Oil & Gas Authority

INTOG

Leasing Round Workshop

Aberdeen

17th of March, 2022

DeepWind

North of Scotland Offshore Wind Cluster

Programme

10.30 – Welcome and Introduction, **Paul O'Brien, DeepWind**
10.40 – The Challenge - Net Zero, **Carlo Procaccini, OGA**
11.00 - INTOG leasing round, **Sarah Knight, Crown Estate Scotland**
11.20 - Floating Wind for Avalon FPSO, **Charles Taylor, Ping Petroleum**
11.40 - Central North Sea Electrification project update, **Arjit Gupta, Shell**
12.00 - Panel session 1 and Q&A
12.30 - Networking lunch
13.30 - INTOG Energy Systems Solutions – **Graeme Rogerson, NZTC**
13.50 - Energy Pathfinder – **Bill Cattanach and Sylvia Buchan, OGA**
14.00 - INTOG - Technology showcase - 3 technology suppliers 10 minute each

a) SENSEwind technology – **Patrick Geraets, SENSEwind**
b) Hydrogen JIP – **Neil Robertson, Crondall Energy**
c) TLP Systems – **Jonathon Jury, OSI Renewables**

14.30 - Practical lessons in electrification, **Allan MacAskill, Flotation Energy**
14.50 - Commercialisation of Floating Wind, **Roger McMichael, Ocean Winds**
15.10 - Panel session 2 & Q&A
15.25 - Closing remarks – Paul O'Brien, DeepWind
15.30 - End of programme

Membership

- Currently 699 members

- Membership Includes
  - 36 Offshore Wind Developers
  - 1 OEM Turbine Manufacturer
  - 15 Tier 1s
  - 8 Councils (Local Government)
  - 6 Universities and 3 Colleges
  - 26 ports and harbours
  - 4 Associations- IMCA, AREG, Decom North Sea and Subsea UK
  - 600 supply chain companies from micro SMEs to multi-national companies

Largest offshore wind cluster in Europe

UK's Lead Floating Wind Cluster

INDUSTRIAL STRATEGY CLUSTER

Oil & Gas Authority

DeepWind
North of Scotland Offshore Wind Cluster

DeepWind Board Members

INDUSTRIAL STRATEGY

SSE Renewables

OW OCEAN WINDS

equinor

PORT OF CROMARTY FIRTH

cobra GRUPO

AkerSolutions

Aberdeenshire COUNCIL

subsea 7

KPL Kishorn Port Ltd

ONE OPPORTUNITY NORTH EAST

GLOBAL ENERGY GROUP

Scottish Enterprise

HIE Highlands and Islands Enterprise Iomairt na Gàidhealtachd 's nan Eilean

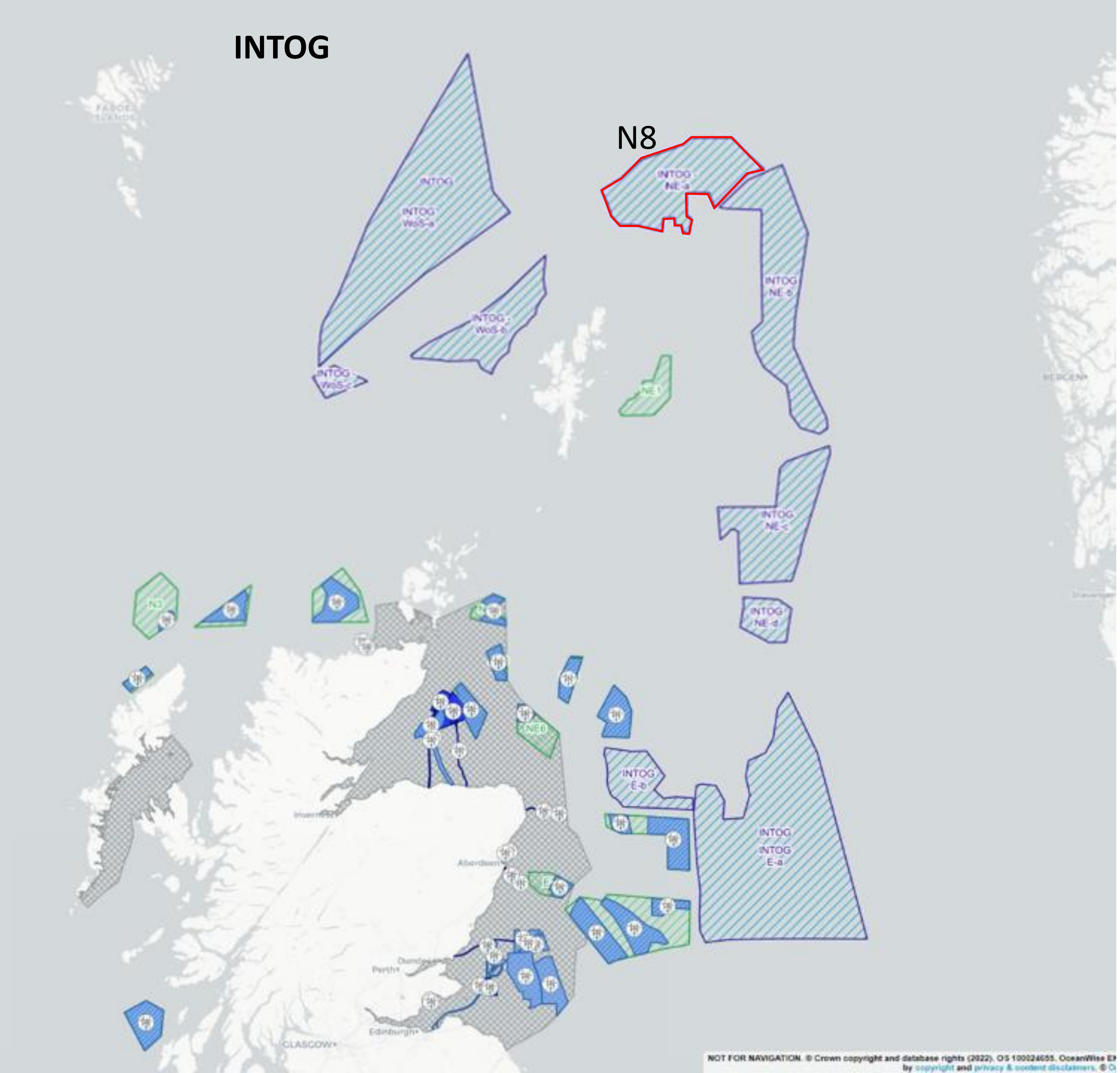
The Highland Council Comhairle na Gàidhealtachd

CIP Copenhagen Infrastructure Partners

University of the Highlands and Islands Oilthigh na Gàidhealtachd agus nan Eilean

Oil & Gas Authority

DeepWind North of Scotland Offshore Wind Cluster



INDUSTRIAL STRATEGY

Large scale wind to hydrogen or P2X projects

N8 was identified by Marine Scotland back in 2018 as part of the early stages of the ScotWind round

It is now included in the INTOG round as NEa

This is the size of site required to deliver large scale Power2X projects for the Scottish Government's 25GW H2 installed generation ambition for 2045

DeepWind
North of Scotland Offshore Wind Cluster

Oil and Gas Authority

Carlo Procaccini

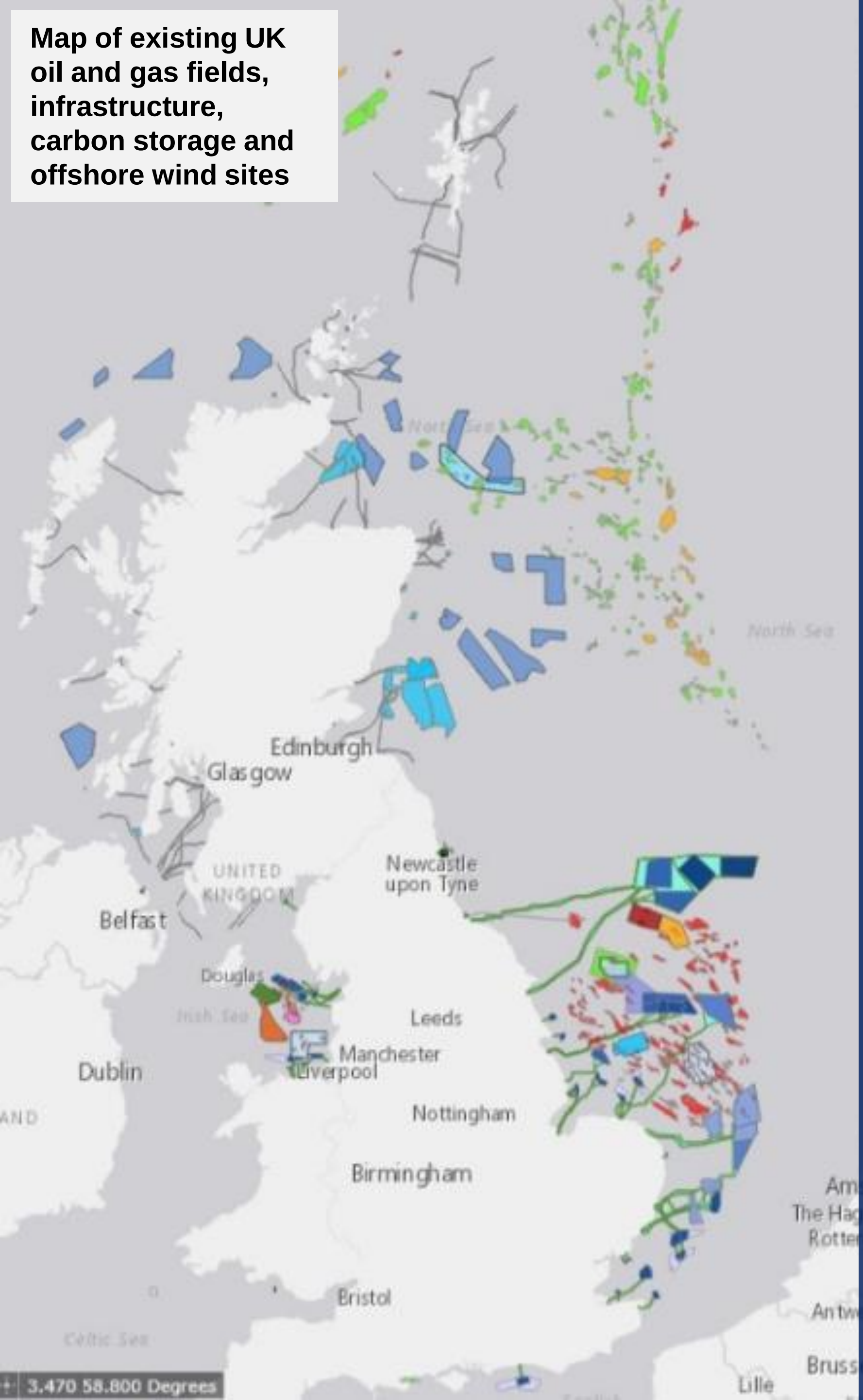
Oil & Gas Authority

The Need for Electrification

Carlo Procaccini

OGA Head of Technology

17 March 2022



Map of existing UK oil and gas fields, infrastructure, carbon storage and offshore wind sites

A basin in transition

290+ installations

250+ subsea systems

>2GW continuous power demand

78 $GtCO_2$

Potential CO_2 storage capacity

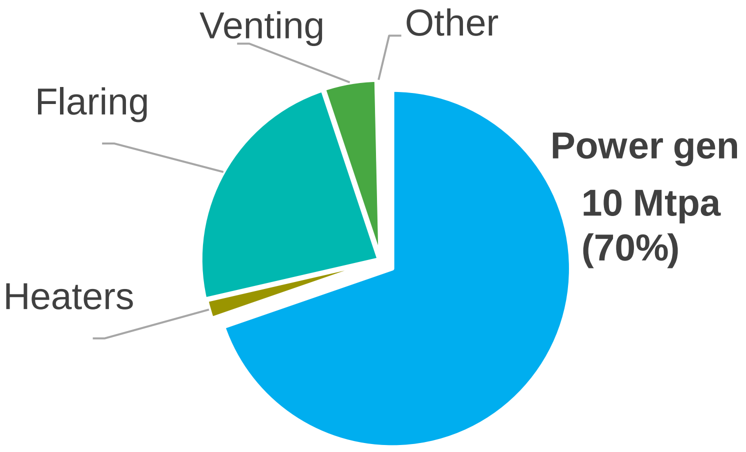
11GW offshore wind capacity,
40GW target by 2030,
70-100GW needed in 2050

200,000+

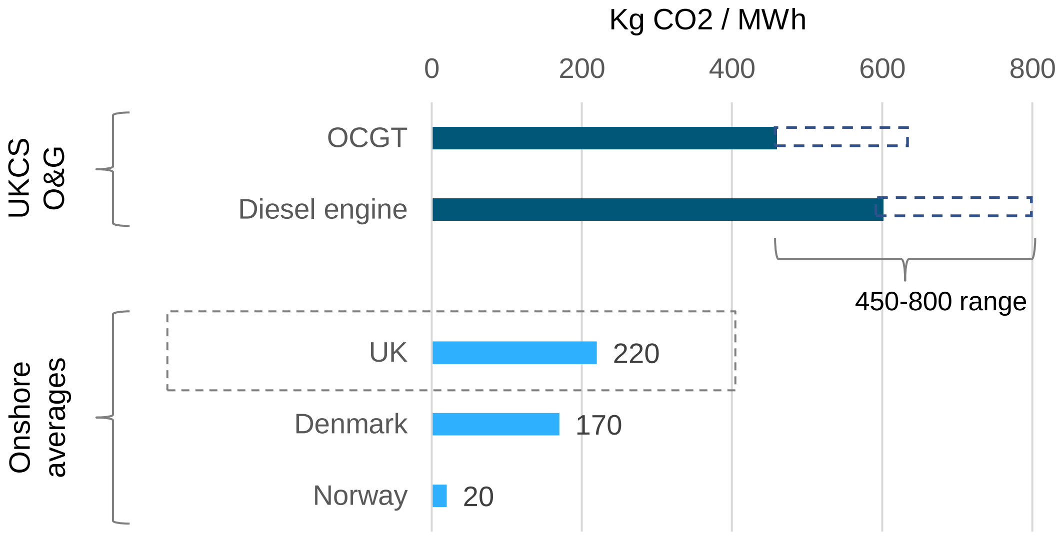
UK jobs supported

Offshore GHG emissions

Offshore O&G emissions (14MtCO_2e pa)



Power generation – emission intensity



Emissions are large on an overall UK scale:

- 4% of overall UK emissions, but…
- … nearly 16% of total UK energy supply sector[2]
- … 126% of Scotland's onshore industrial emissions[3]

Significant gap in emission intensity vs onshore:

- Estimated 450-800 KgCO2/MWh range[4]
- Depending on fuel, equipment and op. conditions
- 2x to 4x gap with average UK onshore power

1) Source EEMS 2016-18, EIP analysis 2020
2) BEIS statistics
3) SEPA reports

4) EIP analysis 2020
OCGT: Open-Cycle Gas-Turbines, generally natural gas-fired, and in widespread use on offshore O&G installations

North Sea Transition Deal

Oil & Gas Authority

Emission reduction targets

2025
-10% Emissions Reduction

2027
-25% Emissions Reduction

2030
-50% Emissions Reduction

Zero Routine Flaring

2050
Net Zero Basin

Required actions

FLARING & VENTING

- Reduce/eliminate routine flaring
- Eliminate fugitive emissions
- Increase flaring efficiency

PROCESS AND ENERGY EFFICIENCY

- Right size rotating equipment avoiding recycle
- Phase out generators spinning reserve

- Tackle emissions from power
- Regional electrification schemes (CNS, OMF and WoS)
- Power from offshore wind
- Concept select in 2022, sanction in 2024, delivery by 2027

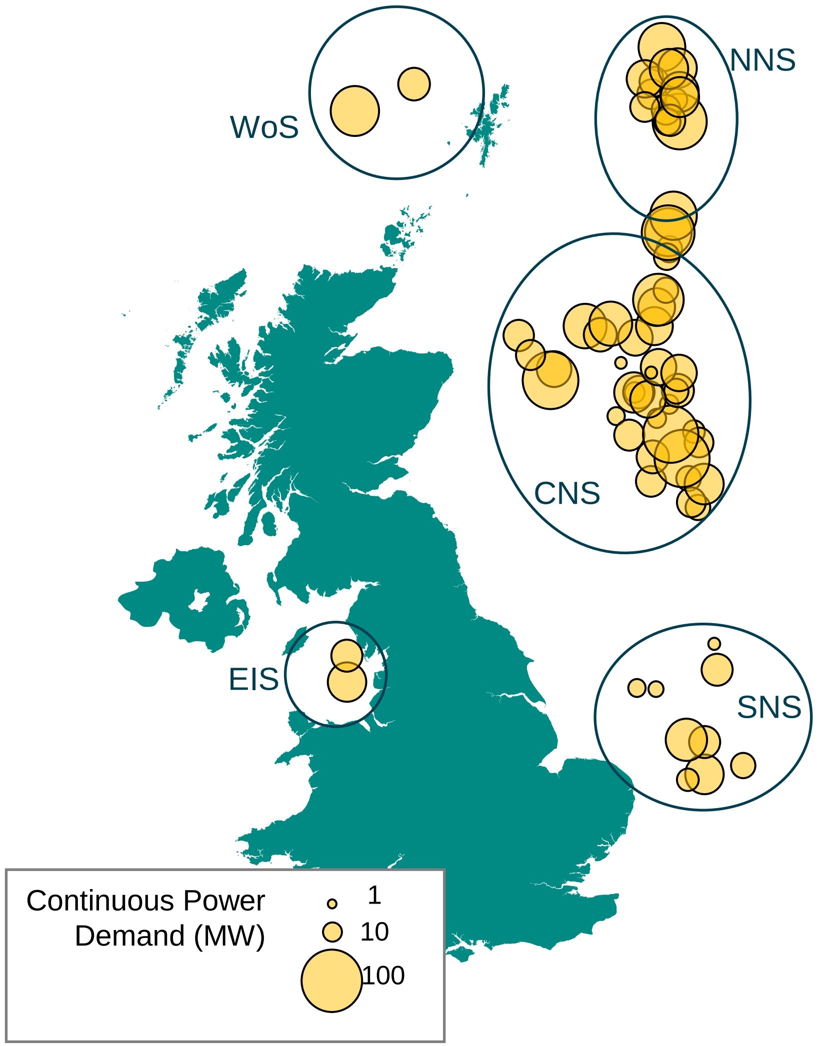
- Supporting offshore wind growth
- Co-investment in offshore transmission

- Full scale deployment of UKCS net zero solutions
- Floating windpower
- CCUS
- Hydrogen

UKCS power demand

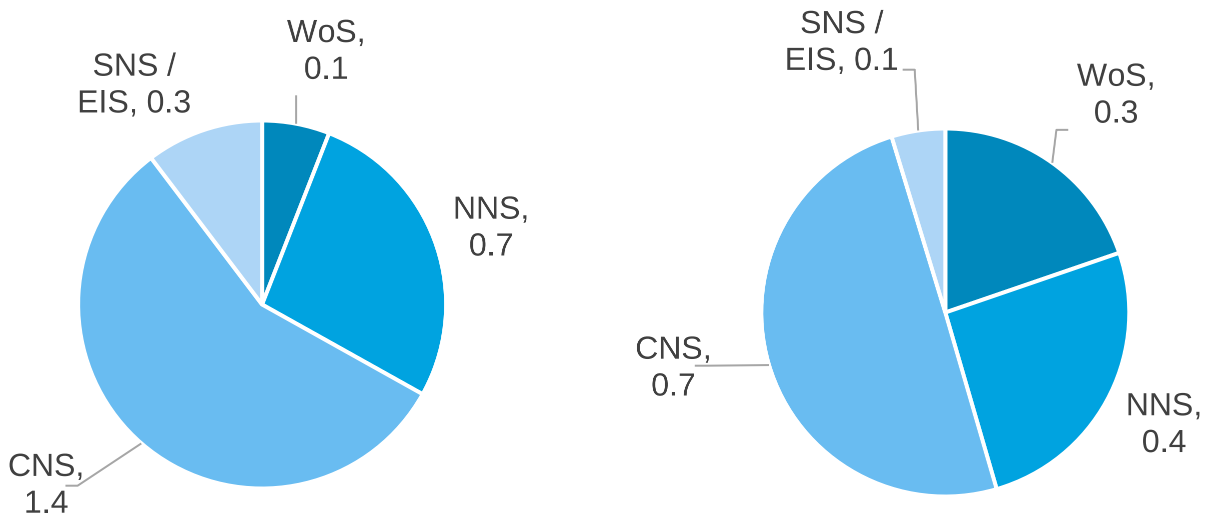
Oil & Gas Authority

Oil & gas offshore power demand



2020 continuous demand (2.5 GW)

2030 estimate (1.4 GW)



- Accounting for expected O&G decommissioning in the 2020's
- Including only new O&G developments already in the planning phase
- Therefore, 2030 demand estimate could be higher reflecting additional new projects and asset life extensions

Power estimates based on 2018 O&G installation emission data (BEIS EEMS) and typical emission intensities. Timelines of asset cessation of production and new developments from OGA UKCS Survey

Central North Sea decarbonisation

Oil & Gas Authority

Electrification requires platform longevity to justify expenditure

500+ MW continuous demand from existing could be realistically decarbonised

~2 $MtCO_2$ pa potential emission reduction

Economies of scale through multiple platforms sharing the power infrastructure

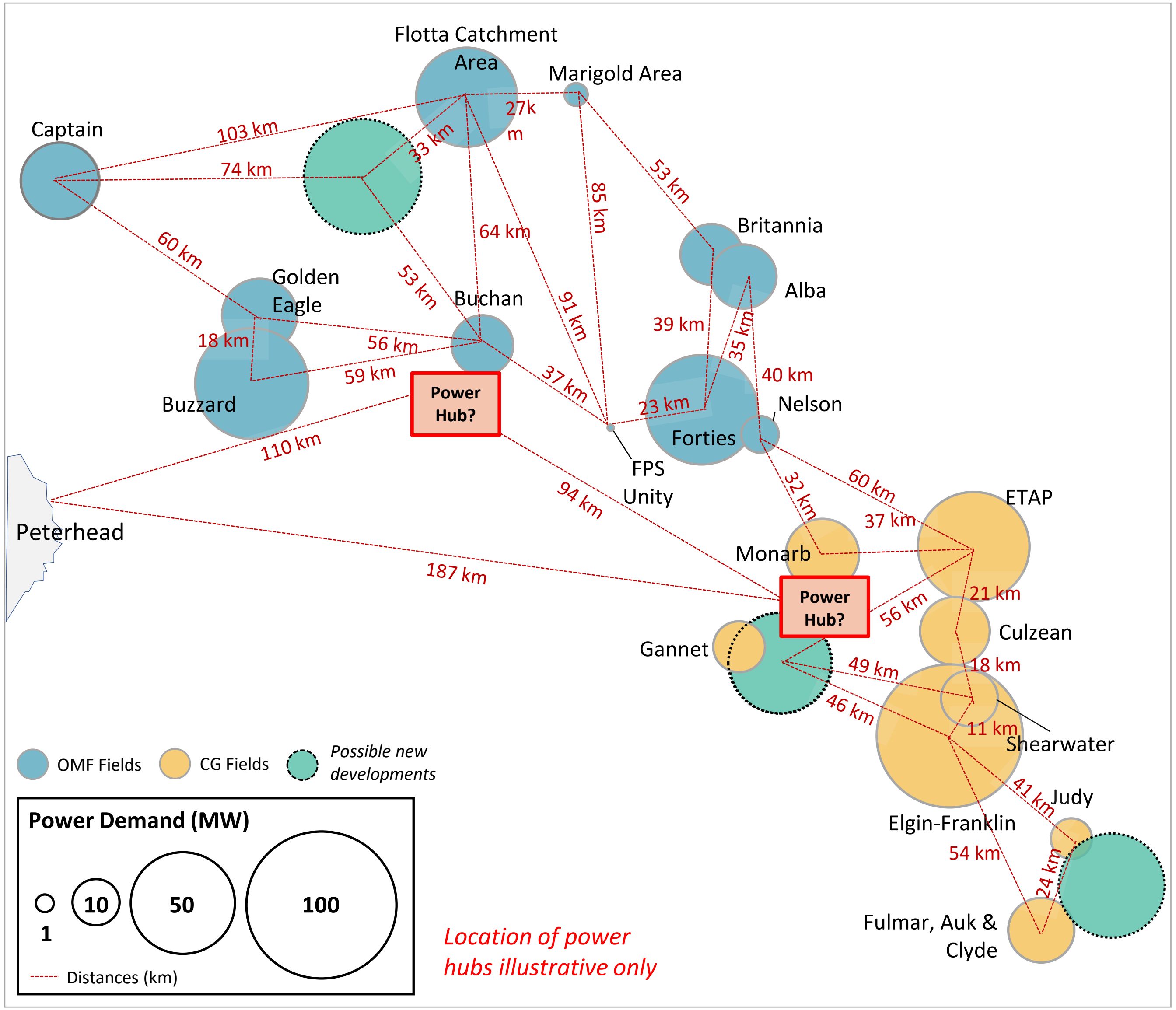
Ongoing operators collaborating via OMFe (Outer Moray Firth) and CNSe (Central Graben electrification)

Aiming for concept select Q2/3 2022

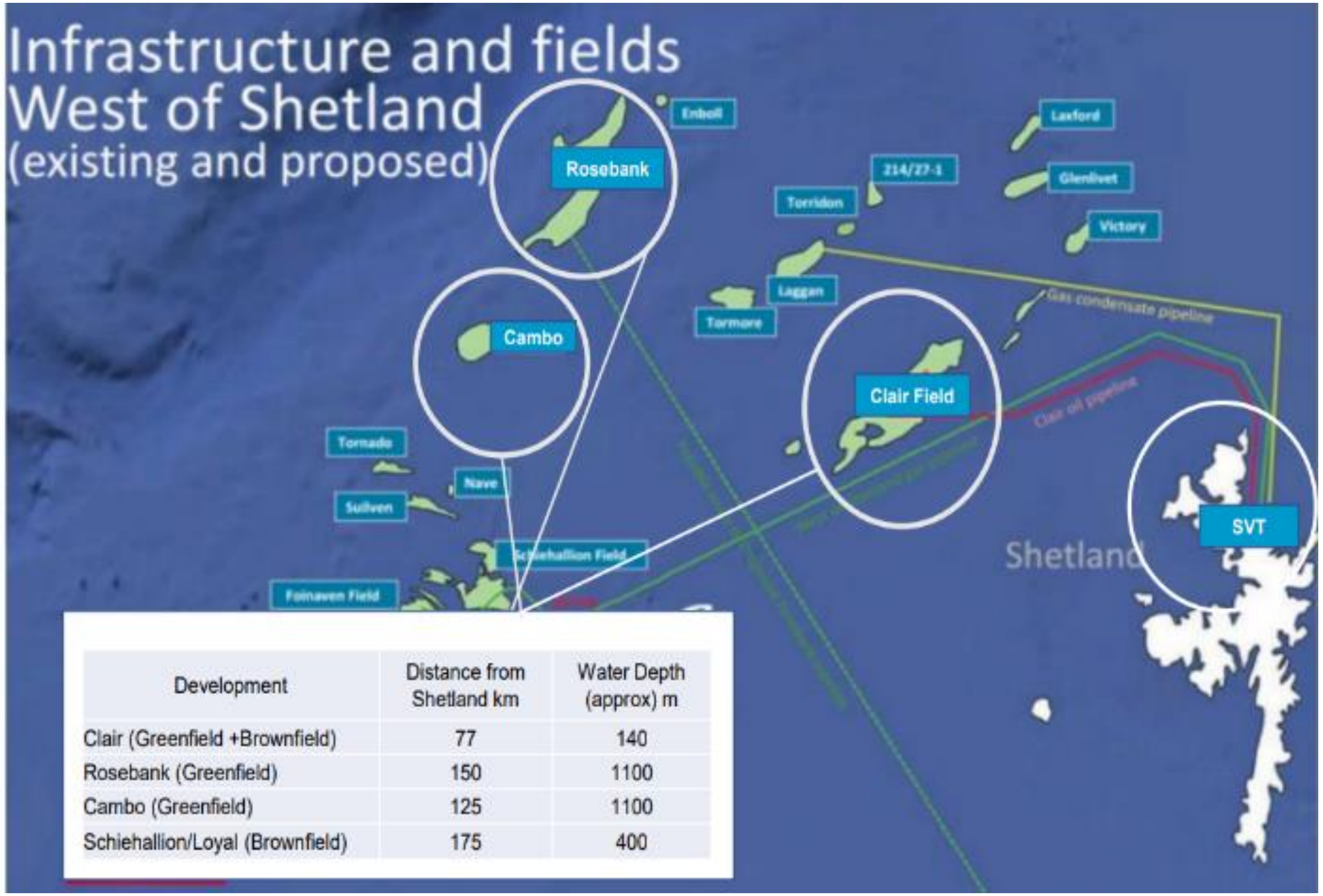
X-sector collaboration with wind sector and supply chain is critical – INTOG is a key enabler

