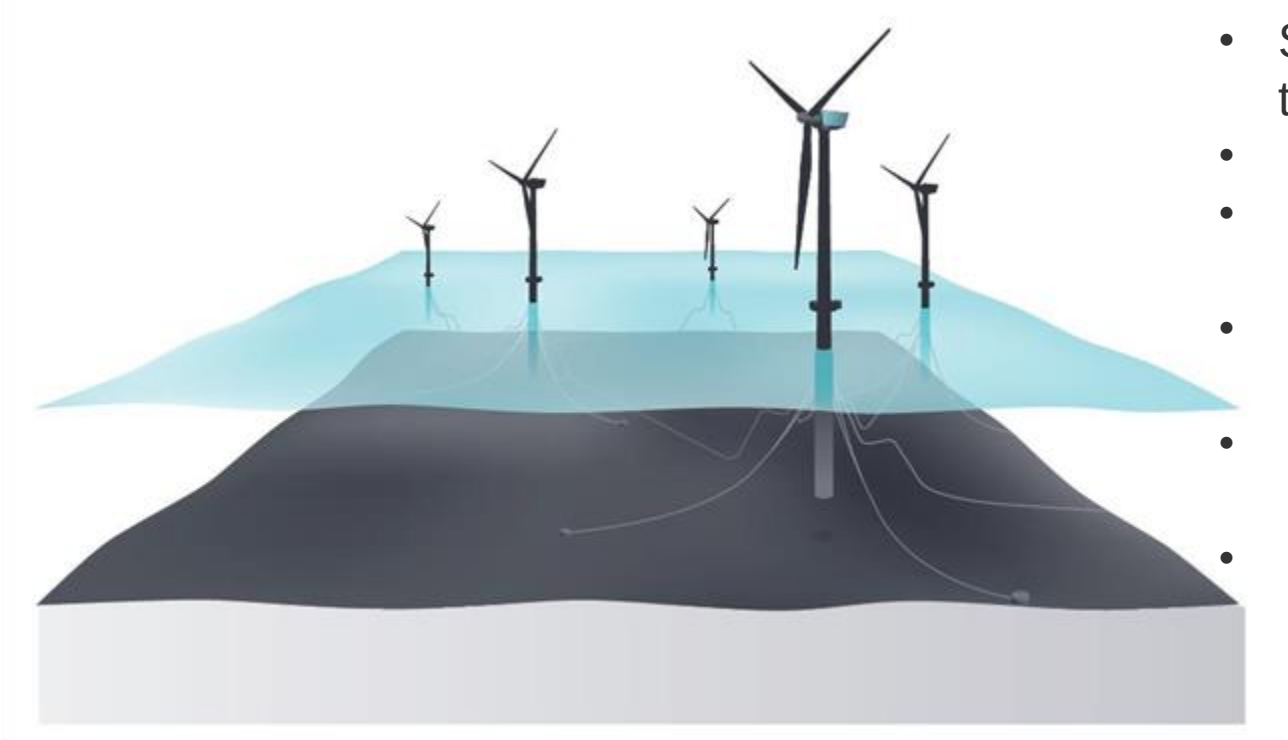
2009-
Demo: Proven in the North Sea

- Concept verified, performance beyond expectations
- Excellent production, well-functioning technical systems

2017-
Pilot park: A world's first

- Development of larger and lighter units and economies of scale
- Further improving cost competitiveness

Applying proven technology in new application



- Standard offshore wind turbine
- Spar-type substructure
- Simple structure – efficient fabrication
- Suitable for harsh conditions
- Simple 3-line mooring system
- Patented motion control reduces fatigue, increases production

Content

- Renewable Energy in:
  - Statoil's Strategy
  - Statoil's climate roadmap

- Statoil position in offshore wind
- Floating offshore wind
- The Hywind development
  - Hywind demo
  - Hywind Scotland

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

Statoil

Content

- Renewable Energy in:
  - Statoil's Strategy
  - Statoil's climate roadmap

- Statoil position in offshore wind
- Floating offshore wind
- The Hywind development
  - Hywind demo
  - Hywind Scotland

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 optimized multi-turbine concept
- Mobilize supply chain

Hywind Demo Hywind Scotland

Hywind Scotland Pilot Park

Installed capacity (5 WTGs)	30 MW
Transmission voltage	33 kV
Water depth	95-120 m
Mean waves, Hs	1.8 m
Average wind speed (@100 m)	10.1 m/s

