CATAPULT
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Space-Enabled Opportunities for Offshore Renewables

Greenbank Hotel, Falmouth

Simon Cheeseman – South West Programme Manager

Welcome to the Greenbank Hotel

- Housekeeping
  - Fire alarm test
  - Muster point
  - Toilets
  - Refreshments
  - Mobile phones

Agenda

- 0900 Arrival, coffee, pastries & networking
- 0930 Welcome, housekeeping and overview of the day
- 0935 Context & Opportunity [Simon Cheeseman - ORE Catapult]
- 0955 The Value of Space, including Case Studies [ESA Regional Ambassador]
- 1025 Innovation funding [Julie Taylor – ORE Catapult]
- 1035 ESA Space for Green Energy Transition [ESA Regional Ambassador]
- 1050 Coffee Break
- 1115 Activity: Session A: Asset inspection and management; or Session B: Consent data collection optimisation
- 1200 Wrap up and next steps [ORE Catapult and ESA Regional Ambassador]
- 12:15 Lunch & Networking

- Afternoon 1-2-1's bookable in the time after to work though ideas with either ESA Regional Ambassador or ORE Catapult or both.

Offshore Renewable Energy Catapult

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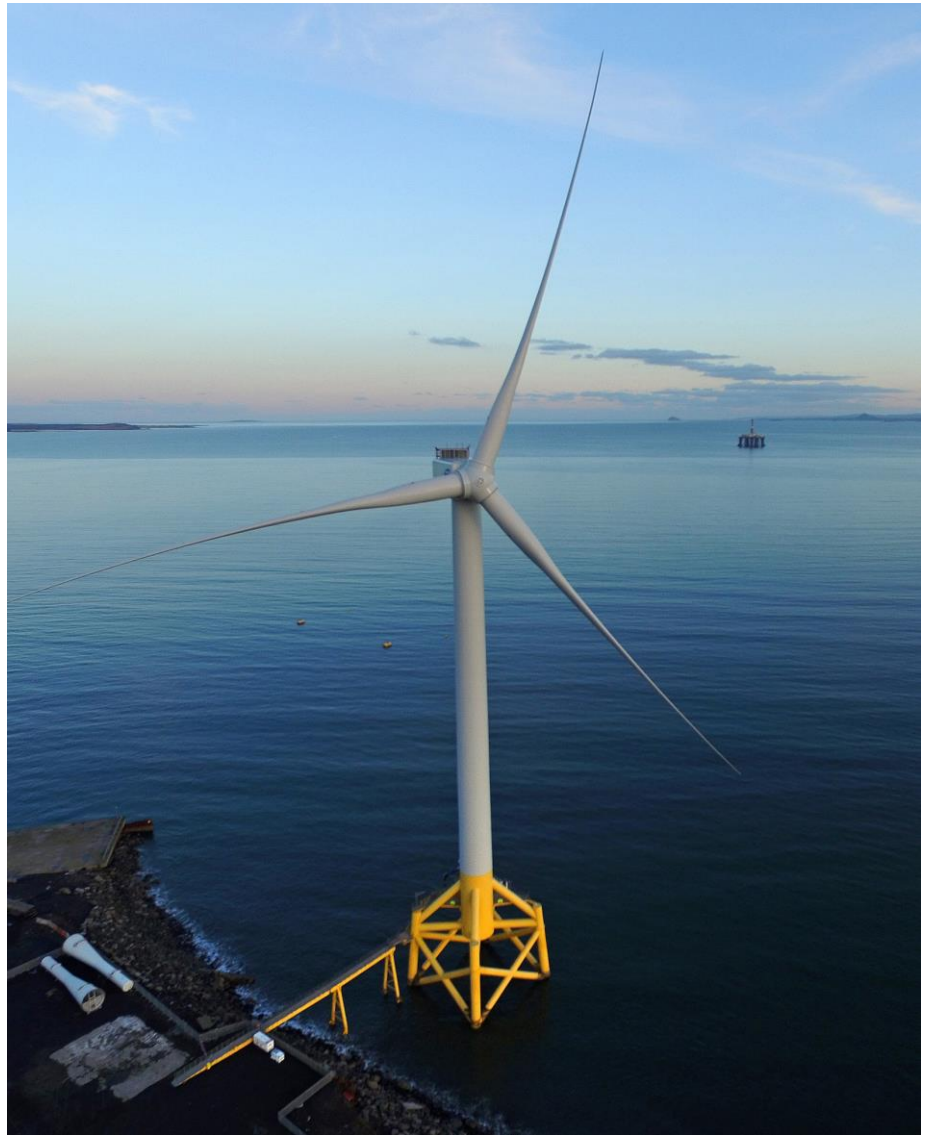
THE OFFSHORE RENEWABLE ENERGY CATAPULT

The UK's leading technology innovation and research centre for offshore renewable energy

Mission: to accelerate the creation & growth of UK companies in the offshore renewable energy sector.

- Unique facilities, research & engineering capabilities
- Bringing together innovators, industry and academia
- Accelerating creation and growth of UK companies
- Reducing cost and risk in renewable technologies
- Growing UK economic value
- Enabling the transition to a low carbon economy



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What We Do

TECHNOLOGY DEVELOPMENT

- Next generation turbines and balance of plant
- Design validation and component testing
- Technology assessment

DEVELOPMENT & OPERATIONS

- Better intervention techniques
- Operations & maintenance
- Developer/owner solutions
- SMEs developing solutions
- Test & validate solutions

RESEARCH, STRATEGY & INNOVATION

- Evaluation and support for emerging technologies
- Floating wind, wave & tidal
- Energy networks and storage
- Under-pinning research
- Gateway to academia

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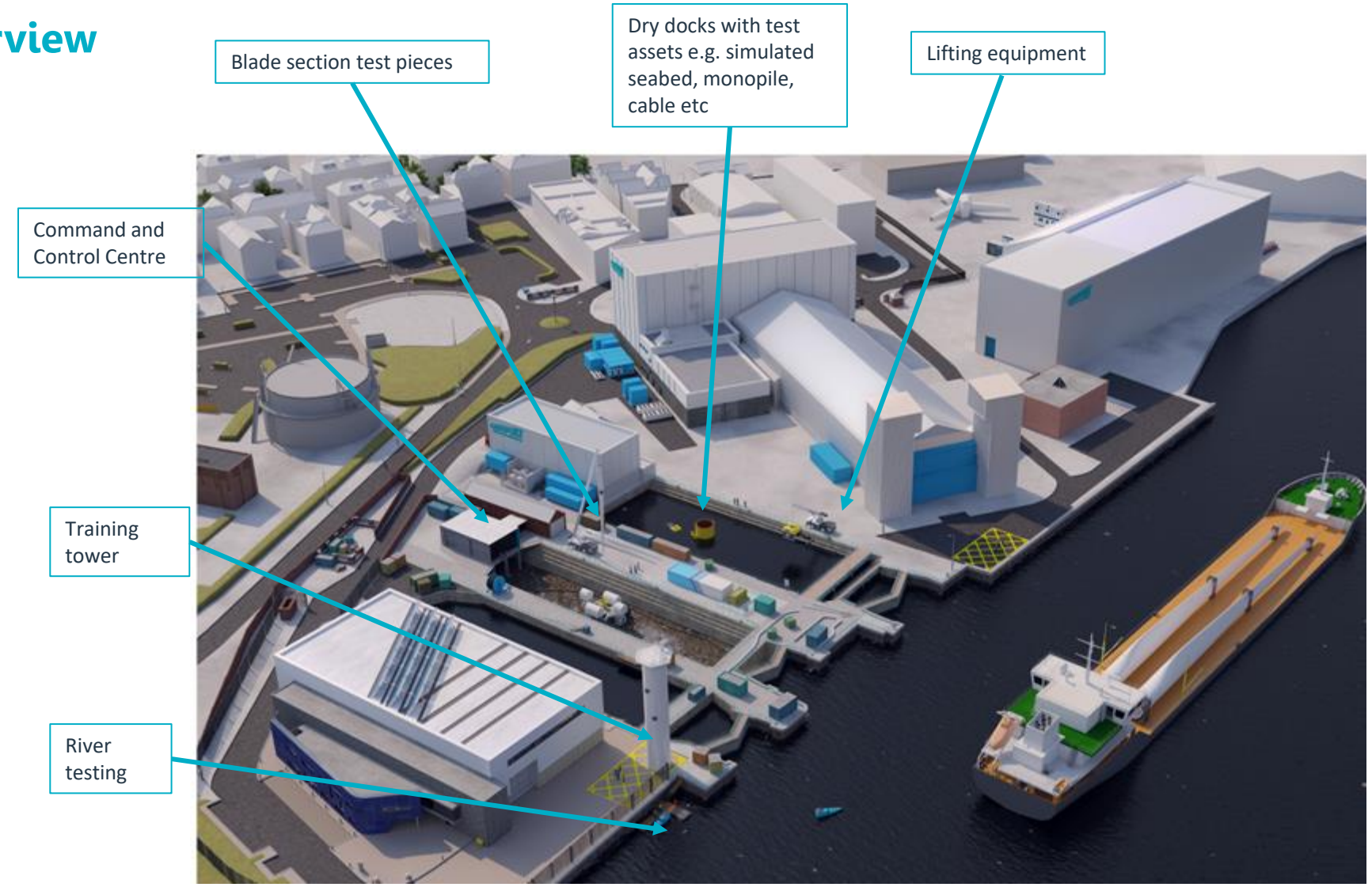
Site Overview