Proven technology available and opportunity now to select solutions that fit best UK's Net Zero ambitions

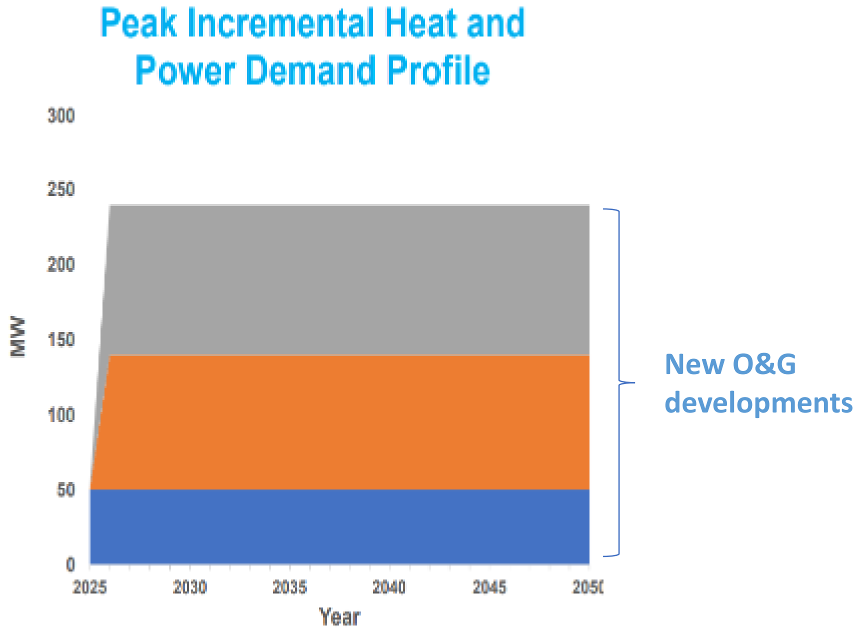
CNS power demand and distances between facilities



West of Shetland decarbonisation



Development	Distance from Shetland km	Water Depth (approx) m
Clair (Greenfield +Brownfield)	77	140
Rosebank (Greenfield)	150	1100
Cambo (Greenfield)	125	1100
Schiehallion/Loyal (Brownfield)	175	400

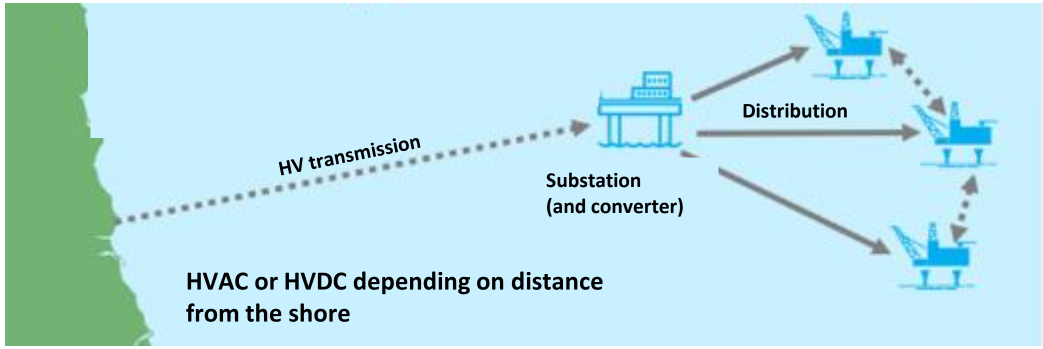


~150MW	Current demand producing assets
150-250MW	Incremental demand from new developments
300-400MW	Total demand 2030-50
1.5-2MtCO_2pa	Unabated annual emissions from power

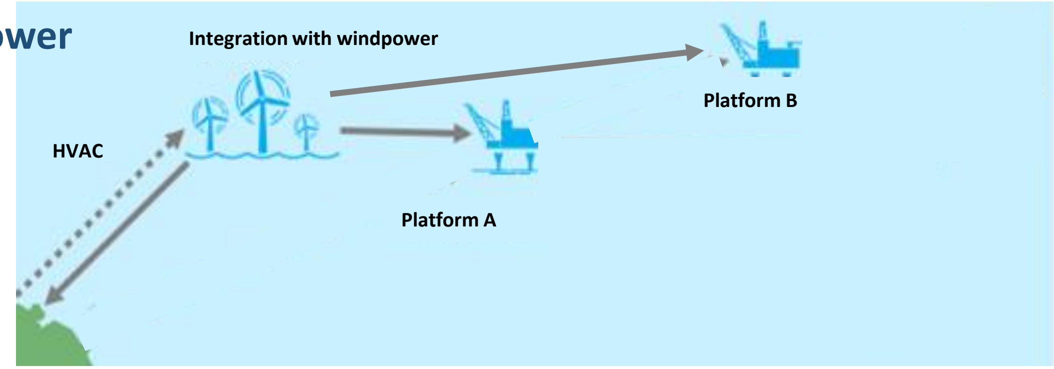
- Requires close O&G/Wind collaboration to break down barriers and realise in the short/mid term (1-5 years)
- Need of technology for harsh WoS environment, off grid due to distance from shore
- INTOG for ‘frontier’ windpower solution for the O&G demand

Alternative concepts

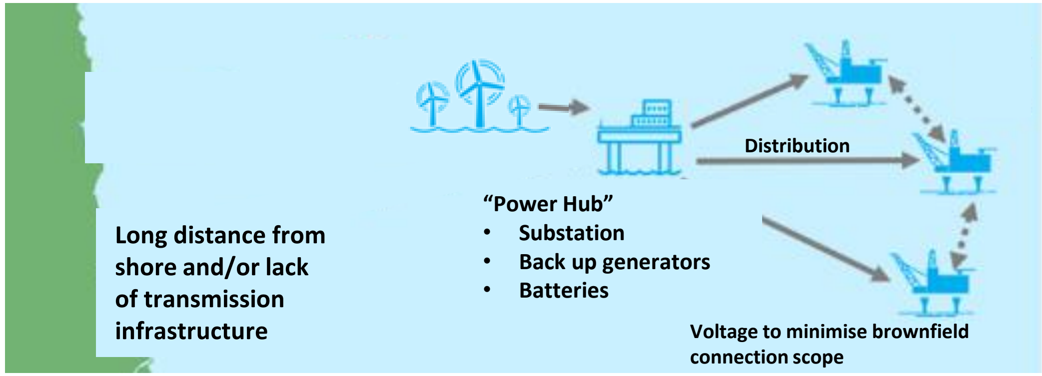
Power from shore



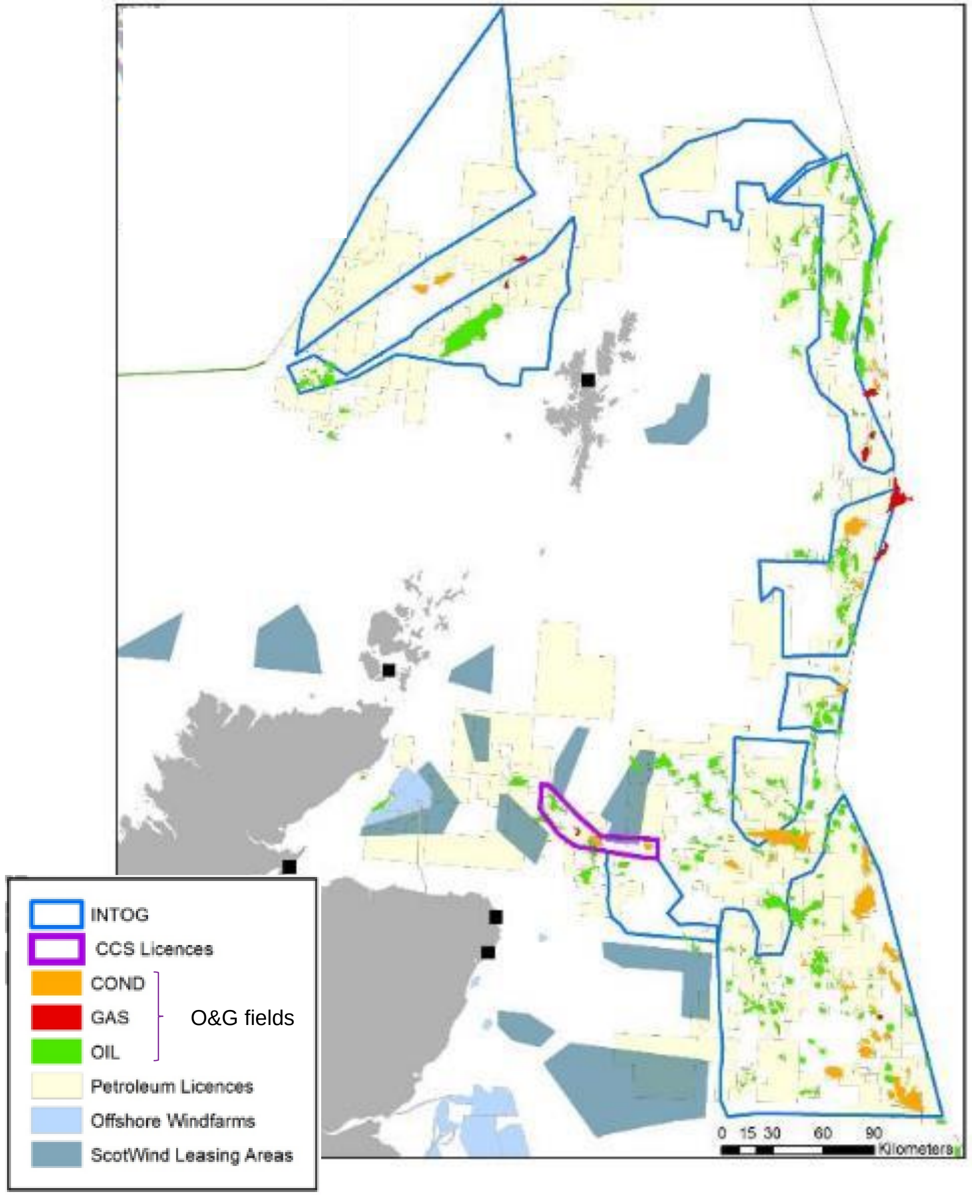
Windpower supply



Off grid



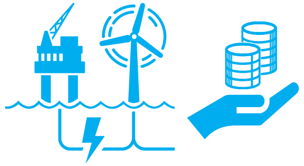
INTOG enables O&G / Windpower synergies



Design optimisation

OGA / BEIS electrification competition

- Promote innovative concepts to accelerate O&G electrification
- £1m towards critical Pre-FEED activity
- Awards in November 2021, projects conclude end of March 2022, findings published in 2Q

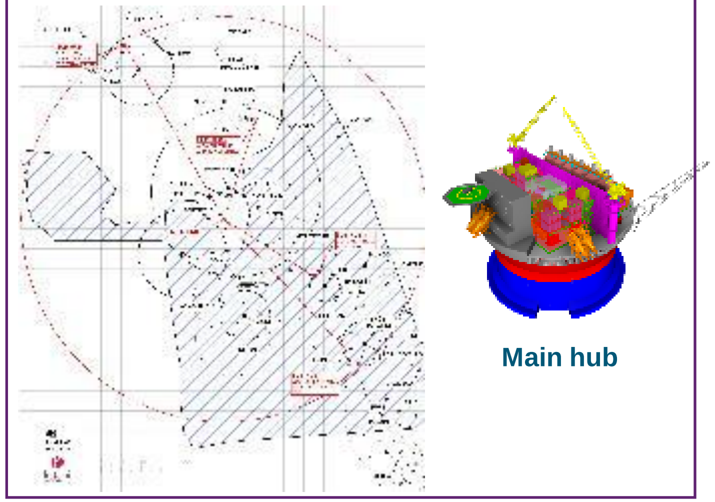


£1 million

Katoni Engineering

Optimised interface to distribute renewable power to existing O&G installations

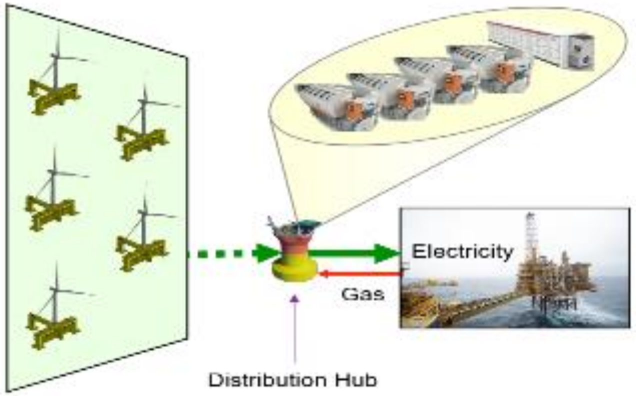
- Solutions compatible with larger numbers of existing assets, low modification costs
- Main Hub concept, windfarm tie ins
- Sub hubs to step down kV to platform
- Power continuity through CCGTs
- 75-80% overall emission reduction



Orcadian Energy & Partners

Alternative concepts for the electrification of O&G fields in the Central Graben

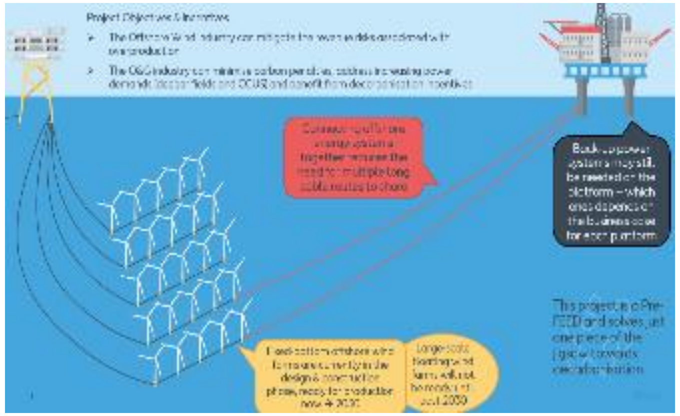
- Alternative option to long cable connection to shore for distant O&G assets
- Partnership with Tier 1 suppliers in Engineering, O&G projects and Power
- Maximises windpower share of supply (70+%) reducing emissions by over 80%
- Scalable through multiple hubs



Ørsted and Neptune Energy

Addressing technical and commercial requirements of windfarm connections with O&G installations

- Integrating windpower supply with O&G
- Connecting offshore energy systems optimises infrastructure costs
- Offshore Wind industry can mitigate revenue risks from overproduction
- The O&G industry can reduce emissions



Pursuing innovation

Oil & Gas Authority

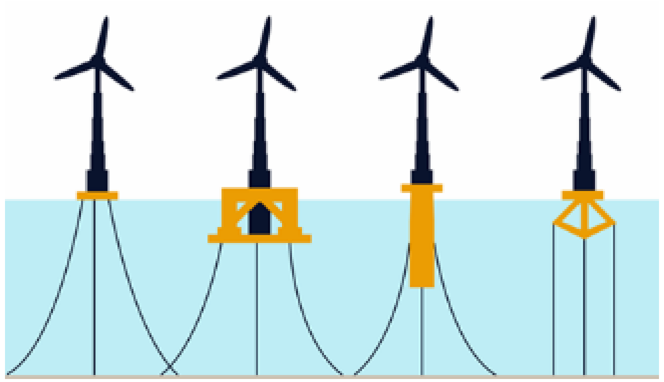
- **INTOG O&G / Windpower collaboration to accelerate experience across a range of deployed solutions**
- **Lessons learned to feed into ScotWind developments enabling optimal technical, environmental and commercial decisions**

Offshore Wind Power

No single or dominant solution

Multiple competing designs

- Incl. barge, semi-sub, spar, tension leg



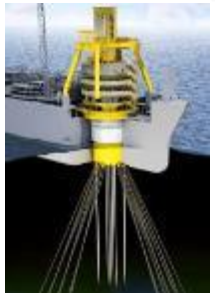
BW ideol Odfjell Oceanwind awc Technology axis

Transmission and distribution

Connecting OFW to O&G

Installation design & modifications

- Renewable power import via risers/J-tubes, FPSO swivels/turrets
- Dynamic cables for floating wind structure to O&G connection
- Compact electrical equipment for subsea or within topsides space & weight capacity for required voltage & power
- Process heating alternative vs waste heat recovery units



SBM OFFSHORE Hitachi Energy

Power storage

Mitigating renewables intermittency

Green hydrogen produced offshore

- Marinisation of electrolysis process
- Water source and treatment
- Hosting on OFW vs O&G structure
- H_2 storage location and capacity
- Turbine vs fuel cell for H_2 to e^- conversion

Battery storage

- Capacity, space, weight & cost

Natural gas/diesel fired turbines/engines

- Availability, reliability, maintenance
- GHG emissions

ERM HITACHI ABB FLOATING POWER PLANT

Crown Estate Scotland

Sarah Knight

ScotWind and INTOG

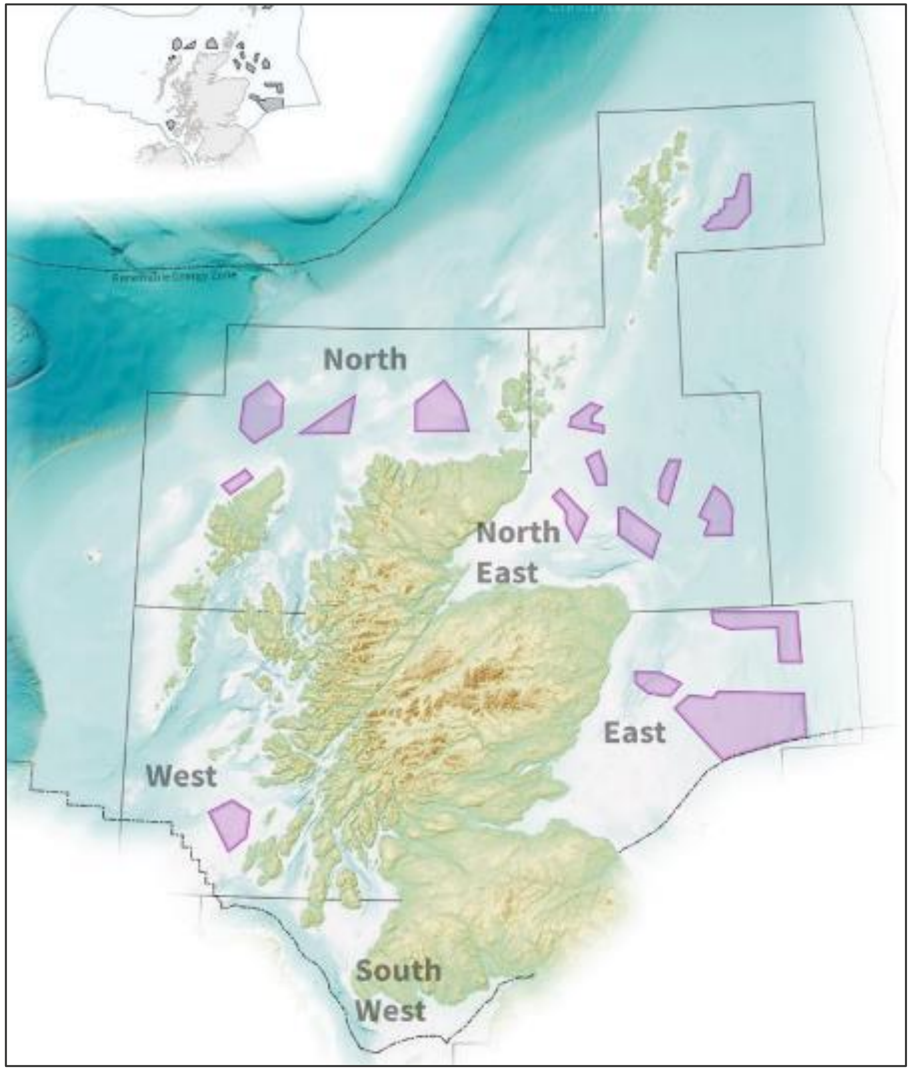
17th March 2022

Scottish Context: Leasing and Planning

- Crown Estate Scotland are the seabed manager. Grant a lease of the seabed only when consents and other permissions are in place.
- Marine Scotland are the regulator and responsible for strategic marine planning. Grant consents for projects.

ScotWind Background

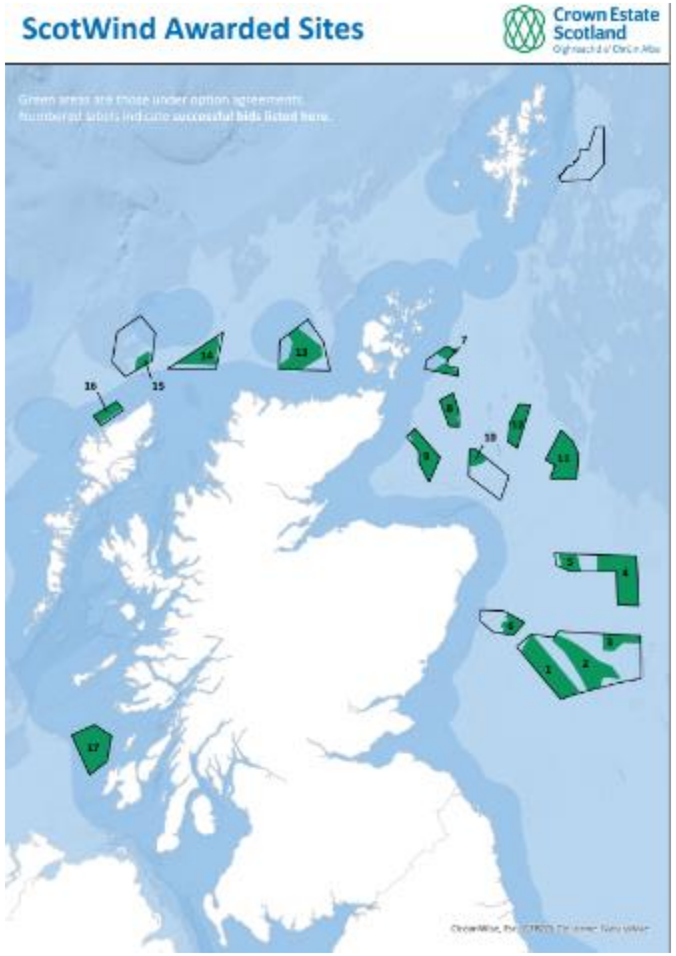
- Plan led approach to leasing
- Sectoral Marine Plan for Offshore Wind Energy (Oct 2020) - provided a spatial strategy to support the seabed leasing process for ScotWind.
- Section 2.5: '*Scottish Ministers may choose to explore the demand for future leasing round to enable **innovative projects** and projects aimed at the **decarbonisation of the oil and gas sector in Scotland**.*'



Update on ScotWind

- Results of ScotWind announced 17th January 2022.
- 17 projects offered Option Agreements.

  Signatures expected in April.
- Option Agreements are in place as project development continues through to approx. FID when they seek to step into lease.
- Area of seabed just over 7000km2 (max. 8600km2 available)
- £700m revenue generation and approx. £1bn per GW of supply chain commitments expected.



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Update on ScotWind Clearing

- Update position published 4th March with confirmation of process expected in April.

Conditions to be met:

- *There must be at least one Applicant entitled to make a Clearing request.*
- *At least one Applicant who is in a position to make a Clearing request, must confirm they intend to do so.*
- *Must be scope for further Option Agreements without any restrictions imposed by the Sectoral Marine Plan.*

- Plan Area NE1 is expected to be made available through clearing, any other areas will be confirmed in April.
- Supply Chain Development Statements will be submitted in any Clearing Application.
- Deadline for Clearing applications is expected around July 2022

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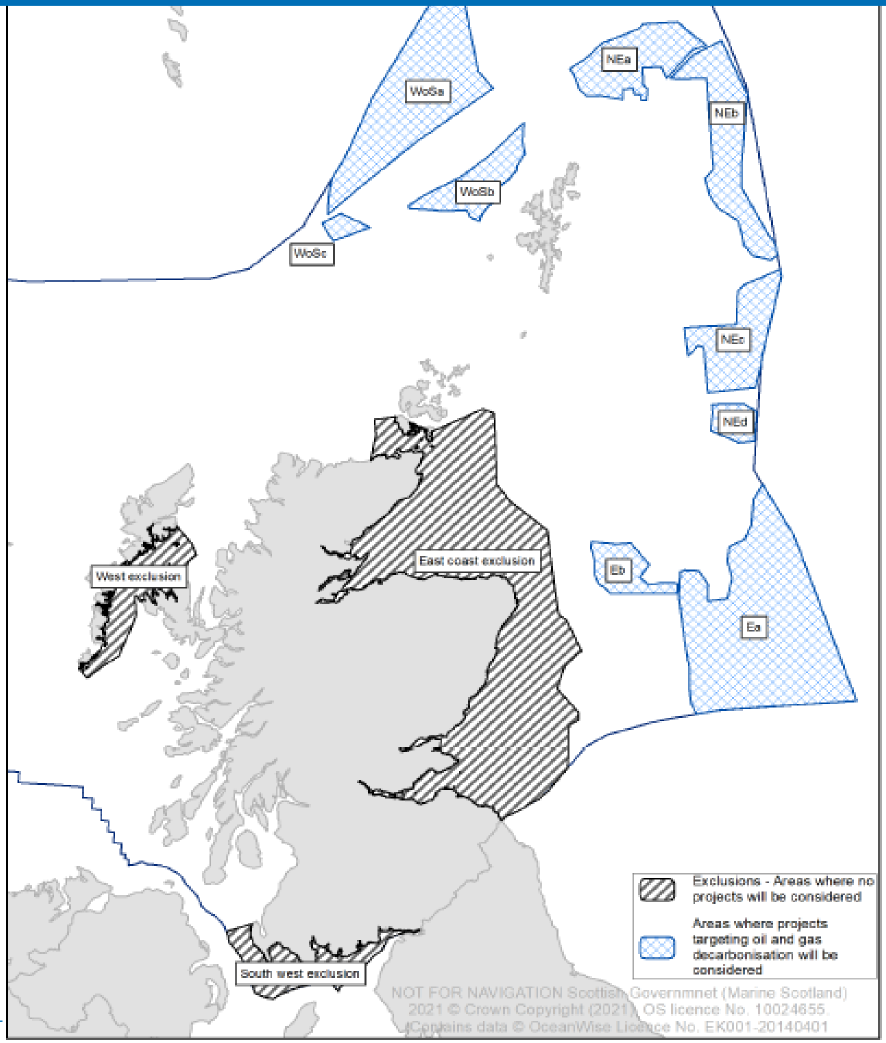
INTOG Update

New Sectoral Marine Plan Initial Plan Framework

- The Initial Plan Framework (IPF) defines the areas available for INTOG leasing
- Planning parameters will be reflected in leasing approach
- The IPF and CES Leasing Information Document (LID) was published in February 22.



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INTOG Leasing Objectives

- Developers will be able to apply for seabed rights for;
  - Small scale (less than 100MW) innovation projects; and
  - Offshore wind projects to provide low carbon electricity to power oil and gas installations.
- Objectives for **Innovation** Projects:
  - To enable projects which support cost reduction
  - To further develop Scotland as a destination for innovation and technical development
- Objectives for **Targeted Oil and Gas** Projects:
  - To maximise the role of offshore wind to reduce emissions from O&G production
  - To achieve target installed capacity in a way that delivers best value for Scotland and supply chain opportunity

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INTOG Agreement Structure

- **Exclusivity Agreements (EAs)** – Successful Applicants will be awarded sole offshore wind development rights over the site whilst planning processes are completed by MS.
- **Option Agreements (OAs)** - set out the terms on which Crown Estate Scotland would grant a lease if the developer succeeds in obtaining all the necessary consents.
- **Lease Agreement** – required before construction can commence.

