CATAPULT
Offshore Renewable Energy

ORE CATAPULT'S FLOATING OFFSHORE WIND OFFERING

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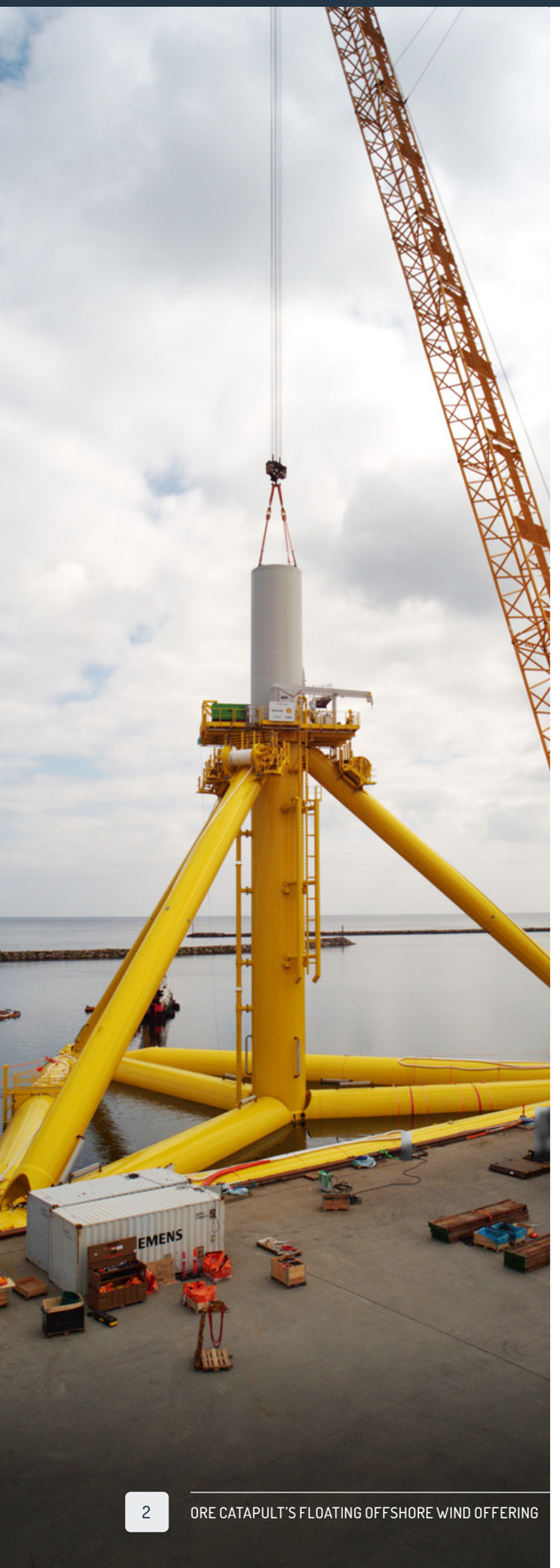


OUR MISSION

ORE Catapult aims to accelerate the commercialisation of floating offshore wind technologies to deliver a cost-effective Net Zero and create economic opportunities across the UK and beyond.

We do this by:

- Using our world leading expertise, in depth industry knowledge and unique technology development, testing, demonstration and optimisation infrastructure to drive innovation in floating offshore wind
- Working with industry, government, supply chain and academia to identify and address barriers to commercialisation and cost-effective deployment of floating offshore wind technologies – addressing barriers in advance of need, accelerating project and technology deployment timescales.
- Developing the supply chain using our unique understanding of existing supply chain capacity and capability, and targeted supply chain development programmes, projects and activities. – ensuring that the opportunities for the UK supply chain are maximised, both in UK floating offshore wind projects and internationally.
- Building impactful projects and programmes with collaborative partners, which allow organisations with common challenges and opportunities to work together for mutual benefit – reducing the risks and costs associated with innovation.

We operate within the existing offshore wind industry and by supporting the transitions of skills, experience, products and services from other offshore and energy sectors in the context of the energy transition.