Levenmouth Demonstration Turbine Statistics

Since 2016...

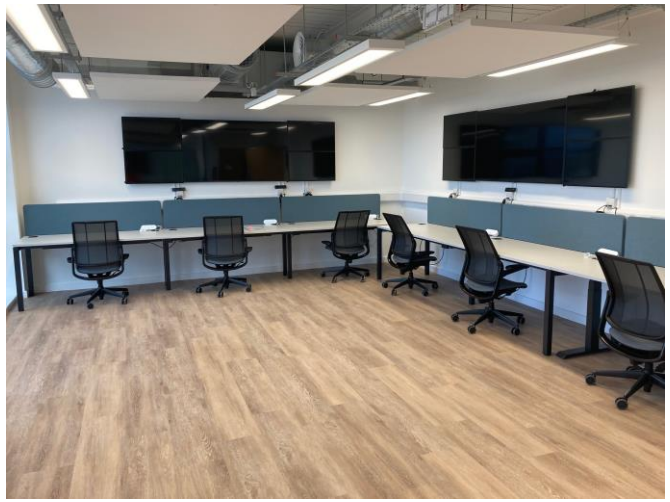
- 7,414 homes powered
- 7 MW rated capacity
- 7,050 tonnes of CO2 offset
- Equivalent to 10,545 return passengers on flights From London to NYC
- 22,986 MWh of electricity generated
- ~ 9,400 horsepower equivalent to 94 cars
- 800+ sensor outputs reporting from the turbine
- ~ 5,282 million revolutions of the rotor

The Digital, Autonomous and Robotics Engineering (DARE) Centre

DARE centre is located at the ORE Catapult's Blyth facility. It is a centre of excellence for robotic innovations and through collaboration with industry is accelerating the UK's Smart Operations & Maintenace sector.

Networking / Conference space

Indoor control room



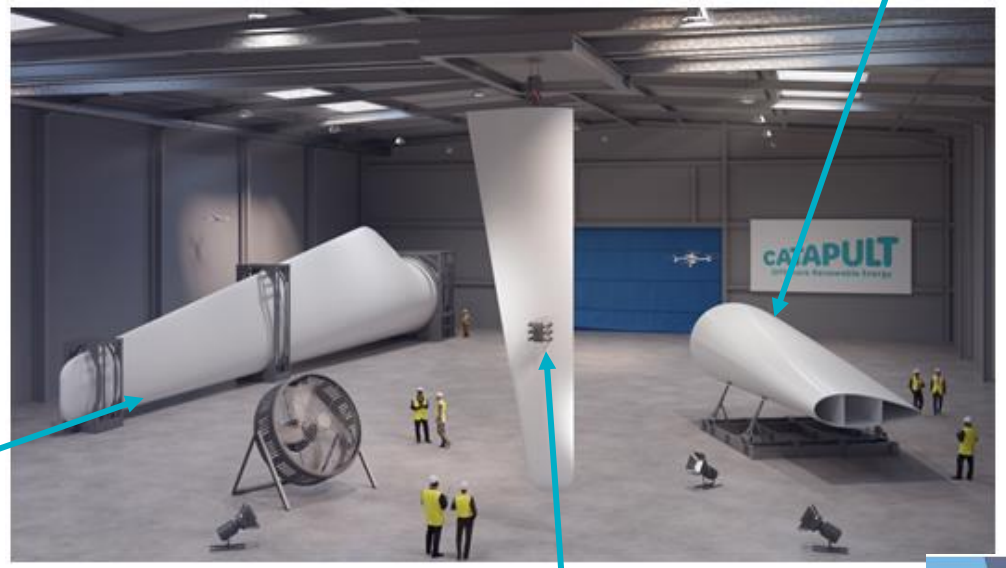
BVLOS room (Testing and simulation)

Facilities include:

- Command and control rooms
- Live environmental monitoring system (Outdoor camera systems / Temperature and water condition data)
- Plug and Play interface system
- Indoor assembly stations
- 3 dry docks with 20,000m3 capacity
- Mechanical and electrical workshop
- Office space and meeting rooms
- Conferencing & Networking spaces with welfare facility

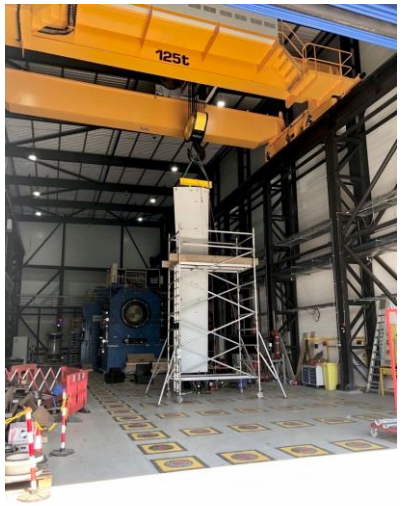
Aerial/Crawler Testing

Indoor Test Hall

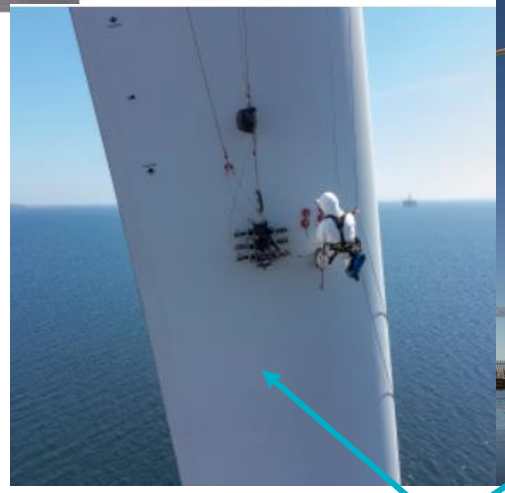


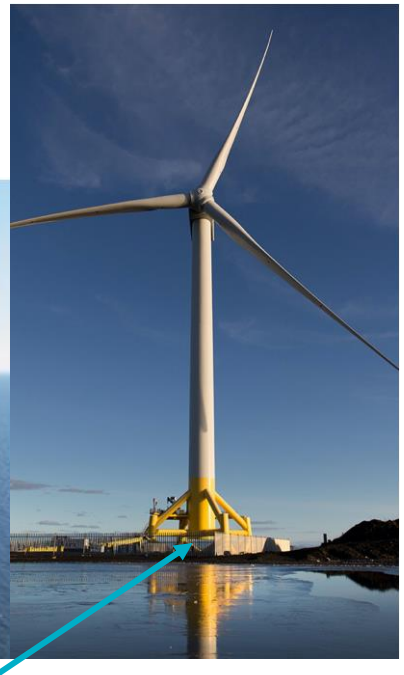
Horizontal test piece

Full blade test piece



Vertical blade section with known and graded defects, including
Tape damage
Erosion
Paint damages
Impact damage
Lightning damage
Surface damage