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Expected Timelines

Activity	Expected Timeline
Leasing Information Document (LID) Published	22nd Feb 2022
Deadline for feedback from potential Applicants	21st March 2022
Launch final leasing docs and Application window opens	June 2022
Application Window closes	Two months after the Leasing documents are launched
Evaluation of Applications	Two to three months after Application Window closes
Exclusivity Agreement Offer Awards	End of Autumn 2022
Option Agreement Awards	Final INTOG SMP Autumn 2023

INTOG: Innovation

- **'Innovation'** may encompass many types of innovative approaches in the Offshore Wind Sector.
- Includes innovations in commercial approach, knowledge sharing, energy integration, and environmental innovation in addition to technical innovations.
- Applicants will be expected to provide information to demonstrate how the proposed project is the best way to prove the innovation, how it is likely to assist in meeting net zero targets.

INTOG: Targeted Oil & Gas

- To ensure a reliable supply of power, it is anticipated that wind farms can be oversized in relation to the power demand.
- However, the scale of the wind farm must be proportionate to the power demand of the installation to ensure oil and gas remain the focus.
- A **letter of intent** or equivalent commitment from the installation operators will be required as part of the application to demonstrate the scale and firm nature of the demand for electricity.
- This should include:
  - Power requirement by the installation that will be electrified.
  - The intent to use electricity from the offshore wind farm for a minimum of 5 years.

- The Oil and Gas Authority's view on whether this is consistent with information on installation operators will be requested

INTOG: Minimum Requirements

- The **location** must be compatible with Marine Scotland's Initial Plan Framework.
- The **density** must be **at least 3MW/km^{2}.**
- For Innovation, the total installed capacity of the project must **not exceed 100MW.**
- For **TOG**, the wind farm capacity cannot exceed **5 x** the annual oil and gas installation power requirement. The electricity demand from the installation will be for a minimum duration of 5 years.
- Supply Chain Development Statement **(SCDS)** will be required.

INTOG: Award of Agreements

Innovation:

- Applications will be assessed on the basis of Price, Innovation and Deliverability.
- A maximum capacity of **500MW** will be available in line with Marine Scotland's Initial Plan Framework.

Targeted Oil and Gas:

- Applications will be assessed on the basis of Price and Deliverability.
- A maximum capacity of **5.7GW** will be available in line with Marine Scotland's Initial Plan Framework.

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Supply Chain Development Statements (SCDS)

- The SCDS will be required as part of an application, setting out the level and geographic breakdown of supply chain impact from a project.
- It will not be used in the assessment or scoring of applications.
- The initial SCDS outlook will be published by Crown Estate Scotland once the Option and Lease Agreement is signed. It must be updated periodically.
- Final Contracted Position Statement submitted around FID and will be measured against the commitments in the most recent SCDS.

	£ Million	***Expenditure Table***		
Stage	**Scotland**	**RUK**	**EU**	**Elsewhere**
Development				
Manufacturing and Fabrication				
Installation				
Operations				

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Thank you

We look forward to your feedback!

Ping Petroleum

Charles Taylor

Oil & Gas Authority

DeepWind

North of Scotland Offshore Wind Cluster

INDUSTRIAL STRATEGY CLUSTER

Floating Wind for Avalon FPSO

INTOG Workshop

Charles Taylor

Overview of Avalon Development

A Brief History

Overview of Asset

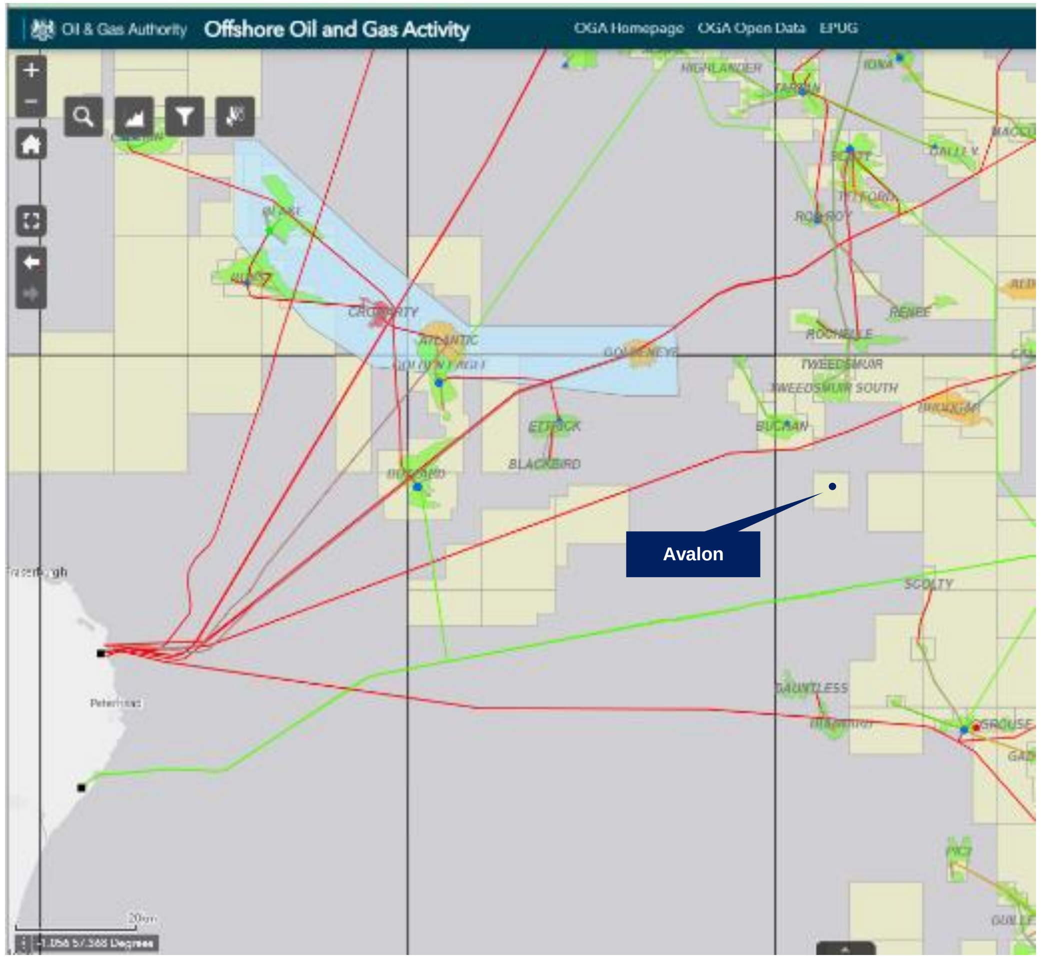
- » Avalon discovered in 2014, appraised in 2017
- » STOIIP: 48 MMbbl, EUR: 20 MMbbl
- » 2 Gas lifted subsea wells back to FPSO

Concept Select

- » Full concept select process followed
- » Key issue: Avalon is a "Stranded Asset"
- » Initial focus **MER UK** and moved **Net Zero** & **MER UK**

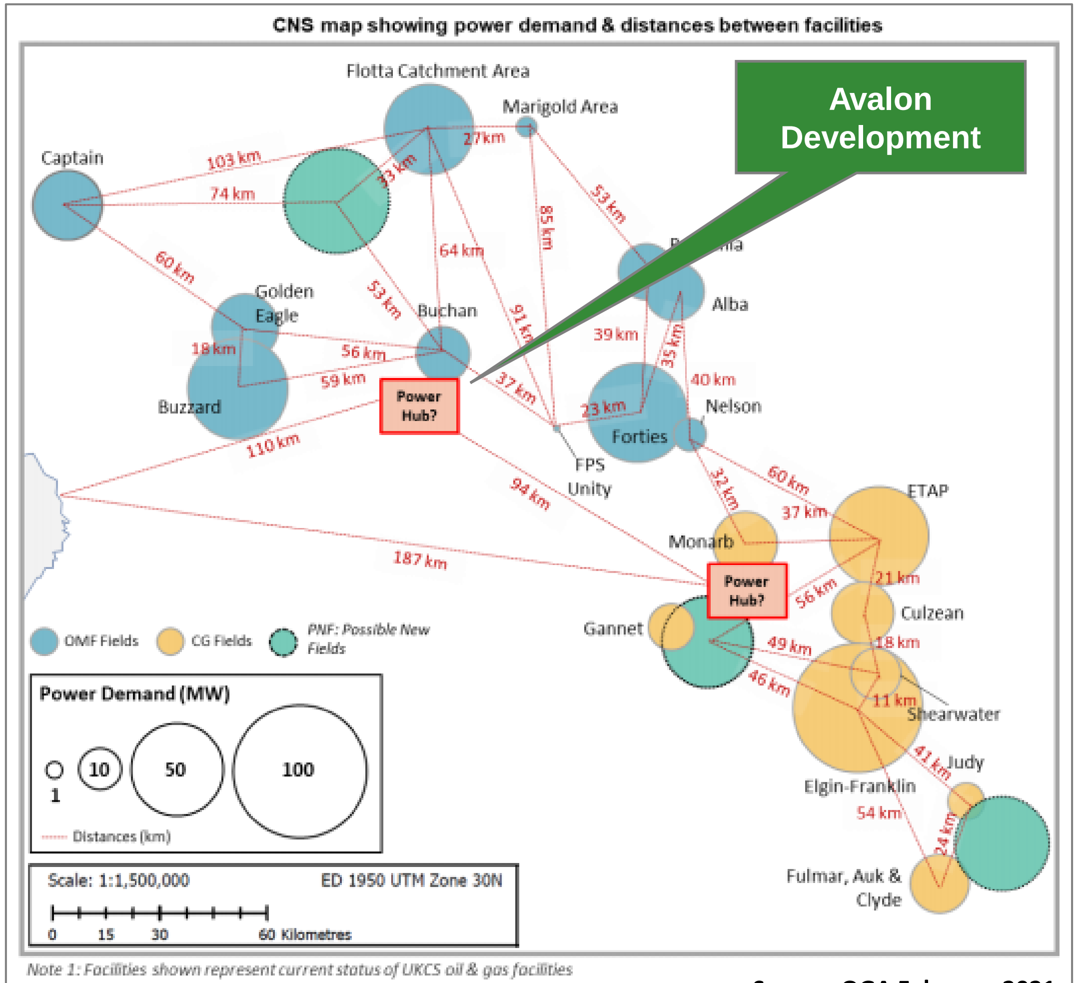
Key Changes over past 2 years

- » Impact of pandemic, FPSO availability
- » Ping move from privately owned to DNeX owned
- » Net Zero focus ramp up
- » Rising price of energy

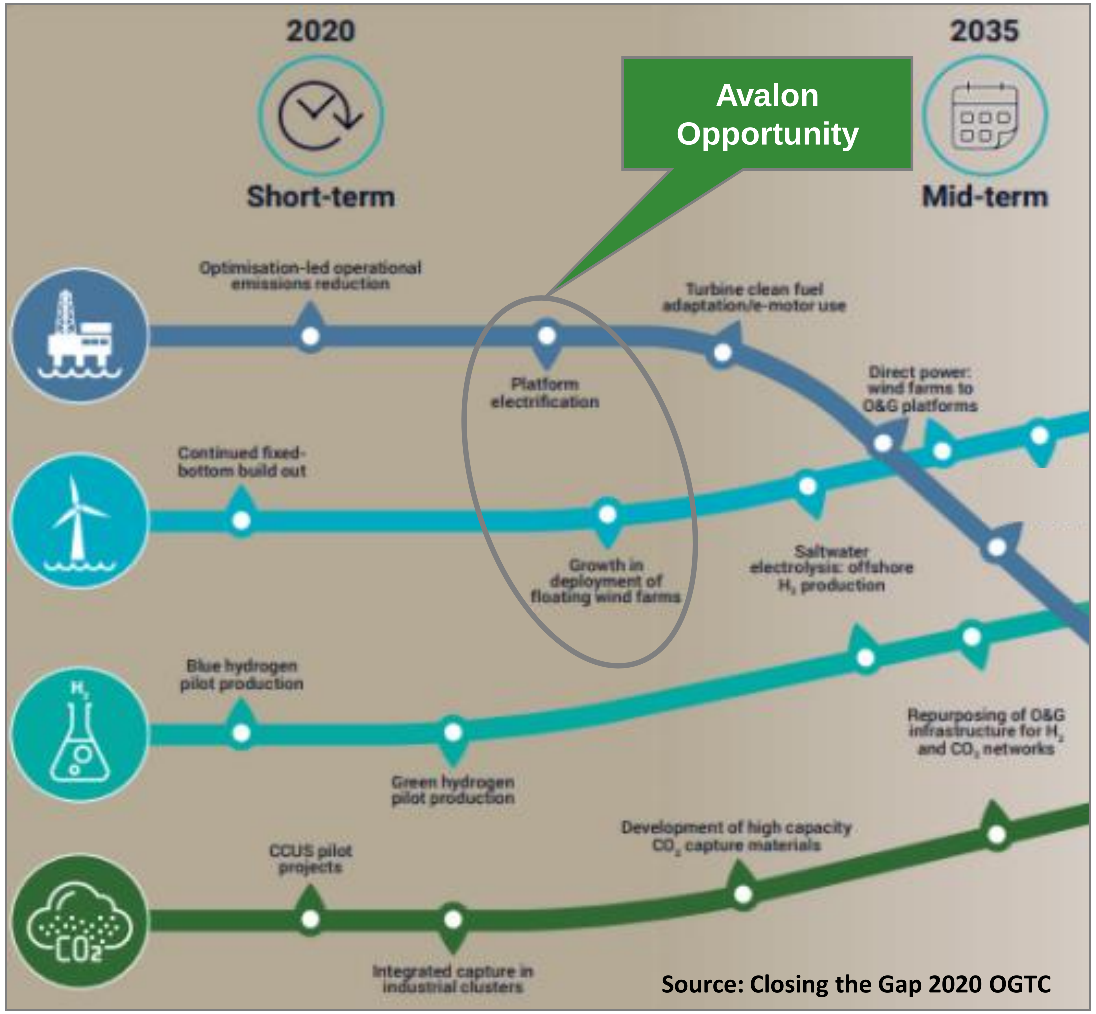


“Energy Hub including Oil & Gas”

Lockdown Homework



Source: OGA February 2021



Source: Closing the Gap 2020 OGTC

Energy Transition Project

Avalon

Technology Challenge

Ping focused on floating wind power source, will it work?

- ✓ Worked with Suppliers, OGA, NZTC & ETZ
- ✓ Reviewed with in house subsea engineers
- ✓ Experience from FPSO ESP work

Conclusion: Single turbine concept will work

Economic Challenge

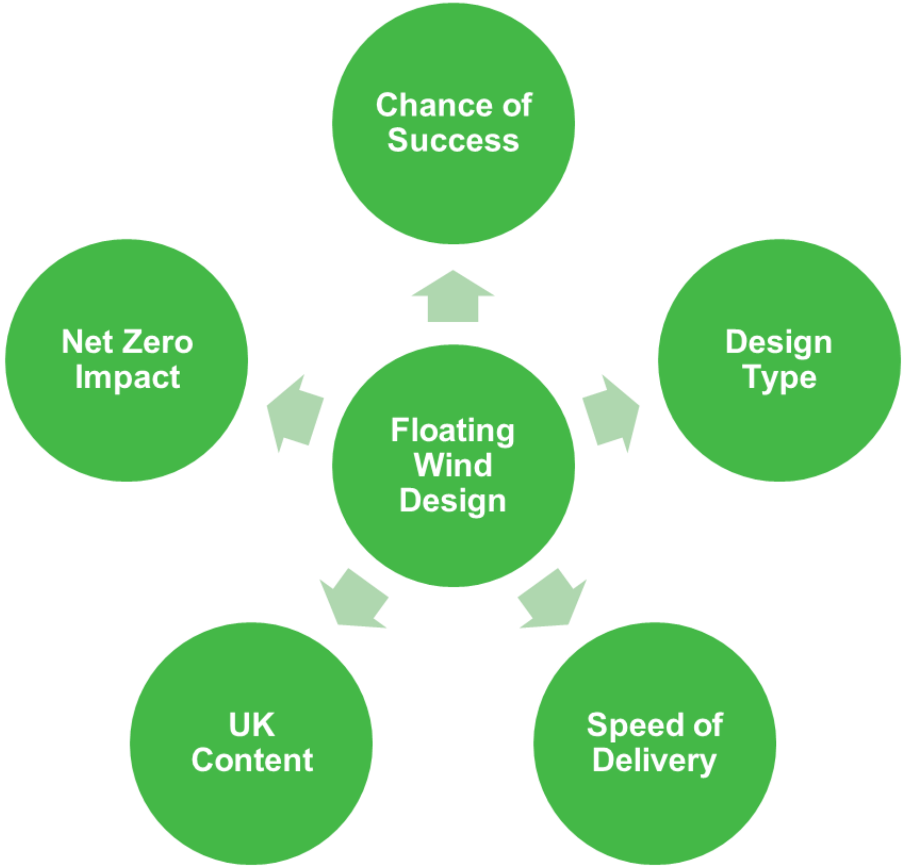
- × Reviewed many models, just additional cost
- × Risk associated with being FWT001
- ✓ Good support from OGA, NZTC & ETZ and the emerging Floating Wind market

Conclusion: Financial support will be required, but achievable

Way Forward

- ✓ Technology review, ongoing
- ✓ Commercial options being worked

Conclusion: Project is feasible and can help drive the Energy Transition in the North Sea



Avalon Development Concept

Example FPSO & Turbine

TIMELINE

2022

- » CSR Approval
- » FPSO Acquisition
- » INTOG Application
- » FDP Approval

2023

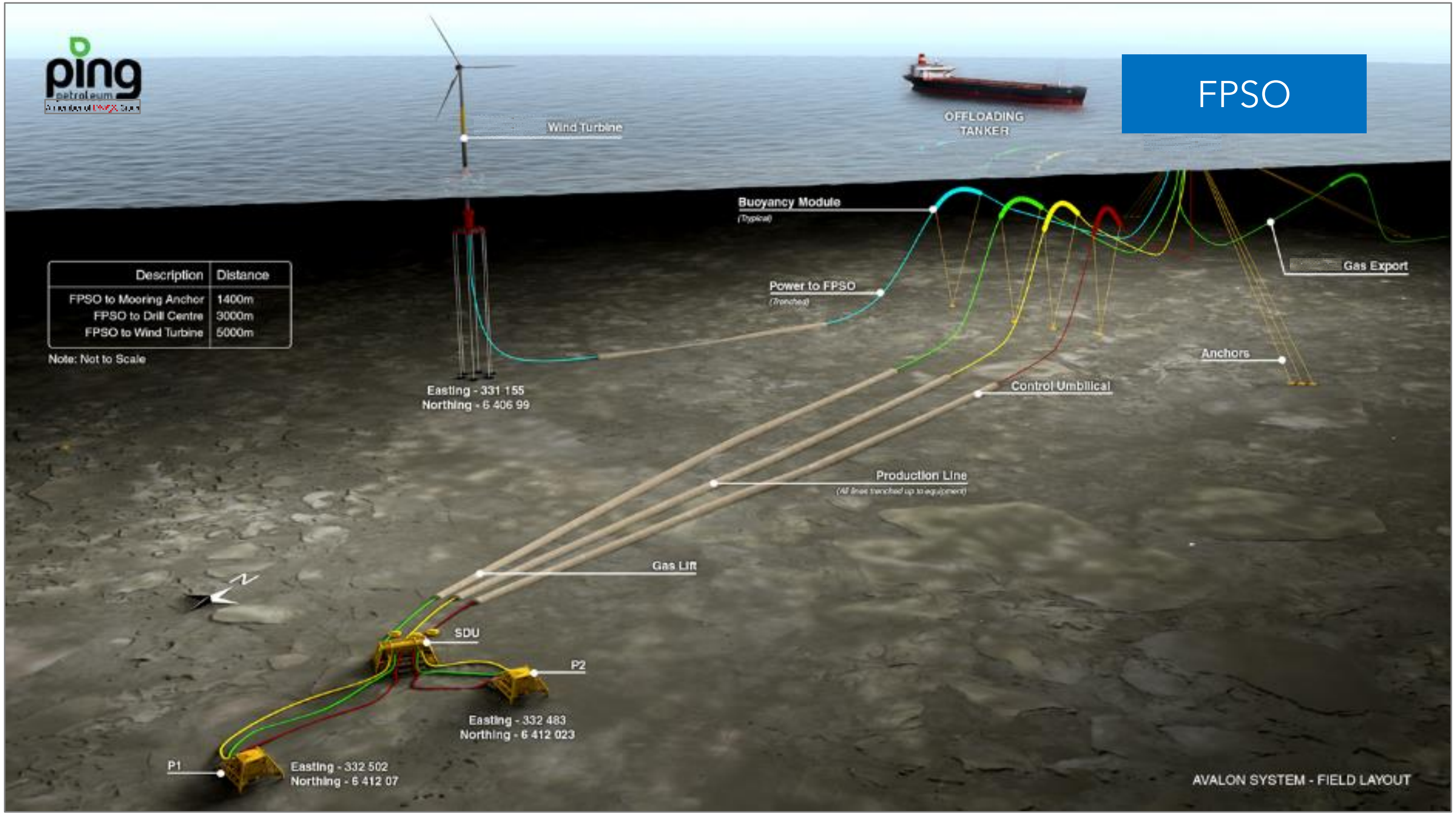
- » Drilling/Subsea Work
- » FPSO Modifications
- » INTOG Agreement

2024

- » First Oil

2025

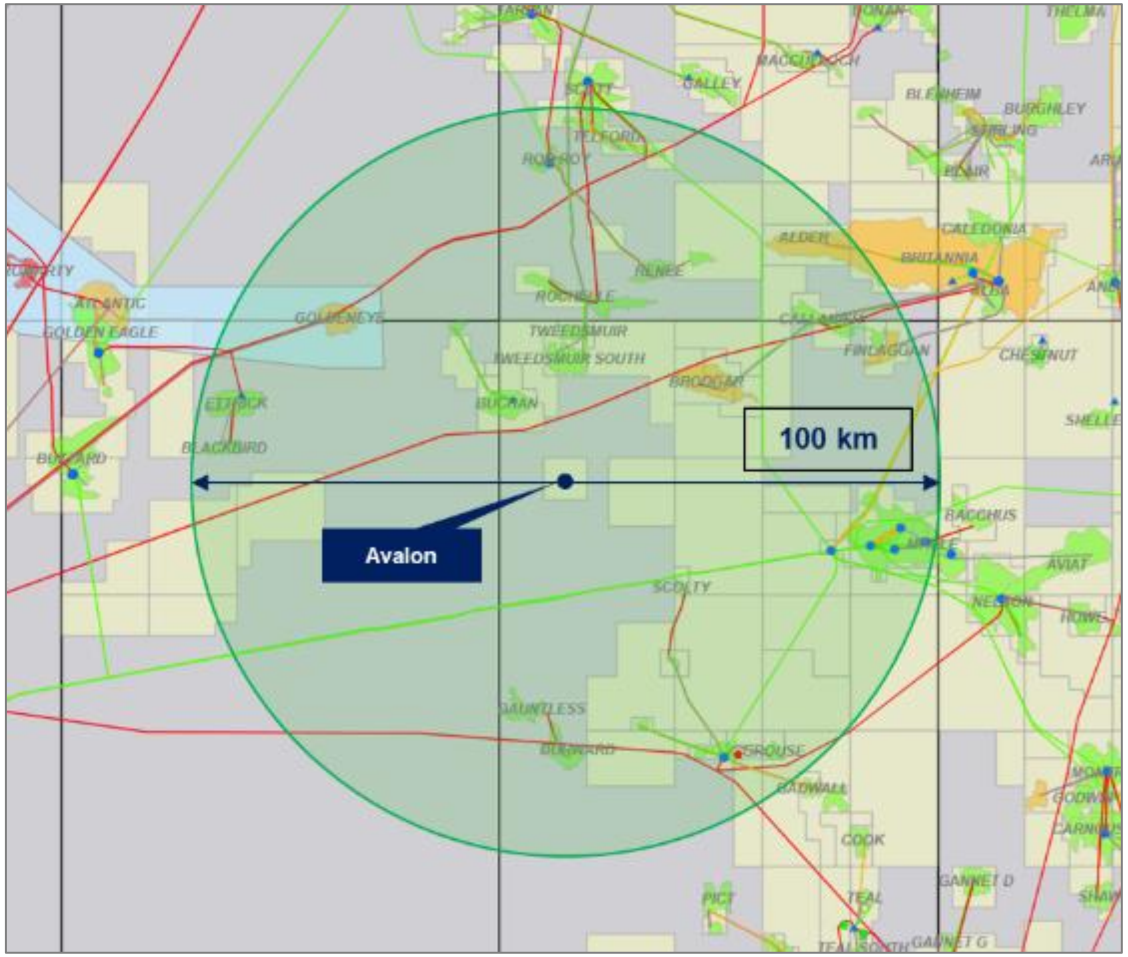
- » First Wind Power



Avalon Energy Hub

Location, Location, Location

- ✓ Avalon is an oil development
- ✓ Avalon can be a catalyst for Energy Transition
  - ➢ Fast delivery of FPSO project
  - ➢ Fast delivery of floating wind
  - ➢ Focus on local supply chain
  - ➢ Demonstrator for larger floating wind projects
  - ➢ Model development for other O&G Operators
  - ➢ Create momentum for Energy Transition
- ✓ Avalon and INTOG can provide a Phase 2 to decarbonise other local assets



THANK YOU

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Central North Sea Electrification

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Oil & Gas Authority

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Confidential

Central North Sea Electrification (CNSE)

Arjit Gupta, CNSE Stakeholder Manager

INTOG Event

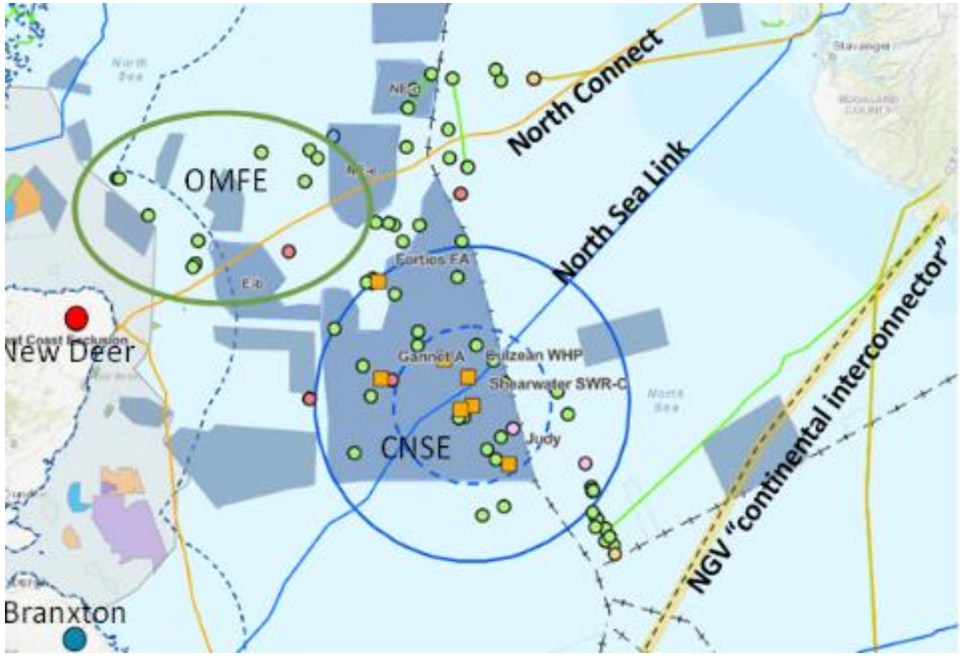
17th Mar 2022

Confidential

Central North Sea Electrification (CNSE) overview

CNSE: A collaboration led by the "CNS4": Harbour, TotalEnergies, bp & Shell

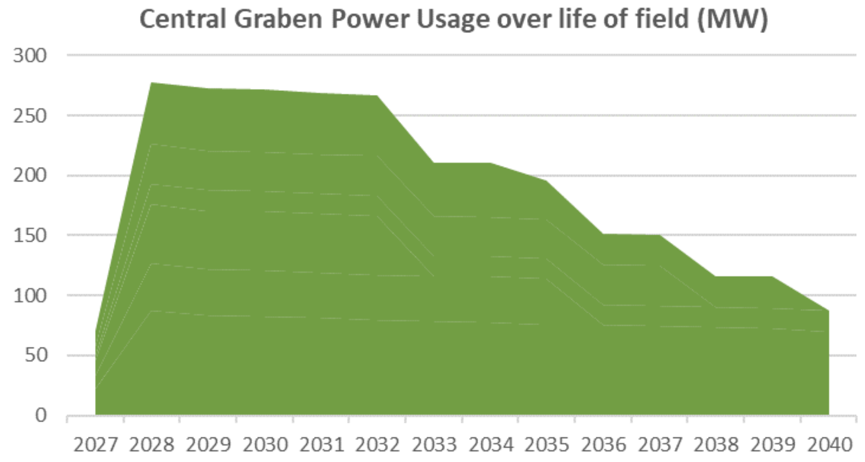
- CNS4 joint dedicated team established April 2021 – progressed since 2019.
- CNS4 is evaluating electrification options for O&G Assets in Central Graben.
- Assets across UKCS and NCS were invited to participate in a Concept Screening Study which concluded that electrification of the CNS should be progressed as two hubs- OMFE and CNSE
- Electrification of the six assets now in scope would substantially reduce operational emissions
- This will require ca. 250-300MW of low carbon electrical power by 2027



