Floating Wind & Geo-industrial Factors

Bergen Wind Academy – 20.06.2024

Philip van Heesch, Equinor Insurance

A big thank you to all those who have supported us in the Energy Transition, and it has only just started!

RENEWABLE PORTFOLIO

Solid progress towards 2030 ambitions

Our projects and pipeline[1]

Installed 900 MW

- Arkona
- Dudgeon
- Hywind Scotland
- Hywind Tampen
- Sheringham Shoal
- Apodi
- Stępień (Wento)
- Zagórzyca (Wento)
- Wilko (Wento)
- Serra da Babilônia (Rio Energy)
- Blandford Road (Noriker Power)

Illustration from CMU

Under construction 1.7 GW

- Dogger Bank A
- Dogger Bank B
- Dogger Bank C
- Mendubim
- Lipno (Wento)
- Welkin Mill (Noriker Power)

- Offshore wind
- Onshore solar
- Onshore wind
- Storage
- Onshore multi-tech

Opportunity pipeline >20 GW

- Atlas Wind 2GW
- Bałtyk I, II, & III
- Bandibuli 750 MW
- Dogger Bank D
- Donghae 1
- Empire Wind 1&2
- Sheringham S. & Dudgeon Ext.
- Rio Energy (solar, wind)
- Wento (solar, wind, storage)
- East Point Energy
- Noriker Power
- BeGreen

High value

12-16
PERCENT
Nominal equity return[2]

4-8
PERCENT
Real base project return[3]

~ 3
BN USD
CFFO from REN and LCS in 2030[4]

2024 outlook

2.5
GIGAWATT
For FID in 2024[5]

1.5
GIGAWATT
Under construction

>4
TWH PRODUCTION
Doubling from 2023

1. List not exhaustive. Equinor share
2. Nominal equity returns are full-cycle not including any future farm-downs. Projects include Dogger Bank ABC, US East Coast and solar plants in Europe with start-up in 2023
3. Internal rate of return after tax, full-cycle, excluding effects from farm downs and project financing
4. REN & LCS indicative cash flow from operations after tax. net to Equinor
5. Equinor share

Floating wind – concept & technology toolbox

Hywind Demo 2.3MW

Hywind Scotland 6MW

Hywind Tampen 8.6MW

Wind semi 15MW

- Korea
- Spain
- France
- California

Floating substation

Hywind XL

Wind Semi XL ~18-22MW

Subsea Substation

2009

2017

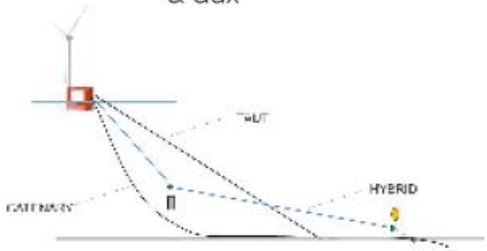
2022

2025

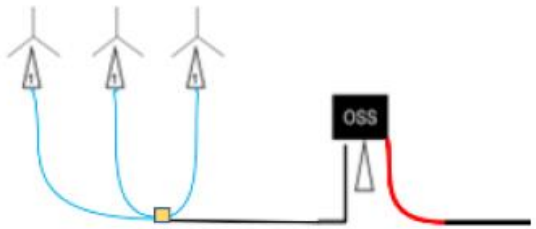
2030

ILT

Fiber hybrid mooring & aux

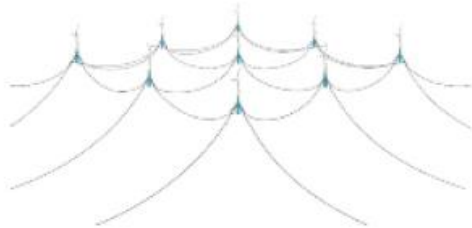


Dynamic export cable & subsea connectors



Nylon fibre mooring

Shared mooring



Maturity of the FOW industry

Will FOW design and technology influence repair costs?

