Offshore Wind Industry Council

Innovation Focus

An assessment of innovation priorities to accelerate the offshore wind sector in the UK

A report by the OWIC Innovation Workstream

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Photo: EnBW

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Foreword

We are delighted to present the findings of the Offshore Wind Industry Council (OWIC) Innovation Workstream's 2023 Innovation Focus Report. With a target of 50GW of offshore wind by 2030, including 5GW of floating offshore wind, innovative solutions will play a major role in removing barriers and accelerating deployment to help the UK deliver upon its ambitions, providing global leadership.

By taking a holistic view of the offshore wind sector and working in close collaboration with the Offshore Renewable Energy Catapult (OREC), the OWIC Innovation workstream has a crucial role in understanding and assessing innovation priorities, highlighted in this report. The output and recommendations in this report cover the full lifecycle from initial project development through to operations and maintenance and decommissioning , providing guidance to support innovators and the supply chain, and insight to those in the public sector.

The results of this work demonstrate the range of innovation solutions to drive forward the solutions that are needed by the industry. We need to look both at longer term challenges, such as sustainability, and areas of immediate challenge such as radar interference and environmental constraints. These challenges demonstrate the need for true collaboration across our industry, public sector, academia and beyond to other sectors such as energy systems, maritime and defence.

The three prioritised areas: (i) novel radar & data processing technologies; (ii) design, manufacturing and assembly of floating substructures, and (iii) recyclability of components demonstrate the diversity and opportunity for the UK.

For the UK to realise its full potential in the innovation space, we fully endorse the recommendations of this report that include the need for greatly increased innovation funding over an extended period of time, and the need for meaningful sharing of data to drive an improved collective understanding of industry challenges.

Thank you to everyone the industry colleagues and companies who have provided their expert knowledge and resources to help the creation of this report. As the innovation landscape changes we look forward to now supporting innovation application on the identified priorities and seeing positive and material impact in the industry.

Richard Sandford
Co-Chair, Offshore Wind Industry Council
Vice President of Offshore Wind UK, bp

Andrew Jamieson
OWIC Board Member and Innovation Workstream Sponsor
CEO Offshore Renewable Energy Catapult

Photo: EnBW

Executive summary

The Offshore Wind Industry Council (OWIC) has a clear purpose to work collaboratively to seek positive change and accelerate the offshore wind sector in the UK. The Innovation workstream takes a holistic view of innovation needs and encourages the collective pursuit of the necessary mechanisms to enable solutions to be developed, communicating a clear direction for the industry.

Driven by a combination of Net-Zero commitments, increased Energy Security and the opportunity for UK Economic Growth, offshore wind is at the centre of plans for the UK's low carbon energy system. With a target of 50GW of offshore wind by 2030 it is urgent that deployment is accelerated and that potential barriers are overcome. In particular, the need for significant new grid infrastructure, streamlined consenting and increased supply chain capacity were all highlighted in the recent Offshore Wind Acceleration taskforce (OWAT) report. These key barriers along with the need for action on floating wind cost reduction, increased operational reliability and decarbonisation of manufacture and operations, were taken as the starting point for this innovation report.

We have engaged with key stakeholders from across industry, academia and the public sector to undertake a structured process for determining where innovation is most needed. The technology roadmaps of the Offshore Wind Innovation Hub provided specific innovation opportunities and an initial prioritisation exercise was conducted using a range of criteria to shortlist a range of innovation needs to address the key barriers.

From this, a gap analysis was conducted to assess the extent to which these innovation needs were already being addressed or supported, and where increased focus is required going forwards. This resulted in the identification of three key areas that are most in need of significant additional proactive intervention. These are:

- Novel Radar & Data Processing Technologies
- Design, Manufacturing and Assembly of Floating Substructures
- Recyclability of components

The analysis has led to a set of recommendations for each of the topics to highlight the most appropriate type of intervention required. Alongside this, some general recommendations are forthcoming, namely:

1. Develop a plan and pipeline for a greatly increased innovation fund, committed over a 10-year period, and of a scale comparable to other nationally strategic industries..
2. Create powerful mechanisms to share data and knowledge, integrating these where possible into current and future systems and processes.
3. Build on UK capabilities in academia through closer collaboration with Supergen ORE and Centre's for Doctoral Training (CDTs), and link innovation priorities to UK supply chain capabilities.