Objective: Deliver affordable low carbon electrical power to our assets by 2030

Schedule: Concept Select Q2 2022, Financial Investment Decision Q2 2024, Start up Q4 2027

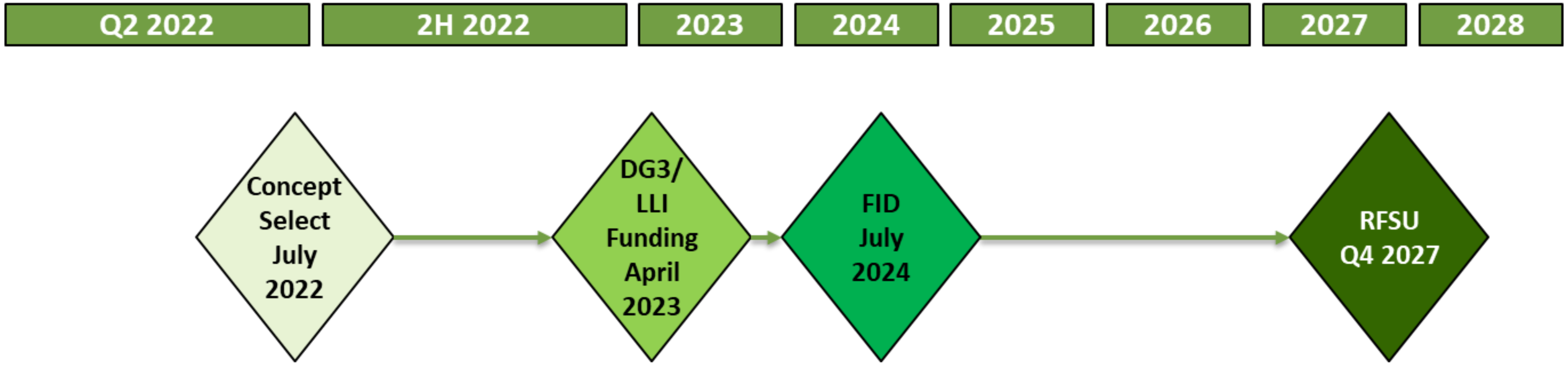
Potential Synergies: Installation of HVDC infrastructure may offer synergies with Offshore Wind development



<u>Pace is critical to delivering this step-change abatement project given remaining asset life</u>

Project Timeline & Latest Updates

- Project Timeline



- Supply chain engagements in Q4’21
  - Multiple responses received with supply chain capabilities in varying areas
  - Given uncertainty on viability of electrification options, further engagements put on hold
  - CNSE team building a clearer view of feasible concepts
  - Re-engagement with Supply chain to commence for delivery of viable options
- Progressing the route surveying activities to accelerate delivery of viable options
- Working on Regulatory requirements and business models for feasible concepts
  - Working on wind integration concepts

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Latest CNSE Concepts Table

#	CONCEPT	CHARACTERISTICS	SUB-OPTIONS UNDER CONSIDERATION	PARTICIPANTS	RFSU (Deterministic)	Key Talking Points
1	**Power from Shore GB**	**Demand only O&G SIZED**	**Option 2.1** 200/300 MW (Demand Only)	CNSE	Q4 2027	Provisional Demand connection 2027
2	**Wind Integration**	**Demand Sized INTOG**	**Option 2.2** 200/300 MW (Demand + Generation)	CNSE + INTOG	Q4 2027	Potential future synergies Infrastructure sharing
		Oversized INTOG	**Option 4.1** 1.2 GW 320kV (300MW Demand + 1.2GW Generation)	CNSE + INTOG	Q4 2029	
			Option 4.2 1.4 GW 525kV (300 MW Demand and 1.4 GW Generation, **MPI enabled**)	CNSE + INTOG	Q4 2029	
		Scotwind	>2.4 GW 525kV (Demand + Scotwind Generation)	CNSE + SCOTWIND	Q1 2032	
3	**ALTERNATE OPTIONS** /MARKET OPTIONS	**Not grid connected**	Completing technical assessments / 3rd party option evaluation			Innovation Timeline

CNSE

INTOG as enabler for Wind Integration

The primary benefit of wind integration in a CNSE project is the shared use (and therefore shared cost) of the transmission infrastructure.

For CNSE to decide on Wind Integration concept, following questions need to be answered

- When is the earliest that an INTOG development could be on line (incorporating the grid connection lead time constraint)?
- What is the process underpinning the transmission infrastructure investment and operations, especially in a large wind capacity scenario with significant upfront investment requirement?
- What is the arrangements for power between wind developments and O&G facilities. Will a CFD be required to underpin market post-O&G; does this impact start-up timeline?
- How can the timetables for infrastructure development and wind developments be aligned to enable investment

Panel Session 1

Carlo Procaccini, OGA
Sarah Knight, CES
Chas Taylor, Ping Petroleum
Arjit Gupta, CNSE

INDUSTRIAL STRATEGY CLUSTER

Networking Lunch

12.30-13.30

Oil & Gas Authority

DeepWind
North of Scotland Offshore Wind Cluster

Net Zero Technology Centre

Graeme Robertson

Oil & Gas Authority

DeepWind
North of Scotland Offshore Wind Cluster

INDUSTRIAL STRATEGY CLUSTER

Technology Driving Transition

INTOG Energy Systems Solutions

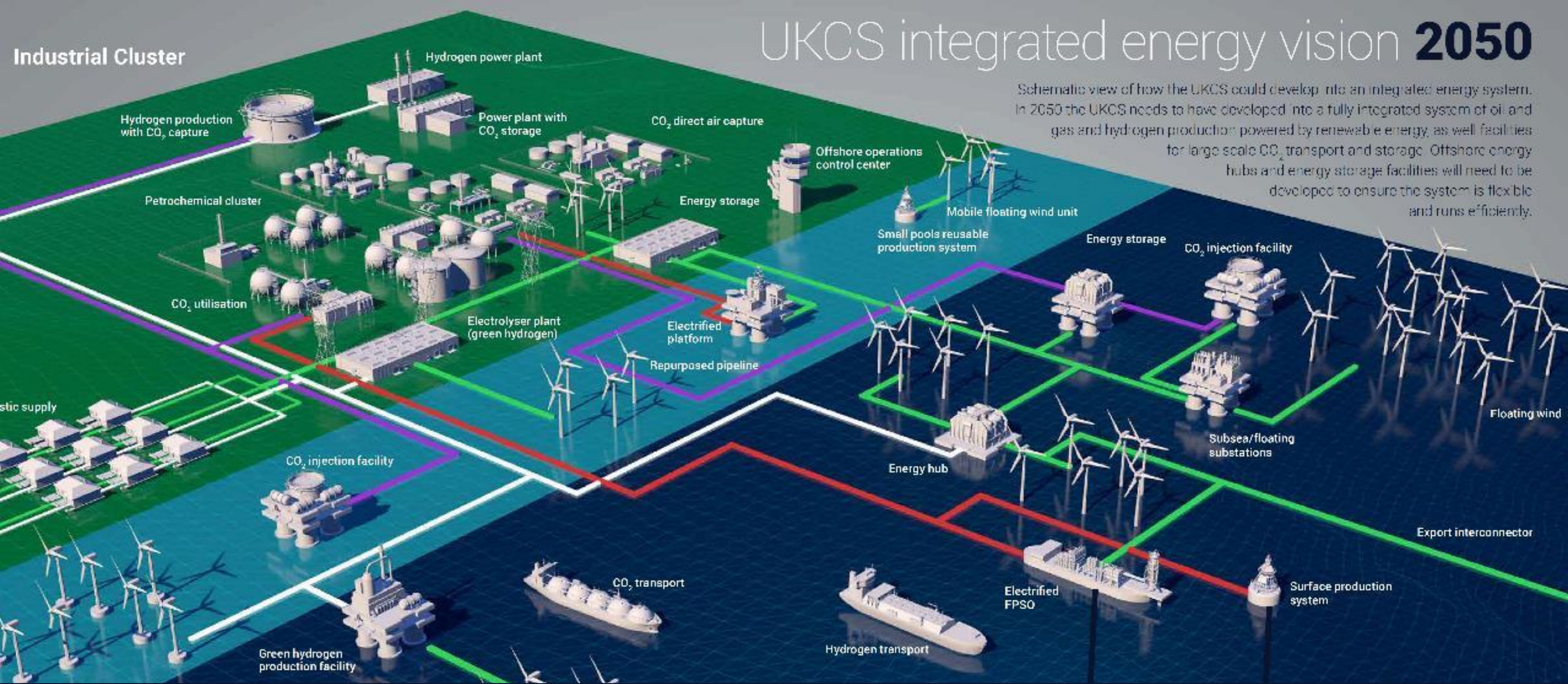
1. Set scene
2. Alt. Fuel Project
3. Energy Hub Project
4. Low Carbon Pwr Solution
5. WINTOG Programme

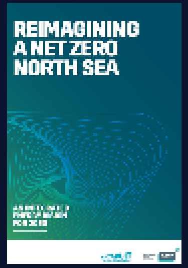
Net Zero Technology Centre

Technology Driving Transition

UKCS integrated energy vision **2050**

Schematic view of how the UKCS could develop into an integrated energy system. In 2050 the UKCS needs to have developed into a fully integrated system of oil and gas and hydrogen production powered by renewable energy, as well facilities for large scale CO_2 transport and storage. Offshore energy hubs and energy storage facilities will need to be developed to ensure the system is flexible and runs efficiently.





CO_2 PIPELINE
OIL/GAS PIPELINE
HYDROGEN PIPELINE
POWER CABLE

Up to **£416bn** investment required over next **30 years.**

Potentially contribute **£125bn** per year to the UK economy by 2050.

Support more than **230,000 jobs.**

UKCS Electrification Studies

Net Zero Technology Centre
Technology Driving Transition

University of Strathclyde | Net Zero Technology Centre

North Sea Electrification

SEALAND PROJECTS | Net Zero Technology Centre

Hub & Spoke Power Hubs

11 Core Element 3 – Integrated Power Hub

Figure 11-1: Core Element 3 Representation

Oil & Gas Authority

UKCS Energy Integration
Final report

CNS ELECTRIFICATION
A Collaborative Approach

BEIS / OGA Electrification Funding Competition

£1 million

Objectives

- Conduct critical Pre-FEED activity to supply renewable power to O&G installations
- Meet Government expectation of Concept Select completed in mid-2022 for 'first power' in the mid-2020's

Awards (December 2021)

1. **Katoni Engineering** - Optimised interface for distributed offshore renewables supplying existing O&G installations.
   Power generation and transmission infrastructure that maximises efficient usage of installed power generation
2. **Orcadian Energy** - Alternative concepts for the electrification of oil and gas fields in the Central Graben.
   Power generation and transmission infrastructure that maximises the use of low carbon power to support installed power generation
3. **Ørsted and Neptune Energy** - Technical and commercial requirements of windfarm connections with O&G installations.
   Establish the key technical and commercial aspects of how to get stable and reliable power from a windfarm to an oil and gas facility

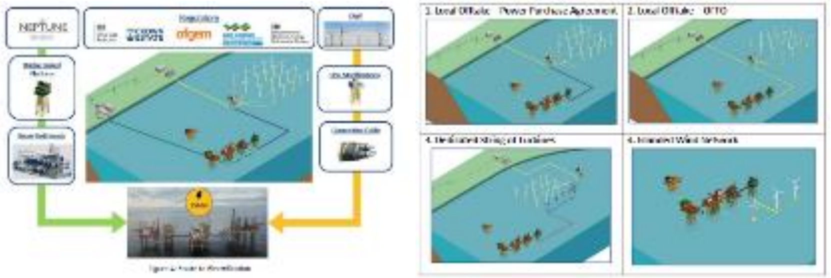
Electrification Appraisal Studies

North Sea Asset

Industry

SEALAND PROJECTS | Net Zero Technology Centre

Wind Farm to O&G Platform



WOS Operator Group + orion Clean Energy Project

CNSE

OMFE

Opportunity & Challenge

Net Zero Technology Centre
Technology Driving Transition

Complexity

Cost

Schedule

UK Grid (PfS)

Large and Small Schemes Req'd

Offshore Wind

INTOG Opportunities

Net Zero Technology Centre
Technology Driving Transition

Large	**+1GW**	• Multiple parties • Basin wide initiative with longer term integration • Wider OTNR impact • ScotWind impact (ScotWind Project?) • 2030+
Medium	**300-500MW**	• 2-5 parties • Area wide initiative with longer term goal • Grid connection (OTNR impact) • 2028+
Small	**<200MW**	• 1-3 parties • Stranded assets. • Off Grid • 2026+

INTOG Energy Systems Solutions

Net Zero Technology Centre
Technology Driving Transition

1. Alt. Fuel Project
2. Energy Hub Project
3. INTOG : Low Carbon Power Solution
4. WINTOG Programme

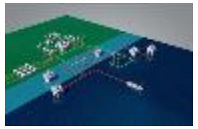
Net Zero Technology Transition Programme (NZTTP)

Net Zero Technology Centre
Technology Driving Transition

Alt. Fuel Project

Developing and testing the right synthetic fuel for use with existing turbines

Energy Hubs



Producing synthetic fuel, from renewable power, for a domestic market.

£5.1M

Phase 1
Develop Consortium
0 – 3months

Consortia Makeup

Asset Owners/Operators
(eg Terminals, Grid, Ports, Pipelines, Facilities)

Stakeholders
(eg Wind Developers, EU/UK Initiatives, Marine, Government, H2)

Develop Project Scope

Phase 1
Study Work
4 – 12 months

Engage Supply Chain

Execute Studies

Phase 2 (2 years)

Develop Technologies & Plan for Pilot Projects

Phase 3 (3 years)

Pilot Projects

Phase 4 (5+ years)

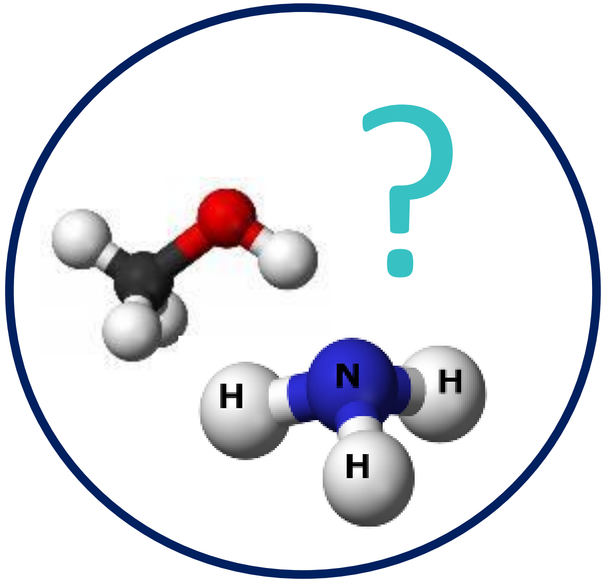
Deployment

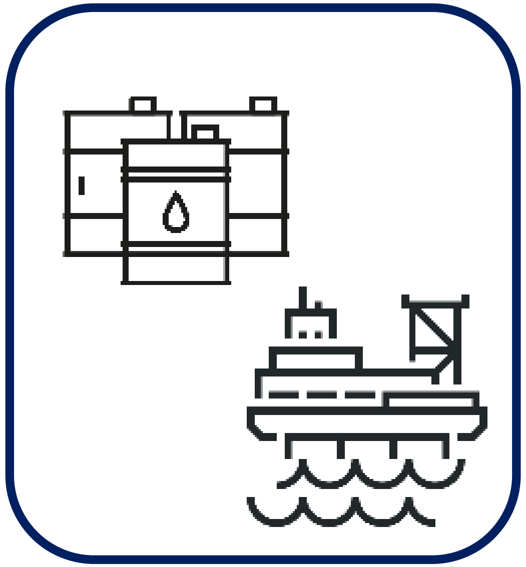
NZTTP : Alt. Fuel Project

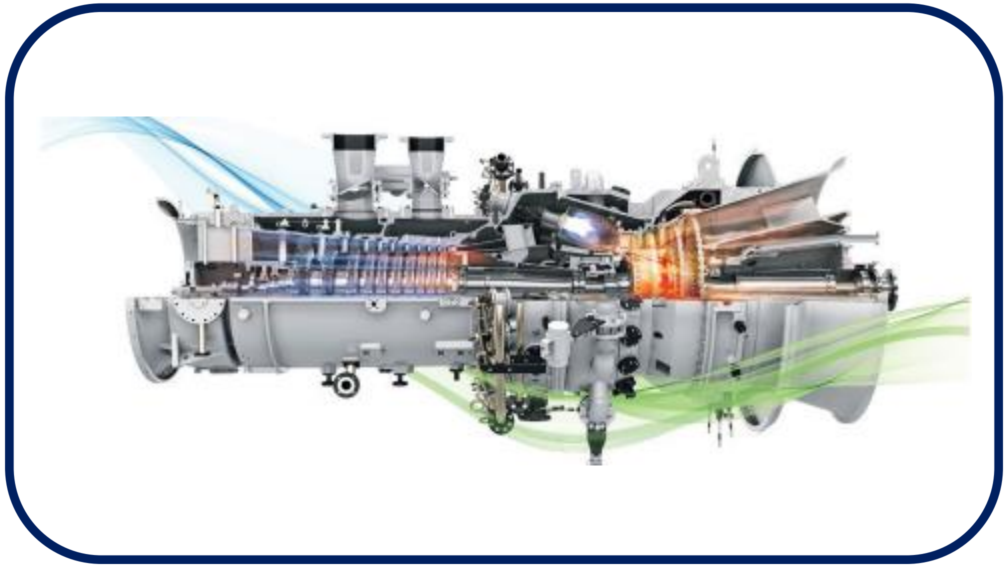
What Fuel ?

Market & Logistics

Onshore test and demo







NZTTP : Energy Hub Project

Net Zero Technology Centre
Technology Driving Transition

Energy
Offshore Wind
ScotWind

Energy Hub
Green Hydrogen
E-Fuels

Local E-Fuel Markets
North Sea Oil & Gas
Alt. Platform Fuel

Marine Ops & Ports
Alt. Marine Fuel

Residential?
Alt. Heating Fuel

Scope 1
Wind to Hub

Scope 5
Energy Hub Concept

Scope 2
Alt.Fuel Market & Case Study

Scope 3
Domestic Marine Market & Case Study

Scope 4
Scottish Market

Scope 6 : End-to-End System Modelling

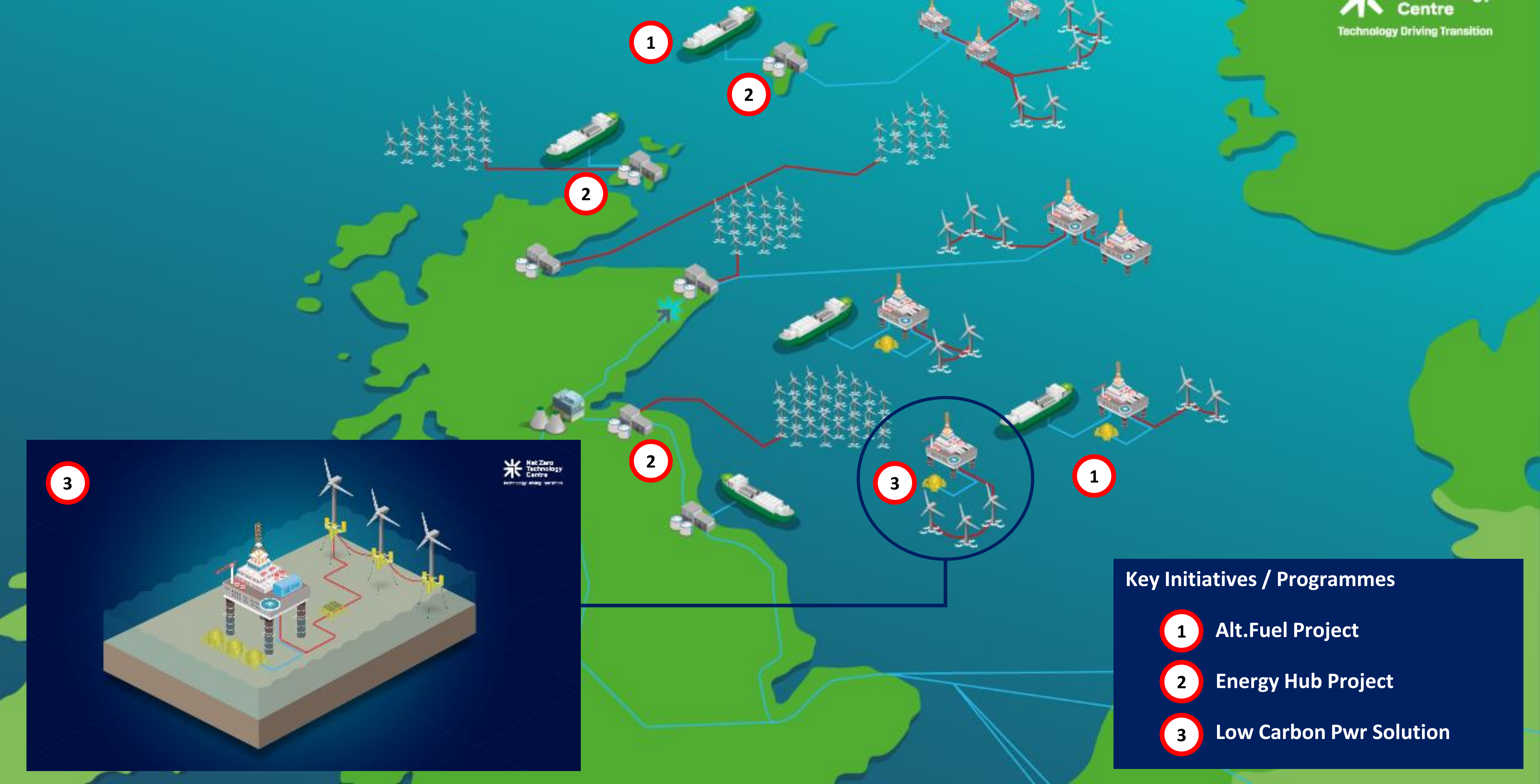
Scope 10 : Economic Modelling

Scope 11 : Power System Modelling

Scope 7
Energy Hub Concept Design

Scope 9
Pilot Project & Build Out

INTOG Energy Systems Solutions



Key Initiatives / Programmes

1. Alt.Fuel Project
2. Energy Hub Project
3. Low Carbon Pwr Solution

Low Carbon Power Solution
(Partial Electrification + Alt.Fuel)

Net Zero Technology Centre
Technology Driving Transition

Associated NZTC Technologies

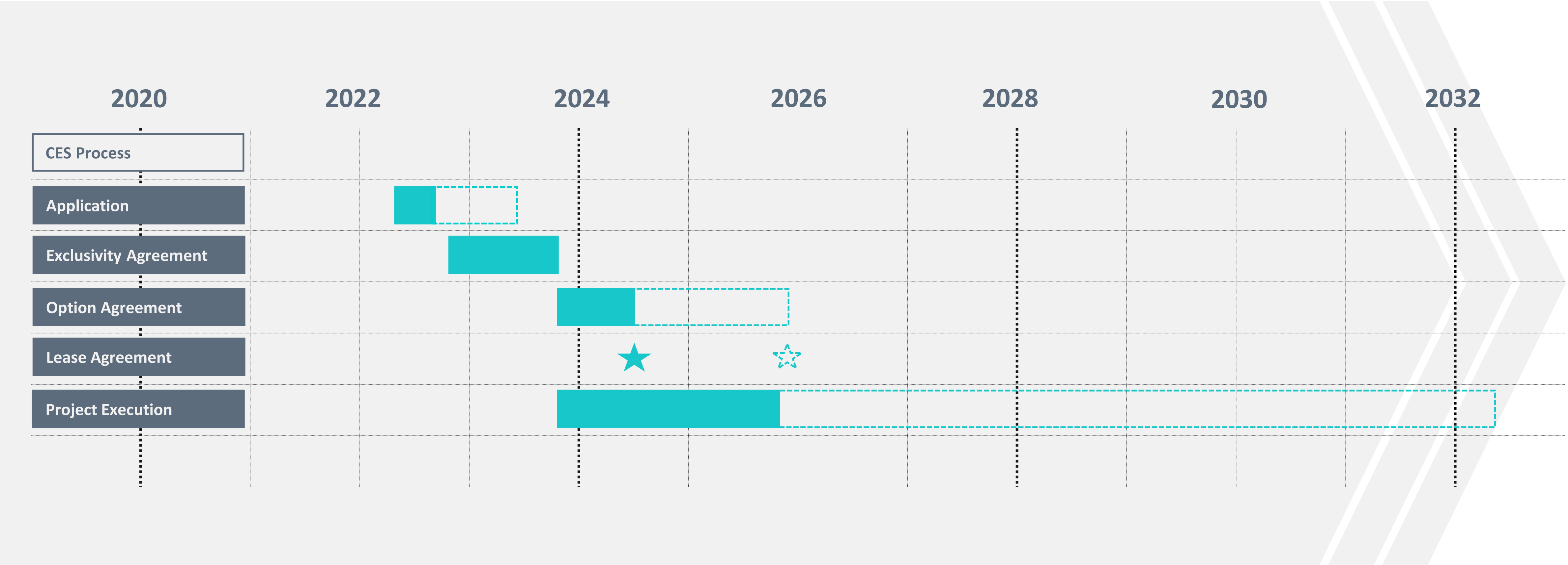
- Axis TLB (FOW)
- SBT Energy (FOW)
- Enertechnos (FOW)
- Brayfoil technologies (TechX - FOW)
- Floating Energy Systems Ltd (TechX - FOW)
- Cedeco Contractors ltd (TechX - FOW)
- Waterwhelm (Hydrogen)
- Supercritical (Hydrogen)
- Hydrogen Green Power (Hydrogen)
- sHYp (Hydrogen)
- NOV Subsea Storage (E-Fuel)
- Exnics Hot Rings (Electrification)
- Mocean EC-OG (Electrification)
- GA R&D Novel Turbine Design (Alt PowerGen)
- B9 Energy Storage (Electrification)
- GM Flow (Hydrogen)
- Immaterial (hydrogen)
- Actuation Lab (Hydrogen)
- Zem Fuel Systems (TechX - E-Fuel)
- Acuature (TechX – E-Fuel)
- T Omega Wind (TechX – E-Fuel)
- Suiso (Hydrogen)
- SuperVAWT (FOW)
- BW Offshore (SFP - E-Fuel)
- McAlpha (SFP - E-Fuel)

2021/22 Programmes

Company	Technology	Location	Solution
Aquature	Renewables, hydrogen and other clean fuels	London, UK	Technology to produce green chemicals and carbon neutral fuels from wastewater, using a net energy-positive bio-electrochemical process.
BeeX Autonomous Systems	Hovering AUV	Singapore	Remote underwater autonomous inspection vehicles that connect to a subscription-based software/platform to conduct assessments and analyses.
Brayfoil Technologies	Novel wind turbine blades	Johannesburg, South Africa	A novel wind turbine blade design that utilises bio-mimicry to improve performance and efficiency.
Cedeco	Wind turbine installation	Glasgow, UK	Technology that offers a mechanical alternative to grout for offshore wind turbine installation.
Dunia Innovation	Renewables, hydrogen and other clean fuels	London, UK	A self-driving laboratory for electrocatalytic CO2 utilisation catalysis, significantly speeding up catalyst discovery.
HonuWorx	Subsea robotics deployment	Aberdeen, UK	An all-electric mothership for worker robots for remote subsea inspection and maintenance that eliminates offshore crew and reduces the carbon footprint.
JET Engineering System Solutions	5G marine communication	Reading, UK	Floating telecom 5G buoys that are able to withstand harsh conditions, supporting data communication in maritime.
PJP Eye	Organic carbon batteries	Fukuoka-shi, Japan	Rechargeable plant-based dual carbon batteries that utilise industrial waste instead of rare metals, with potential applications in marine and aviation.
RepAir Carbon Capture	Direct Air Capture	Haifa, Israel	A modular, cheaper way of capturing carbon through an electrochemical system powered by electricity.
T-Omega Wind	Floating offshore wind	Boston, USA	Low-cost floating wind turbines for coastal community energy which can resist wave-induced motion and align to the wind by weathervaning.
UP Catalyst	Carbon recycling into valuable materials	Tallinn, Estonia	A carbon-capturing reactor that can convert airborne CO2 into graphite.
ZEM Fuel Systems	Ammonia fuel cell	Dundee, UK	An ammonia-based fuel cell to power marine vehicles resulting in zero-carbon transportation.