Levenmouth Turbine

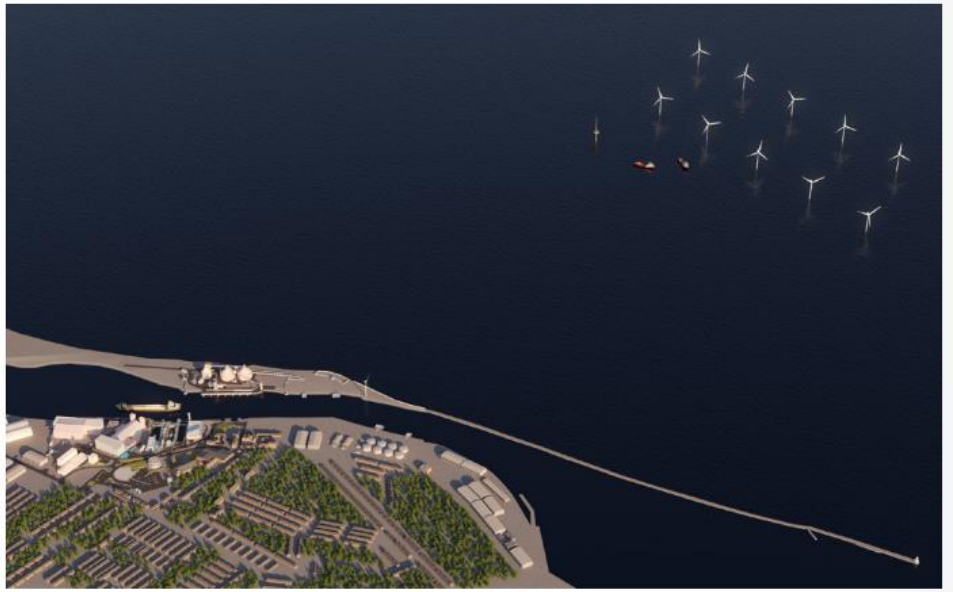
Offshore turbine

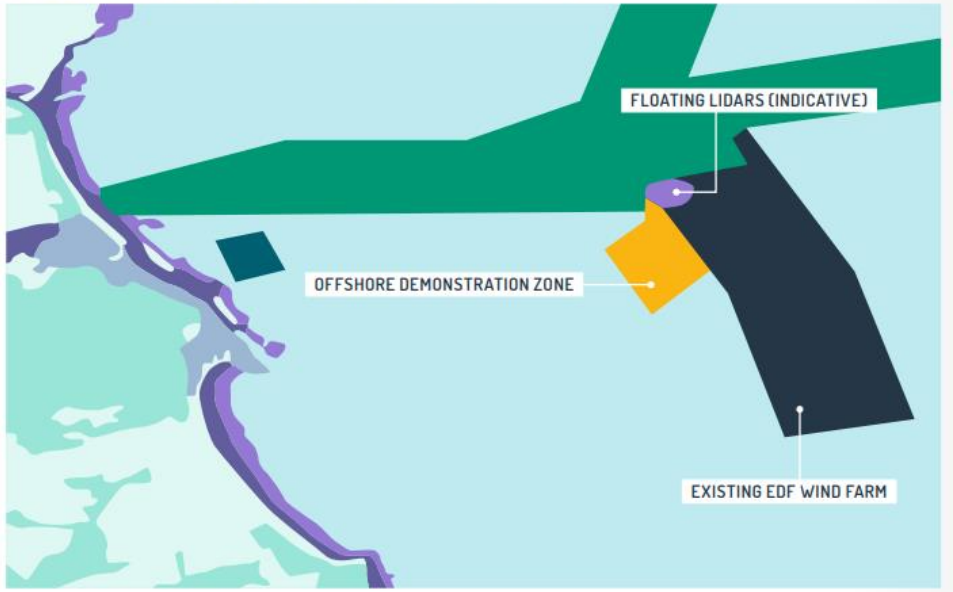
Drone Flying Zone / Pilot / Payload Demo

- Three house drones available to carry out inspections
  - DJI MATRICE 210 RTK
  - DJI MATRICE 100
  - DJI Mini 3 Pro
- Customer payload test (Sensors/ equipment attachment)
- Inhouse qualified drone pilot for testing and demonstration
- Designated indoor / outdoor drone flying zones
- BVLOS (Snowdonia Aerospace)
- De-risking / demonstration of TRL development

Offshore Demonstration Zone

- A representative test site to trial deployment methods, navigation, control and recovery
  - The approx. 1 km^2 zone houses test pieces including scaled monopile structures and visual/manipulation test pieces.
- Licensed Activities
  - Navigation
  - Near target positioning
  - Sensor and instrument function
  - Object detection
  - Status analysis
  - Structural inspection
  - Scanning and data gathering
  - USBL
  - Biofouling removal





Offshore Wind Market

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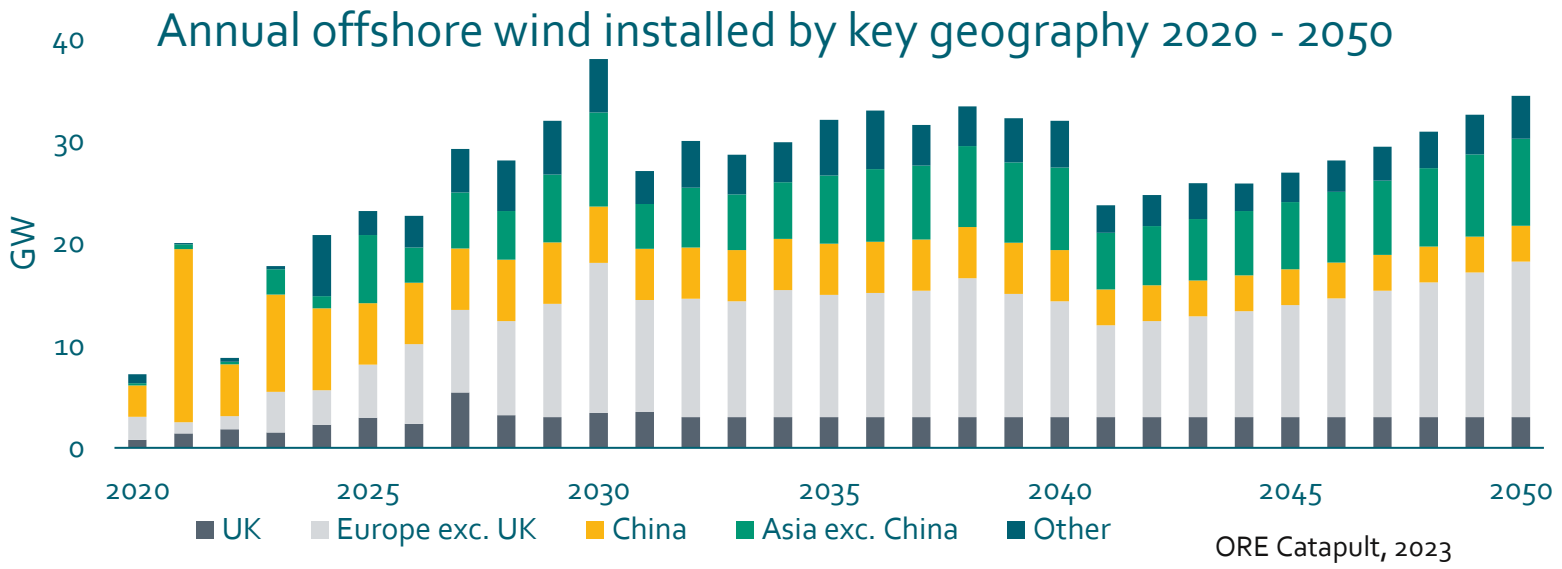
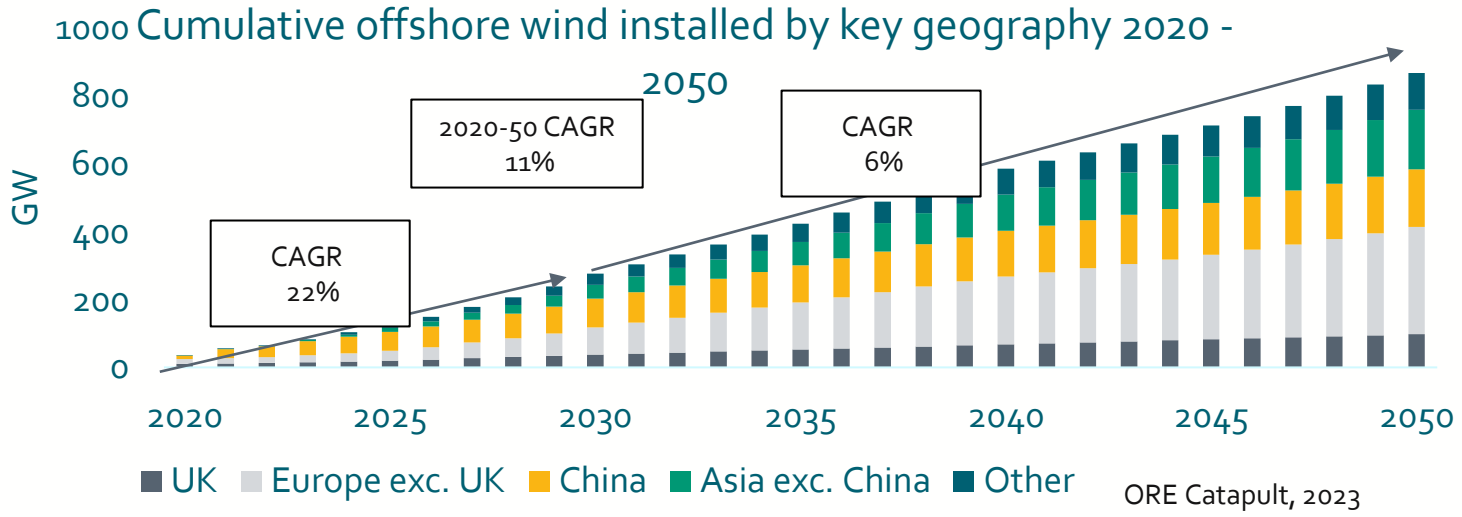
Offshore wind global capacity forecast





