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Offshore Wind R&I Priorities & Opportunities

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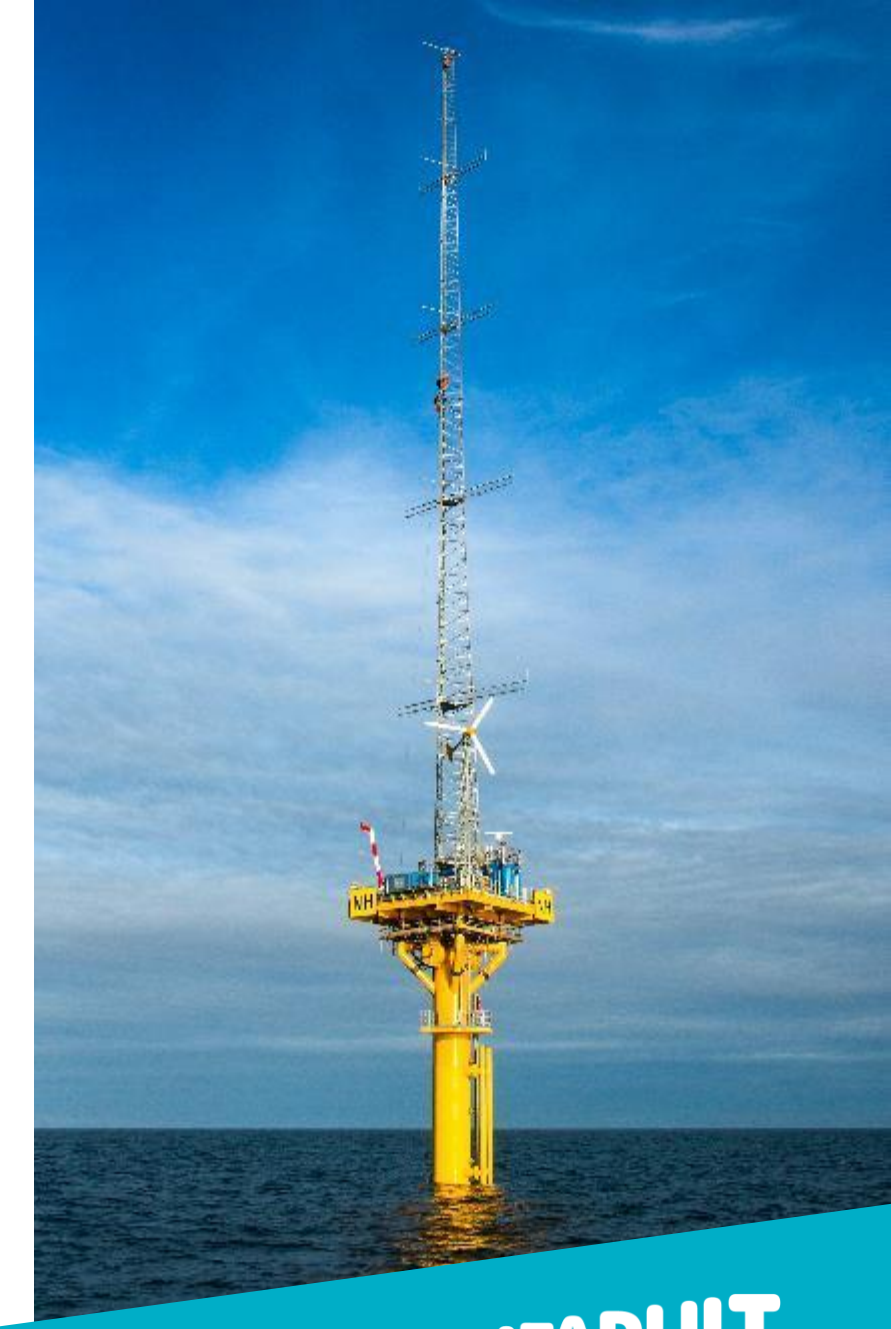
Credit: GE Haliade

Agenda

- ORE Catapult Overview
- R&I Priorities
  - UK perspective (Offshore Wind Innovation Hub)
  - European perspective
    - EERA JPWind
    - ETIPWind
- Collaboration Opportunities
  - Floating Offshore Wind Centre of Excellence
  - ORE Catapult Academic Research Hubs
  - Supergen ORE Hub Advisory Board & Working Groups