OWIC will strive to build on these recommendations to better inform the future direction of the industry and take the action necessary to bring about change. We will champion priority innovation actions as outlined in this report and coordinate with key stakeholders in the industry and the public sector to help expedite these.

01 Introduction

The offshore wind sector is growing at a tremendous rate, with as much as 160 GW of offshore wind capacity predicted could be installed in the UK by 2050.

In many ways the UK is a leading light and an example of best practice to the rest of the world, but despite this, the industry is in a state of flux: soaring energy prices and global supply challenges are increasing production costs in the supply chain, while the success of the CfD mechanism to reduce prices has ended up eroding profit margins across the board. We have an energy security policy that favours home-grown power production however projects are more at risk than ever of facing planning delays as a result of a perceived risk to the environment. The status quo is not sustainable, and this jeopardises UK targets.

Technological solutions are one way to address this. Whether by reducing O&M costs through increased use of automation, reducing environmental impact through better spatial coordination or enabling next generation solutions like floating wind, the application of engineering minds to these challenges will have a major role to play in removing the barriers the industry faces.

Important steps forward are beginning to emerge to adapt the system, not least consideration of 'non-price factors' under a future CfD structure, and the role that supply chain plans have in encouraging investment in new and innovative solutions. Similarly, the inclusion of an 'innovation discount' mechanism in the Crown Estate Round 4 leasing process was a very positive step forward. The UK Government's 'Offshore Wind Net Zero Investment Roadmap' is a welcome initiative, highlighting a range of enabling activities. But on innovation there is, however, much more that is required to capitalise on UK capabilities and to seize the opportunity presented to us.

At the Offshore Wind Industry Council (OWIC), we have a responsibility to take the holistic view and to consider how the industry can best work together to enable and encourage innovation to flourish. We aim to understand where the sector should prioritise its efforts and resources to develop technological solutions, and we will speak as a single voice of industry to build the case for positive change.

OWIC utilises a suite of workstreams targeting key aspects of the industry that require focus, including Supply Chain, Skills, Consenting, Grid and Innovation. By gathering input from expert industrial, academic and public sector representatives from a range of forums, these workstreams are driving forward the formation of best practice, identifying supply chain opportunities and making recommendations to key policy makers. The innovation agenda cuts across much of this and demonstrates the inherent role that technology can playing in delivering solutions and helping to address challenges in other related fields.

02 Identifying Sector Priorities

Objectives

In order to meaningfully inform and recommend the direction of innovation activities, it is necessary to determine which particular focus areas will yield the most benefit to the industry. So, before undertaking a targeted investigation of what we can do to drive technological progress, one must first understand the sector's technical priorities at a holistic scale. To begin this process, a set of six sector objectives were formed, created from the perspective of resolving technology barriers. As such, critical ambitions such as growing the UK supply chain and job creation are not captured here, but rather included in the scoring approach. Each of these objectives and the rationale behind them are described below, with further detail provided in Appendix A-1.