- Our forecast assumes a near-term push to achieve 2030 targets
- Annual installations increase from ~9GW in 2022 to 38GW in 2030 and 34GW in 2050

- Total Europe share falling from 47% in 2022 to 39% in 2050
- China share drops from peak of 49% in 2022 to 20% by 2050
- Other markets grow share from 2% in 2022 to 13% by 2050

CAGR: Compound annual growth rate (CAGR) - annualized average rate of revenue growth between two given yrs

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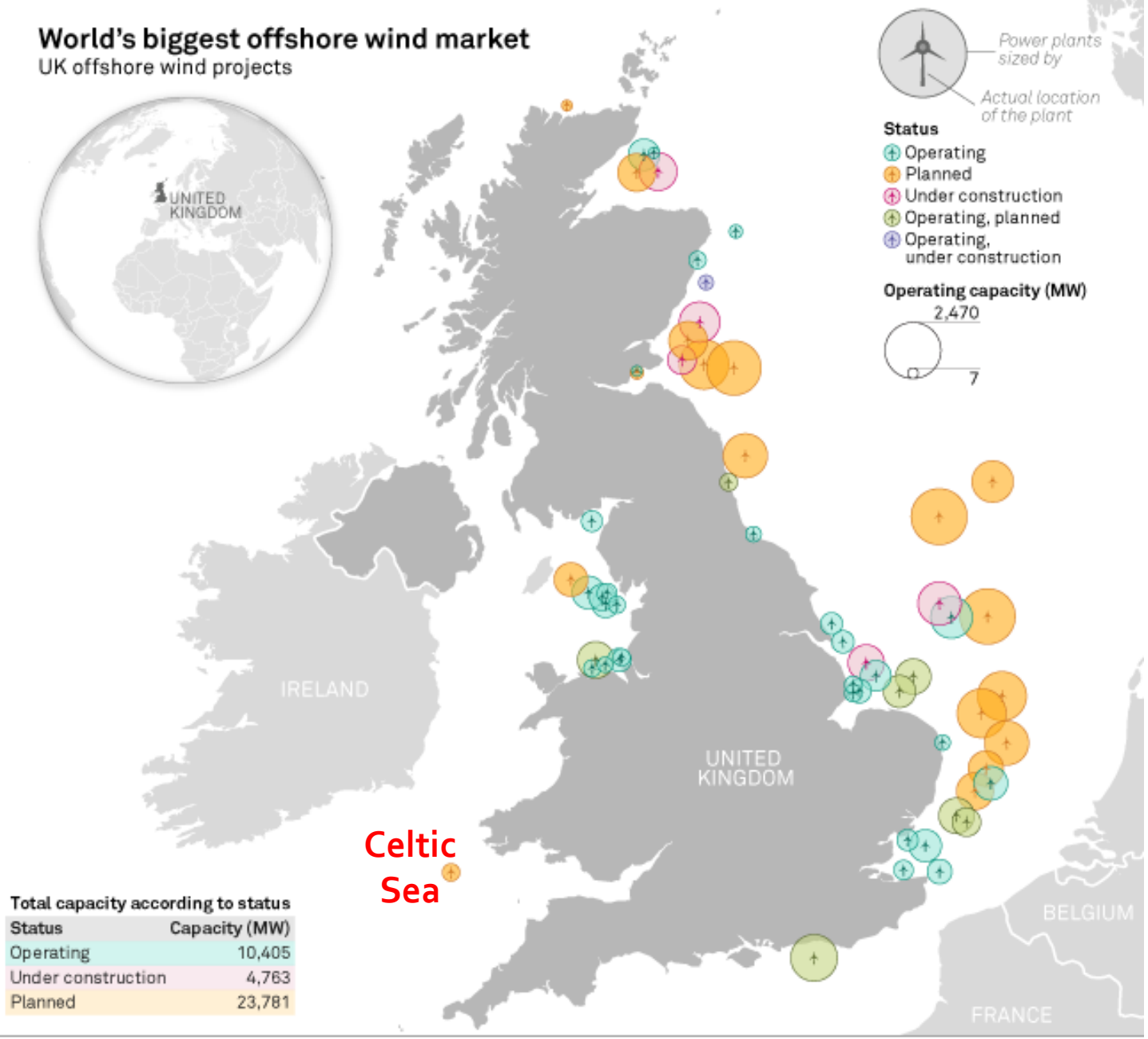

Total capacity according to status

Status	Capacity (MW)
Operating	10,405
Under construction	4,763
Planned	23,781

Data compiled June 18, 2021.
"Operating, planned" and "Operating, under construction" refer to operating wind farms with extensions that are planned or under construction, respectively.
Map credit: Ciaralou Agpalo Palicpic
Source: S&P Global Market Intelligence

S&P Global
Market Intelligence

Future Demand

- ScotWind – 25 GW by 2035
- Innovation and Targeted Oil and Gas – 4.5 GW by 2030
- 14.7 Million tonnes of material required to meet offshore wind build projections in Scotland by 2050
- Current England and Wales pipeline – 20.7 GW by 2030
- Additional 13.3 GW of leases awarded
- Minimum of 75 GW by 2050

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Blyth Offshore Demonstrator Windfarm Project comprises five 8.3MW wind turbine generators located 5km off the Northumberland coast in approximately 40m water depth. These are the world's largest foundations and are pushing the civil engineering boundaries in offshore structures.




Gravity base foundation is a hollow base constructed on land, floated out to sea and submerged in its final location. They are ballasted with sand so that wind turbine loads can be placed upon it.




