



Statoil

# Next Steps in Offshore Wind

## Lillehammer Energy Claims Conference

Halvor Hoen Hersleth – New Energy Solutions - Statoil



Statoil

# Shaping the future of energy

Competitive  
at all times

Transforming the  
oil and gas industry

Providing energy for  
a low carbon future



# NES Strategy Roadmap – Innovation Required to Deliver Ambitions

## Safe and efficient operations

Ensure focus on safety, integrity and commerciality

## A profitable renewables business

Build a robust portfolio

Always safe  
High value  
Low carbon

## Low carbon opportunities

Based on Natural Gas and CCS

## New business models

Emerging new businesses

# Offshore Wind - Building On Our Oil and Gas Competence

SAFETY IS  
OUR FIRST  
PRIORITY



LARGE  
COMPLEX  
PROJECTS



MARINE  
OPERATIONS



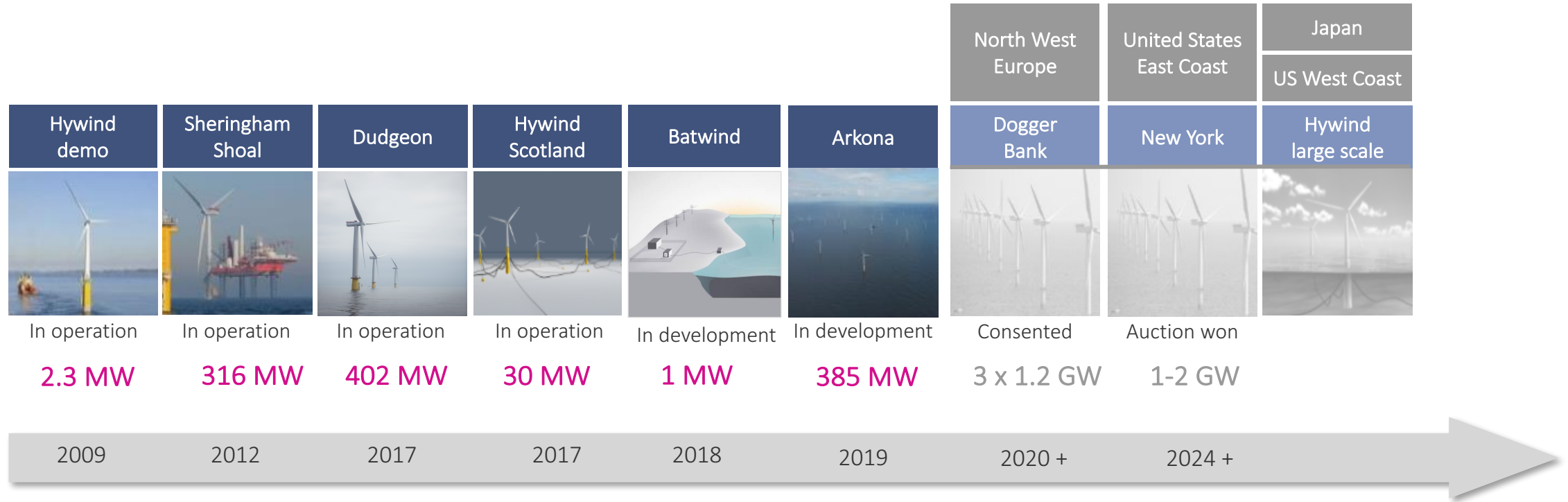
LEVERAGE  
GLOBAL SUPPLY  
CHAIN



TECHNOLOGY  
AND  
INNOVATION



# Offshore Wind – Rapid Expansion



\* All capacity figures on 100% basis

# Offshore Wind – Major Cost Reductions

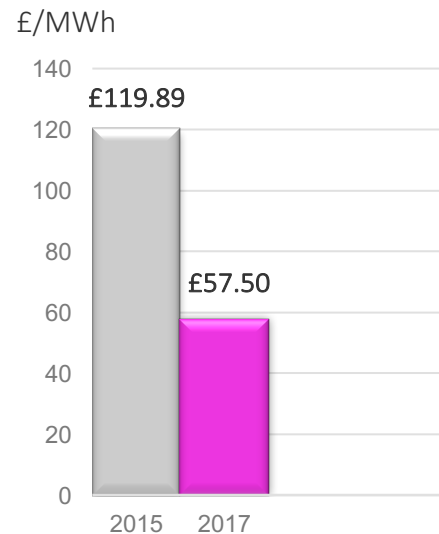
## Dudgeon cost reductions



Cost reductions from estimated £ 1.5 billion to £ 1.25 billion

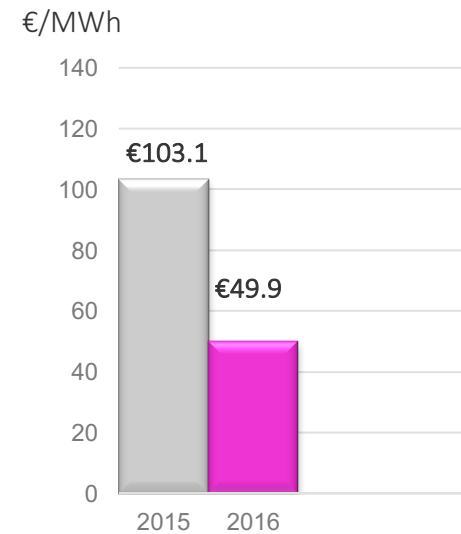
## UK CfD auctions

Auction prices reduced with 52% from 2015 to 2017

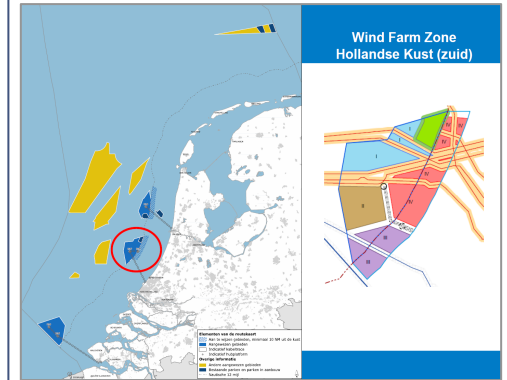


## Danish auctions

Auction prices reduced with 52% from 2015 to 2016



## Hollandse Kust



ZERO SUBSIDY

# What is Hywind?

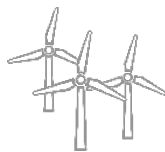
- A standard offshore wind turbine placed on a ballasted steel substructure and anchored to the seabed