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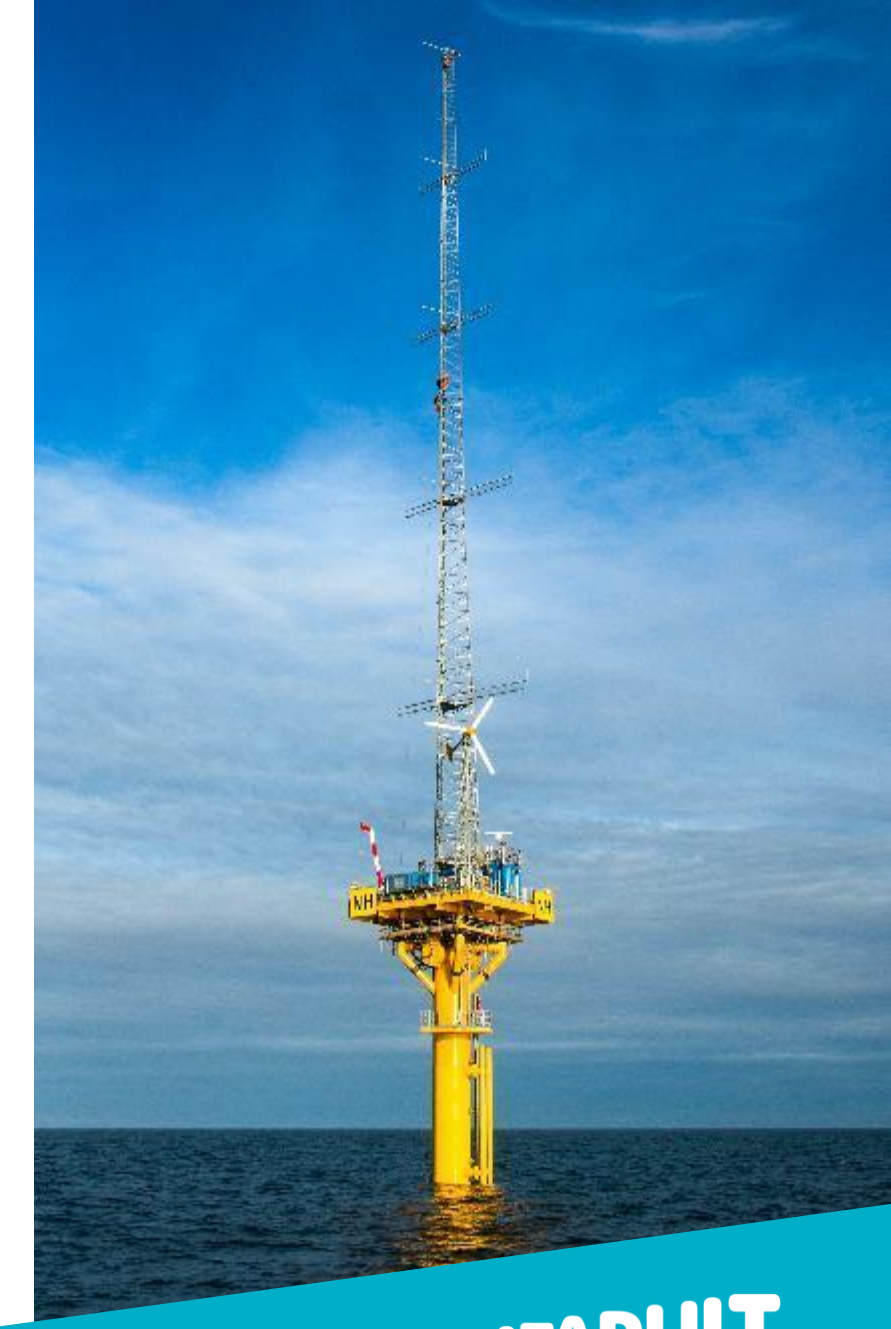
THE OFFSHORE RENEWABLE ENERGY CATAPULT

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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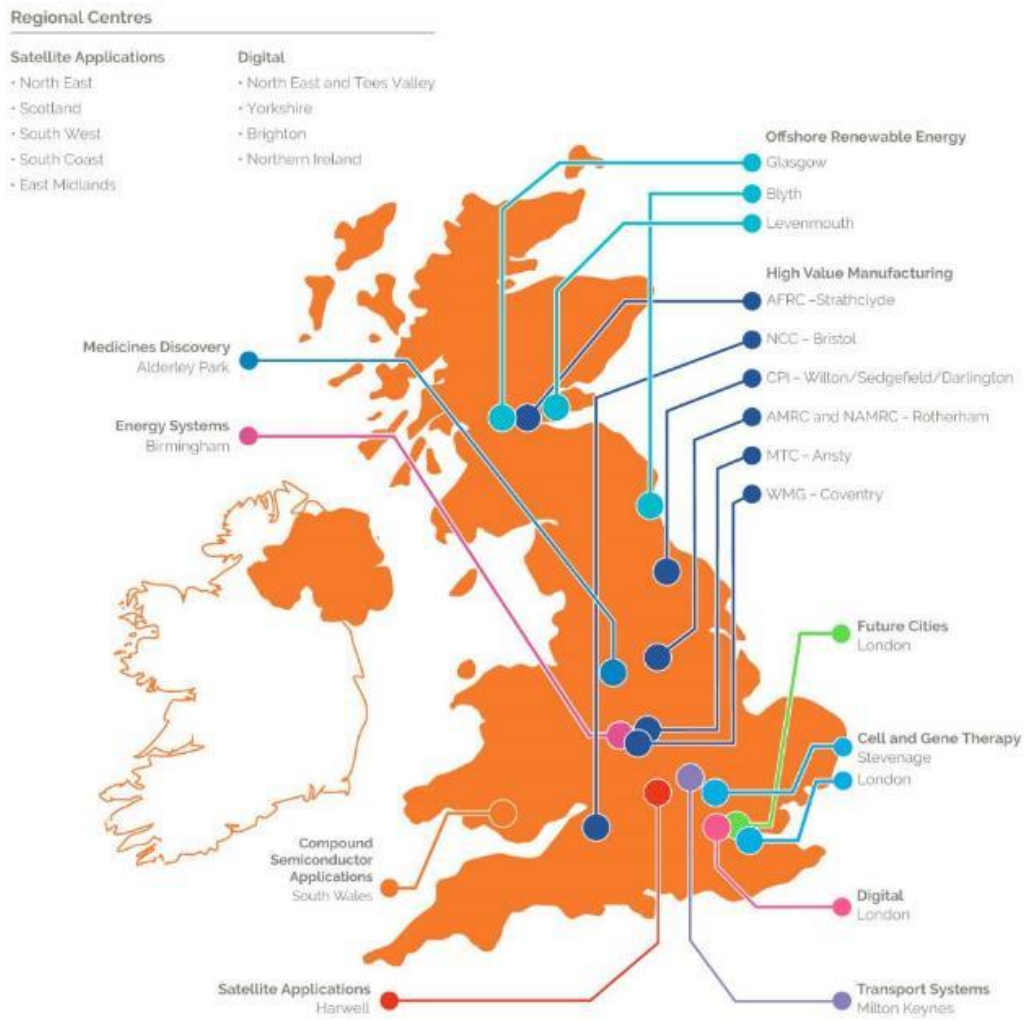
THE CATAPULT NETWORK – A NATIONAL CAPABILITY

- Network of 9 world-leading technology innovation centres
- Supporting businesses in transforming great ideas into valuable products and services
- Independent, not-for-profit
- Delivering impact across the UK economy, enabling businesses to thrive in global markets



UKRI Innovate UK

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THE OFFSHORE RENEWABLE ENERGY CATAPULT

- Over 200 engineering, research and sector experts
- World-leading test and demonstration facilities