WINTOG Programme

Where could collaboration help?



Energy Transition Alliance
WINTOG Programme

Collaborative work programme focused on common challenges and industry impact

Integration, Storage and Transmission Technology and Infrastructure	Supply Chain and Infrastructure	Development and Consent	Policy and Regulation

We expect the programme to be value for money to the partners.
We will collaboratively work specific opportunities and challenges of integrating wind with O&G.
Our success will be measured in supporting the delivery of WINTOG projects.

CATAPULT Offshore Renewable Energy | Net Zero Technology Centre – Technology Driving Transition

Technology Driving Transition

INTOG Energy Systems Solutions

Net Zero Technology Centre

Technology Driving Transition

Energy Pathfinder

Sylvia Buchan, OGA

Energy Pathfinder

INTOG – Energy Pathfinder

Sylvia Buchan – Energy Supply Chain Manager

17th March 2022

Oil & Gas Authority

Welcome to Energy Pathfinder

One stop shop for visibility of future UKCS work and collaborative opportunities

Supply Chain

Operator Login

Register for Email Updates

Pathfinder Guidance Video

Decom Data Visibility Dashboard

Projects

Back

9	41	79	7
Discovery	Development	Decommissioning	Energy Transition

Operator	Field Type	Field Stage	Project Title	Contact Details	UKCS Area	Date Project Updated
PALE BLUE DOT ENERGY		Energy Transition	Acorn CCS Project	Murad Elfituri Procurement Manager murad.elfituri@pale-blu.com 01330 826890		12 May 2021
ENI UK LIMITED		Energy Transition	LIVERPOOL BAY CCS TRANSPORT & STORAGE PROJECT (Part of the HyNet Northwest CCS Project)	Nicola Ruff Technical Activities Procurement Co-Ordinator nicola.georgina.ruff@eni.com 0207 344 6103		22 February 2022
OCEAN WINDS UK		Energy Transition	Moray West offshore wind farm	Roger Mcmichael Stakeholder Manager roger.mcmichael@oceanwinds.com 07717367150		9 February 2022

Project Details

Back

Operator

OCEAN WINDS UK

Project Title

Moray West offshore wind farm

Field Type

(Blank)

Field Stage

Energy_Transition

UKCS Area

(Blank)

Location

(Blank)

Water Depth

(Blank) metres

First Production

(Blank)

Project Contact Details

Roger Mcmichael
Stakeholder Manager
roger.mcmichael@oceanwinds.com
07717367150

Energy Transition Category

Offshore Power Generation

Project Summary

An 860MW grid connected fixed foundation offshore wind farm in the Moray Firth. Onshore and offshore consents in place for up to 85 wind turbines and export cabling from two offshore substations to an onshore project substation before connecting the national electricity transmission network at the Blackhillock substation near Keith, Moray.
Construction works are due to start in 2022 and full commissioning by early 2025. Operational phase planned for 30 years.
Tier 1 CAPEX contractors will be appointed through to end of Q1 2022. Sub contracting opportunities promoted via Meet the Buyer events, Energy Pathfinder and use of supplier databases. CAPEX subcontracting running through 2022.
Suppliers should only use this portal for responding to tender opportunities where they have a clear offering in response to the tender scope.

Right click on numbers below to see more information

0 Collaboration Opportunities	4 Awarded Contract	3 Upcoming Tenders	0 Wells to be Decommissioned	0 Platforms FPSOs	0 Integrated Rigs

Energy Pathfinder

Awarded Contracts

Back

4

Total Upcoming Contract

Operator	Function	Description of Work	Date Awarded	Contract Band	Contact Details	UKCS Area
OCEAN WINDS UK	Facilities (onshore)	Onshore substation to step up voltage from 220kV to 400kV. Location at Whitehillock near Keith, Moray. 860MW export capacity to national electricity transmission network	10 November 2021	> £25 million	Stephen Hewitt Project Manager stephen.hewitt@siemens-energy.com 07921 240568	
OCEAN WINDS UK	Subsurface	Supply and installation of export cables in two circuits from the two offshore sub-stations to the national grid connection point at Blackhillock substation near Keith, Moray. Buried offshore and onshore cables. 220kV from offshore sub-stations to project substation at Whitehillock near Keith then 400kV to Blackhillock substation.	01 December 2021	> £25 million	Ryan Singleton Tender & Project Purchasing Manager Uk ryan.singleton@nexans.com 07392 080831	
OCEAN WINDS UK	Facilities (offshore)	Supply and installation of offshore wind turbines. Preferred bidder agreement in place (November 2021)	20 October 2021	> £25 million	Xxxxx Procurement xxx@siemensgamesa.com 02011111111	
OCEAN WINDS UK	Facilities (offshore)	Two offshore sub-station transmission platforms receiving	10 November 2021	> £25 million	Stephen Hewitt	

Click to see selected Project Details

Technology showcase

SENSEwind technology – Patrick Geraets, SENSEwind
Hydrogen JIP – Neil Robertson, Crondall Energy
TLP Systems – Jonathon Jury, OSI Renewables

SENSEwind

Patrick Geraets

SENSEwind

Engineering to reduce the cost of wind energy

INTOG Leasing Round Workshop

17 March 2022

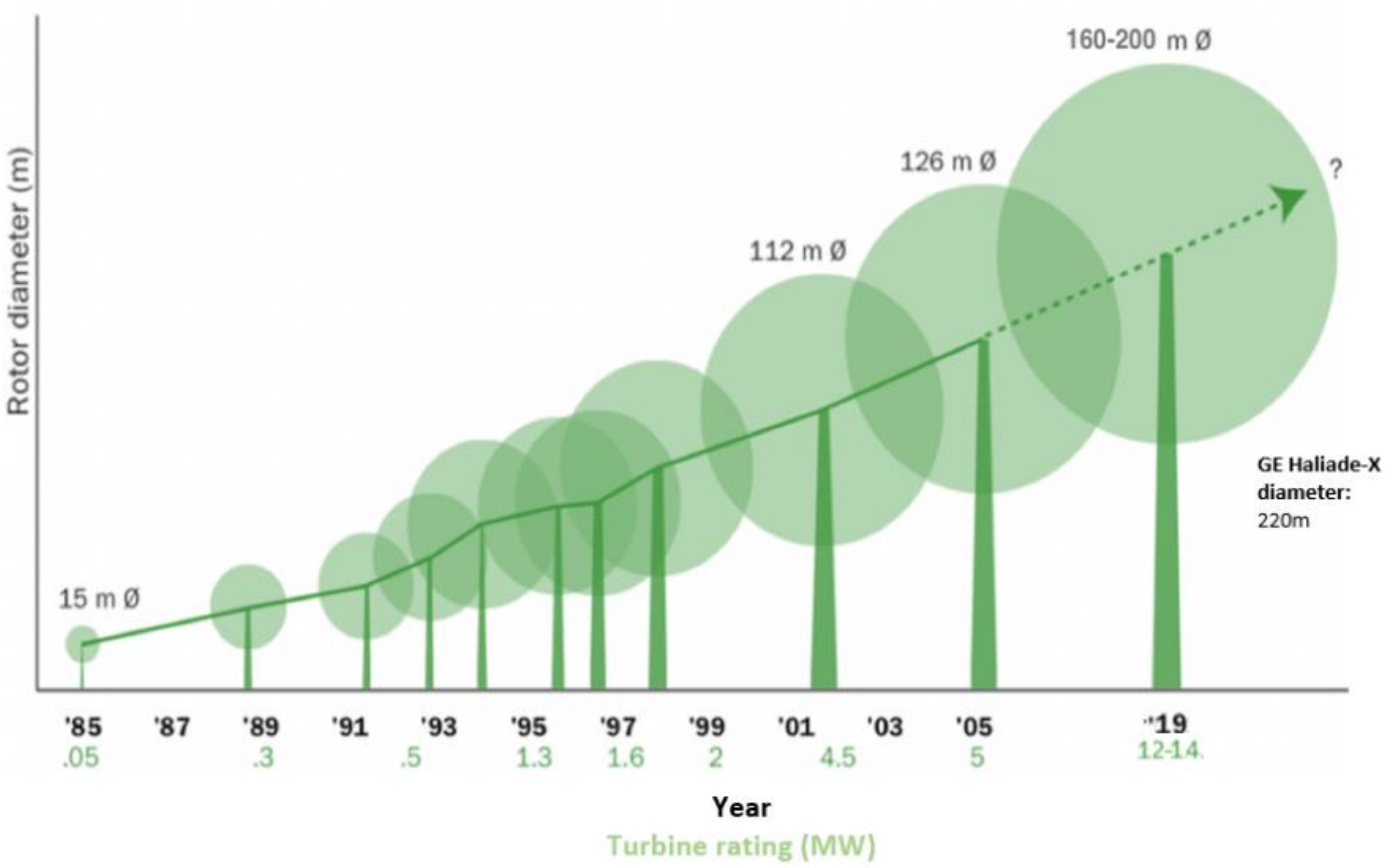
Funded by:

www.sensewind.com

Department for
Business, Energy
& Industrial Strategy

Patrick Geraets – pgeraets@sensewind.com

The problem



Rotor diameter (m)
15 m Ø
112 m Ø
126 m Ø
160-200 m Ø
?
GE Haliade-X
diameter:
220m
'85
.05
'87
'89
.3
'91
'93
.5
'95
1.3
'97
1.6
'99
2
'01
4.5
'03
'05
5
'19
12-14
Year
Turbine rating (MW)

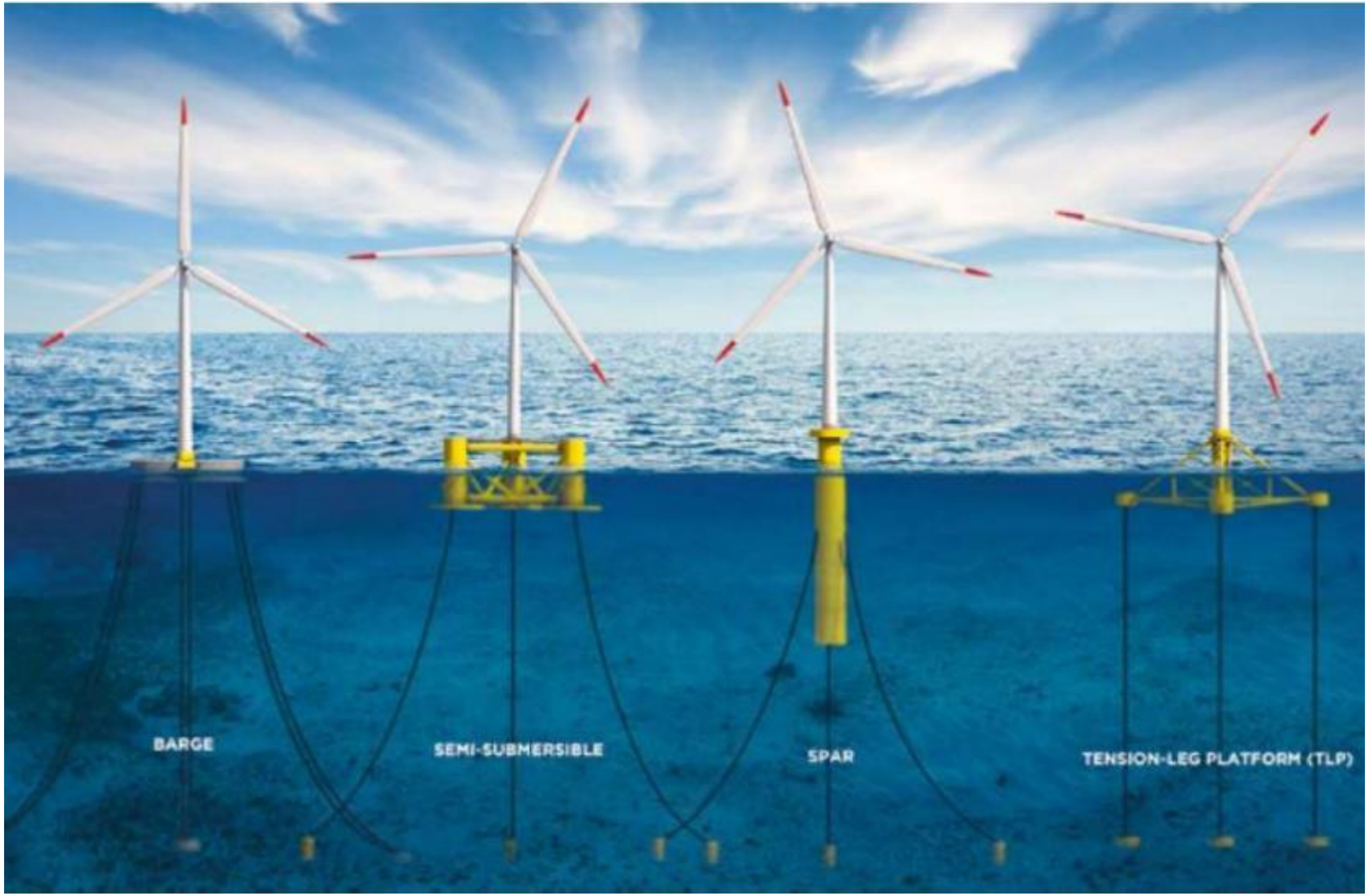
The solution

Self Erecting **N**acelle and **SE**rvice (SENSE) system

Watch the video: *sensewind.com*

SENSEwind will transform installation and servicing

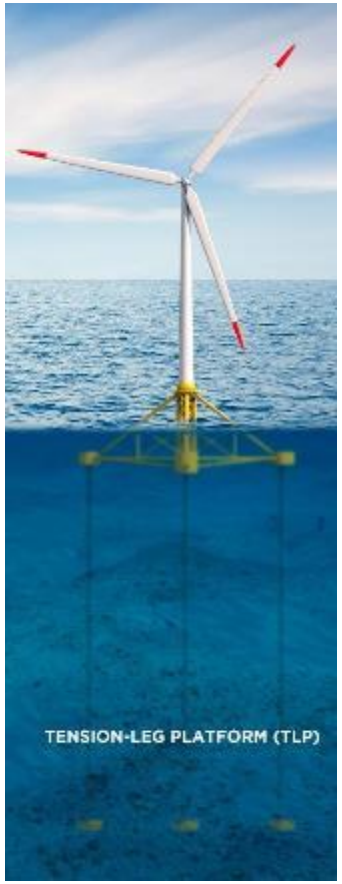

SENSE can be used on all floating concepts



Source: WindEurope

Cost savings with SENSE System incorporated

For a typical 1 GW floating offshore wind project e.g. ScotWind for construction and 25 year operation



£740m saving

for a tension leg concept

9% LCoE reduction
18% OpEx NPV reduction

£162m saving

for a semi-sub/barge/spar concept

2% LCoE reduction
5% OpEx NPV reduction

SENSEWind has a £10m grant towards a demonstrator

PelaStar TLP floating foundation

+

SENSE turbine installation and service system

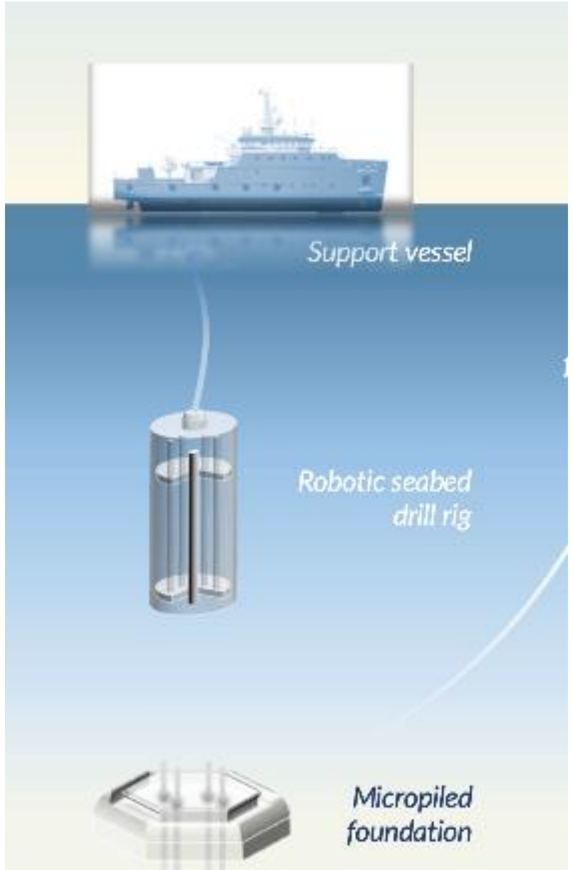
+

Subsea Micropile seabed anchors

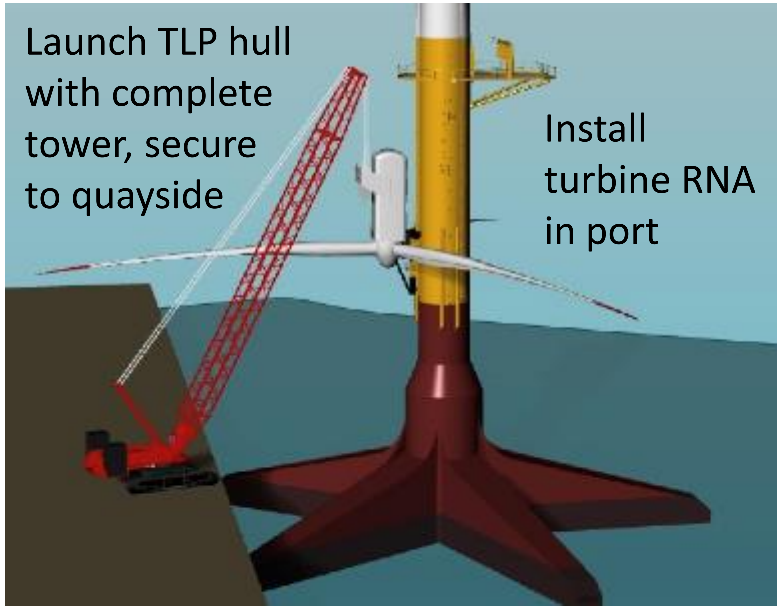
=

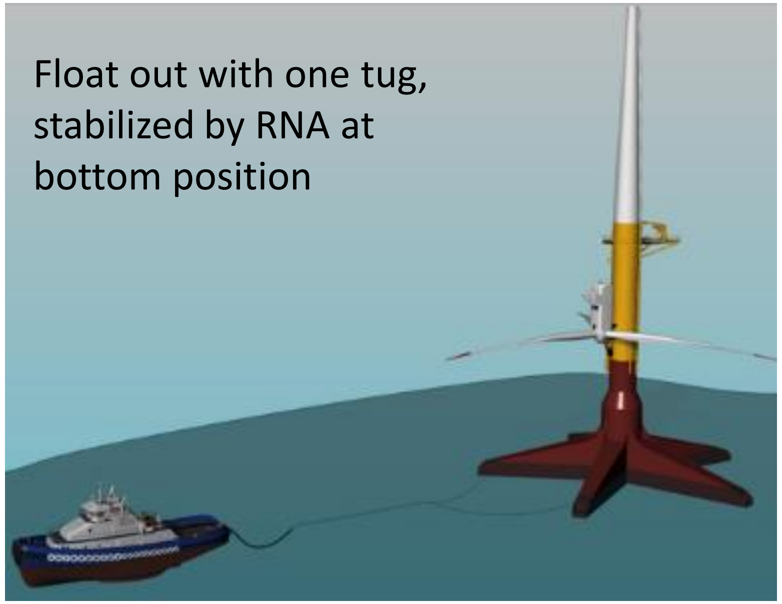
SENSE PelaStar Demonstrator

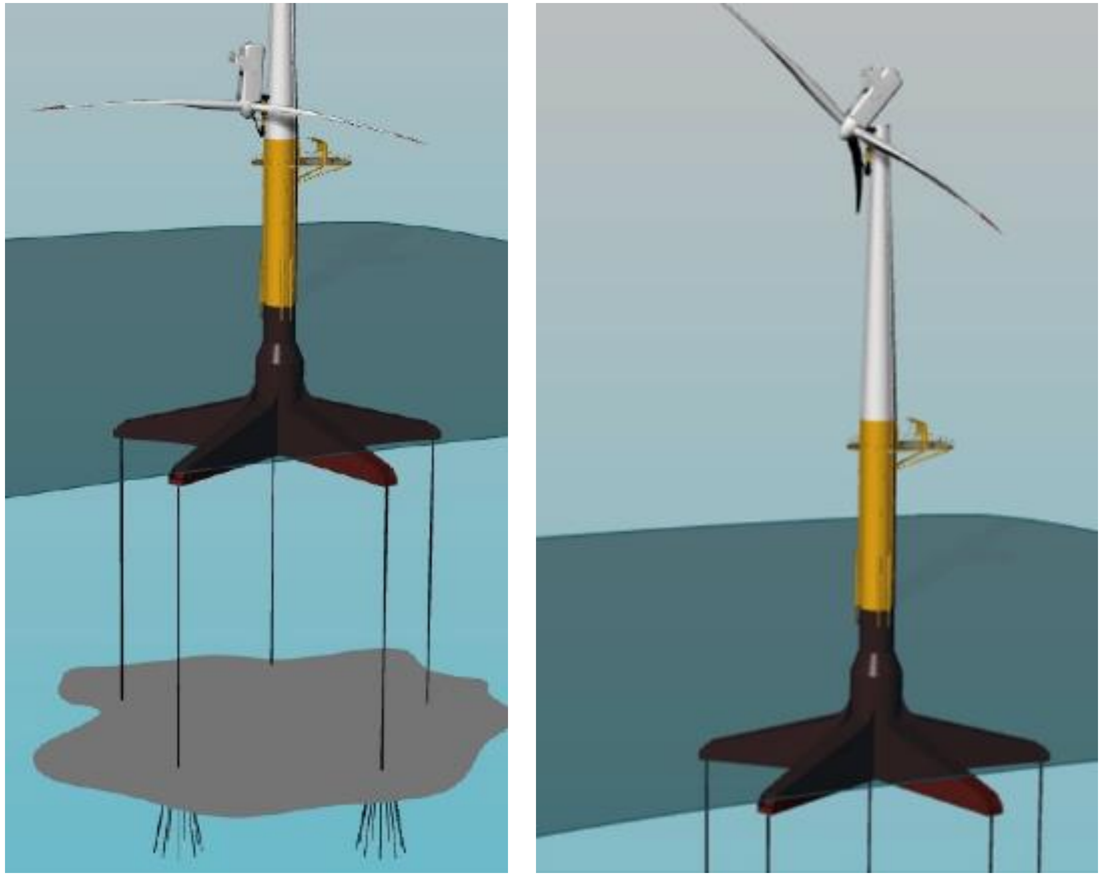
Installation sequence: from port to operation



Install micropile anchors offshore (with load test)

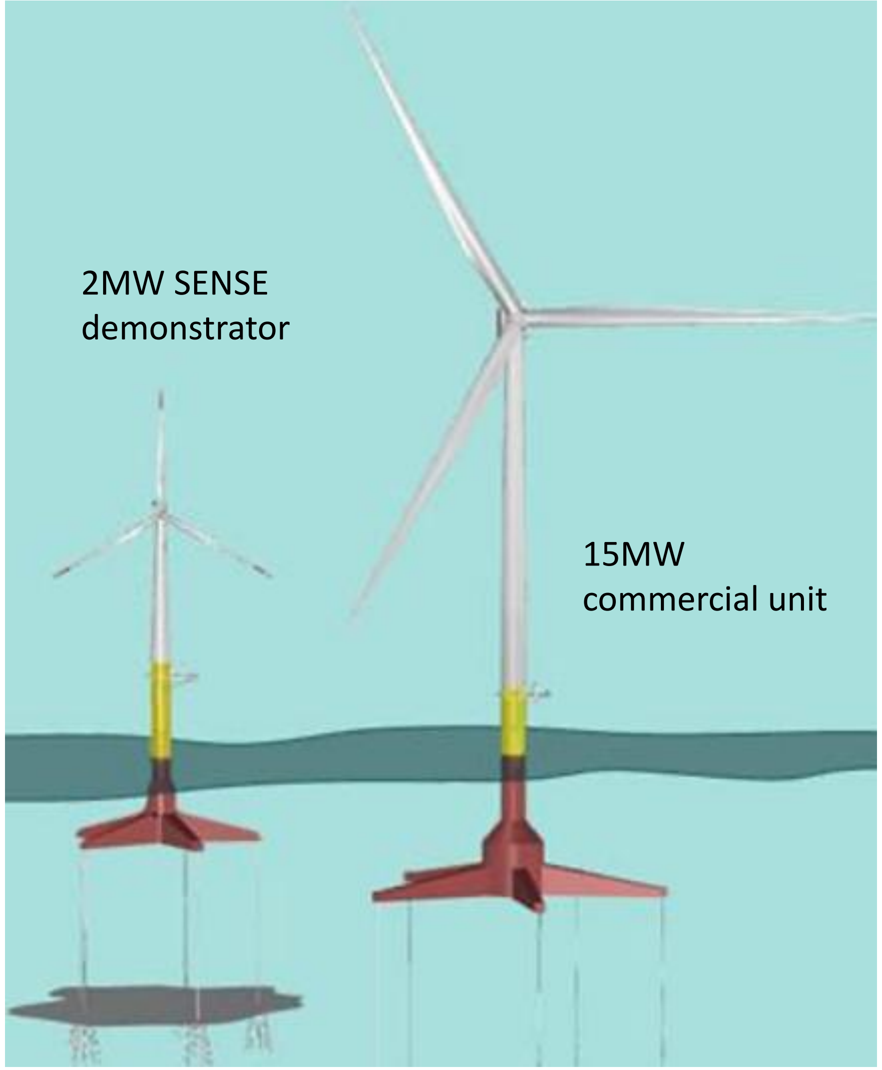


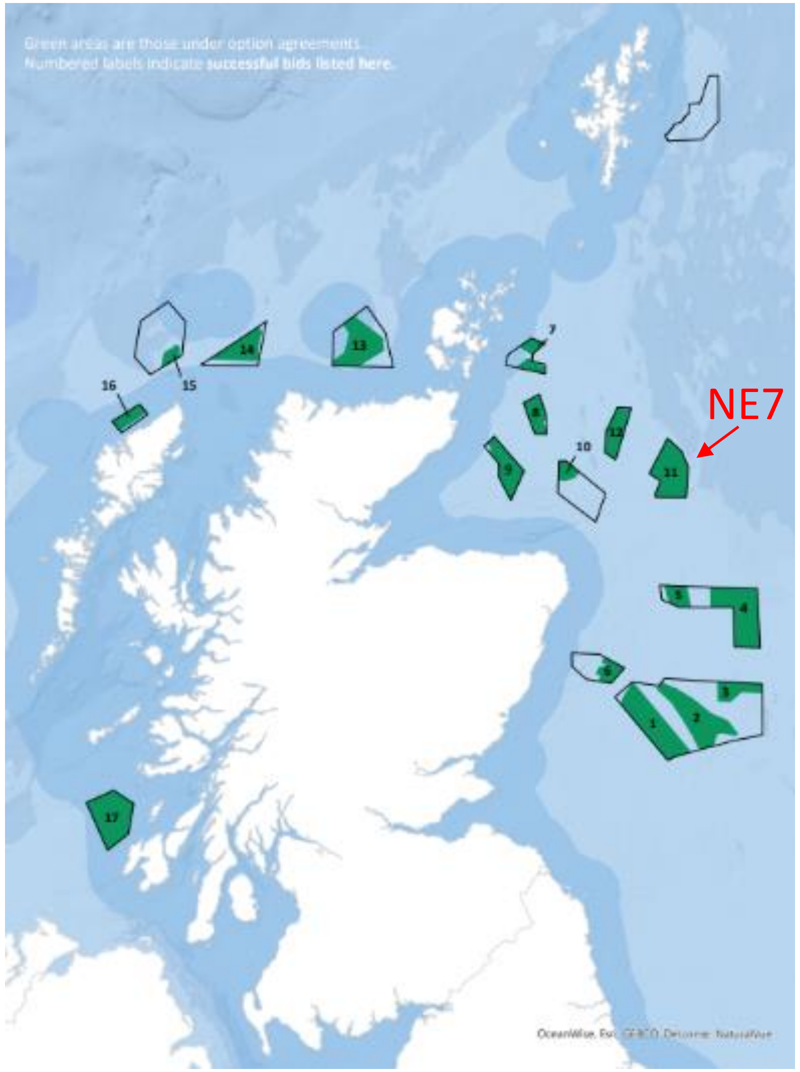




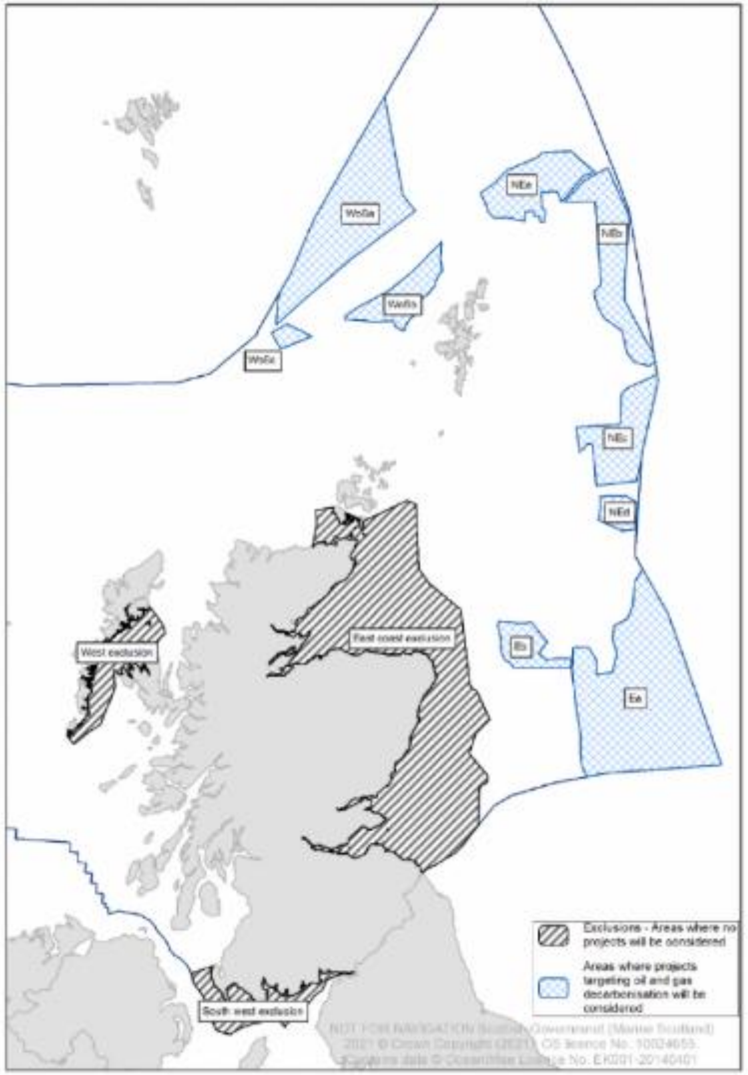
Connect to anchors, install RNA, commission turbine