  - Conventional technology used in a new way
  - Simple substructure construction that enables mass production
  - Inshore assembly reduces time and risk of offshore operations
  - Beneficial motion characteristics and blade pitch control to dampen out motions
- Statoil owned technology



2001  
The idea



2009  
The demo



2017  
The world's first  
floating wind park



# Hywind Scotland

	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)	10.1 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 (no OFTO)
Grid connection	Peterhead, Grange
Mooring	Pre-laid chains
Anchor	Suction
Operational base	Peterhead
Lifetime/TQP	20/5 years





# Hywind Scotland – Main 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
- Test, verify and further develop the Hywind motion controller (EMC) for a larger turbine
- Develop, test and verify a developed motion controller using individual pitch to control yaw motions



Hywind Demo

Hywind Scotland

# Hywind Scotland – Project Execution

**Fabrication**



**Transport**



**Assembly**



**Mating**



**Tow**



**Anchoring**



# Hywind Scotland – Immediate Success

- Project delivered on time and without serious incidents
- Successful commissioning and start-up
- Opening in Scotland 18.10
- Handover to operations 15.11
- Production and performance exceeding expectations



Hywind Demo

Hywind Scotland

# Hywind Scotland – Generation

Month	Generation vs. Budget	Wind Speed vs. Expected	Availability vs. Budget
Nov-2017	111%	117%	97%
Dec-2017	102%	102%	101%
Jan-2018	108%	97%	108%
Feb-2018	113%	104%	109%