8 UK Regional Centres

Aberdeen, Blyth, Fife, Glasgow, Hayle,
The Humber, Lowestoft, Pembroke Dock

3 UK Academic Research Hubs

Universities of Manchester
& Strathclyde – Electrical Infrastructure
University of Bristol – Blades
University of Sheffield – Power Trains

International Research and Innovation Centre

Yantai, China

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R&I Priorities

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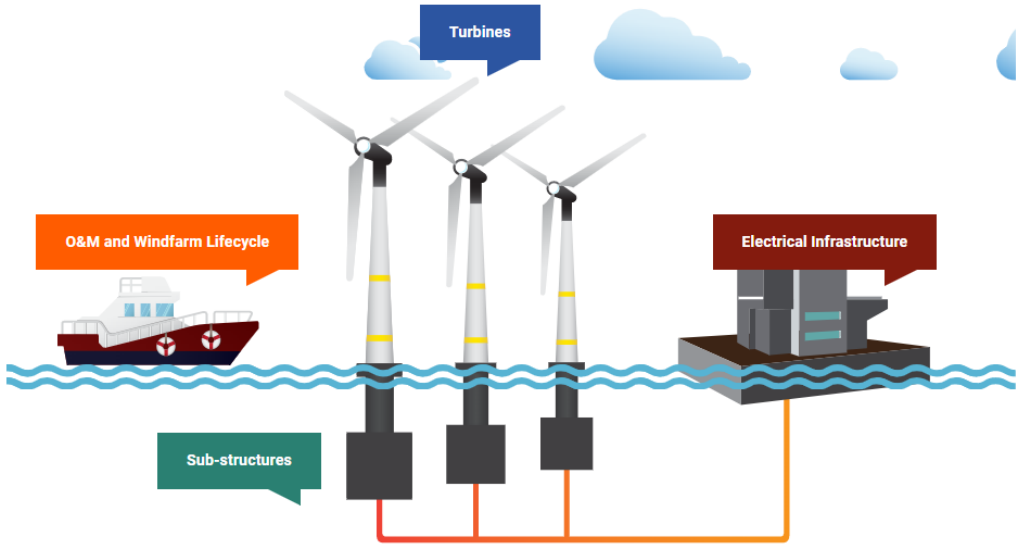
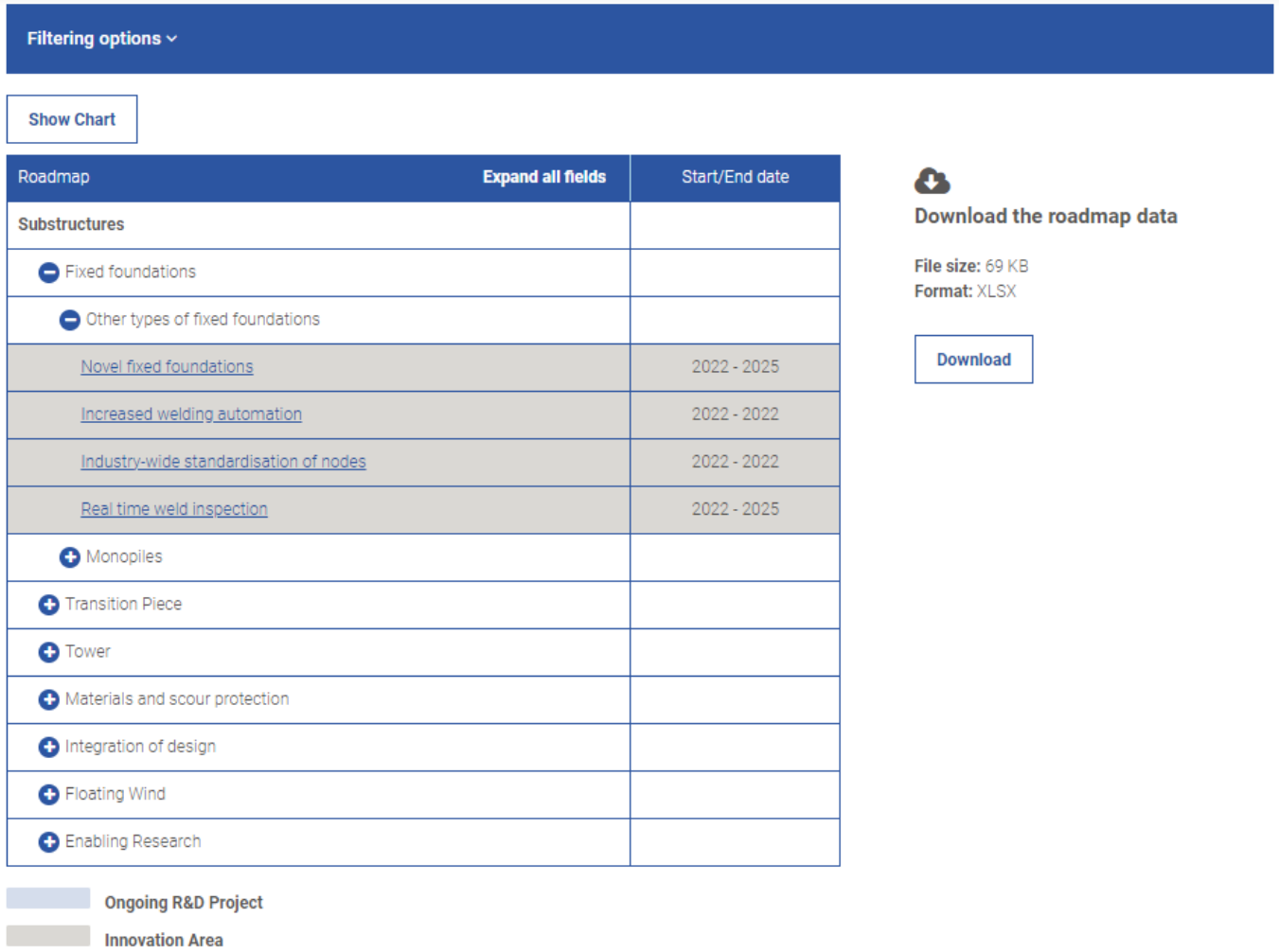
UK Perspective – Offshore Wind Innovation Hub (OWIH)