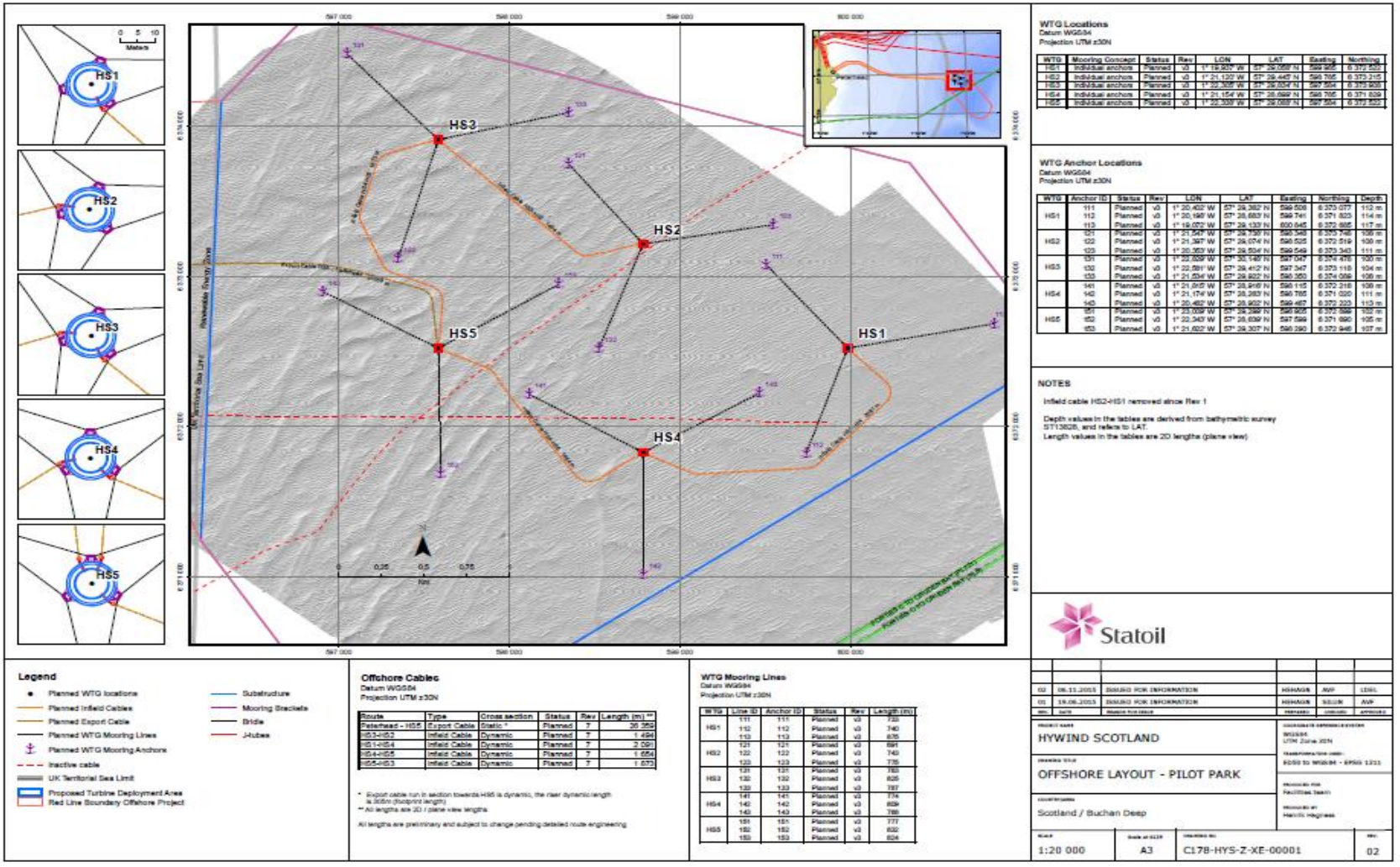
Major milestones:

Final investment decision	2015
Construction/installation	2016/2017
In operation	2017