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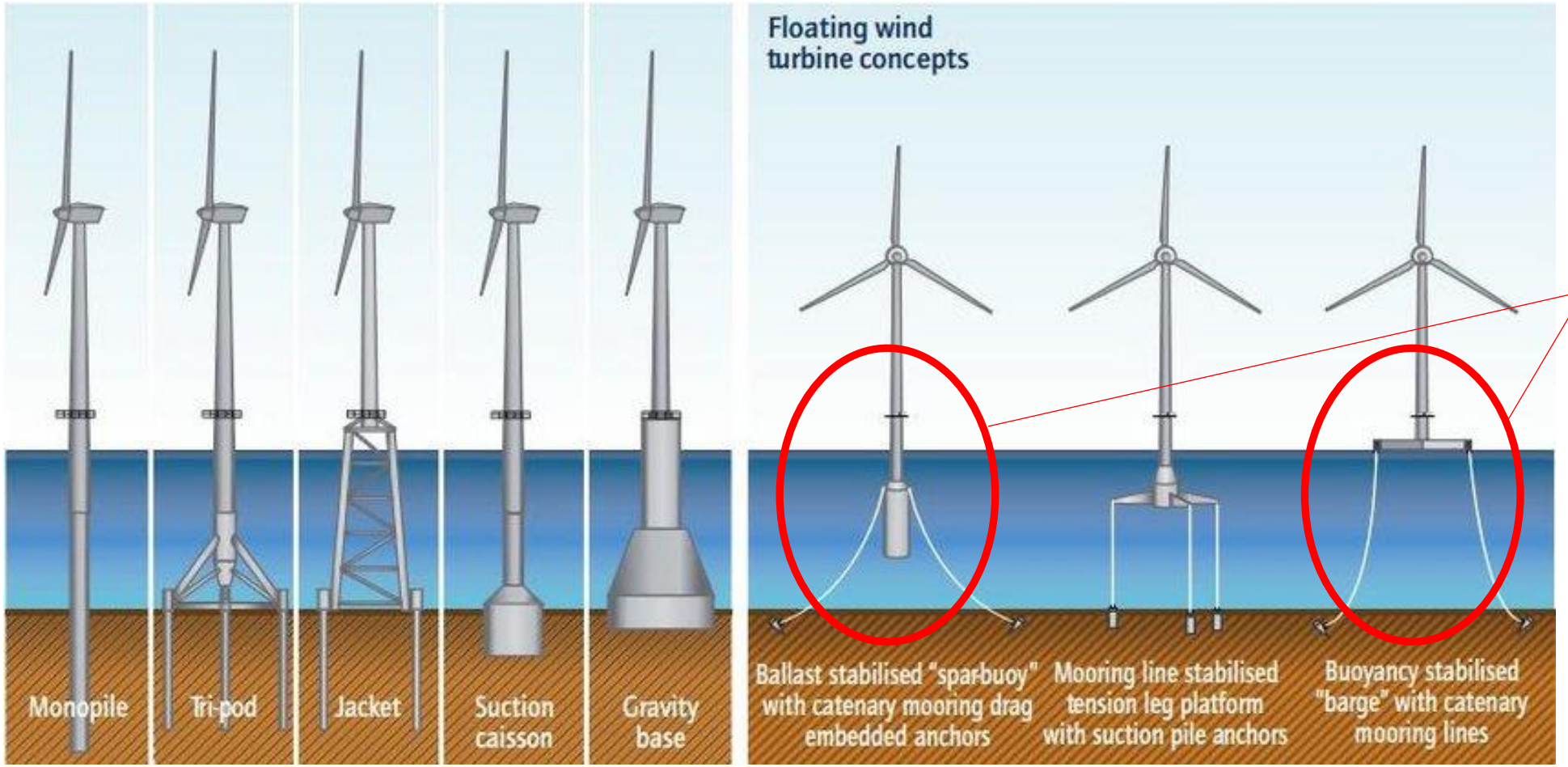
Offshore wind - fixed and floating foundations



Technology suitable for the Celtic Sea

Floating platforms in deeper water (circa 200+ metres) to capture stronger, more consistent wind resource

Foundation platforms typically 70m x 70m weighing 3000 tonnes (steel)

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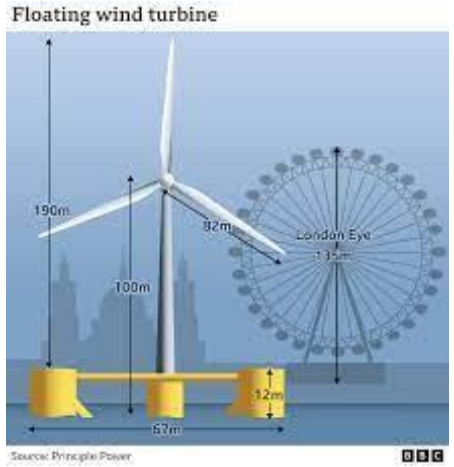
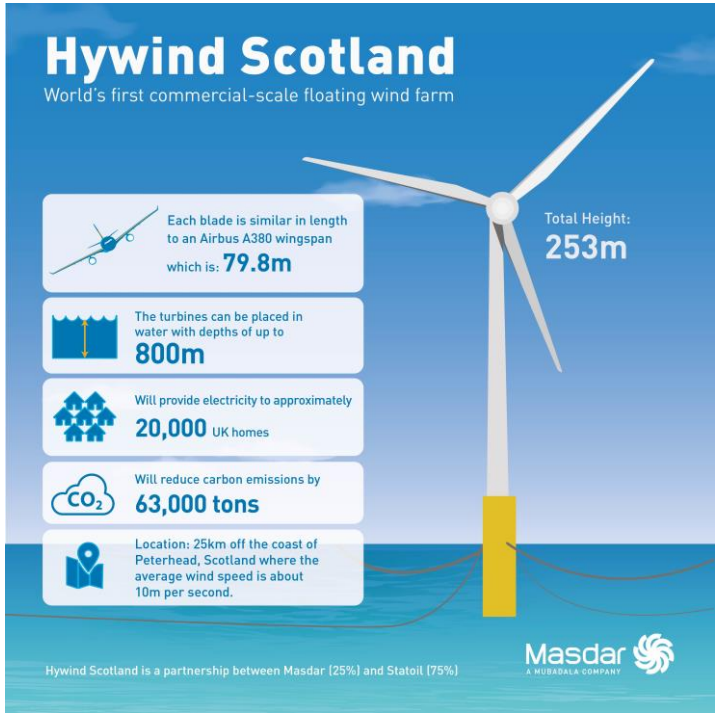
Floating Offshore Wind