- https://offshorewindinnovationhub.com/
- The Offshore Wind Innovation Hub was established to be the UK's primary coordinator for innovation, focusing on offshore wind energy cost reduction and maximising UK economic impact
- Innovation Roadmaps focus on four areas/themes
  - Turbines
  - Electrical Infrastructure
  - Sub-structures
  - O&M and Windfarm Lifecycle



OWIH – Substructures Innovation Roadmap



- Dropdown menus available for each Innovation Roadmap
- Roadmap data is downloadable
- R&I priorities are nested in the dropdown menus

Offshore Wind Innovation Hub

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Floating Wind – Mooring System Design

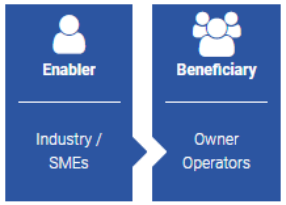
Mooring system design

Type of Entry: Innovation Area

Substructures > Floating Wind

Description

Background: The mooring system for a floating offshore wind turbine is based on oil and gas industry standard. The requirements between these two are relatively similar and moorings have largely been optimised. Their importance in OSW is significantly higher as there are only 3 lines supporting the structure (comparing to ~15 in O&G FPSO) and backup options when one line is broken are limited. Shallow water (<100m) is an additional challenge for mooring and tendon design. Innovation: Improvements in design standards (possibly standardisation of components), materials (including synthetic rope) and array layouts to further optimise mooring systems for floating offshore wind. A more integrated design interface between anchors, mooring system and substructure would enable further benefits. More research is needed in fatigue of moorings.



Strategic Outcome

- **Enabling disruptive innovation**
- Commercialising >15MW turbine platforms
- Maximising operational performance of existing wind farms

Requires implementation offshore

- **Yes**
- **No**

UK Benefit

Low **Medium** High

Notes: Currently, UK has limited capabilities to manufacture chain mooring lines, but significant capabilities in synthetic moorings.

Potential To Reduce LCoE

Low **Medium** High

Notes: Potential to reduce the CAPEX (material and installation) and OPEX of mooring systems.

Case for Intervention

Low Medium High

Notes: This is a complex problem that requires inputs from WT OEMs, substructure designers and mooring system manufacturers and designers. Academia and research organisation are well placed to facilitate this communication.

HSE impact

Low **Medium** High

Notes: Potential to reduce probability of mooring failure that will impact H&S and Environment. Future designs of mooring systems could limit seabed disturbance.

Technology Readiness Level

1 2 3 4 5 6 7 8 9

Read more about TRLs

Forecast start and finish

Now 2025 **2030** 2035 2040

Offshore Wind Innovation Hub

- Mooring System Design
  - One of the R&I priorities identified for Floating Wind
- Information presented includes:
  - Description
  - Strategic Outcome
  - UK Benefit
  - Potential to reduce LCoE
  - TRL
  - Development forecast

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European Perspective – EERA JPWind

- https://www.eerajpwind.eu/eera-jp-wind-ri-strategy/
- EERA JPWind is the European Energy Research Alliance Joint Programme for Wind
- Consists of the EU's leading research organisations involved in wind energy
- Circa 50 members

EERA JPWind – R&I priority areas

Structure of the EERA JP Wind R&I strategy

The partners in EERA JP Wind have defined the R&I strategy. It is intended to highlight the priority topics for wind energy research, each with associated challenges and key action areas. The resulting R&I strategy is the result of discussions with the 53 major European research groups organised in EERA JP Wind. Six urgent and important topics have been identified:

1 NEXT GENERATION WIND TURBINE TECHNOLOGY & DISRUPTIVE CONCEPTS

Large technology developments are being realised and foreseen while wind energy is being implemented in large numbers. The wind sector requires a strong scientific knowledge base to develop wind energy generators beyond its capabilities of today and tomorrow. New concepts contribute to the massive deployment but require major support at higher TRLs to overcome the inertia of existing concepts.

2 GRID INTEGRATION AND ENERGY SYSTEMS

R&I must contribute to the transition towards 100% RES power systems, understanding the challenges and developing the required technical capabilities. This includes aspects such as dynamic stability of systems with very large penetration of converters, market designs and interactions with other energy systems, energy sector coupling, energy conversion and storage.

3 SUSTAINABILITY, SOCIAL ACCEPTANCE AND HUMAN RESOURCES

Massive implementation of wind power must be done in a sustainable manner, creating maximum value for stakeholders, including investors, users and citizens with respect to the Sustainable Development Goals. This is achieved by taking away barriers to massive deployment, implementing more integrative development, and ensuring sufficient qualified human resource.

4 OFFSHORE WIND (BOTTOM FIXED + FLOATING)

Massive offshore implementation of wind power requires R&I to further reduce risks and costs, thus accelerate deployment. Developments will occur further offshore and in deeper water requiring floating wind power. Integrated design methods need to be developed, including wind and waves, electrical infrastructure, environment, substructures, control, logistics and risks.

5 OPERATION AND MAINTENANCE

In order to reduce the cost of wind power, operation and maintenance must be optimised. Robotics solutions should reduce the required human intervention and sensor system provide the information for improved monitoring and control to increase life. The abundance of data and information should be used in big-data analytics technologies to improve O&M.

6 FUNDAMENTAL WIND ENERGY SCIENCE

Research in the fundamental wind energy sciences is required to develop the research competences and the underpinning scientific knowledge. This leads to improved standards, methods and design solutions. Models and experimental data are needed for complex sites and extreme climate, larger and lighter turbines, more efficient wind farms and large-scale penetration in the energy system.