FLOATING WIND IN THE UK

UK'S LEADING POSITION

The UK already leads the way in floating offshore wind. The first floating offshore wind farm in the world, Hywind Scotland, was installed off Peterhead in Scotland in 2017, and has consistently delivered the highest capacity factor of any offshore wind farm in UK waters. The Kincardine Project, southeast of Aberdeen, has now overtaken it as the world's largest floating offshore wind farm, with a combined capacity of 50MW and the ability to power 35,000 homes.

The UK also has the world's largest pipeline of large scale floating offshore wind projects in development. A total of 18GW of project option agreements were awarded in 2022 for sites around Scotland as part of the ScotWind process. Further option agreements are anticipated to be awarded as part of the ongoing Innovation and Targeted Oil and Gas (INTOG) leasing process. In the Celtic Sea, a leasing process is in development which is set to deliver up to 4GW of floating offshore wind by 2035, with longer term potential to deliver 20GW of floating offshore wind in the Celtic Sea by 2050.

THE GLOBAL OPPORTUNITY FOR FLOATING OFFSHORE WIND IS SIGNIFICANT, WITH MORE THAN 250GW ESTIMATED TO BE DEPLOYED BY 2050.

FLOATING WIND AND NET ZERO

Floating offshore wind is an essential ingredient for the UK's energy future and will play a key role in the delivery of a cost-effective Net Zero. Only by unlocking access to deeper waters and areas of highest wind resource will we be able to meet our Net Zero targets for renewable energy output by 2050.

ENERGY TRANSITION

Similarities between the oil and gas and floating offshore wind industries mean floating wind will also play a key role in supporting a sustainable energy transition – both by supporting the transition of skills, experience, products and services from oil and gas to floating and broader offshore wind energy sector, but also by being directly integrated with existing oil and gas operations to substantially reduce their carbon emissions.

GLOBAL OPPORTUNITY

The global opportunity for floating offshore wind is significant, with more than 250GW estimated to be deployed by 2050. There is the potential for the UK to export skills, experience, products and services across the globe, supporting other markets to deliver Net Zero ambitions, while creating economic activity and opportunities for the UK.

Photo courtesy of Principle Power. Artist: DOCK90

OUR OFFERING

At the centre of our offering is our world-leading capability in the development, qualification, testing, demonstration and optimisation of technology-based products and services.

Our unique blend of deep technical knowledge, commercialisation know-how, manufacturing expertise and testing and demonstration infrastructure allow us to work collaboratively with technology and project developers to de-risk technology and project delivery.

We have a range of advanced analysis and simulation capabilities which have been applied to floating offshore wind technologies. From coupled multi-physics engineering design and analysis tools, monitoring and data acquisition system design and implementation, test development, design and delivery, materials and operational performance analysis tools, our floating wind team works with partners to develop, test, demonstrate and optimise technologies using the latest digital tools and methods.

INTEGRATED DESIGN AND SIMULATIONS

Given the complexity of floating wind turbine systems, a deep interdisciplinary understanding of the interactions between the floating structure and hydro-aerodynamic loads, station keeping forces and the wind turbine's control system underpins component and system design, simulation, testing and optimisation.

Our expertise includes:

1. Floating structure preliminary design
   - Homogeneous geometry, inertial properties, hydrostatic, and stability analysis
   - Structural design for the floating structure according to the rules and guidelines
2. Hydrodynamic analysis
   - Frequency-domain analysis (Linear) using OrcaWave and/or Ansys AQWA.
   - Nonlinear time-domain analysis using OrcaFlex and/or Ansys AQWA.
   - Station keeping forces from fairlead to anchor.
3. Coupled analysis
   - Aerodynamic loads calculations on the rotor and tower.
   - Fully coupled hydro-aero-servo-elastic analysis using Orcaflex.
   - Sequential coupled analysis using Ansys AQWA by integrating the aerodynamic loads caused by the turbulent wind on the rotor, control system, and large deflection of the tower and blades from third-party software.
4. Finite Element Analysis (FEA)
   - Load mapping from Ansys AQWA to Mechanical
   - FEA using Ansys Mechanical
5. Design & site-specific analysis of floating wind turbine power generation, downtime and fatigue consumption over turbines' technological life.
6. OrcaFlex-based simulations of other offshore scenarios
   - Towing and crew transfer

MOORING AND ANCHORING SYSTEMS

Whilst they only make up a small part of a floating offshore wind project's CAPEX, effective design, testing and qualification of mooring technologies plays a critical role in maximising turbine availability and reducing project risk – in that respect, they are relatively "high value" systems