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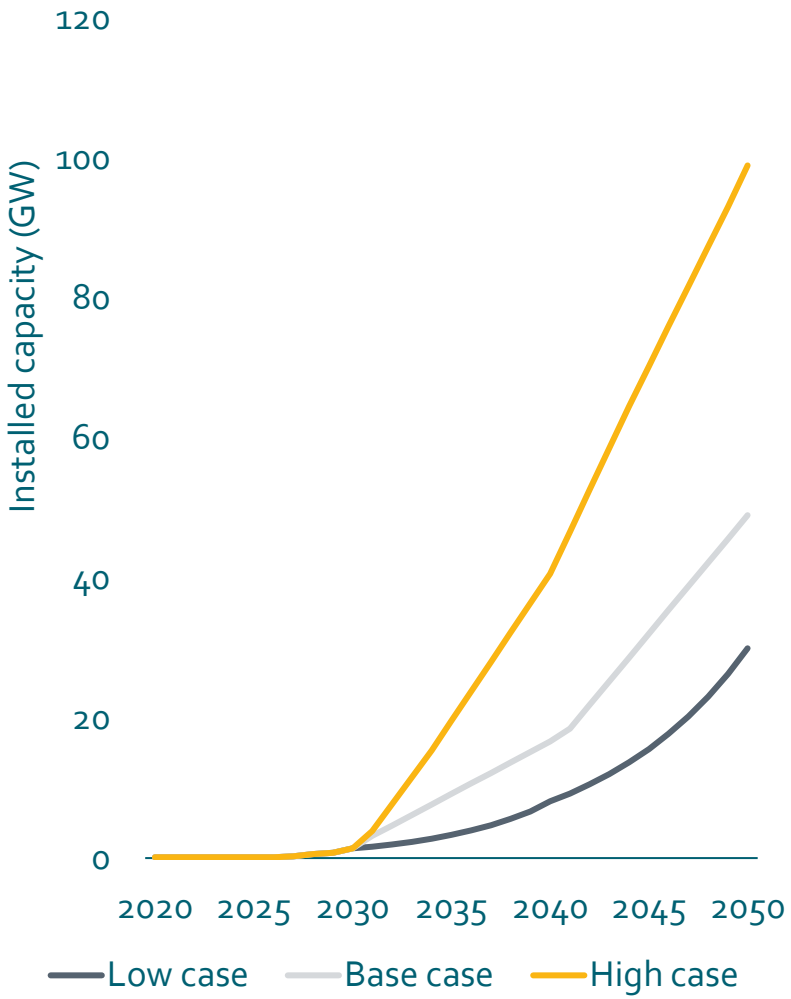
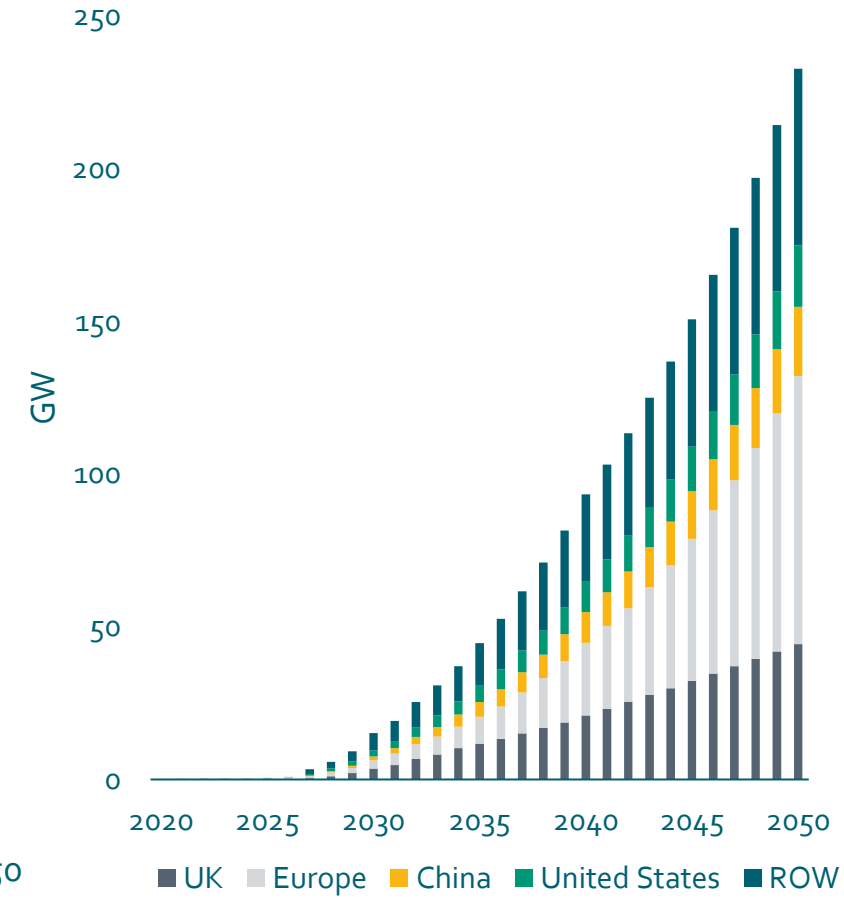
Floating wind is expected to take off from a standing start

UK floating wind forecast



Cumulative floating wind deployment by region



- ScotWind leasing round allocated nearly 17GW to floating offshore projects.
- March 2023 saw the announcement of 5.4GW of floating wind lease capacity from the INTOG round.
- Scotland is expected to be one of the largest markets in the world for floating offshore wind with planned projects currently making up 31% of the global floating pipeline.
- The UK has a target of 5GW of installed floating wind capacity by 2030.
- Forecasts for the UK market depend on total OSW deployment – geographical constraints are not an issue.

- Europe is expected to be a first-mover in floating wind as it was with bottom-fixed
- Elsewhere, the west coast of US, Japan, S. Korea and Taiwan are likely to be core floating wind markets

ORE Catapult, 2023

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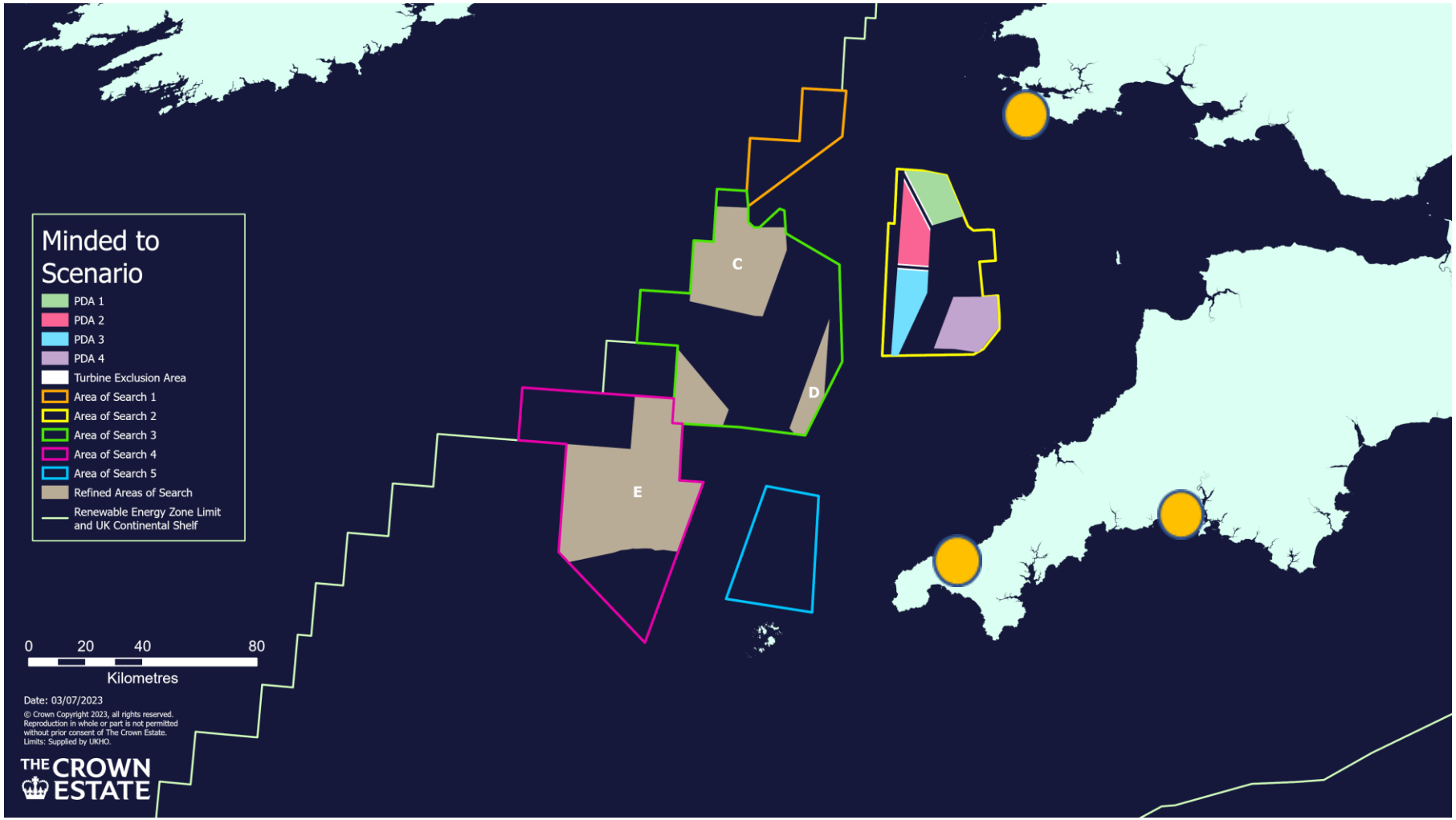
Celtic Sea FLOW Four Project Development Areas