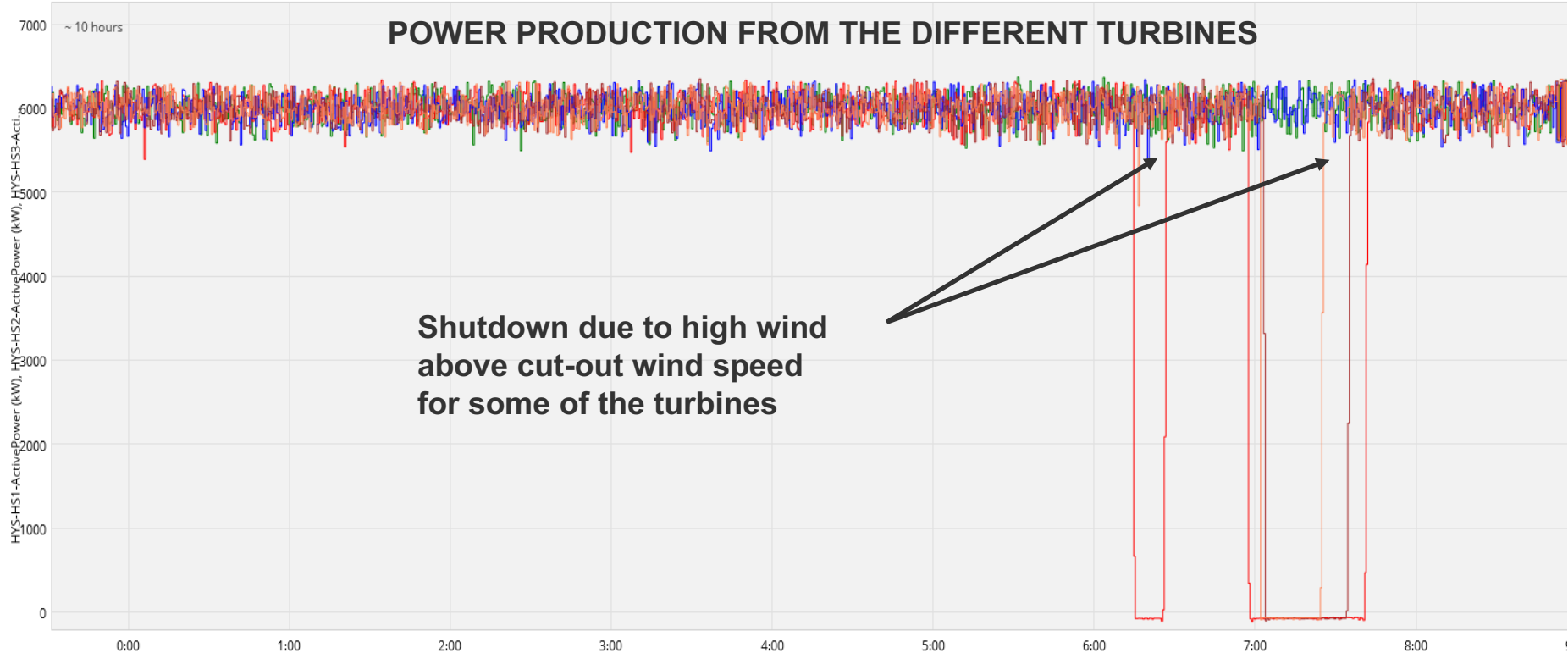
### Extreme weather

- Recorded 80 mph (125 km/per hr) gusts of wind during Storm Ophelia
- These wind speeds were surpassed during Storm Caroline in early December: gusts in excess of 100 mph (160 km/per hr) and waves in excess of 8m.