Photo Credit: EnBW


Photo: ORE Catapult

Maximise Efficient Use of Sea Space and Accelerate Deployment in Consideration with Other Sea Users and the Environment.	There are numerous areas of focus that need to be tackled in order to continue the accelerated deployment of offshore wind. Reducing the need for time-consuming and expensive activities relating to data gathering and environmental impact assessments will streamline the consenting process, and there is a need to remove some key barriers to consent. Improvements in these areas will be brought about via a combination of improved communication of expectations, data sharing and technological developments. Onshore, there is the growing risk of resistance from local residents and environmental groups around the cable route and substation planning process. Technologies which are capable of mitigating these impacts will be of incredibly high value.
Reduce Project Costs Through Efficiency Improvements and Increased Reliability	Legacy design and operational issues continue to hamper projects and increase risk. This results in business cases for new projects having to take this into account. A lack of sufficient data and feedback from operational projects makes this process more challenging. Common issues include blade erosion and inter-array cable failures.
Ensure Energy Integration has the Required Capacity and Flexibility	The current UK grid and wider energy system requires major upgrades to be compatible with future sources of energy. Transmission system improvements will be required so that vast quantities of offshore wind can be successfully integrated with the national grid onshore, such that national energy security and grid stability is maintained, allowing offshore wind to be compatible with other forms of energy production and distribution. The creation of hydrogen and its subsequent integration into the energy network is another opportunity that needs tackled to lessen the burden of increased electrification of transport and heating.
Avoid Supply Chain Bottlenecks	This group of challenges typically refers to things which effect the industry as a whole - on a national scale - where limitations in major infrastructure capabilities can lead to bottlenecks down the line. A secure supply chain is critical to the success of the industry. Whether in the installation, operations or decommissioning phases, greater costs will be incurred, and greater risks exposed unless solutions are found for key high-level challenges. Potential bottlenecks include vessels, ports, materials, major component manufacturing and test assets.
Enable Floating Wind Solutions and Continued Cost Reductions	Floating offshore wind has rapidly become a major technology opportunity for developers. This comes with additional technology challenges inherent in deeper waters further from shore with dynamic movements, and there is a pressing need to reduce costs further and to ensure high reliability of critical components such as mooring lines and dynamic cables. In addition, existing capability in buoyancy, moorings and substructures from the O&G sector potentially puts the UK in a strong position.
Decarbonise the Sector	Decarbonisation of the offshore wind sector is of increasing importance, not least from a political perspective. Emissions need to be minimised in all phases of a project life cycle including maritime service operations and in the production of concrete and steel components within turbine foundations. Improved circularity including the recyclability of components will also play a role in reducing emissions in the supply chain.

Against each of these objectives the team identified key high-level challenges and to each of these were assigned more granular technical innovation priorities as taken from the Offshore Wind Innovation Hub Technology Roadmaps. These are shown in Appendix A-2.

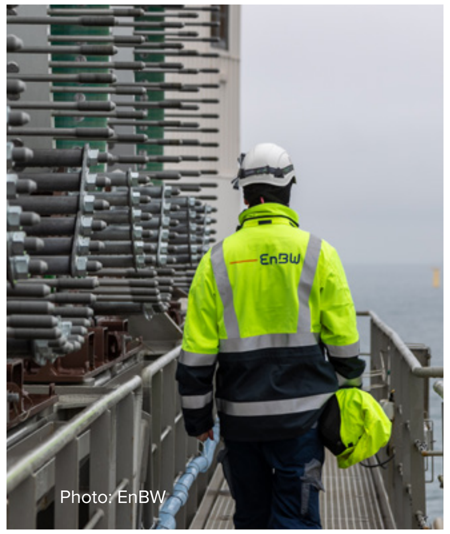


Photo: EnBW

What is Important

What is important? When discussing priorities, the conversation naturally turns to the question of "in whose interest is something a priority?". In effect, what do we mean by something being "important"?

There are many angles on which to approach this, and as such the team selected a range of metrics on which to assess each innovation area, summarised below.

Technology Roadmaps

In order to ensure a well-informed process that pulls knowledge and expertise from across the sector, a range of industry stakeholders have been closely involved. This has built on the impressive work of the Offshore Wind Innovation Hub's 'Technology Roadmaps' which have been developed since 2017 and regularly validated by industry representatives.

These roadmaps previously informed the UK round 4 leasing round innovation discount, employed by The Crown Estate, having a material impact on project costs.