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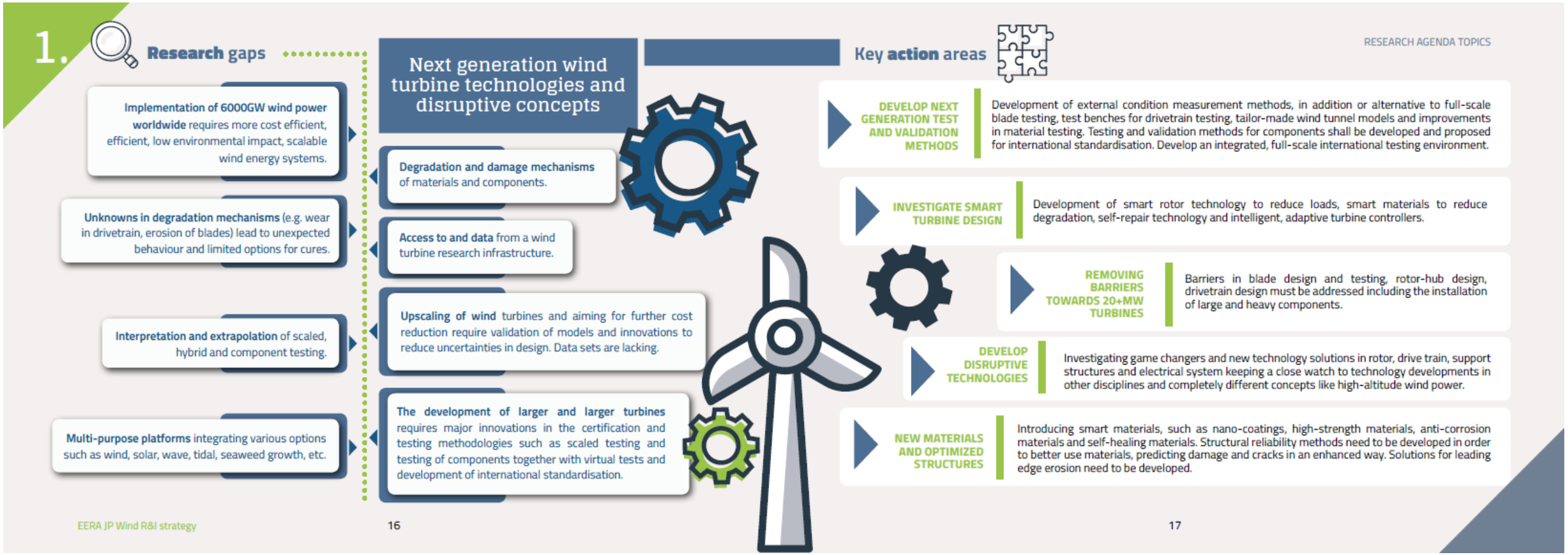
EERA JPWind – Next generation wind turbine technologies



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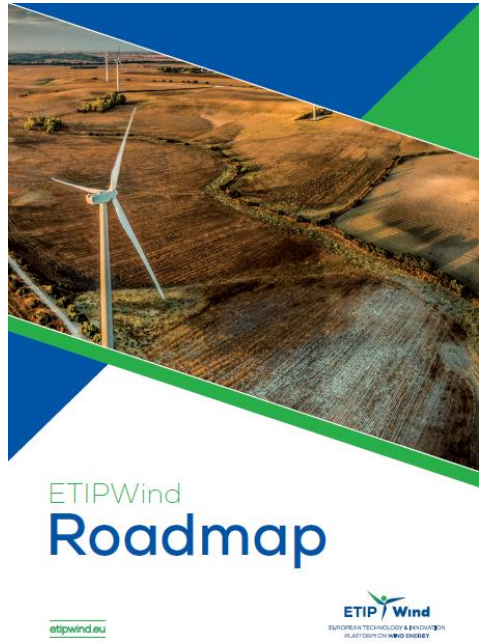
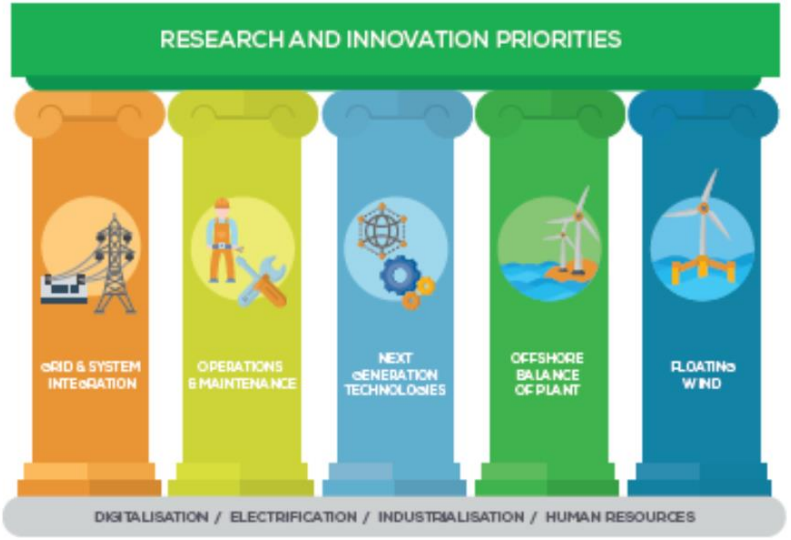
European Perspective - ETIPWind

ETIP Wind
EUROPEAN TECHNOLOGY & INNOVATION PLATFORM ON WIND ENERGY

- European Technology & Innovation Platform for Wind Energy https://etipwind.eu/roadmap/
- Consists of 25 leading European industry and research organisations, e.g. wind farm owner/operators, wind turbine OEMs, 1st tier supply chain, RTOs
- ETIPWind or the European Technology and Innovation Platform on Wind Energy was first established in 2016 by WindEurope with the support of the European Commission.
- The ambition is to define and agree on concrete research and innovation (R&I) priorities and communicate these to the European institutions and other decision making bodies in order to support the EU's ambition of a decarbonised economy by 2050.