SENSE will scale to 15MW





ScotWind



INTOG

For further information contact: Patrick Geraets – pgeraets@sensewind.com

Crondall Energy

Neil Robertson

Crondall energy

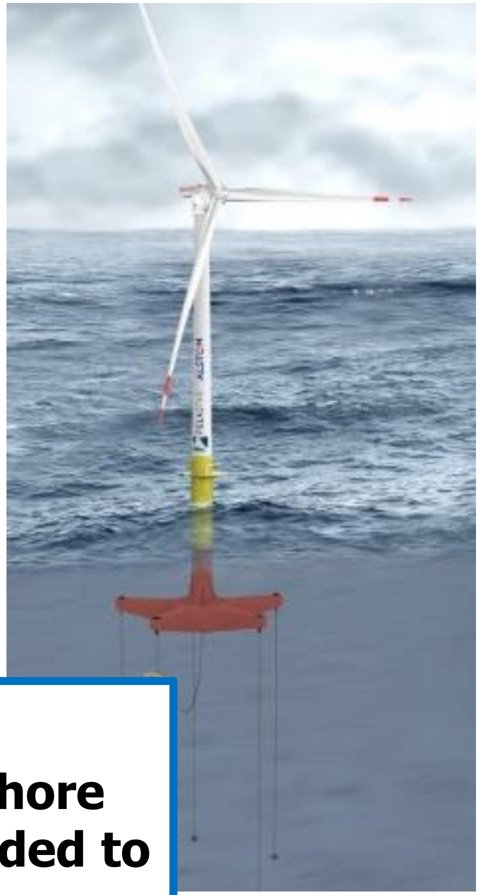
Future Offshore Wind Concept Selection (FOWCOS)

Nov 2021

Offshore Wind Concept Selection

Crondall energy

- In March 2019, the UK Government targeted 30GW installed offshore wind capacity by 2030.
- To reach this level of installed capacity the industry will be moving from fixed foundation wind turbines near shore to more remote locations (probably floating facilities in deeper water).
- Energy transmission distances to the onshore grid will increase and as the overall UK installed capacity grows exponentially the ability and flexibility of the grid to accept electrical power from offshore energy will become increasingly constrained.
- For this reason, the conversion, storage, and transportation of energy in alternative forms (P2X or Power (electrical) to other ("X") forms) is likely to become increasingly attractive to offshore renewable developments.



This introduces a wider range of feasible concepts for a given offshore wind development and consequently a selection process will be needed to identify the best value concept for each location.

JIP Future of Offshore Wind – Fresh look at what may now be possible.

Crondall energy

Emerging Opportunities:

Low cost, high reliability, low OPEX wind turbines

H_2 electrolyser technologies at different scales

H_2 Electrolysis of seawater

Available NS O&G Infrastructure

Chemical conversion of H_2 into lower risk, more readily transported fluids (NH3 MCH (Spera H_2)

Deepwater, remote offshore engineering experience

Reduce cable failures / power limitations.

Incorporate storage as part of the deliver system – maximise flexibility and commercial return.

Proven Technology: Turbines/a.c.- d.c. transmission/ deliver to grid.

Novel turbine designs to reduce offshore structure loading.

Alternative delivery markets. H2, fertiliser, protein feedstock

H2 conversion – offshore electrolysis facility.

Re-locate wind farms to maximise value of existing infrastructure.

Wind to H2 at turbine – simplify energy conversion.

Chemical energy (H2, NH3, MCH) transmission in pipelines.

Offshore reliability engineering – what works.

Best value technology; lowest life-cycle costs.

Existing infrastructure – feasibility for different chem. modes.

System Engineering – Remove unnecessary complexity & cost.

Design for installability, robustness and ease of maintenance.

Bringing it all together

Potential Outcomes:

UK plc. Best Value Strategy for North Sea future.

Best Value Offshore Wind Industrial Concepts for Various Scenarios

Highly Reliable, Low OPEX Wind Energy Capture from Offshore Resources.

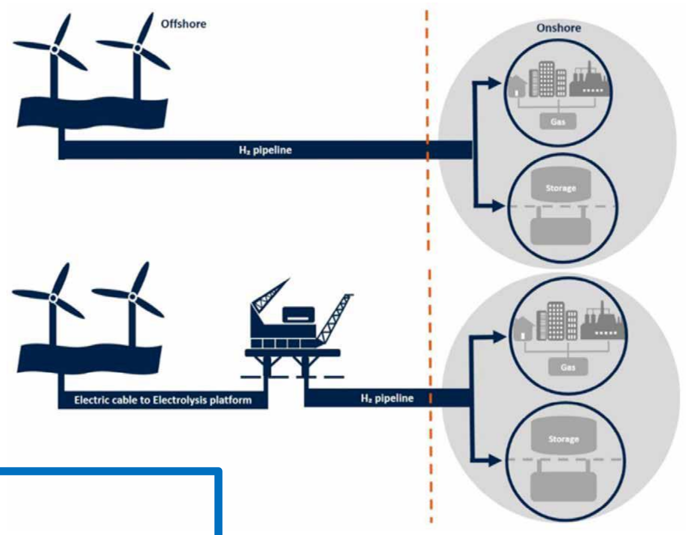
Range of High Value Products to UK and International Markets.

Built in Energy Storage for Maximum Flexibility and Commercial return.

Crondall energy

Crondall Energy believe there is value in running a JIP to explore these issues and develop guidelines to support developers in concept selection for offshore wind developments.

The JIP will cover the entire energy delivery chain across the key P2X systems i.e., electrical power generation, power delivery from a renewable source to a conversion point, energy conversion (electron or molecular form, gas or liquid), storage, and energy export (chemical or/and electrical).



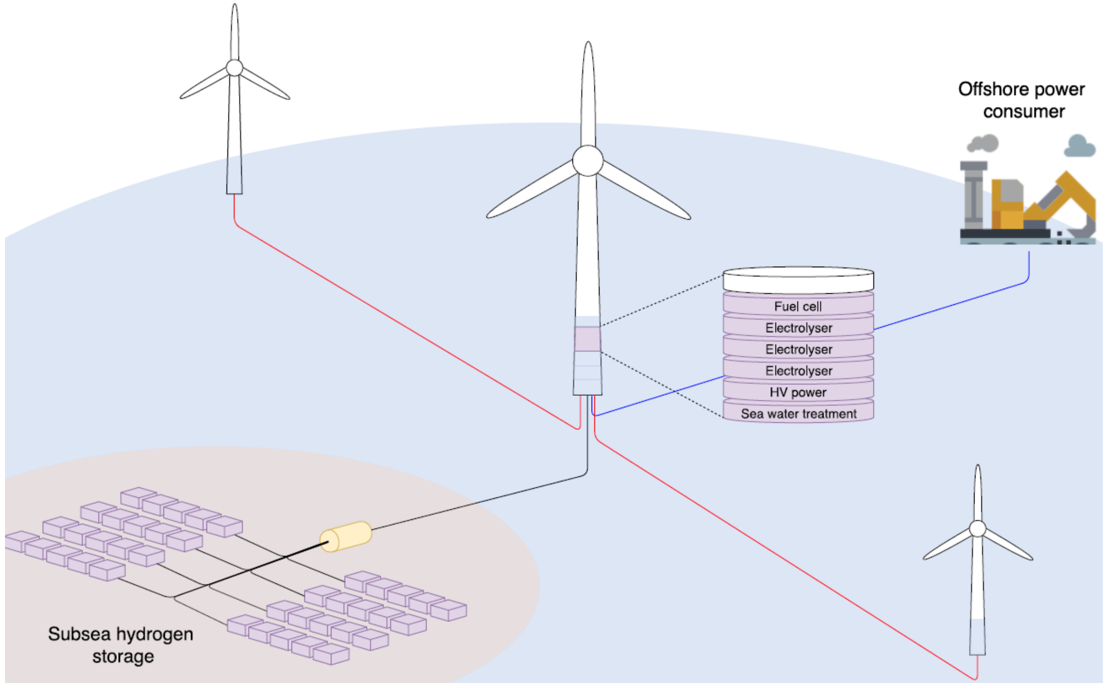
The purpose of the guidelines is to:

- Give supply chain and technology developers an understanding of selection criteria and drivers likely to be prioritised in P2X developments.
- Provide developers and investors with knowledge of P2X opportunities and risks as they look ahead to the practical realisation of larger scale offshore P2X renewable developments in the foreseeable future.

And as a consequence ensure all viable concepts are identified during early phase consent applications.

Potential drivers influencing concept selection are expected to include:

- Size of the wind farm (number and size of turbines)
- Distance from shore / market
- Available markets / distance to markets /flexibility in geographic delivery
- Grid constraints
- Bankability / return on investment (low risk/reward vs. high risk/reward)
- Technical feasibility
- Available technology / developing technology
- Safety and risk
- Cost (CAPEX/OPEX and future Decommissioning).
- Energy efficiency / CO2 emissions per kW delivered
- Operational Flexibility (e.g., P2X to monetise surplus power)
- Reliability, Availability & Maintainability
- Ease of storage / volume and cost of storage
- Potential for infrastructure re-use (transport or storage e.g., compressed air storage).
- Potential to provide alternative power to offshore oil and gas (or CCUS) installations and potentially use the current route to market e.g., via blended gas.



Phase 1 – Concept Selection Guidance

a) Research - Will cover two areas: the wind farm planning process and P2X technology. Technology assessment includes identification of TRL and estimated time/effort to full commercial operation.

b) Create a Concept Library

Identify the range of feasible options and document the pros, cons, benefits, risks, trade-offs and limitations of each. Undertake comparative cost analysis to identify tipping points between concept value as the distance from shore and the scale of the developments are varied.

c) Develop Draft Guidance

Create technical guidance that takes users through the feasible concepts and provides a comparative view on the concept selection factors identified above in relation to each concept.

Crondall energy

Phase 2 – Case Study

A case study will be developed to road test the guidance. The case study will be written up as a worked example and appended to the final guidance document(s) for the benefit of users.

Phase 3 – Final Guidance

Updated to capture improvements suggested through the stakeholder review and feedback process and lessons learned in developing the case study.

The final deliverable is expected to comprise:

- **Written guidance on feasible P2X concepts**
- **Work example as an appendix to the guide**
- **Evaluation tool and data input sheet that can be adapted by users for their own projects.**

OUR TRACK RECORD: KEY CLIENTS

Floating Production & Subsea Specialists

OSI
Renewables

Jonathon Jury

Oil & Gas Authority

DeepWind
North of Scotland Offshore Wind Cluster

INDUSTRIAL STRATEGY CLUSTER

OSIRenewables™

INTOG Workshop Presentation

What do we do

- **We Design things!**
  - Mooring systems, riser and umbilical systems, pipelines, structures all at TRL Level 9 before
- **We make things!**
  - Risers, Connectors, TLP tendons, Tensioners, Flex-Joints, Remote Monitoring systems – all at TRL Level 9
- **We Install things!**
  - Structures , cables and umbilicals, TLP tendons
- **We service**
  - All of the equipment we manufacture
  - Other 3rd party equipment as well

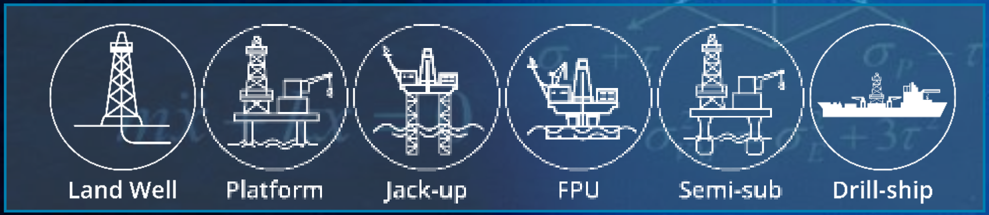
OSI Renewables

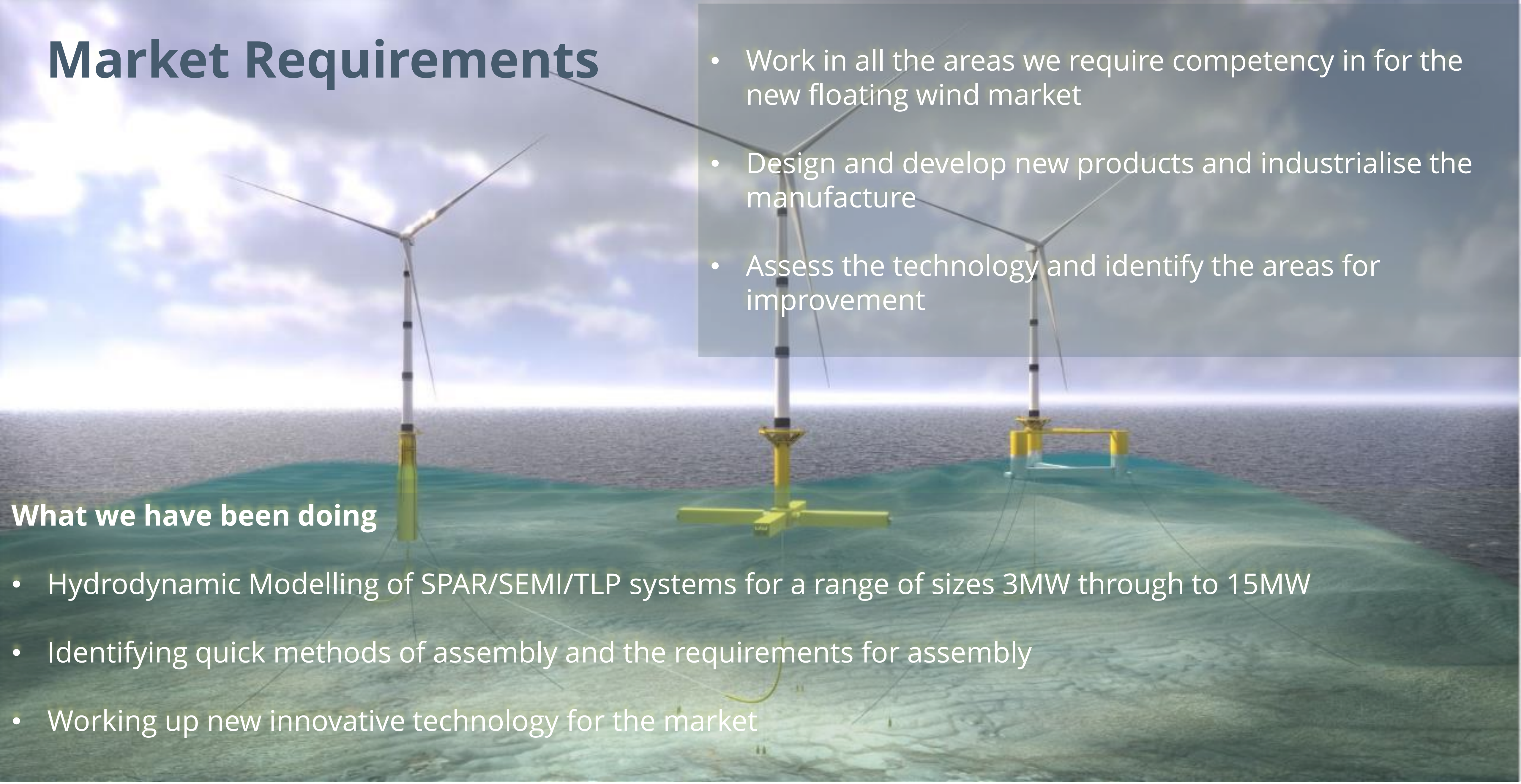
We Work on;

- Jack-ups
- Semi-subs
- Drill-ships
- TLP's
- Fixed Structures

DESIGN & ANALYSIS

- Subsea Structures
- Floating Systems
- Deepwater Mineral Systems
- Installation of structures and umbilicals





Market Requirements

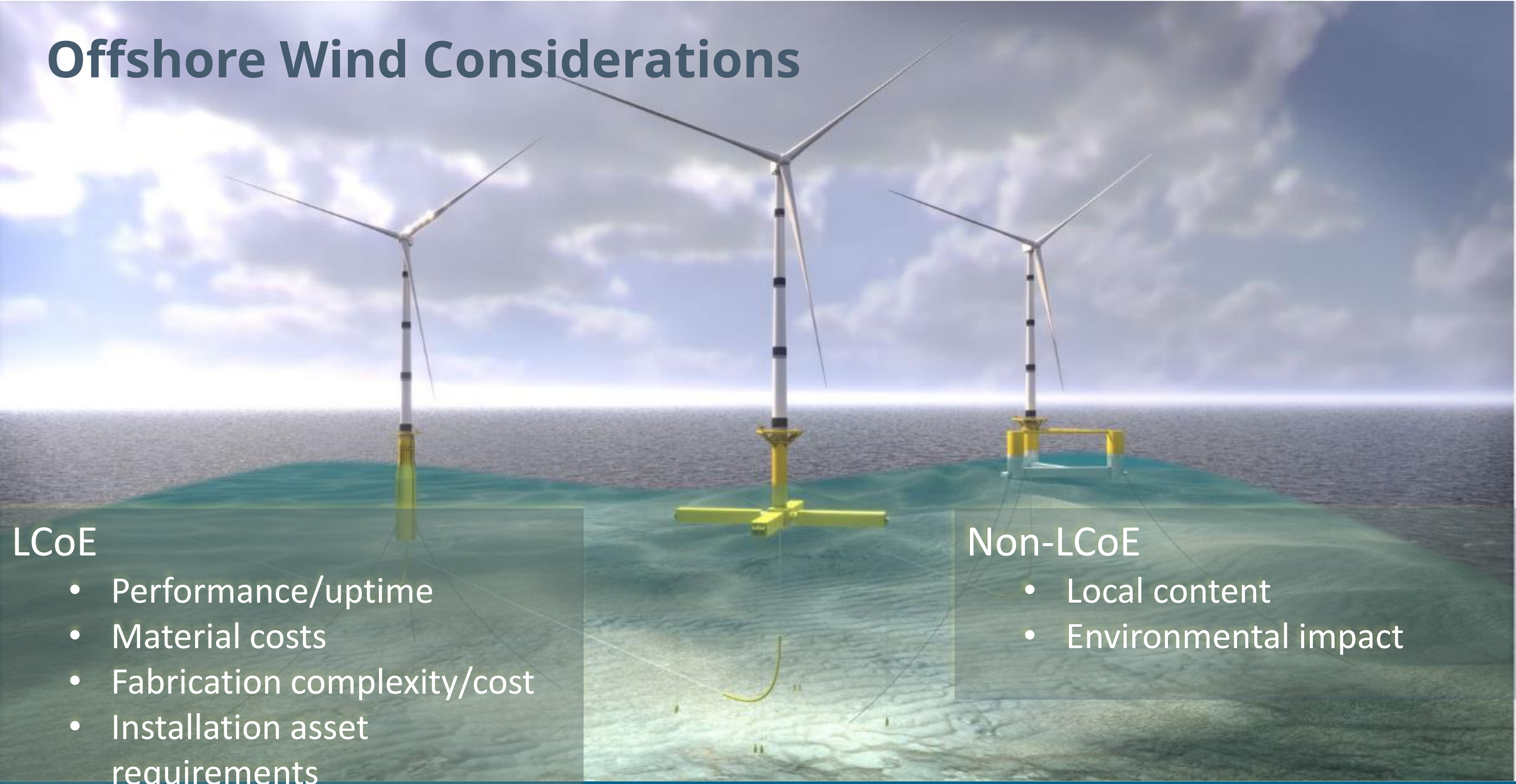
- Work in all the areas we require competency in for the new floating wind market
- Design and develop new products and industrialise the manufacture
- Assess the technology and identify the areas for improvement

What we have been doing

- Hydrodynamic Modelling of SPAR/SEMI/TLP systems for a range of sizes 3MW through to 15MW
- Identifying quick methods of assembly and the requirements for assembly
- Working up new innovative technology for the market

OSIRenewables™

Offshore Wind Considerations



LCoE

- Performance/uptime
- Material costs
- Fabrication complexity/cost
- Installation asset requirements

Non-LCoE

- Local content
- Environmental impact

SPAR

Benefits

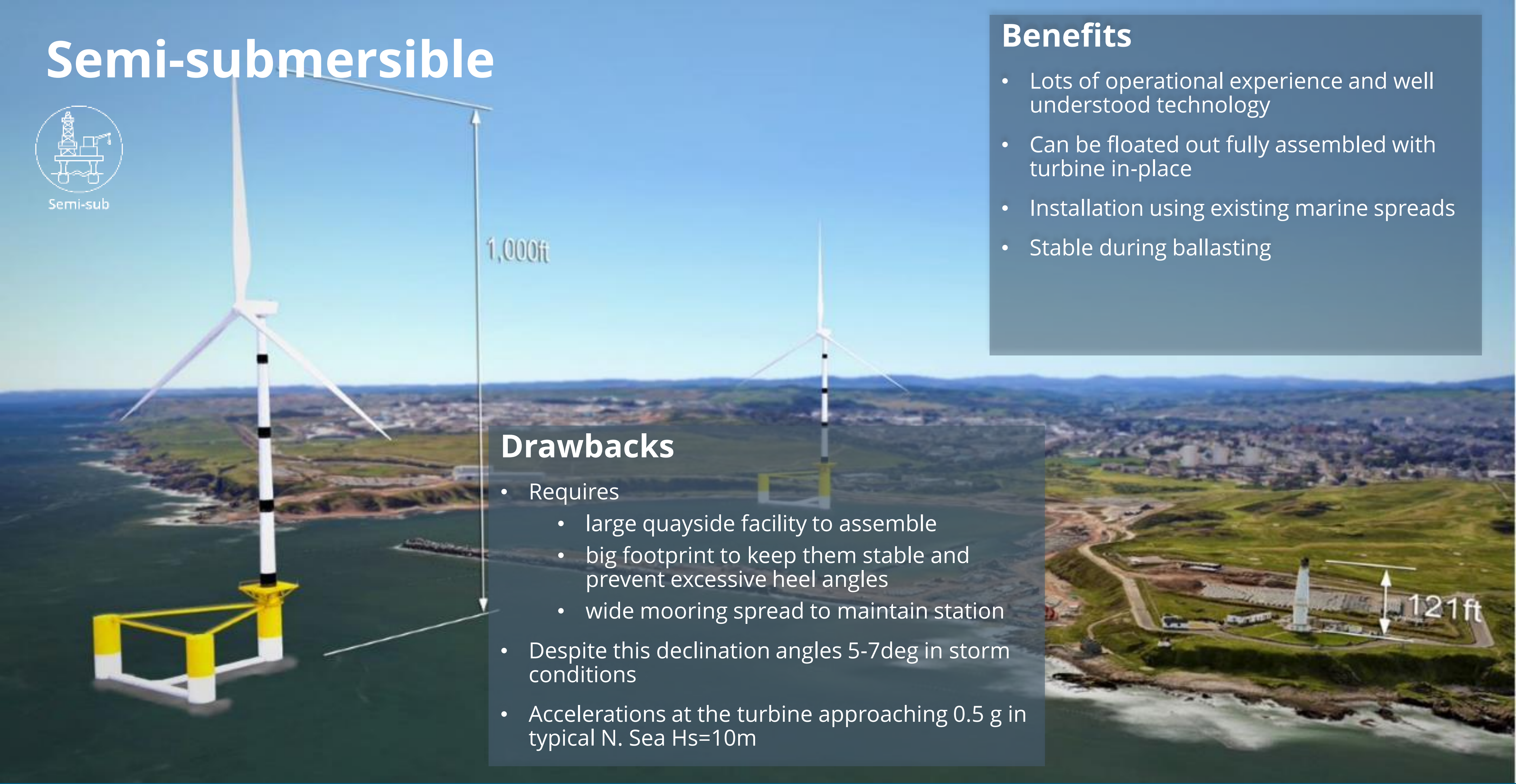
- Lots of operational experience and well understood technology
- SPAR shape is good for transition to the wind turbine tower
- Installation using existing marine spreads
- Stable during ballasting

Drawbacks

- Requires:
  - deepwater harbour or fjord to upend
  - a lot of ballast to keep them stable
  - a big floating offshore crane to install the turbine as can't be pre-installed
  - a wide mooring spread
- Declination angles 5-7deg and 0.3g at Nacelle in max operating (Hs 7m)
- Accelerations at the turbine approaching 0.5 g in typical N. Sea Hs=10m

OSI Renewables™

Semi-submersible



Benefits

- Lots of operational experience and well understood technology
- Can be floated out fully assembled with turbine in-place
- Installation using existing marine spreads
- Stable during ballasting

Drawbacks

- Requires
  - large quayside facility to assemble
  - big footprint to keep them stable and prevent excessive heel angles
  - wide mooring spread to maintain station
- Despite this declination angles 5-7deg in storm conditions
- Accelerations at the turbine approaching 0.5 g in typical N. Sea Hs=10m

TLP

Benefits

- Performance field proven
  - Installed 95% of the Worlds TLP's
- Mooring system is inside the platform footprint
  - Smaller Hull structure footprint like-for-like
- Can be installed with standard vessels
- Declination angles < 1 deg even in Hs=10m storm
- Accelerations at the turbine < 0.1 g in typical N. Sea Hs=10m for conventional TLP

Drawbacks

- Can be floated out fully assembled but may need temporary stability system for deballasting and tether tensioning
- Seabed piles carry high vertical load
- Conventional TLPs not well suited to shallow water
- Conventional TLP installation may not be cost effective