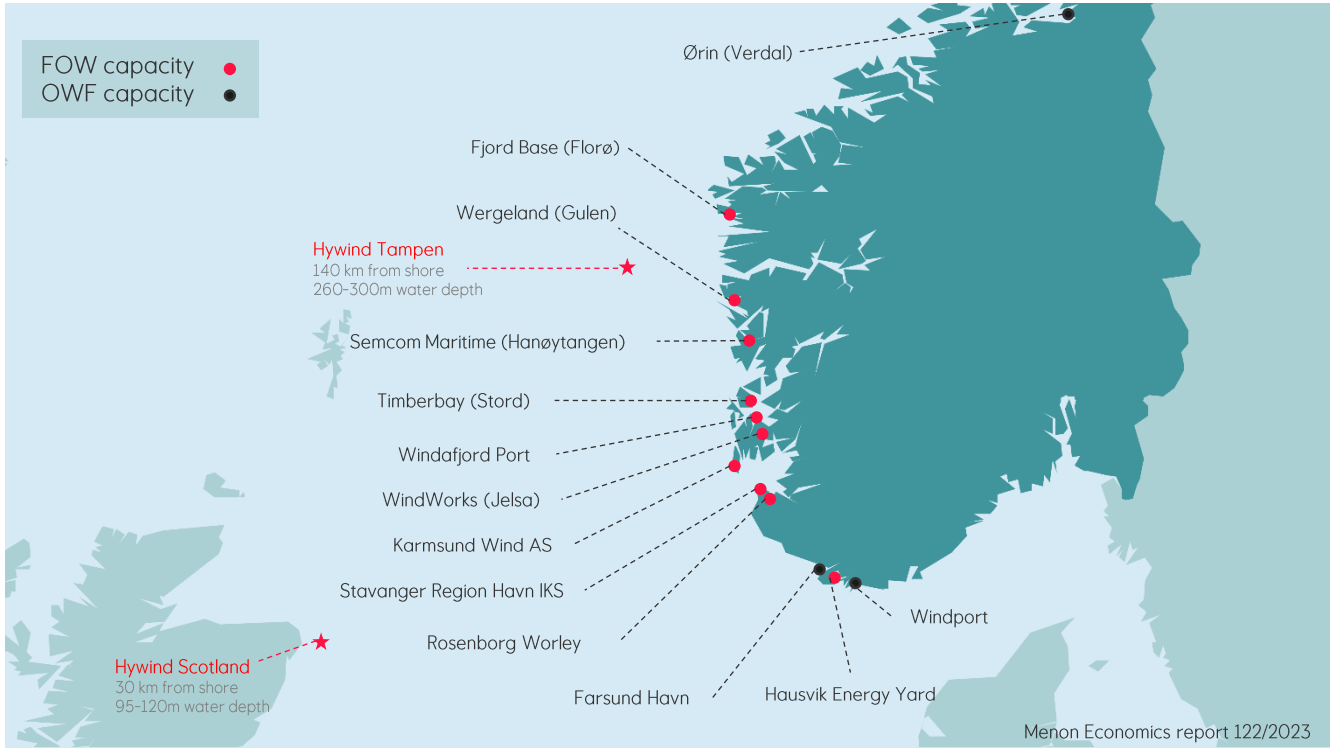
- Draft
- Maturity of local industry
- Supply chain
- Availability of vessels and cranes
- Repair contingency plans
    - O&M readiness
    - Cable repair systems

The drive for economies of scale

- 2.3MW – 6MW – 8MW
- Equinor planned 15MW turbines for Trollwind, and the same for Bandibuli/Firefly, 20.8MW for Jupiter

➢ **Can quality be maintained?**

Potential ports for offshore wind industry Norway by 2030



Improving Quality – constant focus

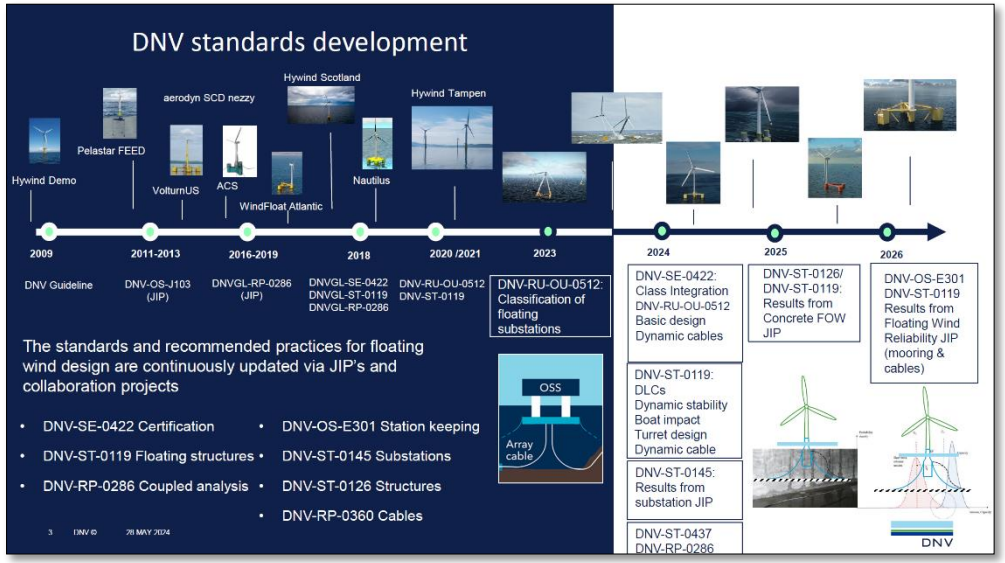
DNV estimates 18,000 WTGs (270GW) by 2050