Our key capabilities include:

- Mooring system component and system technology development and qualification (including test and demonstration);
- Mooring system technology design development, assessment and optimisation;
- Innovative anchor design development, testing and qualification;
- Mooring system risk and reliability analysis;
- Mooring system and component digital twin development and validation;

DYNAMIC CABLE SYSTEMS

Dynamic cables are high value technologies playing a critical role in maximising turbine availability and reducing floating wind project risk. ORE Catapult has developed specific expertise in dynamic inter-array cabling (DIAC) system technology, through research, collaborative industry programmes, and commercial testing.

Our key capabilities include:

- OrcaFlex cable dynamic analysis
- Local cable cross section mechanical analysis (using UFLEX)
- Cable and array electrical design and analysis
- Cable qualification, testing, and integrity risk assessment (inter-array and export)
- Cable condition monitoring system design (electrical, thermal, mechanical)
- Dynamic cable system and component digital twin development and validation

PORTS AND INFRASTRUCTURE

Ports and associated fabrication infrastructure are at the heart of floating wind development, maintenance and eventually decommissioning. As such, we have developed specific expertise in the space of ports infrastructure.

Our expertise includes:

- Extensive in-house database of UK port infrastructure
- Port requirements for steel and concrete substructure fabrication, wind turbine and mooring equipment staging
- Market analysis to support port infrastructure or supply chain development in/near ports
- Technical and economic assessment of port infrastructure development
- Port infrastructure assessment for specific floating offshore wind projects

PROJECT CONSTRUCTION, OPERATIONS AND MAINTENANCE

Large scale floating offshore wind project construction, operation and maintenance activities shall entail complex, high risk onshore and offshore operations. Our team work with a range of advanced simulation tools to assess and optimise these operations, as well as support the development of technologies and innovations which can reduce cost and risk within these operations.

Our key capabilities include:

- Full physics 3D spatial project construction, operation and maintenance simulation;
- Construction, operation and maintenance planning and risk assessment (enabled by advance simulation tools);
- Application, testing and demonstration of robotic and autonomous systems for construction, operation and maintenance;
- Application, testing and demonstration of advanced and innovative lifting and logistical aids;

TECHNOLOGY ROADMAPS

Technology roadmapping is a useful tool for identifying barriers in various sectors and finding ways of addressing them. The outcomes of technology roadmaps can guide future activities in specific sectors and inform the broader technology innovation funding landscape.

Our roadmapping expertise includes:

- Identifying and assessing specific innovations which will drive cost reduction in offshore wind and floating offshore wind, and their relative impact on Levelised Cost of Energy (LCoE);
- Providing a clear and detailed understanding of the impact of technology innovation on FOW cost reduction to partners and other key stakeholders, to inform broader technology innovation funding / investment programmes;
- Developing a wholistic roadmap that shows how technology, market, regulation, policy, consumer preference, organisational, and business and commercial models, would be needed to effectively achieve desired goals

MAJOR FLOATING WIND PROGRAMMES

FLOATING OFFSHORE WIND CENTRE OF EXCELLENCE

Established in 2019, the Floating Offshore Wind Centre of Excellence (FOW CoE) aims to accelerate the commercialisation of floating offshore wind in the UK.

Working across four workstreams – technology, supply chain and operations, development and consenting and delivering Net Zero – the centre has laid the groundwork for increased deployment of floating wind, delivering evidence and guidance to partners and stakeholders regarding the industry's commercialisation.

The centre's focus is now expanding, moving into a technology driven position. In this new phase, the centre will establish larger scale projects looking at build out requirements, the supply chain, and technical and environmental challenges of deploying large-scale floating wind, where ORE Catapult will be able to deploy the full weight of its engineering capabilities.

NATIONAL FLOATING WIND INNOVATION CENTRE

Alongside the FOW CoE, ORE Catapult, in collaboration with Energy Transition Zone (ETZ) Ltd, has established the £9 million National Floating Wind Innovation Centre.

The open-access test and research centre will support innovative companies developing solutions for floating offshore wind, particularly focusing on moorings and anchors, dynamic cables and electrical systems – dynamic components that are unique to the industry.