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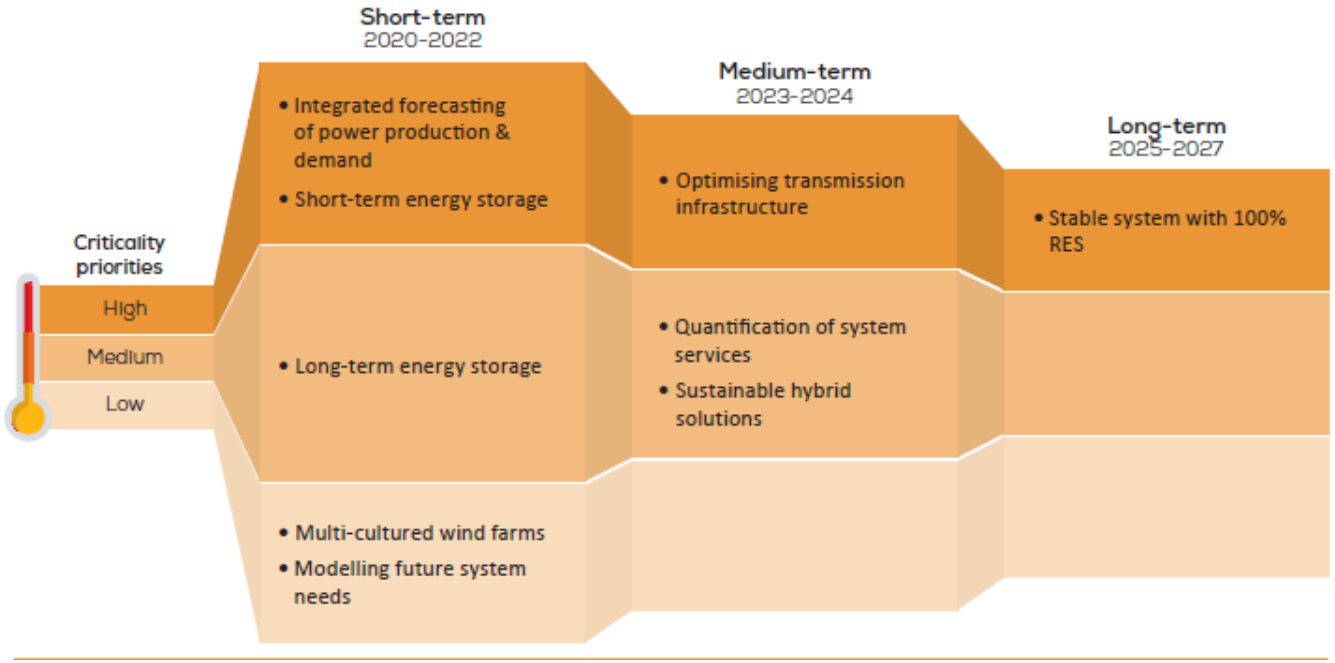
ETIPWind – R&I priority areas – Grid & System Integration



ETIP Wind

EUROPEAN TECHNOLOGY & INNOVATION PLATFORM ON **WIND ENERGY**

Short-term energy storage

Short-term

High priority

Description and scope

With further installation of renewables into the grid, the pressure grows for them to support grid and system stability. A combination of wind and battery storage can offer short-term solutions and has already shown promising results.

However, only a few projects are realised in real grids and their impact on grid support and their cost-effectiveness are still open important questions for the renewable energy system of the future. Whilst this is mostly a matter of market design and grid operating principles, research should further investigate the different battery technology and wind combinations to determine the potential use and business cases in various regions across Europe.

The approach would be to first identify and assess (both in terms of technology and economics) the grid and system services a wind + battery storage facility could offer. Second, to optimise design and dimensions of storage units in line with the size of the wind farm and the requested provision of grid services. Third, to assess the impact of providing grid services on the wind turbine control system and farm controller. Finally, to assess the business cases of wind + battery systems against wind systems without battery.

Recommended research actions

- Economic and technical assessment of selected battery storage technologies (li-ion, flow, high temperature) with regard to their suitability in providing different requirements of grid and system services.
- Model simulation and comparison of ideal versus real windfarm conditions in combination with technologies and services including variations in design and dimensioning of wind farm controller and storage system.
- Implementation of measurements in combination with selected best case storage systems and analysis of the results.

Milestones

- Economic assessment in the form of a matrix which shows the different storage system in regard to grid and system service under consideration of cost and revenue (development of cost of today and future).
- Demonstration of optimisation potential based on simulation and measurement results.
- Formulate guidelines which show an optimised storage system in dependence of the wind farm size and in regard to the respective grid and system service.

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Collaboration Opportunities

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Floating Offshore Wind Centre of Excellence (FOWCoE)

Vision/Mission - To establish an internationally recognised centre of excellence in floating offshore wind and drive the commercialisation of floating offshore wind for the UK's benefit.

Objectives

- Establish the UK as the leading FOW market in the world;
- Establish an internationally recognised centre of excellence in FOW
- Reduce the LCoE from FOW to a commercially manageable rate
- Cut back development time for FOW farms
- Develop opportunities for the UK supply chain
- Attract investment in FOW research and development in the UK

https://ore.catapult.org.uk/what-we-do/innovation/fowcoe/

Industry Partners

- The FOWCoE and the Supergen Offshore Renewable Energy (ORE) Hub are collaborating on several co-funded R&D projects, focused on floating offshore wind
  - Flexible funding model