# Hywind Scotland – Extreme Weather

Trend From: 2017-10-16 23:31:39 To: 2017-10-17 09:01:46 Apply Now \*

Realtime + + + + + +  
 Cursor Zoom Tag list Data table Options

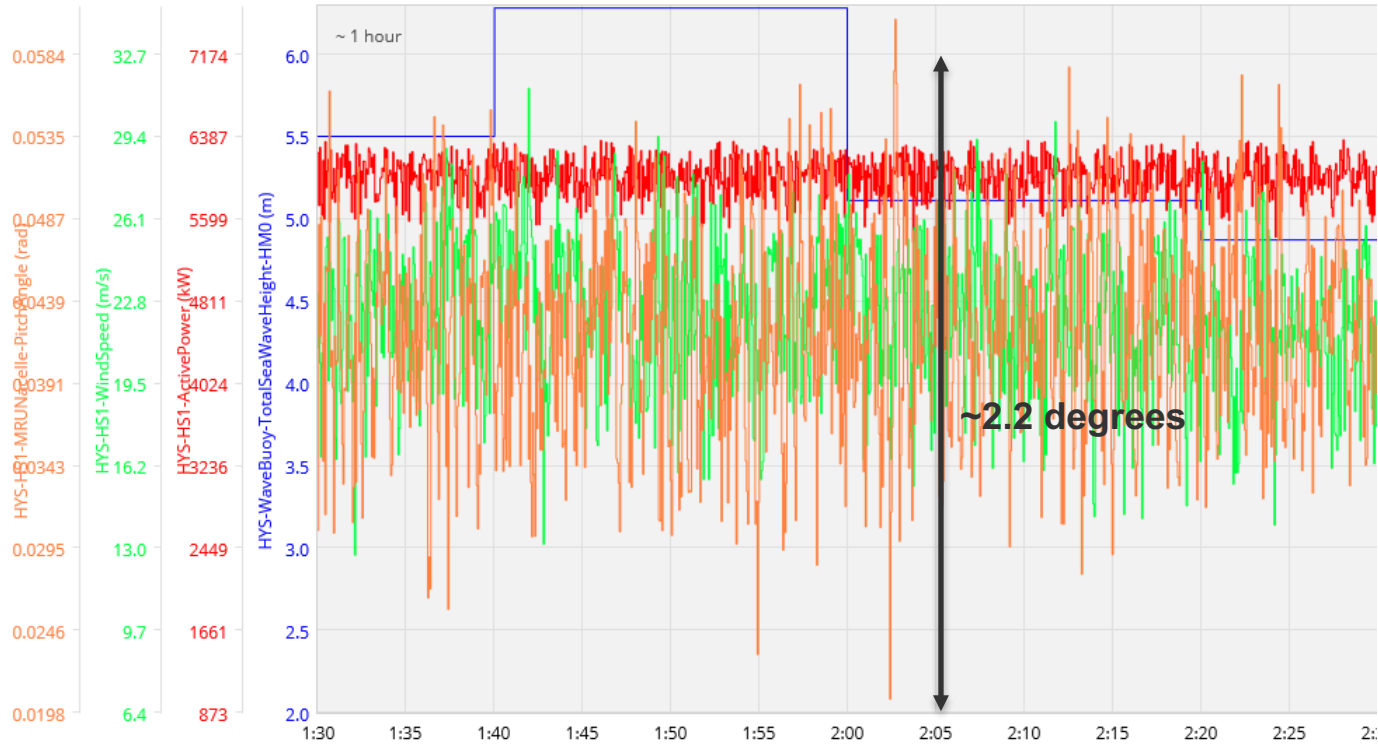


<input type="checkbox"/>	Tag Name	Aggregate	# Pts/Int.	Value	Unit	Timestamp	Quality	Description
<input checked="" type="checkbox"/>	HYS-HS1-ActivePower	Interpolative	1000	6169.2000...	kW	2017-10-17 09:01:43.170	Good	Active Power Production
<input checked="" type="checkbox"/>	HYS-HS2-ActivePower	Interpolative	1000	6318.4000...	kW	2017-10-17 09:01:35.165	Good	Active Power Production
<input checked="" type="checkbox"/>	HYS-HS3-ActivePower	Interpolative	1000	5871.7000...	kW	2017-10-17 09:01:39.167	Good	Active Power Production
<input checked="" type="checkbox"/>	HYS-HS4-ActivePower	Interpolative	1000	5911	kW	2017-10-17 09:01:40.178	Good	Active Power Production
<input checked="" type="checkbox"/>	HYS-HS5-ActivePower	Interpolative	1000	6109	kW	2017-10-17 09:01:37.165	Good	Active Power Production