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

Hywind Scotland – Park Layout

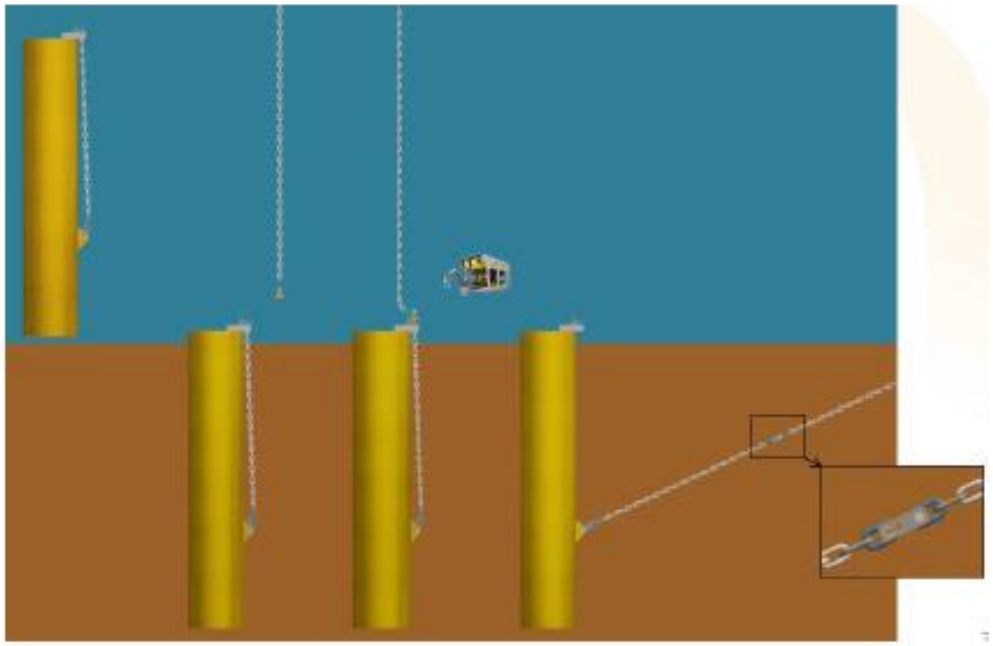


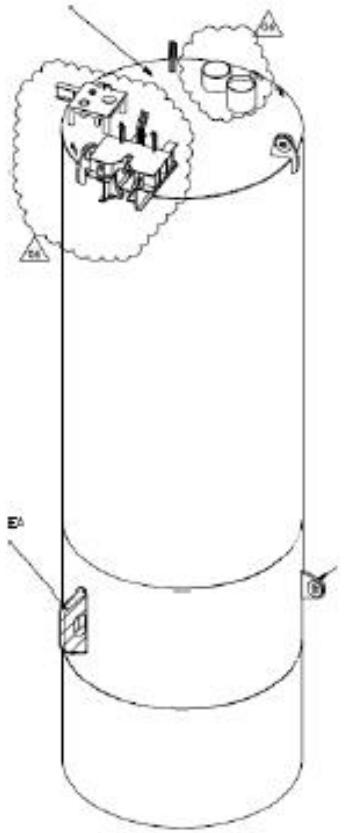
SWT-6.0-154 turbine

Rotor Diameter: 154m
Rotor Area : 18.600m^2

Mooring system pre-installation

- Separate campaign for suction anchor and bottom chain pre-installation (~100Te, 16m x 5m Ø)
- Intermediate chain and pre-tensioning