JIP – Joint Industry Project; FOSS, supply chain, T&I, mooring and dynamic cables, site investigation and ground modelling, concrete, others.

- ST - 0119 Floating Wind Turbine Structures
- ST - 0145 Offshore Substation Standard
- ST - 0437 Loads and site conditions for wind turbines (general)
- SE - 0422 Certification of floating wind turbines (Service Specification)
- RU-OU-0512 Floating offshore wind installations

- Operator's experience / background (Hywind Demo - 2009)
- Safety in design
  - NL CO2 and pillars
  - DB access drift-off

- Is there a quality clause in the procurement contract?
- Can operator impose their testing regime on contractor?

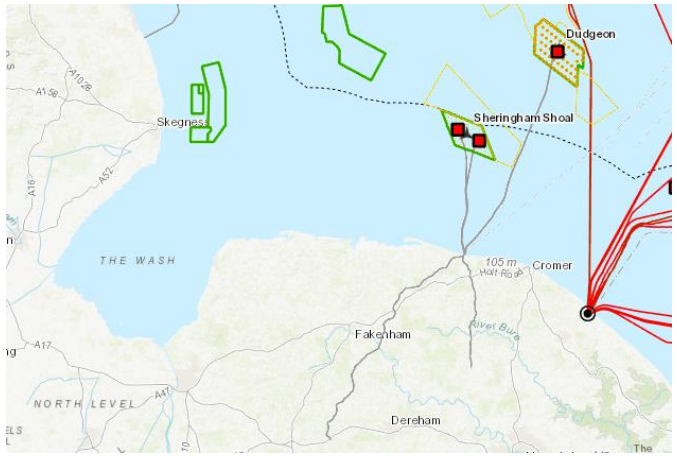


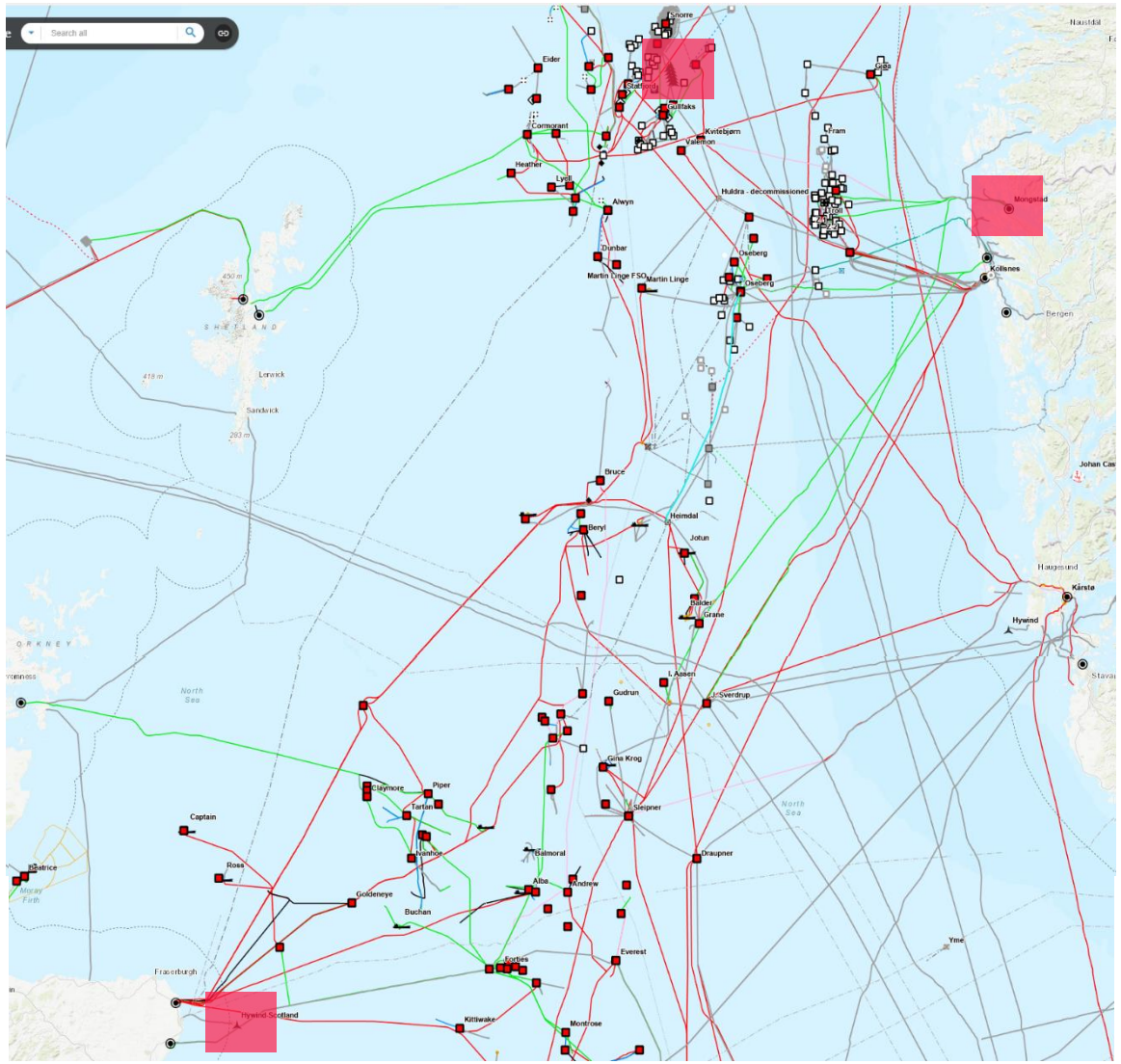
@DNV – Norsk Stålforbund conference 28.05.2024