# Hywind Scotland – Extreme Weather HS1

Trend From: 2018-01-15 01:30:00 To: 2018-01-15 02:30:00 Apply Now \*

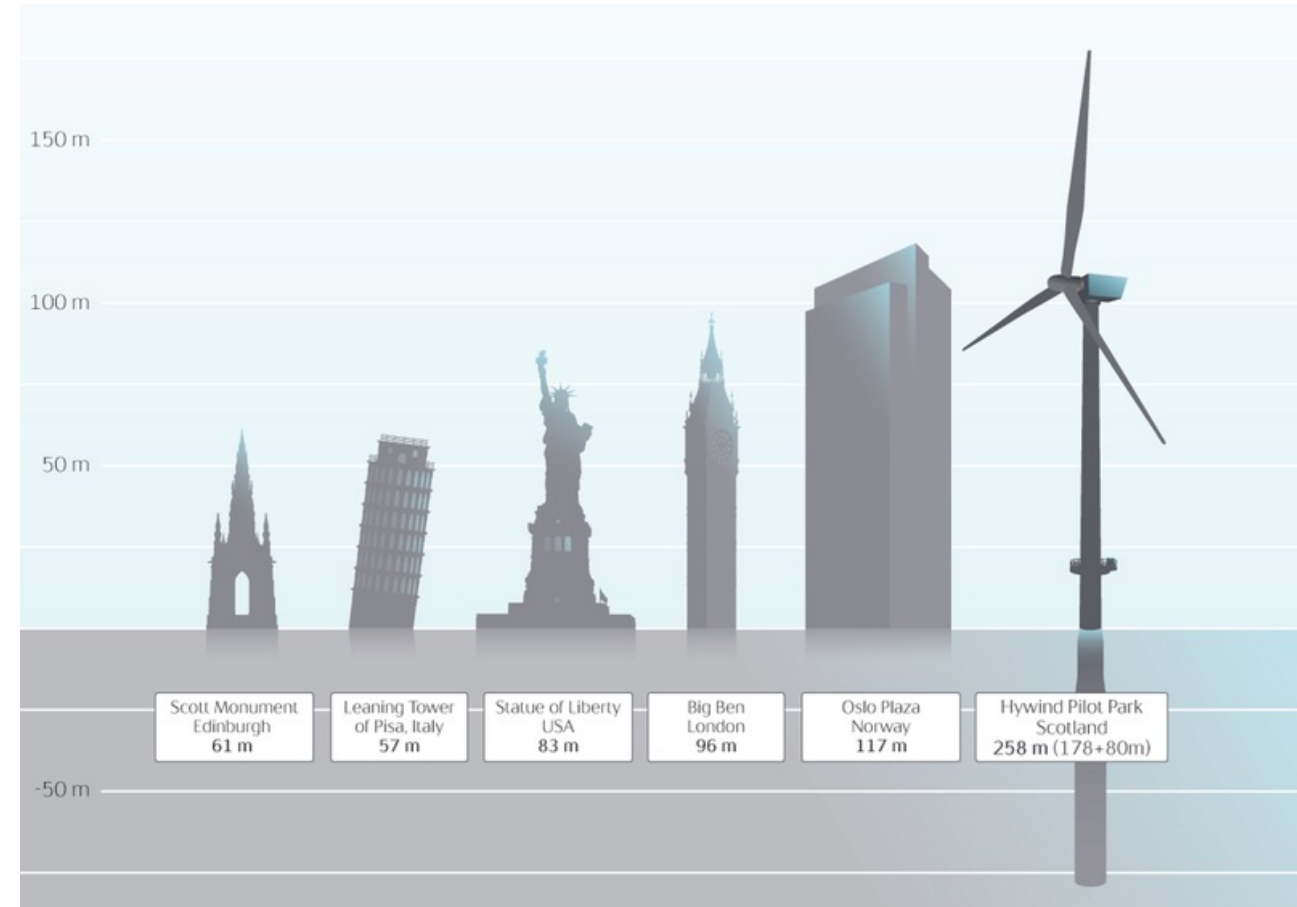
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 Realtime Cursor Zoom Tag list Data table Options