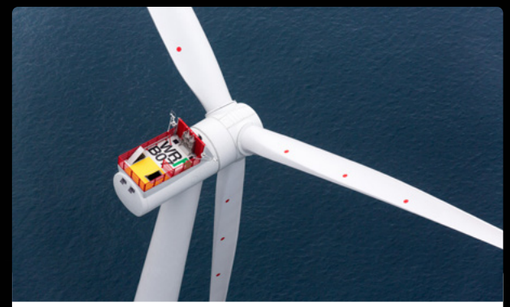
Situated in Aberdeen, the centre provides the North-East of Scotland with an opportunity to become a global leader in floating offshore wind. The testing capabilities of the centre, coupled with the significant synergies with subsea technologies and locally based expertise, means there is no stronger region to set up and accelerate the development of floating wind.

MEECE

Our Marine Energy Engineering Centre of Excellence (MEECE) is delivering research, development and demonstration activities to support growth in the Welsh supply chain, and accelerating commercialisation and cost reduction of the marine and offshore wind sectors.

As MEECE is based close to the Celtic Sea, it is ideally placed to support Welsh companies develop new products and services for the floating offshore wind sector in particular.

MEECE is also supporting companies transition into the sector through collaborations that aim to develop their existing products into those tailored to the floating offshore wind market.



OWIC

In our role as sponsor and delivery lead for OWIC innovation activities, we have a unique position to drive forward technological development in priority areas. This involves encouraging sector-wide collaboration to understand common challenges and working with key stakeholders to establish a range of innovation enablers. Floating offshore wind technologies feature often in such activities and are one of the best opportunities on the table to secure a highly skilled UK supply chain within a fast-growing market.

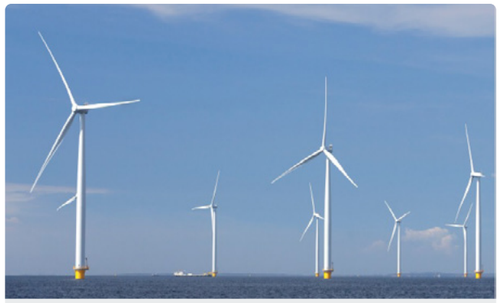
MAJOR FLOATING WIND PROGRAMMES (CONTINUED)

MARINE-I

The Marine-innovation project has been enabling innovation in the marine technology sector in Cornwall and the Isles of Scilly since 2017. It focusses on four interconnected themes: marine energy, marine manufacturing, maritime operations and marine environmental technologies. It was established to stimulate and support research, development and innovation (RD&I) to help businesses exploit new market opportunities.

Part funded by the European Regional Development Fund, the project brings together expertise and key infrastructure from lead partner University of Exeter, supported by University of Plymouth, Offshore Renewable Energy Catapult, The Cornwall College Group, Cornwall Marine Network and Cornwall Council.

In recent years the project has increasingly targeted floating wind by running workshops to address floating wind market analysis, identifying technology challenges and introducing SMEs solution providers to project developers.



CORNWALL FLOATING WIND ACCELERATOR

The Cornwall Floating Wind Accelerator project is helping pump prime regional understanding and technology solutions to help unlock 24GW in the Celtic Sea, and the 17,000 UK jobs and £33.6bn GVA projected for the floating wind sector. Launched in 2021 the project is working with industry to develop low carbon floating wind technology and provide a real world simulator to model 500MW arrays and identify logistics and technology pinch points. Other deliverables include a 12-month floating LIDAR campaign in the Celtic Sea, the identification of new low-carbon Environmental Impact Assessments methodologies and in-depth analysis of low carbon manufacturability processes and materials across blades, nacelles, towers, platforms, mooring and anchoring.

Part funded by the European Regional Development Fund, the project is led by Celtic Sea Power (a wholly owned subsidiary of Cornwall Council) working in partnership with University of Exeter, University of Plymouth, and Offshore Renewable Energy Catapult.

The project regularly runs workshops often in conjunction with Marine-i aimed at raising regional supply chain awareness of the opportunities available through FLOW in the Celtic Sea.
The focus now is on reducing project time to deployment through environmental data sharing, modelling analysis of deployment scenarios and logistics and developing innovative solutions to address challenges bespoke to the Celtic Sea.

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