Insurance considerations

Current FOW repair costs are expected to be greater than OWF repair for the same damage

- FOW rates are higher than OWF rates
- Little or no statistical data
- Hywind Scotland (HYS) MCR compared to Dudgeon's. One will be over the deductible; the other under.
- The HYS MCR would have been less if it was HYT, 30-40%?





Case study – Bandibuli/Firefly FOW Project

Key Facts

Capacity	750 MW (50x15 MW)
Foundation	Steel semi-sub w/4 mooring lines
O&M base	Onshore (~70 km)
Water depth	150–300 m
Wind speed	8.5 m/s

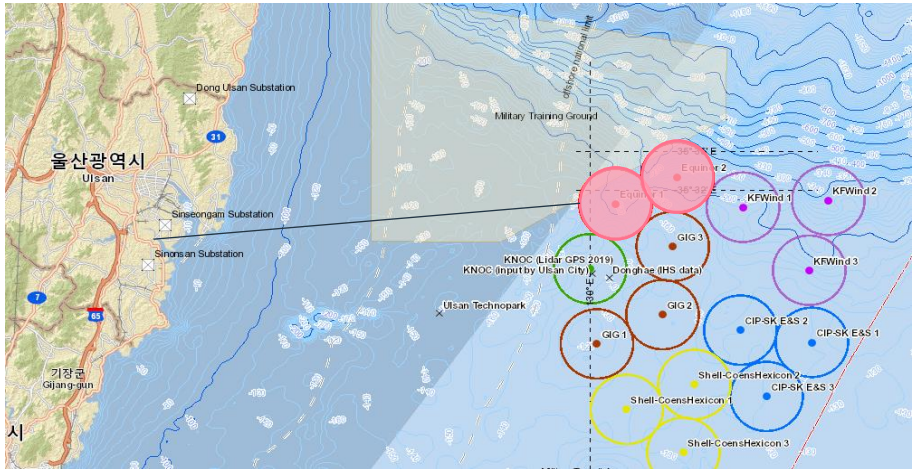
Business case

- Two Flidars deployed June 2020
- Grid study ongoing
- EBL (Electric Business License) obtained 2021
- EIA (Environmental Impact Assessment) initiated
- 100% Equinor (Korean partner expected)