<input type="checkbox"/>	Tag Name	Aggregate	# Pts/Int.	Value	Unit	Timestamp	Quality
<input checked="" type="checkbox"/>	HYS-WaveBuoy-TotalSeaWaveHeight-...	Interpolative	1000		m		
<input checked="" type="checkbox"/>	HYS-HS1-ActivePower	Interpolative	1000		kW		
<input checked="" type="checkbox"/>	HYS-HS1-WindSpeed	Interpolative	1000		m/s		
<input checked="" type="checkbox"/>	HYS-HS1-MRUNacelle-PitchAngle	Interpolative	1000		rad		

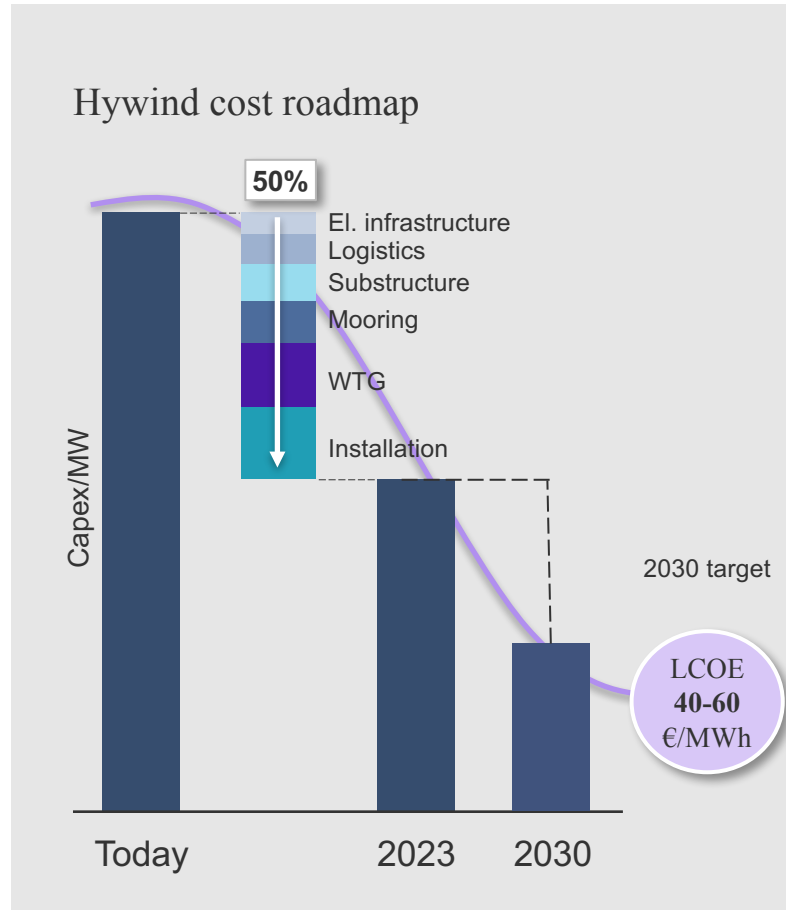
# Hywind Scotland – Next Steps

- Power production for 20 000 households
- Optimize operations
  - Production
  - Cost
- Test, qualify and develop the technology
- Input to ongoing and new projects