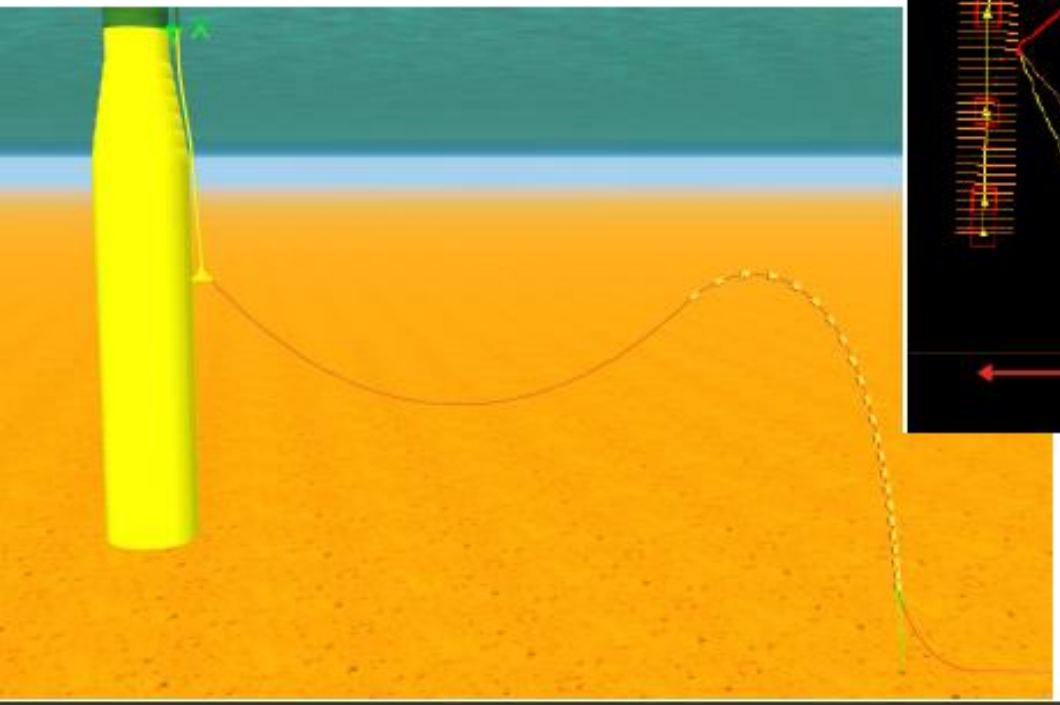


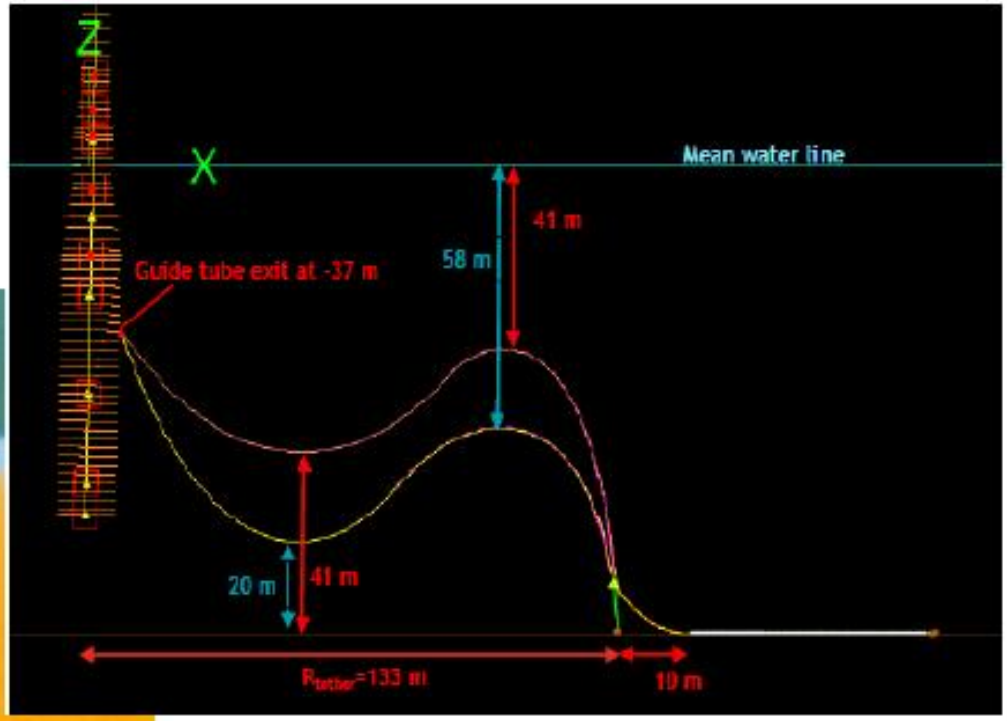


Statoil

Dynamic riser configuration

Pliant wave design





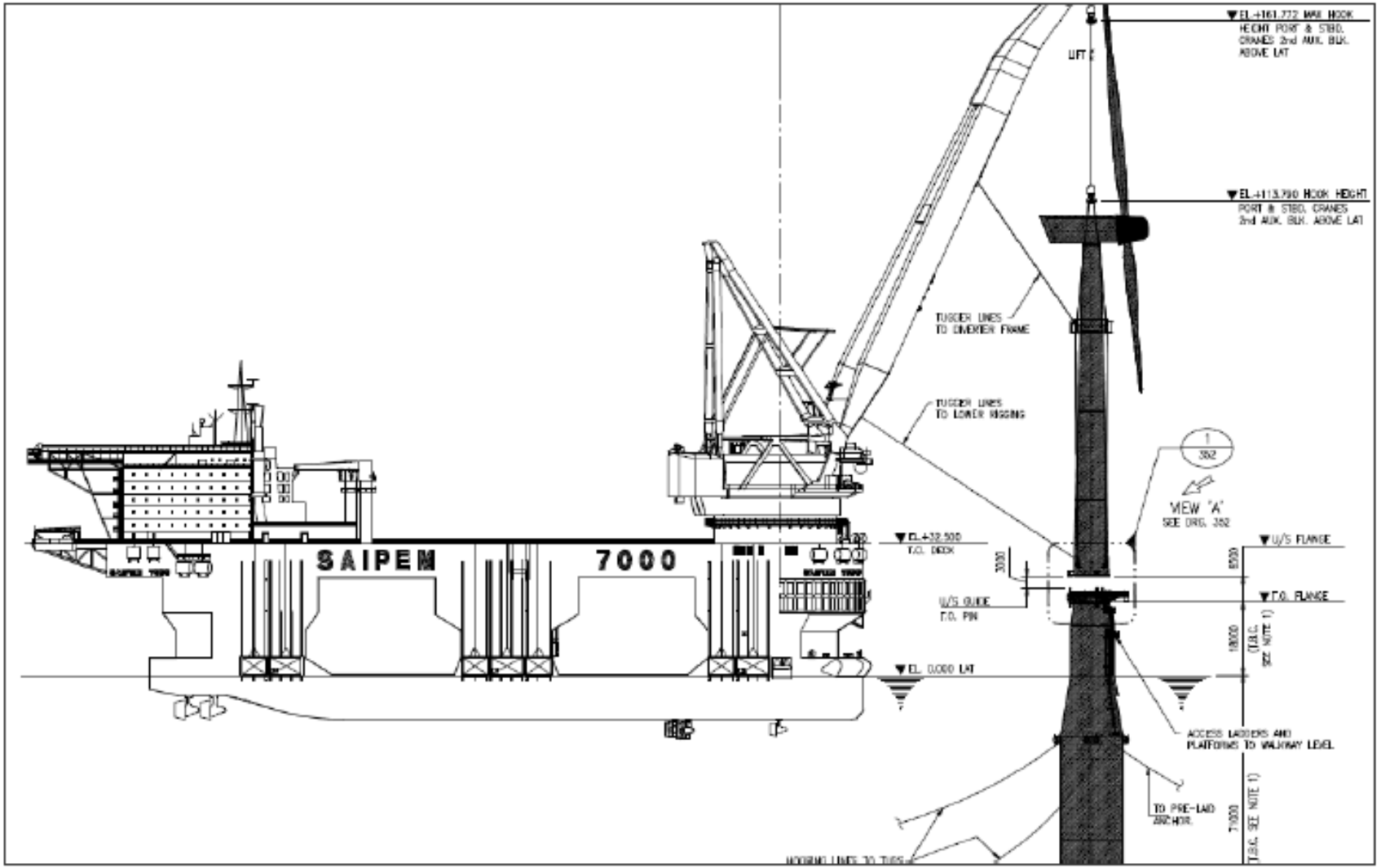
Statoil

Hywind – WTG and tower assembly on shore

Upscaling effects

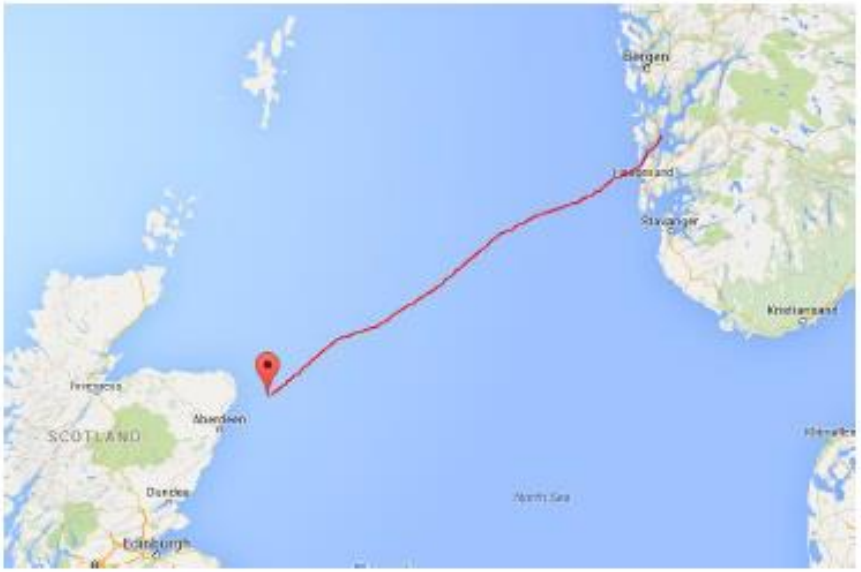
- Fabrication
  - Increased diameter of the substructure is an important challenge for the fabrication
- Marine operations, assembly site
  - Lifting heigth increased significantly
  - Available vessels to install under floating conditions very limited
  - The operation related to lifting from a floating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

Mating



Tow to field & hook-up

- 4 days at 3-knot speed per WTG
- Model tests performed to check VIM
- Hook-up performed simulatenously as the next WTG is towed out



Hywind Scotland - Status

Statoil

Statoil. The Power of Possible

Presentation title

Presenters name/title, etc

www.statoil.com

Statoil