OSI Renewables – The Alternative TLP

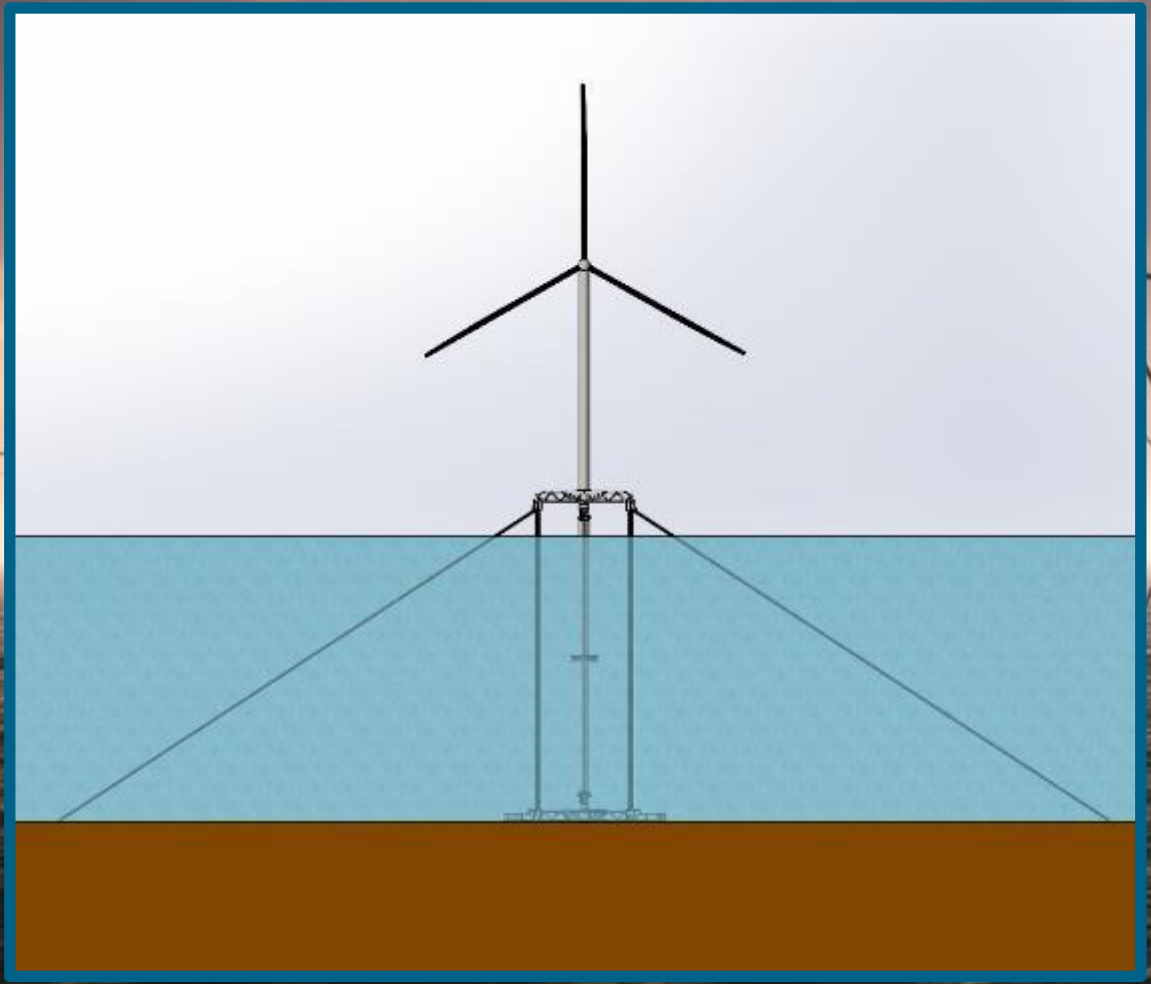
All the advantages of a fixed platform from 50m up to 150m with a disruptive design

The initial design process shows:

- Good dynamic performance similar to a conventional TLP system
- Good range of water depths for offshore wind expect it to be suitable 50m to 150m
- Declination angles < 1 deg even in Hs=10m storm
- Accelerations at the turbine < 0.10 g in typical N. Sea Hs=10m
- Design is ideal for the Innovation INTOG category

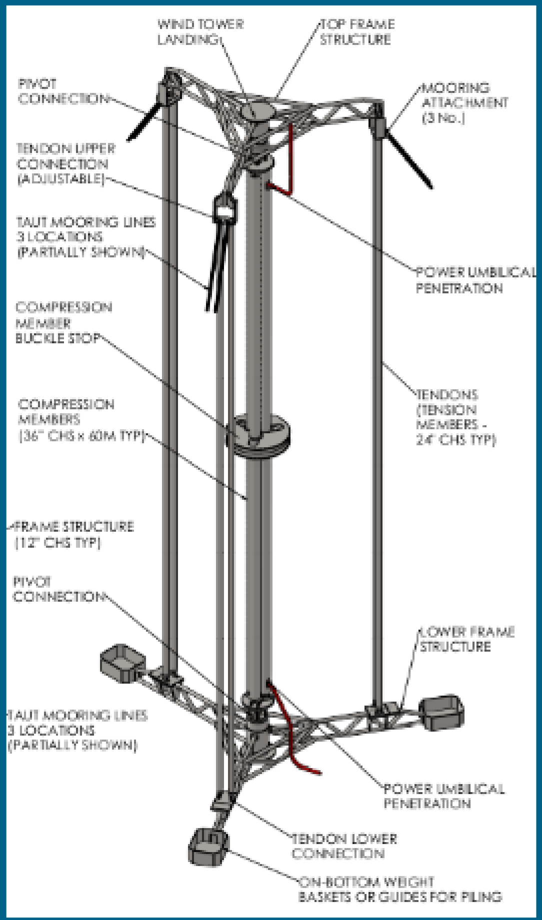
This is the solution which will give minimal downtime for the operator

OSI Renewables – Alternative TLP



Patent Pending

OSI Renewables – The Alternative TLP



Patent Pending

Key Components:-

- Central compression member
- Tendons maintain tension under extreme loads
- Seabed structure pre-installed
- Taut mooring resists side loads
- Seabed structure could be weighted if required
- Very small frontal area reduces wave load
- Very stable and low motions and declination

OSI Renewables – The Alternative TLP

Cost Competitive Design and Installation

Expected Steel Weights of Alt_TLP Systems:-

- **5MW – 70m WD – 700T**
- **10MW – 100m WD – 1500T**
- **15MW – 150m WD – 2250T**

(Predicted weights of a semi-sub option -10MW c. 3000T - 15MW c. 4100T)

OSI Renewables – The Alternative TLP

All the advantages of a fixed platform from 50m up to 150m with a disruptive design the initial concept shows:

- Structure made up of standard offshore structural components already demonstrated at TRL 9 reliability
- High local content most components manufactured in UK we can utilize a lot of components made at OSI Heartlands facility.
- Reduced construction time
- Onshore Structure assembly is quick and easy with standard port water depth and minimal components, minimum space required.
- Can be installed with standard vessels; wind turbine installed at shore and seabed part is pre-installed
- Cost competitive with a fixed tower and floating solution
- Reduced environmental impact relative to other solutions
- This technology is aimed at a developer looking for the most cost-effective solution for the wind turbine support structure that offers easy deployment and maintenance


OSIRenewables™
Rising to the Challenge in Offshore Energy™
Fixed Structure Foundation and Installation Systems
Pile grippers, passive grout seals, inflatable grout packers, grout injection tools, pile centralizers & leveling systems for turbines and substations
Turnkey Floating Wind Systems
Dynamic analysis, engineering, manufacturing, installation and service of integrated floating wind packages for developers from seabed to turbine
Feeder Vessel & Platform Lifting/Handling Solutions
Custom lifting/handling systems for feeder vessel optimization, blade lifting frames, davit & man-riding solutions
Global Analysis
Wind turbine FEED studies foundation and installation system
Services
Offshore installation and aftermarket support

INDUSTRIAL STRATEGY CLUSTER

Flotation Energy

Allan Macaskill &
Alexander Quayle

Oil & Gas Authority

DeepWind
North of Scotland Offshore Wind Cluster

FLOTATION ENERGY

Practical Lessons From The Beatrice Demonstrator and its Application to INTOG

Allan MacAskill Technical Director Flotation Energy

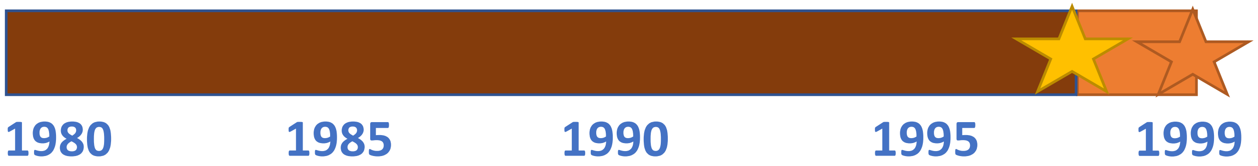
Alexander Quayle Green Volt Project Manager

DeepWind INTOG Workshop, 17 March 22

Beatrice: a brief history

FLOTATION ENERGY

- Discovered in 1976 by Mesa Petroleum
- Developed by Britoil with first oil in 1980
- Low GOR / pumped field
- Grid connected to Scottish mainland in 1986
  - 33 KV AC cable at 50 Hz
  - Transformer and frequency converter on Alpha to 60 Hz.
- Talisman acquired field in 1997 and
  - Cost reduction in 99 reduced OPEX, shutdown offshore generation and switched to grid power
  - All power from sourced from grid
  - Redevelopment in 2001 extended field life to 2011
  - Beatrice Demonstrator project in 2004 to 2007 installed 2 turbines.
- Turbine power was combined with grid power for the remainder of field life
- Jackie satellite discovery in extended field life to 2015



Original decom plan was for 1999

Beatrice: Impact of electrification

FLOTATION ENERGY

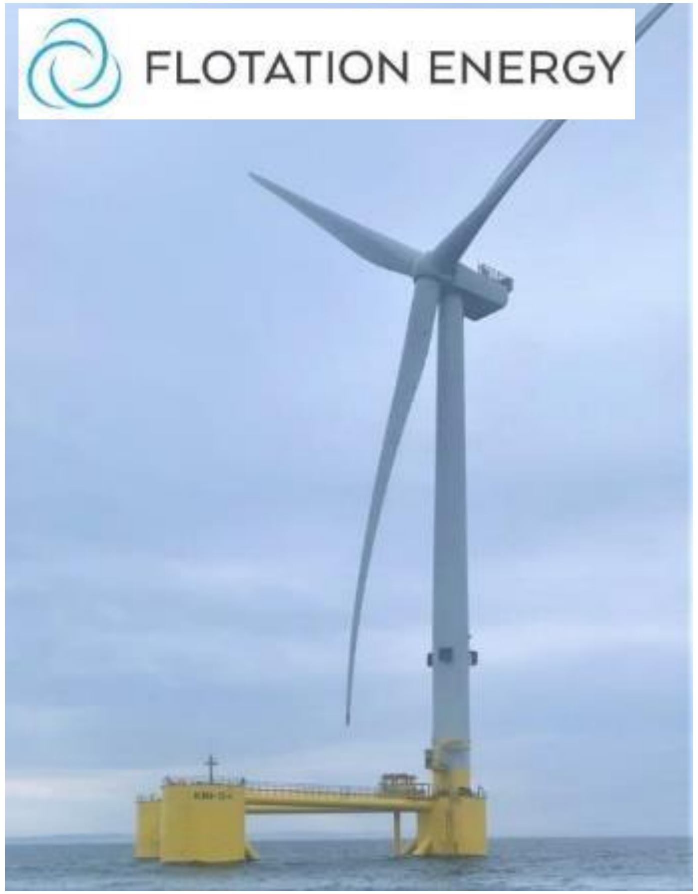
- Electrification was a key element of cost reduction, without which it could not have been delivered
- Electricity supply from the grid constrained production, but platform learned to operate differently and restored most of the lost production
- The cost reduction created the opportunity for field re-development to increase production and optimize process in 2001/2
- Beatrice Demonstrator project was approved in 2004 and 2 turbines were installed around 2 km from platform.
  - Turbines provide direct supply to platform
  - Connected up stream of grid connection
  - Became major source of supply of power with backup from grid
- Demonstrator was grant and ROC supported, pioneered jacket structures in offshore wind: it was furthest from shore, in deepest water with largest turbine at the time

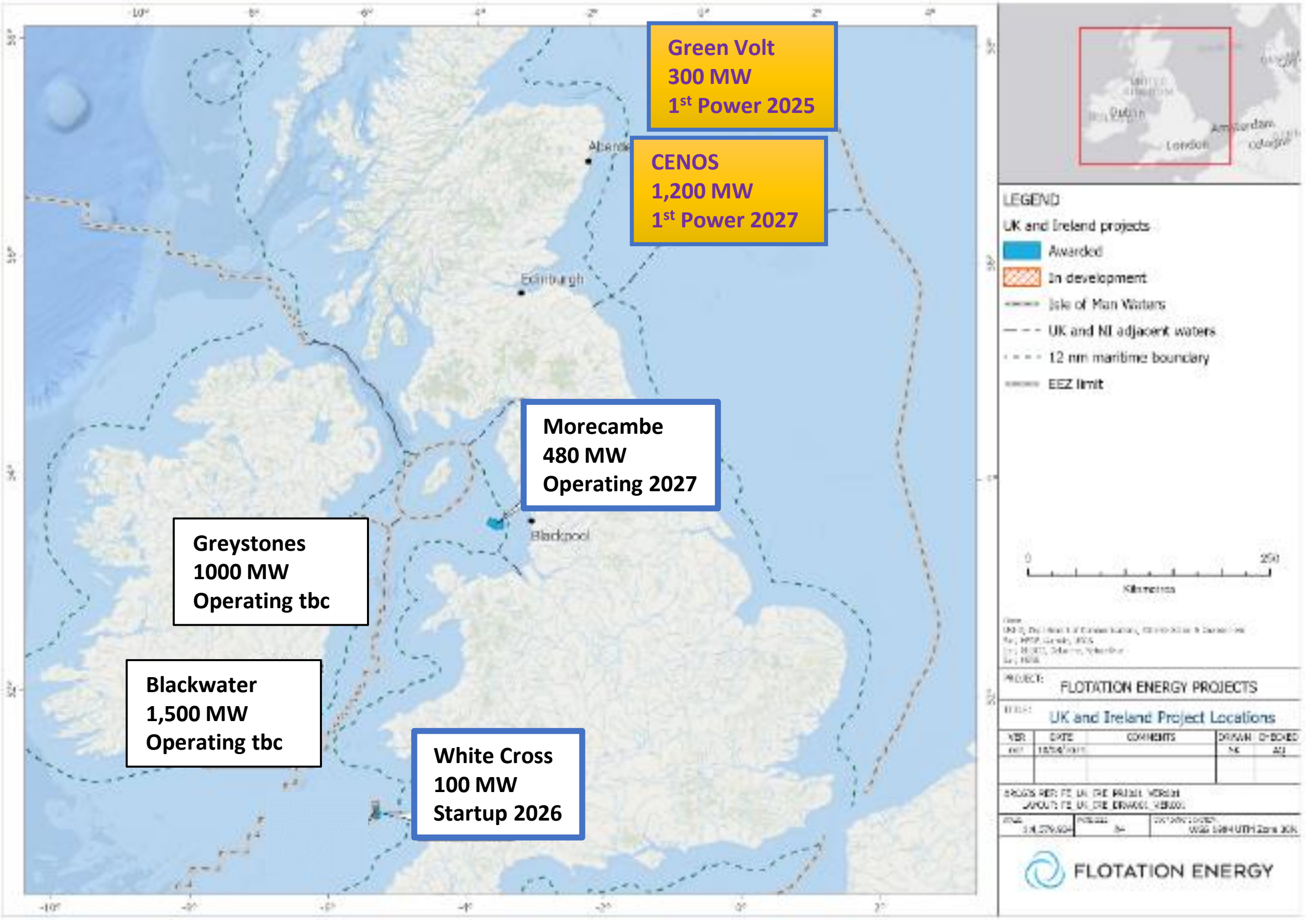
INTOG - the Challenge

- UK oil and gas assets part of the Energy Transition
- North Sea Transition Deal goal
- 50% emission reduction by 2030
- Net Zero basin by 2050

Flotation Energy – an independent offshore wind developer

- 10GW pipeline across UK, Ireland, Australia, Japan and Taiwan





Key Parameters for Success – O&G electrification

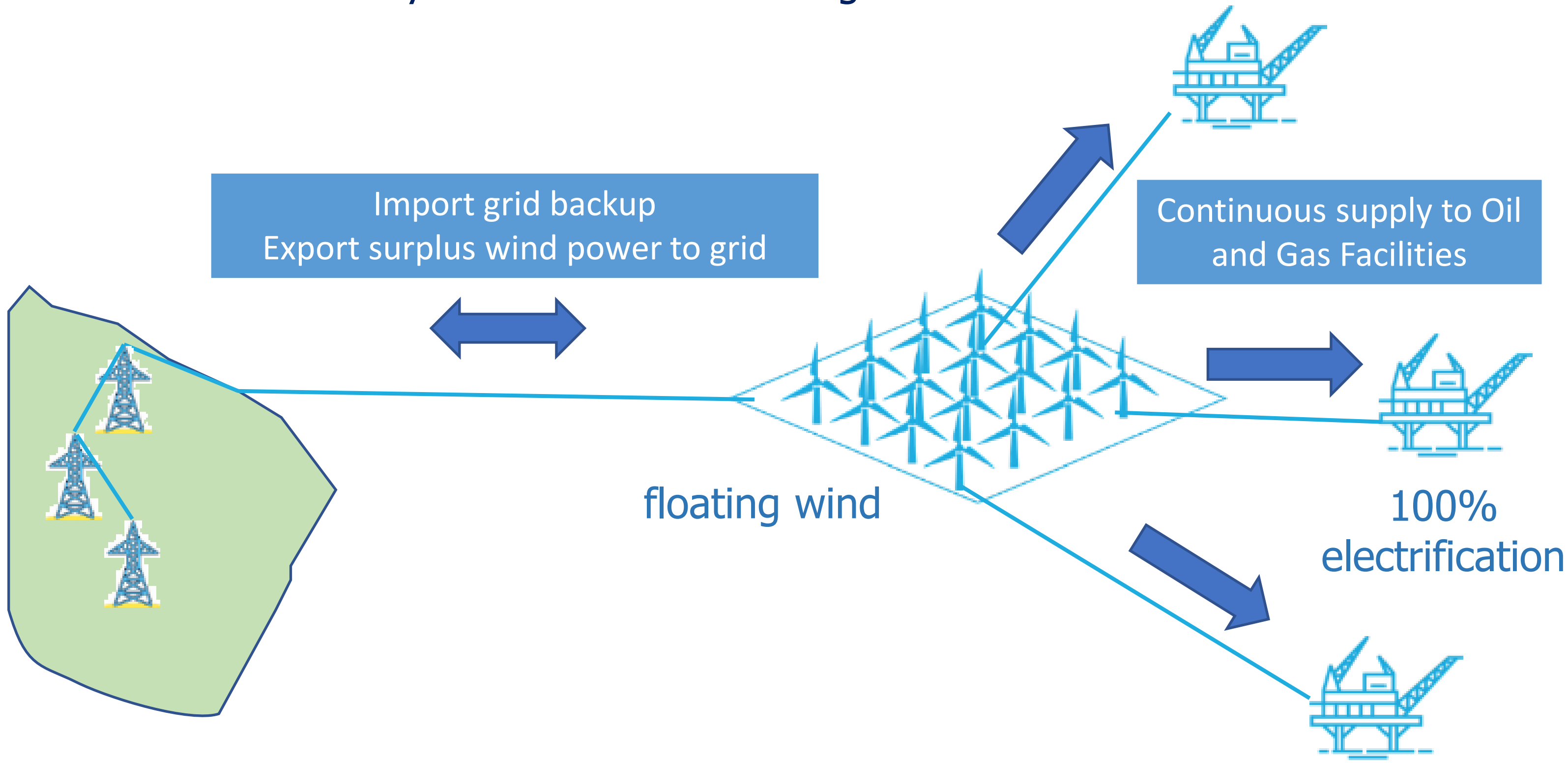
FLOTATION ENERGY

- Established Technology
  - Kincardine 50MW installed and operating 2021
- Rapid deployment
- Flexible electrical connection to O&G facilities from 2026/7
- 100% electrification with renewable electricity
  - 90-95% from the wind farm
  - UK grid reliability (99% +)
- 35+ year wind farm lifetime

Electrification – Our Concept

FLOTATION ENERGY

- Grid connected floating offshore wind farm to power UKCS O&G
- 100% retirement of onboard power generation
- Leverage offshore demand and CFD subsidy scheme to provide affordable, renewable electricity for North Sea oil and gas

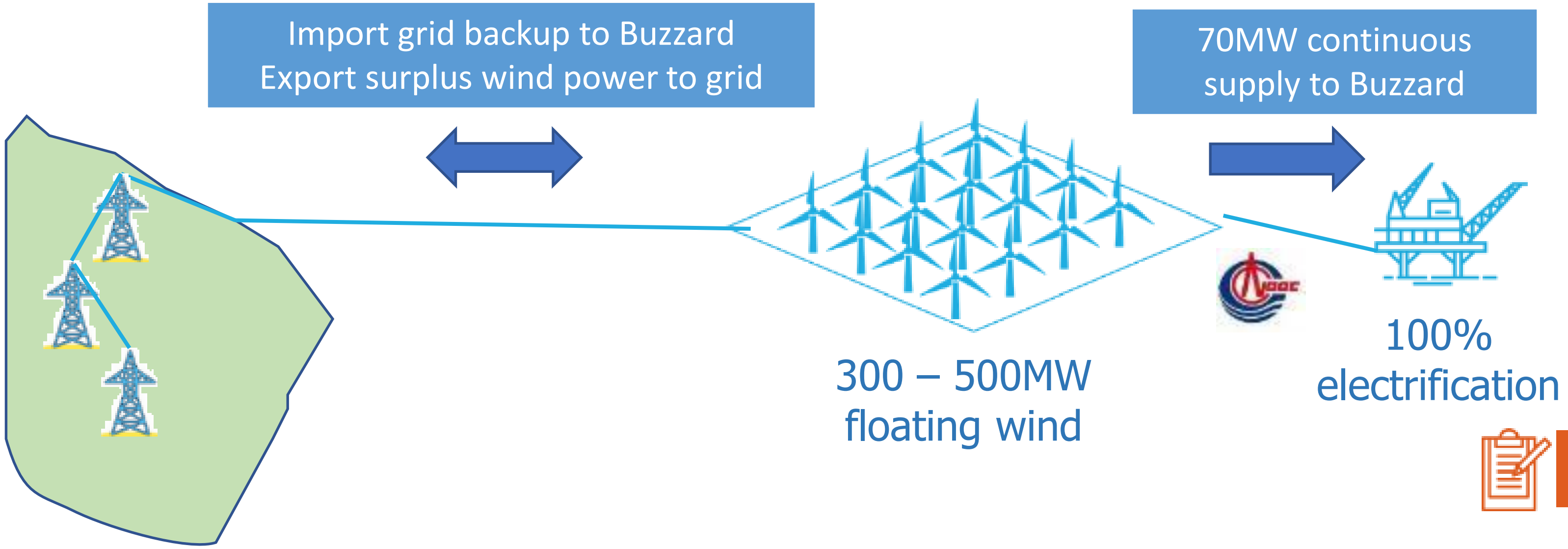


- ✓ 100% electrification
- ✓ Rapid deployment
- ✓ Maximum decarbonisation
- ✓ Grid reliability
- ✓ Fully eliminate GTG maintenance costs
- ✓ No late life gas buy back
- ✓ Optimal CapEx
- ✓ UK offshore wind growth targets

Project Green Volt

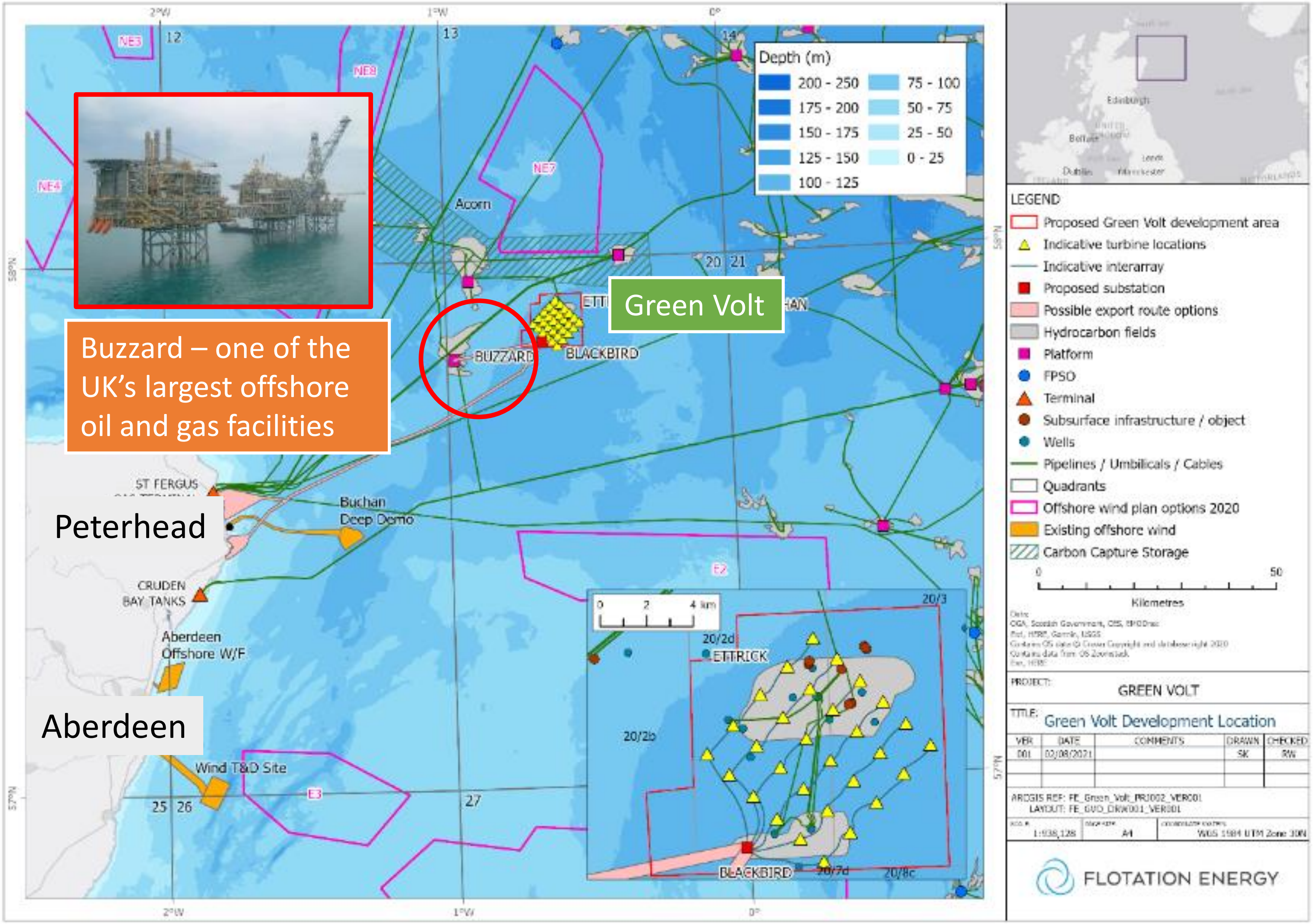
FLOTATION ENERGY

- Buzzard is the 2nd largest producing asset on the UK Continental Shelf (UKCS)
- 80km from shore, within reach of AC grid connection
- Pioneering opportunity to develop UK floating offshore wind infrastructure and expertise
- **Mitigates 500,000+ tonnes of CO_2 per year from 2026**