# Next Step for Hywind – Lead Floating Wind to Industrial Scale

## Cost

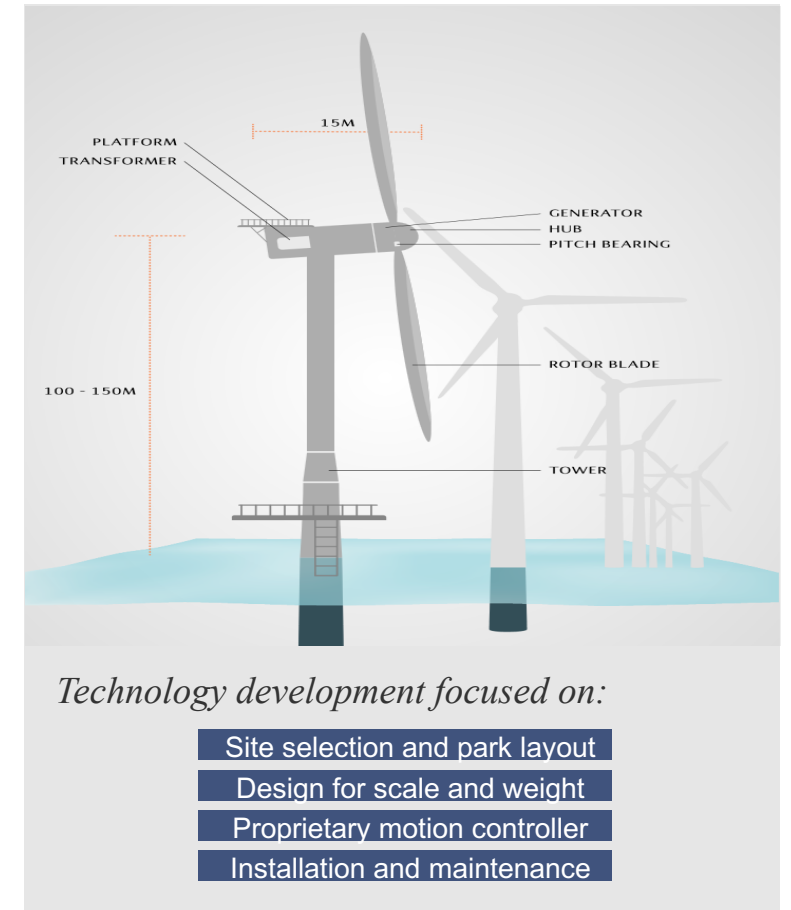


## Deployment

Scalability critical for market success  
Supply chain mobilisation

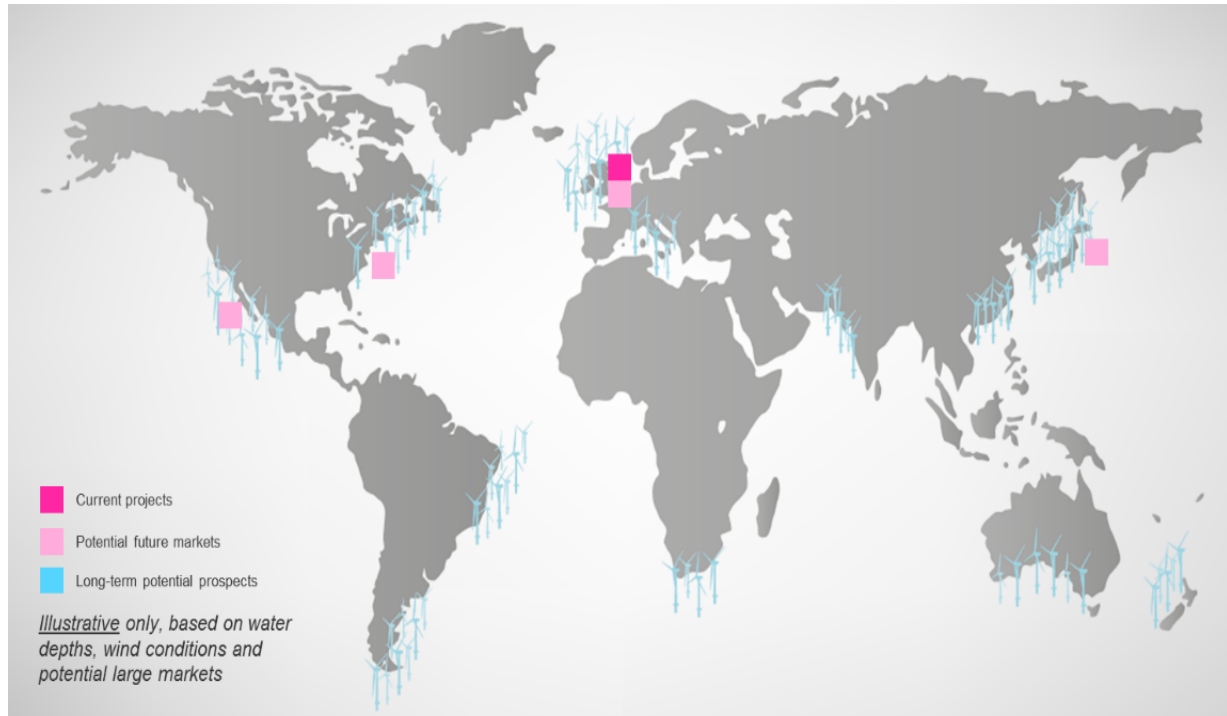


## Concept development





# Vast Potential for Floating Offshore Wind



## Size of the prize

12 GW in 2030