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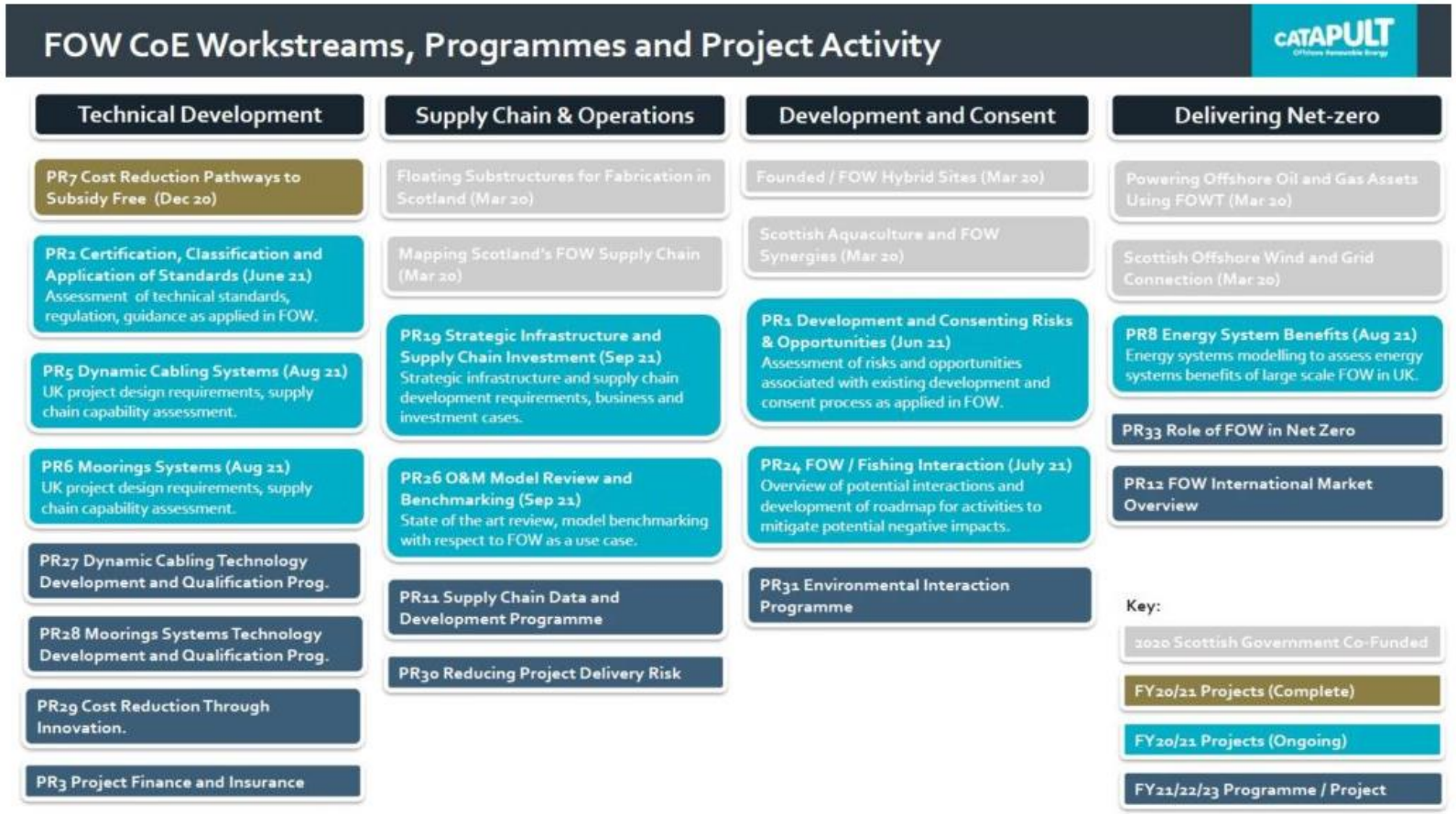
Floating Offshore Wind Centre of Excellence (FOWCoE)



- Opportunities remain to collaborate with the FOWCoE

Contact our team

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PROGRAMME MANAGER
ralph.torr@ore.catapult.org.uk

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ORE Catapult Academic Research Hubs

Wind Blade Research Hub

Research objectives

- Developing new and improved blade manufacturing technologies
- Improving in-service blade integrity
- Designing new and improved blade technologies
- Developing sustainable materials and processes

Length: 2017 - 2022

Electrical Infrastructure Research Hub

Research objectives

- Improving reliability and availability of electrical infrastructure components
- Optimising system and subsystem infrastructures
- Developing smart energy systems of the future

Length: 2018 - 2023

Powertrain Research Hub

Research objectives

- Reliability improvement and advanced test methodology development
- Advanced health condition monitoring and prognostic technologies
- Development of next generation powertrain components for larger wind turbines

Length: 2019 – 2024

£Multi-million investment enabling:

- Doctoral students
- Post-doctoral researchers
- Co-funded lectureships
- Facilities access, management and oversight from senior academics
- Incentivises partnerships with industry, other universities, and further leveraging of funding

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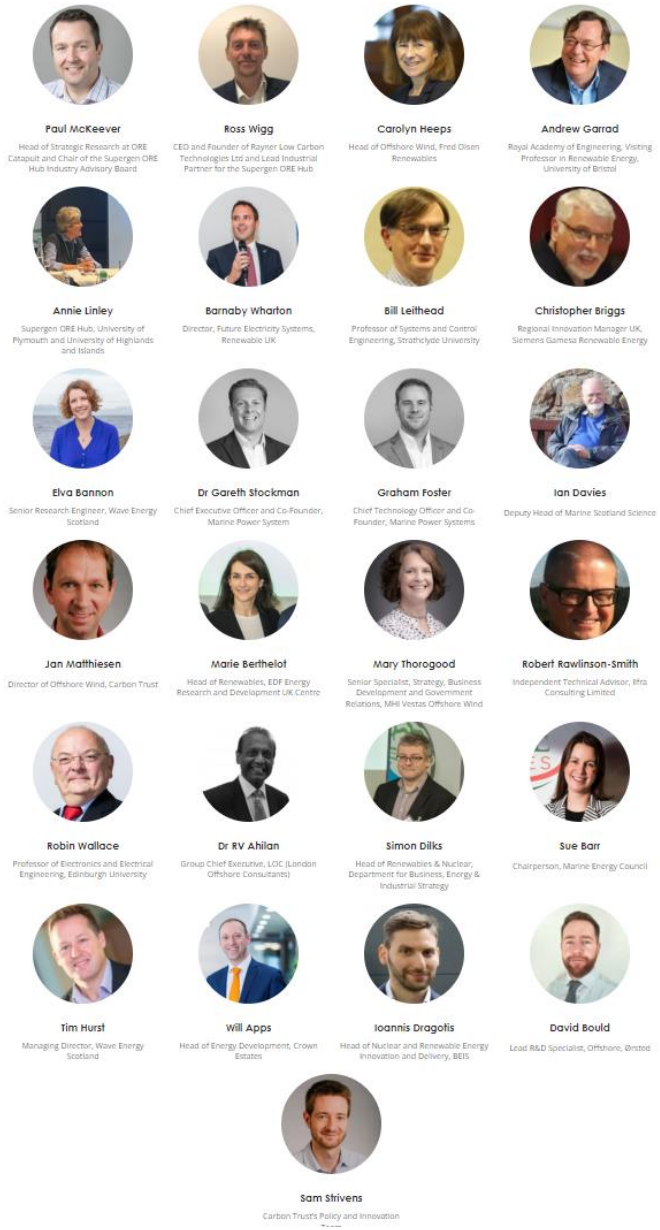
Supergen ORE Hub Advisory Board

Advisory Board

- Our Advisory Board brings together a group of experts within industry and government to provide the Hub with essential insight and dialogue beyond the academic sector.
- The Advisory Board comprises of representatives from the Department for Business, Energy and Industrial Strategy, ORE Catapult, Carbon Trust, RenewableUK, Original Equipment Manufacturers (OEMs), utilities, developers and other sector leaders, covering all sectors and disciplines.