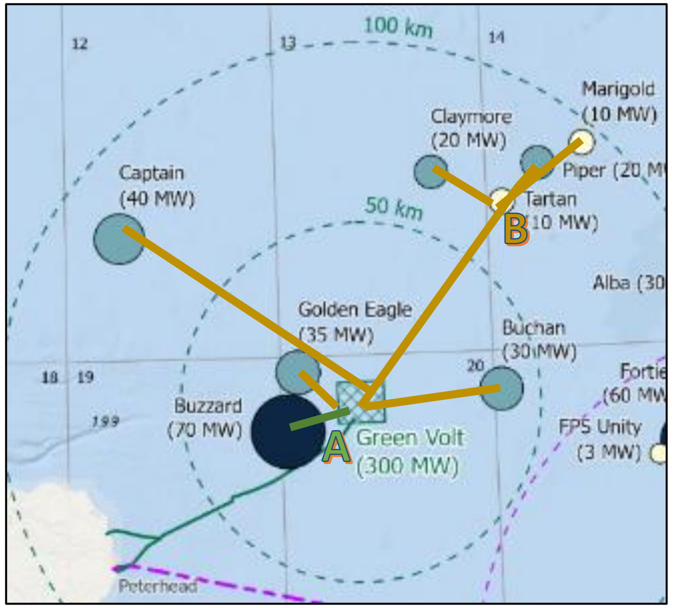
First power 2026, Completed 2027

Project Green Volt - Site



Key Opportunities

- Brownfield, de-risks environmental and engineering scopes
- 100m depth (floating wind)
- Stepping stone to key long-life assets, using O&G infrastructure



Project Green Volt – Timing

FLOTATION ENERGY

2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026 | 2027

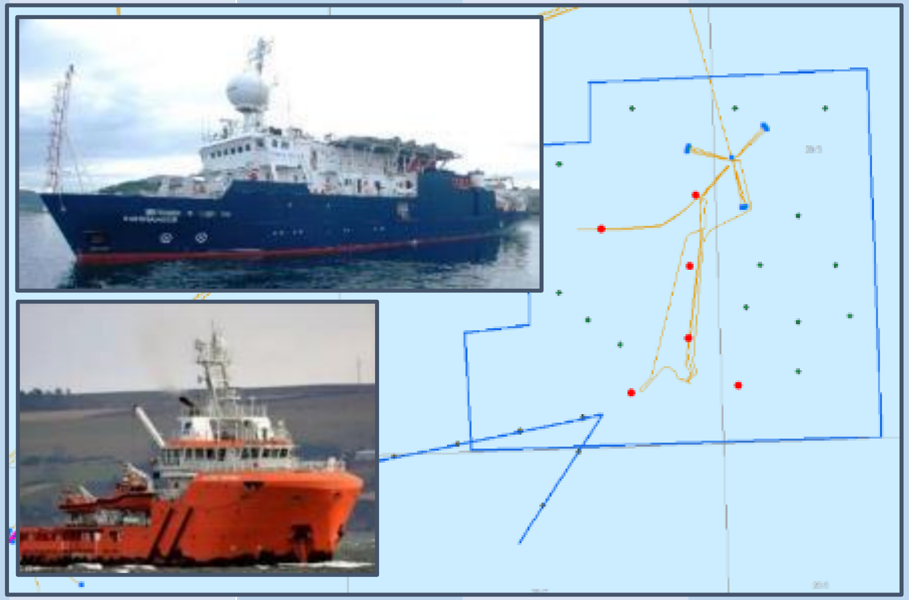
Concept Select

INTOG

EIA

Consent

Offshore Surveys



Engineering and Procurement

Construction

Operation

Q1 2022 Update

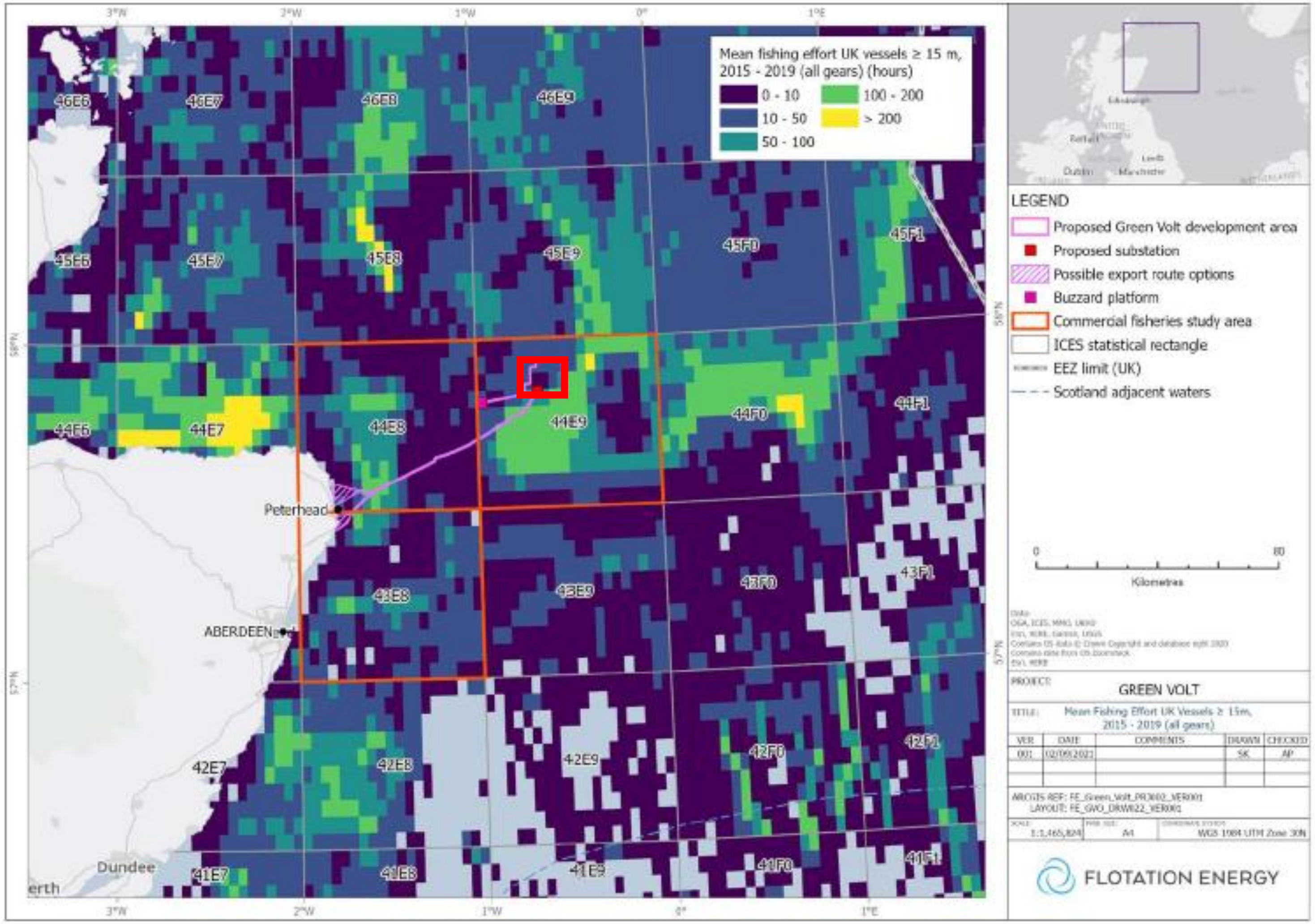
- ✓ Environmental Scoping
- ✓ Environmental Site Surveys (April 2022)
- ✓ Environmental Impact Assessment
- ✓ Grid connection
- ✓ Engineering Basis of Design
- ✓ Ready for INTOG

Green Volt – Key Stakeholders

FLOTATION ENERGY

EIA Update

- ✓ Critical assessments and baseline surveys complete
- ✓ Low Impact on the Marine Environment
- ✓ Low impact on fishing community
- ✓ Low impact on key ornithology species
- ✓ Low impact on marine environment (brownfield site)



Green Volt – Key Stakeholders

FLOTATION ENERGY

EIA Update

- ✓ Critical assessments and baseline surveys complete
- ✓ Low Impact on the Marine Environment
- ✓ Low impact on fishing community
- ✓ Low impact on key ornithology species
- ✓ Low impact on marine environment (brownfield site)

Kittiwake

Guillemot

Gannet

Sunfish

Flotation Energy – Addressing the decarbonisation challenge

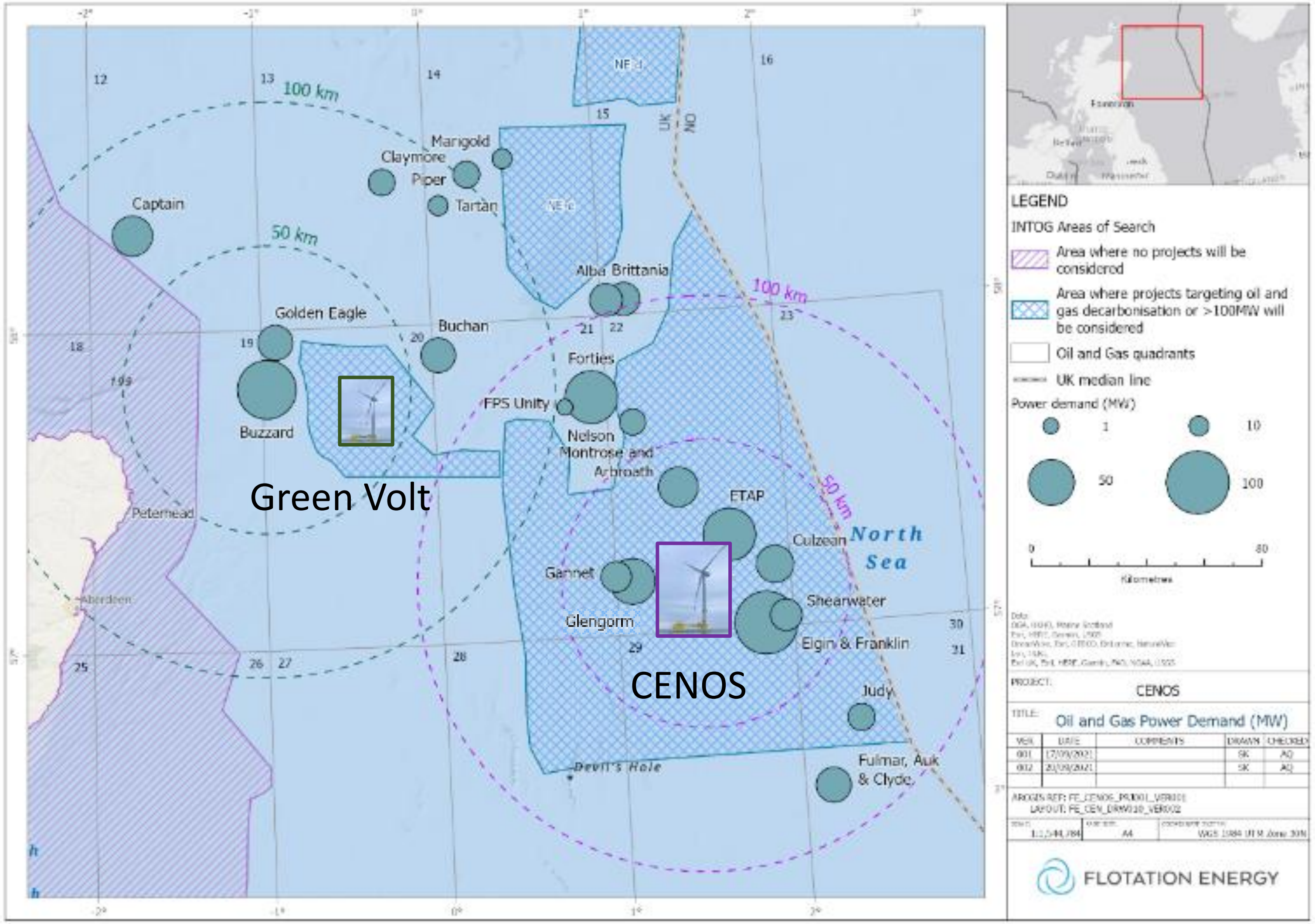
FLOTATION ENERGY

Green Volt (2026)

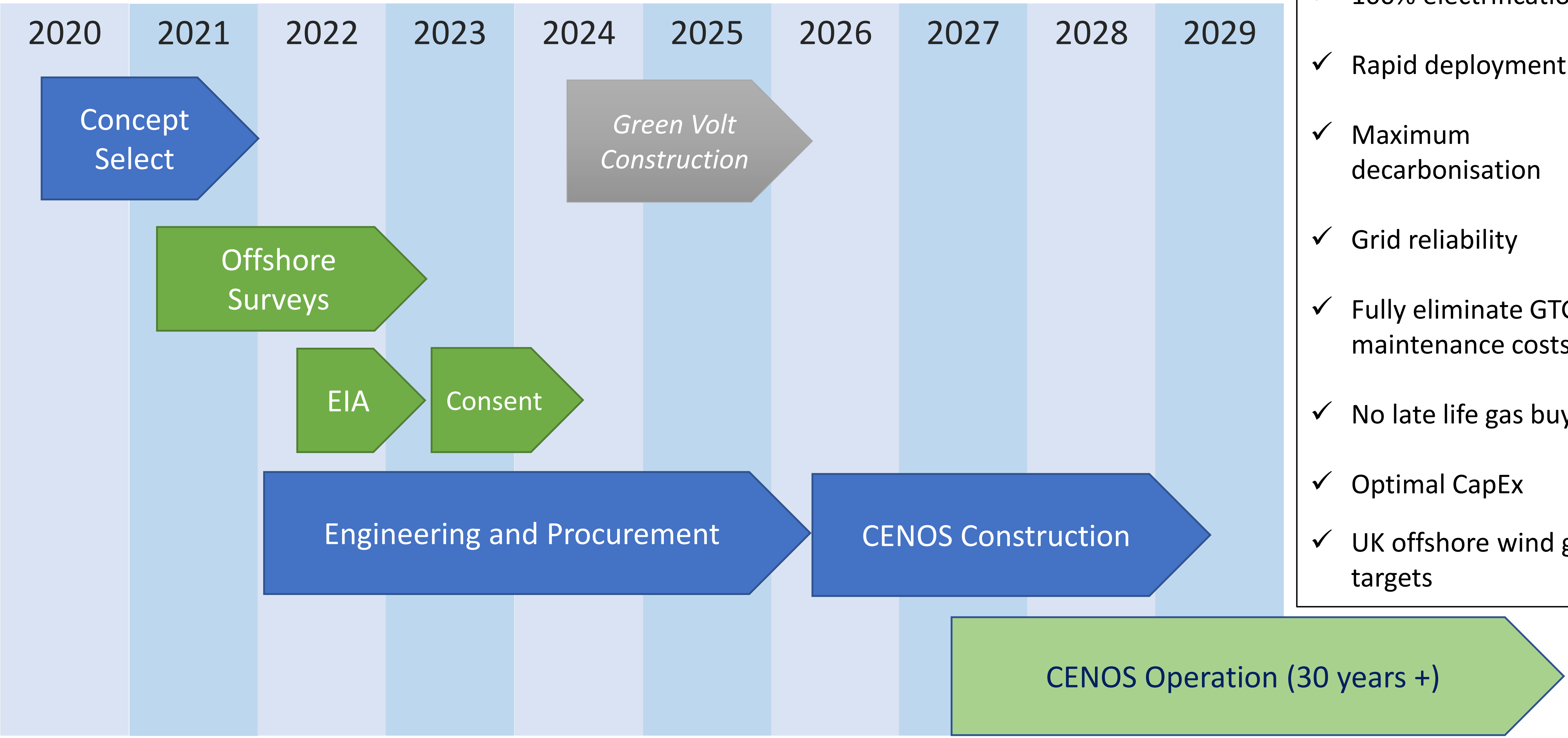
- 300 MW floating wind farm
- Renewable power to Outer Moray Firth assets
- Power from 2026

CENOS (2027-2029)

- Replicates the Green Volt concept for Central North Sea assets
- "Plug and Pay" from 2027
- Flexible connection format, recognising the need to minimise brownfield mods



CENOS – Schedule

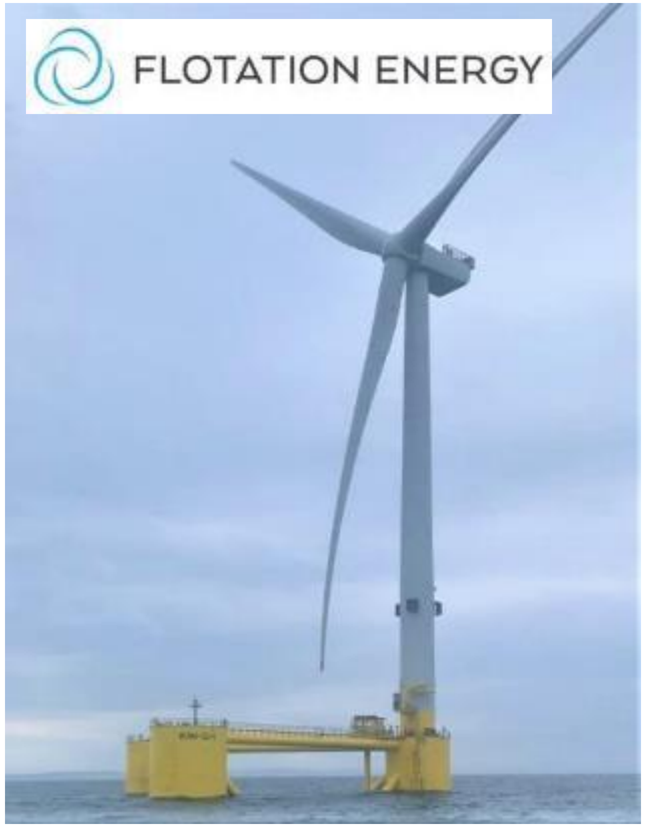


- ✓ 100% electrification
- ✓ Rapid deployment
- ✓ Maximum decarbonisation
- ✓ Grid reliability
- ✓ Fully eliminate GTG maintenance costs
- ✓ No late life gas buy back
- ✓ Optimal CapEx
- ✓ UK offshore wind growth targets

Summary

FLOTATION ENERGY

- INTOG is a unique opportunity to decarbonise a major source of UK emissions
- Flotation Energy builds on globally leading experience in floating offshore wind
- 100 years' oil and gas experience



✓ Established Technology
✓ Rapid deployment
✓ 100% electrification with renewable electricity
✓ 35+ year wind farm lifetime
✓ Flexible electrical connection to O&G facilities from 2027

FLOTATION ENERGY

Ocean Winds

Roger McMichael

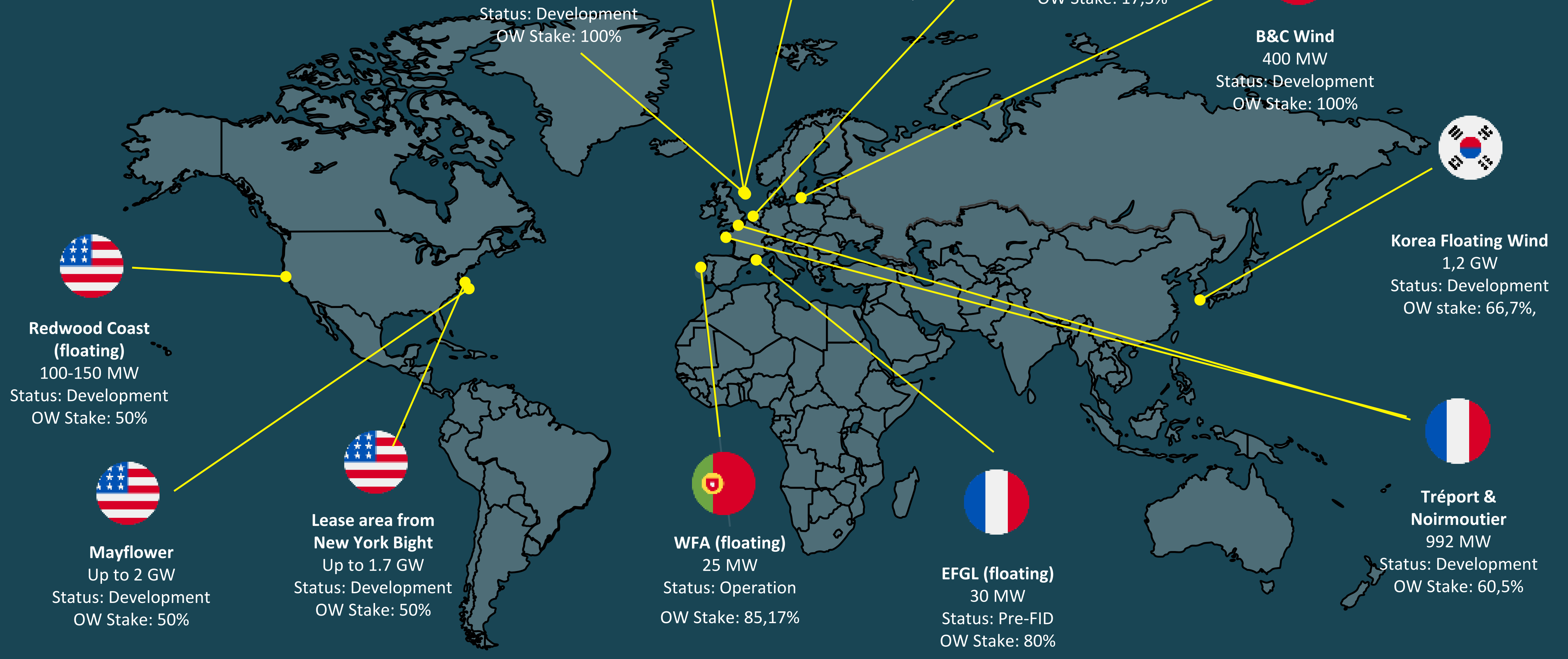
OCEAN WINDS

DeepWind's INTOG Leasing Round Workshop

Roger McMichael & Dr. Andronikos Kafas

17 March 2022

OW will have as of inception presence in 7 countries, in which it will continue to develop current projects as well as create new growth opportunities



Active in floating offshore wind since 2008, with close links to Principle Power (PPI).

PPI
Major sharehorder, together with partners

EFGL, France

WF1, WFA, Portugal

KFWind, Ulsan, South Korea

Redwood Coast, Humboldt, California, USA

WF 1 (2 MW)

Portugal

▶ Successful 2MW demonstrator

▶ First semi-submersible structure supporting a multi-MW

▶ Design is now being utilised in the Kincardine Project off the coast of Aberdeenshire

WFA (25 MW)

Portugal

▶ World's FIRST semi-submersible wind farm

▶ 3 x 8.4MW turbines fully commissioned

▶ Revitalised local ports in northern Portugal

EFGL (30 MW)

France

▶ FID reached in Jan-22

▶ To feature the world's most powerful turbines

▶ 3 x 10MW turbines

Redwood Coast (ca. 150MW)

California, USA

▶ 10 – 15 Turbines

▶ Gross capacity of approx. 150MW- Grid agreement with local authority in place

KFWind (ca. 1,200 MW)

Ulsan, South Korea

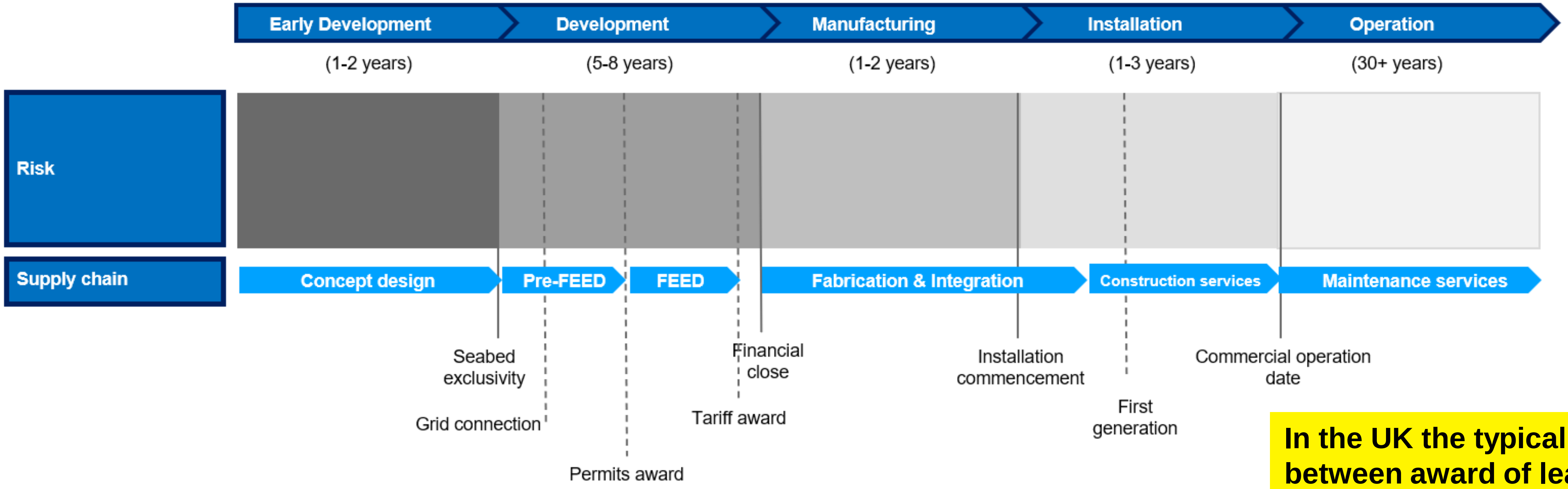
▶ 1,200 MW gross capacity

▶ EBLs obtained in Feb/Mar 2022

▶ MoU signed with Ulsan City, South Korea

Commercial floating offshore wind farms

Timescales and key development milestones

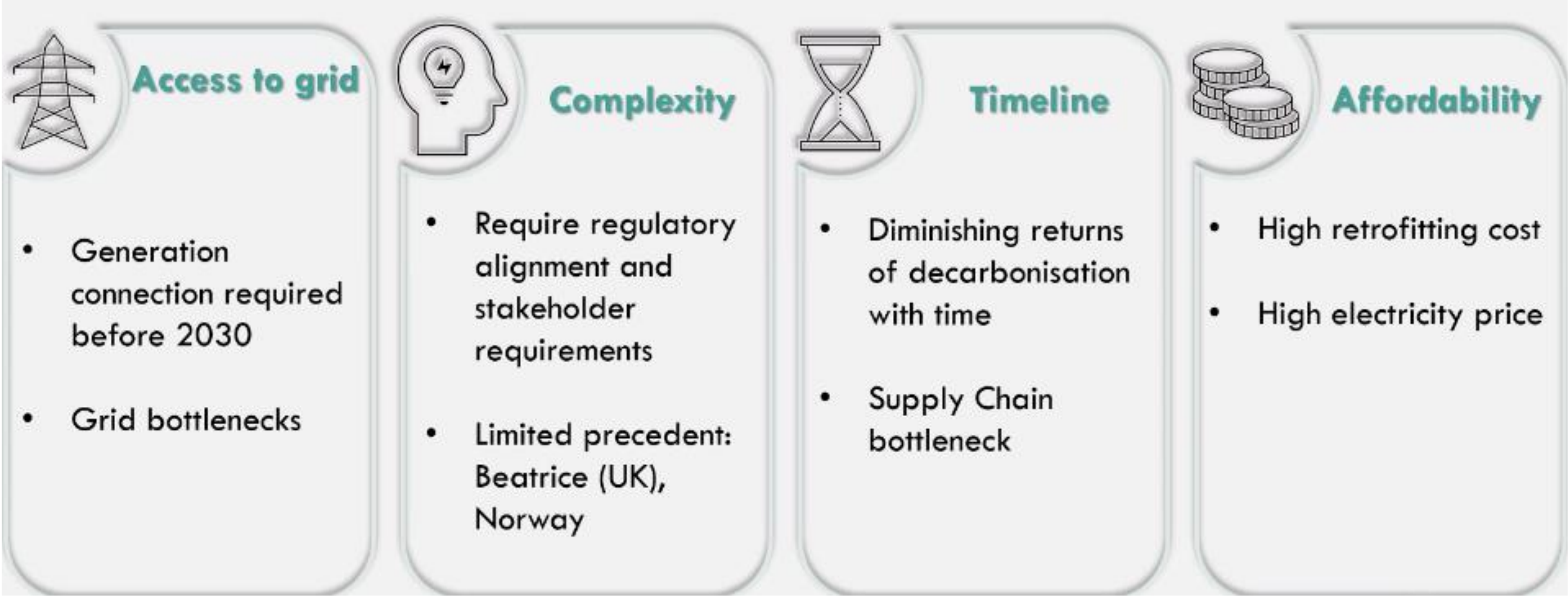


In the UK the typical timeline between award of lease option and consent submission

3 - 3.5

+9 months determination period

Electrification challenges & OW’s USPs



Source: OEUK

THANK YOU

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Panel Session 2

Graeme Rogerson, NZTC
Sylvia Buchan, OGA
Allan Macaskill, Flotation Energy
Alex Quayle, Flotation Energy
Roger McMichael, OW

Oil & Gas Authority

DeepWind
North of Scotland Offshore Wind Cluster

Closing Remarks

Paul O'Brien, DeepWind