## Expected LCOE

40 – 60 €/MWH by 2030

## The big four

US West Coast

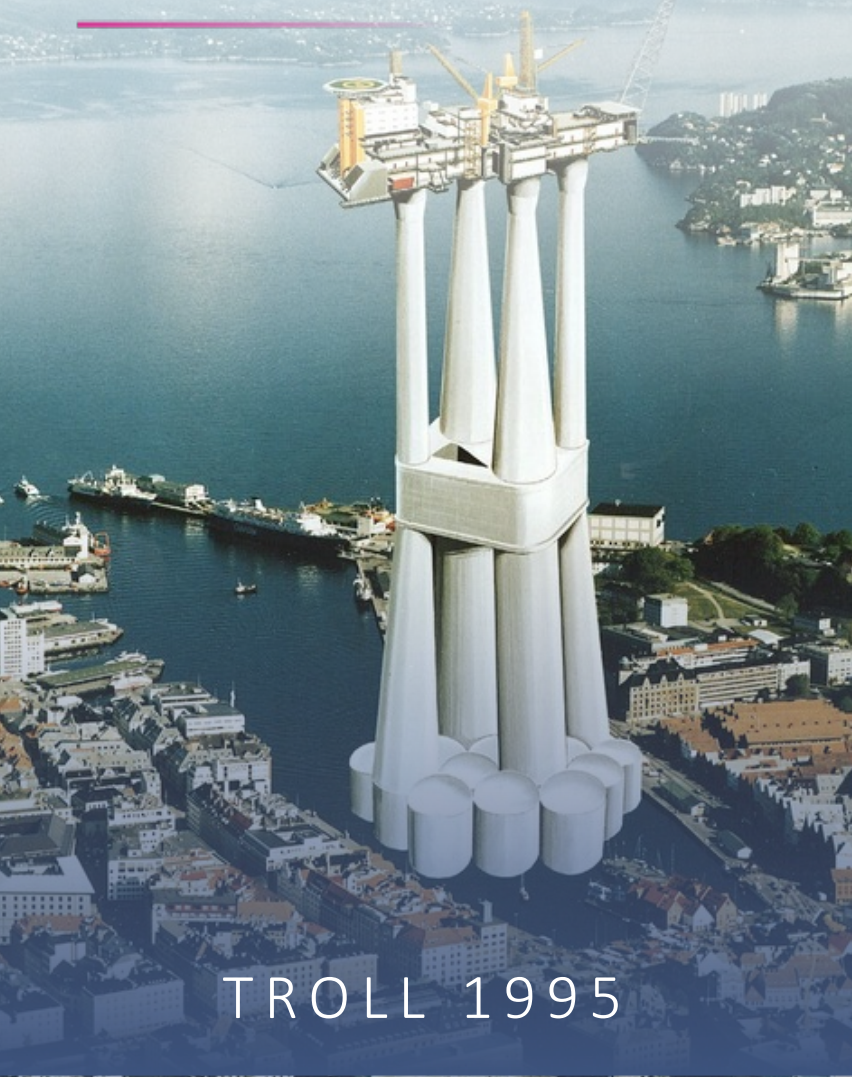
Japan

France

Scotland/Ireland



# Energy transition is a journey...



Statoil. The Power of Possible

*Halvor Hoen Hersleth  
Plant Manager  
Hywind Scotland Pilot Park  
Statoil*

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