- Energy Security Strategy calls for 50GW of offshore wind by 2030 including UK Government ambition 5GW of FLOW by 2030, with rapid expansion anticipated thereafter.
- Celtic Sea will unlock up to 4GW of FLOW by 2035.
- Initial leasing round late 2023.
- Long term ambition 24GW from Celtic Sea by 2045

Catapult offices: Pembroke Dock; Hayle; University of Plymouth

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Where can space help FLOW

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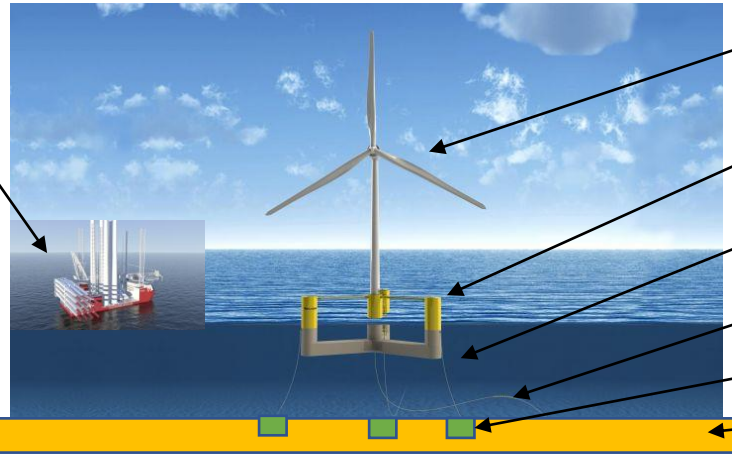
Space Applications support to Floating Offshore Wind

Task: Port operations

Task: Offshore operations



Task: Wind Turbine: blades, nacelle, tower

Task: Floating Platform

Task: Mooring

Task: Electrical System

Task: Anchoring

Task: Seabed Characterisation

★
- Geoconsulting
- Geophysical survey
- Metocean survey
- Environmental services
- Hydrographic survey

Project Phases	P1: Concept & definition	P2: Design & development	P3: Manufacturing	P4: Installation	P5: Operations	P6: Decommissioning
	T1.1 ★ Data base	T3.1 Manned Vessels	Port infrastructure	T3.1 ★ Subsea cable lay	T3.4 ★ Asset inspection	Wind turbine dismantling
	T1.2 T1.4 ★ Seabed characterisation	T1.5 T2.3 ★ Autonomous Vessels	T2.1 Wind turbine manufacture	T3.1 Anchor installation	★ Offshore planned maintenance	Platform dismantling
	T1.3 ★ Zonal Planning	T1.6 T4.1 Engineering	T2.1 T2.2 Floating platform manufacture	T3.1 T4.3 Mooring installation	Inshore planned maintenance	Mooring & anchoring dismantling
	T2.2 Array design	T4 Training	T2.1 T2.4 Moorings manufacture	T3.1 T3.2 T3.3 ★ T4.2 Platform installation		Electrical elements dismantling
			T2.1 Anchor manufacture	T3.1 T4.3 Electrical hook up		Recycling
			T2.4 Electrical elements	Commissioning & start up		★ Materials disposal

★ P4, P5, P6
- Positioning support
- Monitoring & forecasting
- Inspection services
- Inspection Repair Maintenance (IRM) services

Note:

★ **Areas of interest for Sat Apps,** e.g. evolving low carbon footprint for data collection, asset monitoring, command & control

Potential areas of interest for Sat Apps

- Data base
  - Geoconsulting
  - Geophysical survey
  - Metocean survey
  - Environmental services
  - Hydrographic survey
- Seabed characterisation
  - Wave height measurement
  - Sea current profiling
  - Hydrographic survey
- Zonal Planning
  - Bird migration survey
  - Illegal/Legal fishing monitoring
- Autonomous Vessels
  - Positional dead reckoning
  - Command & control data relay
- Subsea cable lay
  - Positional accuracy
  - Helping manage a congested seabed (multiple cables and moorings
- Platform installation
  - Wave height measurement for vessel safety
  - Confirm positional accuracy
  - Operational exclusion zone security
- Asset inspection
  - Wave height measurement for vessel operational limits
  - Confirm positional accuracy
  - Images for analysis of impact, or weather damage
  - Data relay for autonomous inspection systems
  - Spillage and pollution monitoring
- Offshore planned maintenance
  - Wave height measurement for crew transfer limits
  - Vessel traffic incident & safety monitoring
- Materials disposal
  - Wave height measurement for operational safety
  - Vessel traffic monitoring for safety
  - Positional accuracy
  - Spillage and pollution monitoring

Note:

★ **Areas of interest for Sat Apps,** e.g. evolving low carbon footprint for data collection, asset monitoring, command & control

Consenting

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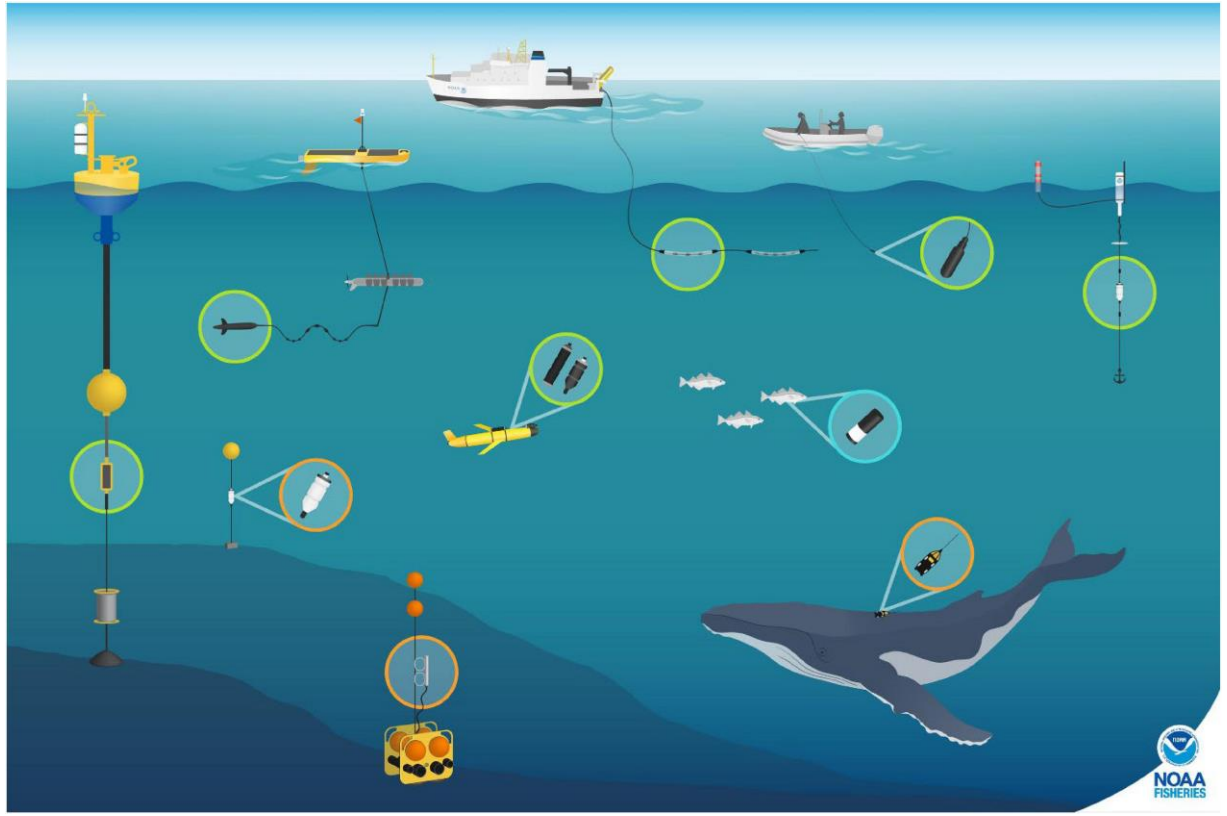
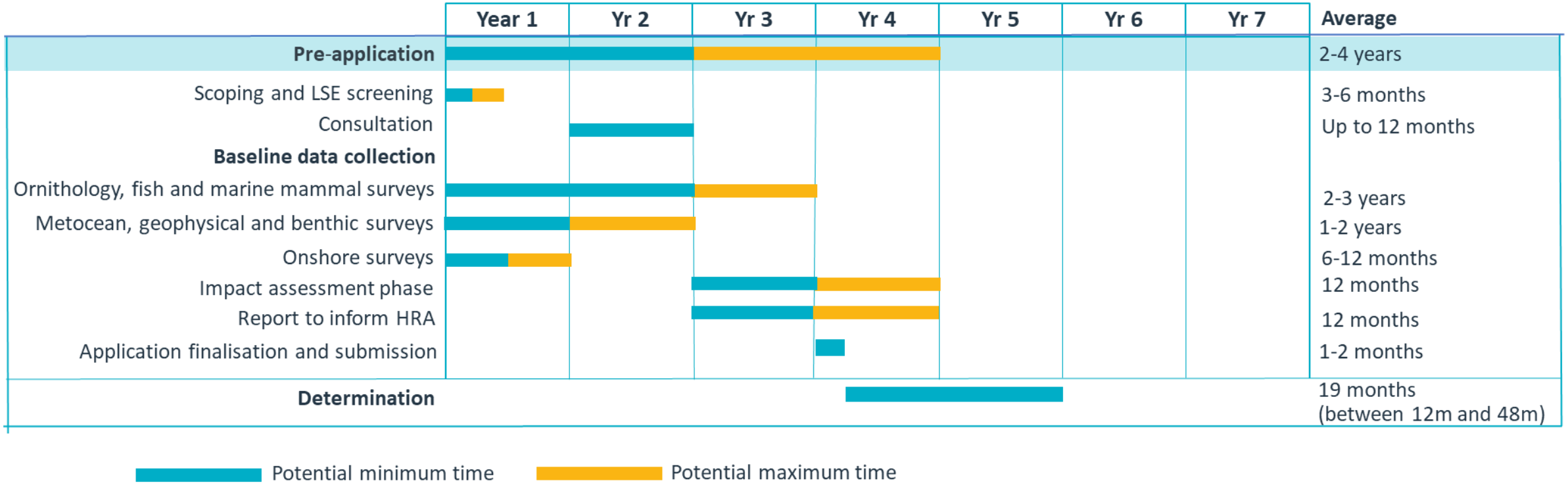
Consenting