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Supergen ORE Hub Advisory Board Working Groups

Selected Working Groups

- Policy & Economics – Chair (Sue Barr)
- Floating Wind – Chair (Dan Kyle Spearman)
- Offshore Wind O&M – Chair (David Bould)
- Energy System Integration – Chair (Paul McKeever)
- Equality, Diversity, Inclusion – Chair (Ross Wigg)
- Health, Safety, Environment – Chair (Panos Stavrakakis)

- Working groups have been addressing two questions:
  - What does the ORE sector need?
  - How can (or should) the Supergen programme contribute to those needs?
- Opportunities for non Advisory Board representatives to participate

  For further details, contact:
  - Paul McKeever paul.mckeever@ore.catapult.org.uk

  or
  - Ross Wigg rossrwigg@gmail.com

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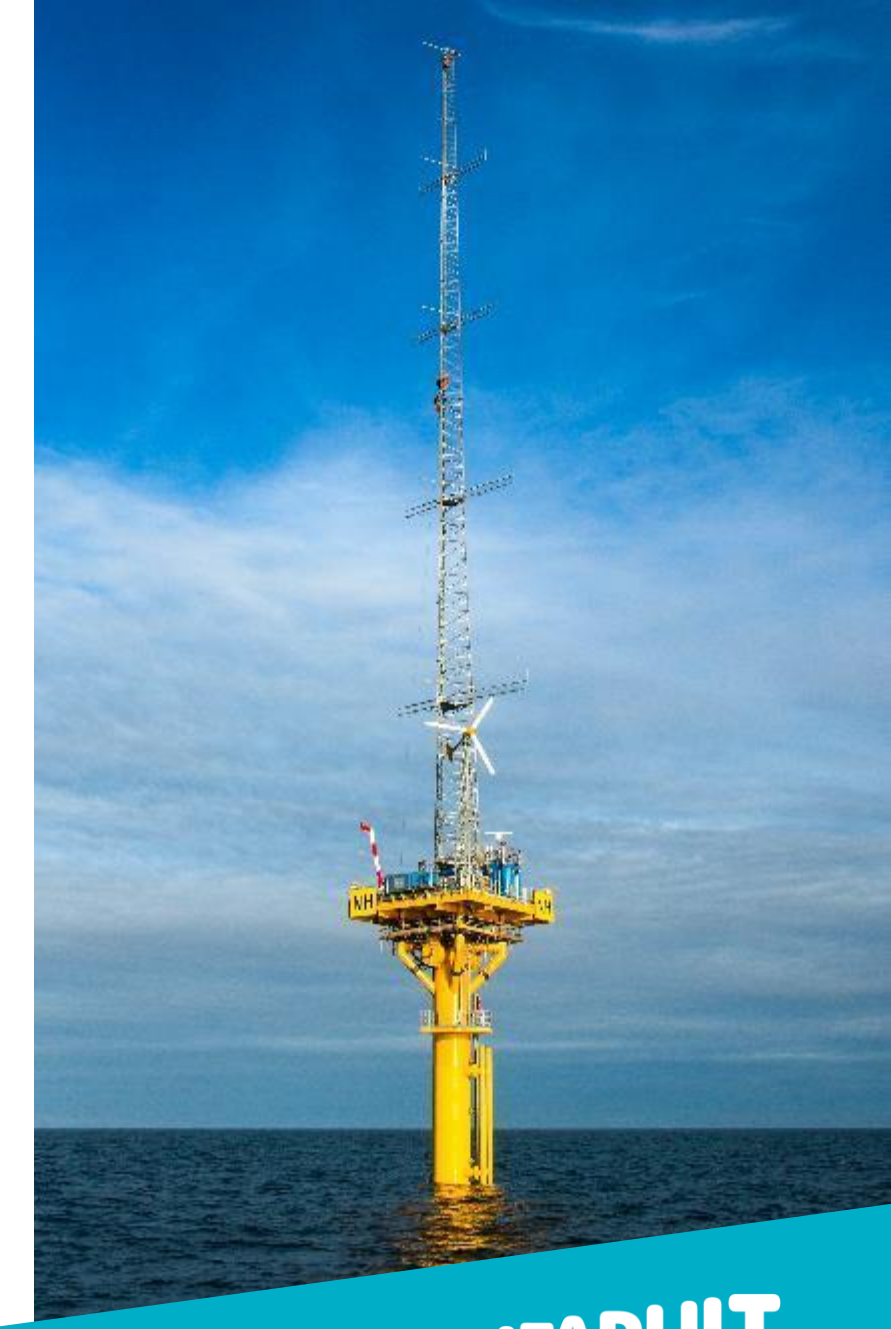
Conclusions

- Summarised the role of ORE Catapult and the Catapult network
- Presented R&I Priorities from different perspectives
  - UK and European perspectives
  - Research, innovation and industry perspectives
- Highlighted a selection of collaboration opportunities where ORE Catapult are already active
  - Floating Offshore Wind Centre of Excellence
  - ORE Catapult Academic Research Hubs
  - Supergen ORE Hub Advisory Board Working Groups



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GLASGOW

BLYTH

LEVENMOUTH

GRIMSBY

ABERDEEN

CHINA

LOWESTOFT

PEMBROKESHIRE

CORNWALL

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