Timeline

Project Location

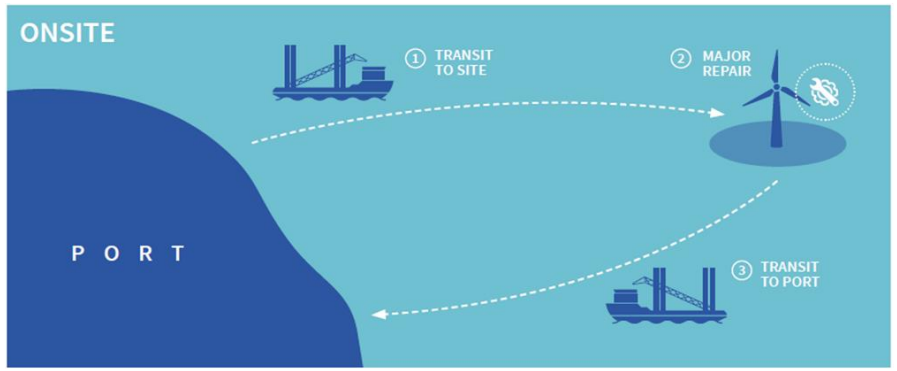
Wind farm located in a 2 x 75 km2 area ca. 70 km off the city of Ulsan, South Korea



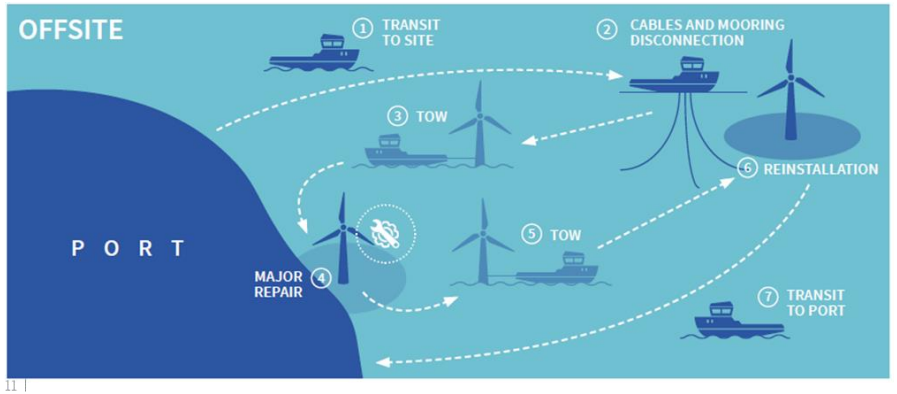
Commercial structure (subject to change)

Costing Exercise Bottom Fixed (BF) versus Floating (FOW)

- Bottom fixed component exchange done with HLV
- Floating Major Component Repair (MCR) with tow-to-shore principle
- Not considered any campaign based MCR, but only a single MCR for BF and FOW
- Availability impact not assessed
- FOW vessel rates assumptions based on Firefly/Bandibuli
- BF HLV rate assumed local



Onsite (Heavy lift vessel) repair



Offsite (tow-to-port) repair

Cost picture (mill USD, real 2023) - 57% increase

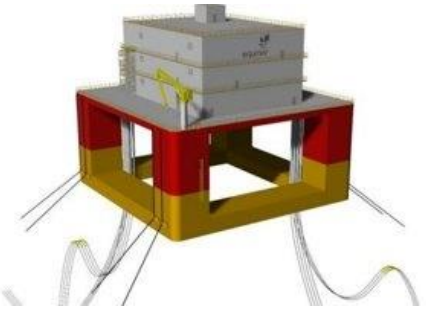
Floating (assuming jack-up barge):

Vessel Type	Mob/demob time	Weather time	Repair time	Charter days	Mob/demob cost	Logistics cost per MCR
Lead AHT	2	3	18	23	-	2.3
Trailing AHT	2	3	18	23	-	2.3
Harbour Tug #1	2	3	18	23	-	0.3
Harbour Tug #2	2	3	18	23	-	0.3
Jack-Up Barge	0	3	4	7	4.1	5.0
Total MCR Cost						**10.2**

Bottom-fixed (assuming HLV):

	Mob/demob time	Weather time	Repair time	Charter days	Mob/demob cost	Logistics cost per MCR
Total MCR Cost	0	3	4	7	4.2	**6.5**

Recent calculations indicate lower cost compared to OWF



Concluding remarks

Geo-industrial factors are at play

FOW industry is immature, as are our understanding of the risks

DNV, and others, are working to standardize and find risk mitigating tools

If we look at O&G technical progression, what will FOW look like in 20-30-40 years time?

This is a journey that we want to take together