- Regulatory and planning delays pose a risk to meeting the UK's Net Zero targets
  - 3 turbines installed every 2 days needed to meet 50 GW by 2030 target
- Smart technology could streamline the decision-making process and accelerate consenting, but knowledge gaps exist
  - Technology demonstration required
- The use of robotics and artificial intelligence could lead to highly efficient environmental monitoring that would fit more with the regulators' needs



Existing consenting timeline



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New Project Acceleration Thought Leadership Report

- New ORE Catapult report has been released on the consenting process and how digital and autonomous systems could reduce consenting timeline to 3 years and save 40% on cost whilst dramatically increasing data confidence.

- 4 key recommendations:
  - There is a need to demonstrate the capabilities, speed and accuracy of innovative technologies and their potential to create a step change in the way we gather and process marine ecological data.
  - ORE Catapult, technology and service providers work with statutory bodies, policy-makers, and environmental stakeholders to ensure new technologies can be confidently incorporated into environmental impact assessments and future monitoring plans.
  - Scope the activities for a large-scale data acquisition trial involving:

    a) the review of existing data in new ways and

    b) the use of new, high-autonomy technologies proactively evolve this important area for floating wind.
  - Explore the potential for industry to work collaboratively on joint data acquisition projects in key future development areas.

Asset Management

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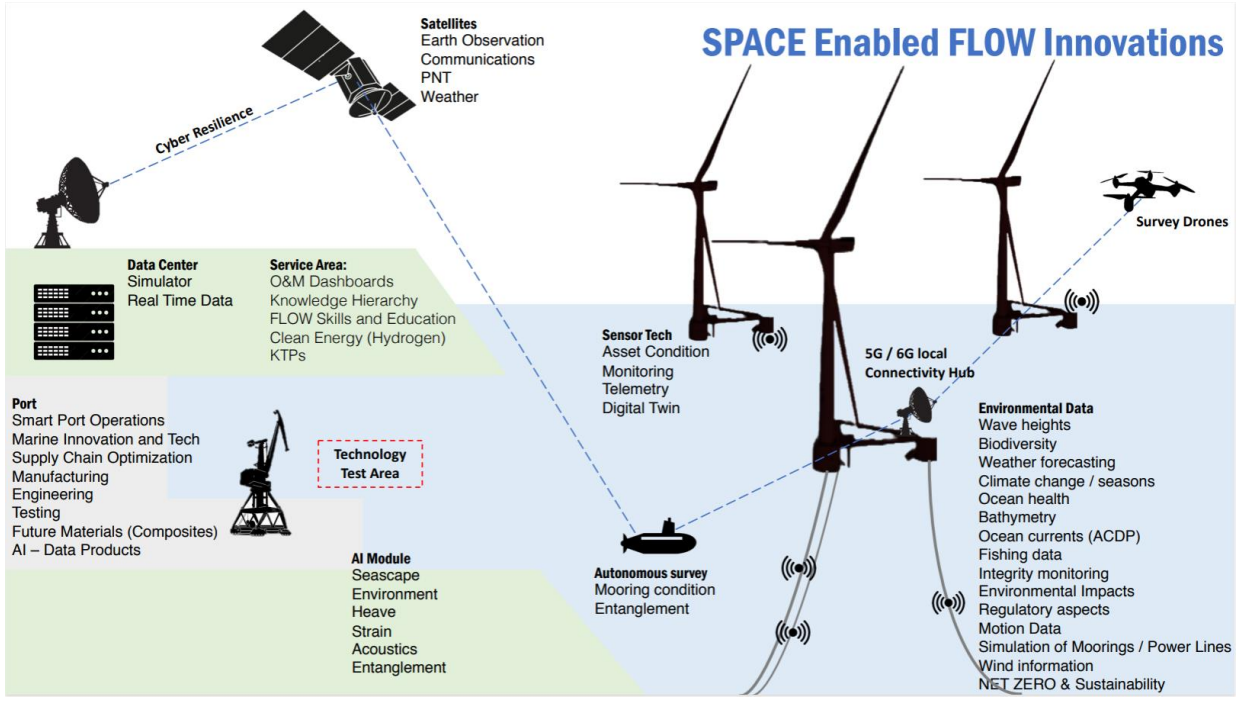
Asset Management

- Working offshore is expensive and inherently unsafe:
  - Industry wants to move towards using more autonomous and remote solutions, but uncertainty remains on suitability and integration
  - More reliable environmental data needed to improve planning offshore trips where technicians are required at sea
- Industry is shifting towards data-driven techniques to inform turbine maintenance
  - Digital twins can be used to assess turbine health, but need reliable input data
  - Needed to prolong turbine life and reduce maintenance costs
  - Floating wind brings even more uncertainty and unfamiliarity with maintenance challenges



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Innovation Funding

Julie Taylor, South West Innovation Manager

Innovation Funding (1)

ORE Catapult

- City Deal – enables Catapult to convene projects
- Offshore Wind Growth Partnership
- F4OR – Fit For Offshore Wind
- IUK Edge - £15,000 to spend with ORE Catapult

UKRI Innovate UK EDGE

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Innovation Funding (2)

Space and Digital Transformation for Green Energy Utilities

- https://business.esa.int/funding/space-and-digital-transformation-for-green-energy-utilities

Space for Infrastructure

- https://business.esa.int/funding/intended-tender/space-for-infrastructure

Market report

- https://commercialisation.esa.int/wp-content/uploads/2023/03/Green_Energy_report_230314.pdf

Wrap up and next steps

- What did we discuss – *Offshore wind, minimise sending people offshore, maximise use of robots, AI, MAS and satellites to provide data collection, reconnaissance, surveillance, communications, command & control, and security*
- Next steps – *ORE Catapult convening consortiums to:*
  - *Demonstrate MAS capability;*
  - *Satellite coverage over Celtic Sea*

CONTACT US

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Visit us: ore.catapult.org.uk

Engage with us:

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