Potential Timeline Impact (acceleration or delay)	The degree to which the challenge will cause delays if not resolved, or in some cases the upside in terms of saving time in the development/consenting process.
Cost Driver	The extent to which persistent technological risks drive costs. This covers DEVEX, CAPEX, OPEX and decommissioning costs.
Positive Supply Chain Impact	This is included as a means to judge how well the resolution of each challenge can create economic opportunities for UK businesses. This centres on the existing UK capability in the relevant field, including industry and academia. Scoring will be marked down if a solution's market opportunity is deemed to be small. Note: in this score we include the potential for exports when considering the relative strength of UK supply chain.
Impact Scale	An estimate of how prevalent this challenge is across future UK projects out to 2050. E.g. taking into account the geographical range and the range of project designs (foundation types, logistics options etc.).
Case for Intervention	A metric that refers to the need for external stimulus to enable an innovation to develop.

See Appendix A-3 for a more detailed explanation of the scoring criteria used to identify the top innovation priorities across each objective.

The priority innovation topics determined within each key objective are as shown below in Table 1.

Table 1 Highest ranked innovation priorities

Objective	Top 3 Technical Innovation Priorities
Maximise Efficient Use of Sea Space and Accelerate Deployment in Consideration with Other Sea Users and the Environment	Creation a Central Evidence Base of Environmental Impact
	Novel Radar & Data Processing Technologies
	Large Scale, Long-Term Spatial Planning, with Data Shared to Central Repository
Reduce Project Costs Through Efficiency Improvements and Increased Reliability	Minimising Cable Failures
	O&M Robotics
	Advanced Wind Farm CMS and Data Analytics
Ensure Energy Integration has the Required Capacity and Flexibility	Electricity Storage Systems
	Flexible and Smart Grid System Solutions
	Electrolyser Technologies
Avoiding Supply Chain Bottlenecks	Mitigations for Material Bottlenecks
	Mitigations for Manufacturing Bottlenecks
	Heavy Lift Vessel Solution Shortages
Enable Floating Wind Solutions and Continued Cost Reductions	Design, Manufacturing and Assembly of Floating Substructures
	Installation, Monitoring and Maintenance of Dynamic Cable Systems
	Installation, Monitoring and Maintenance of Mooring Systems
Decarbonise the Sector	Vessel Decarbonisation
	Recyclability of Components

At least the top two innovation areas from each of the objectives was then taken forward into the gap analysis stage, to better understand the extent to which the sector is adequately working towards addressing these innovation needs.

Note: It is important to understand the difference between what is deemed an important area of focus for supporting innovation versus other important mechanisms of support for the supply chain. There are a wide range of critical aspects of the supply chain that should be supported to grow and develop, but which don't necessarily need to see significant innovation per se. These areas could otherwise be well served by securing capital investments, optimising procurement processes or improving core business management practices. Such areas are not considered in this report.

Innovation Impact

Innovation is certainly a driver of resolving industry challenges, but it should be noted that it can deliver much more than that. Through innovation the industry can support the development of home-grown solutions, creating high value jobs, UK local content and significant growth in GVA.

In addition, as we open our collective arms to novel technologies like floating offshore wind, it is critical as an industry to ensure such technologies have a successful implementation, minimising risks, and improving their bankability.

Essentially, the initial prioritisation approach and metrics listed above, try to capture these considerations.

03 Gap Analysis

3.1 Approach

In order to better understand the state of current industry actions and enablers of innovation, a gap analysis was designed and implemented. This work was conducted by BVG Associates in late 2022 and continued into early 2023. The methodology comprised four stages: 1) Selecting the top 15 topics from the prioritisation exercise; 2) Conducting desk research on each topic, to understand the levels of activity and support; 3) Conducting interviews with industry stakeholders to understand key gaps; and 4) Compiling key recommendations for each topic and those of a general nature.

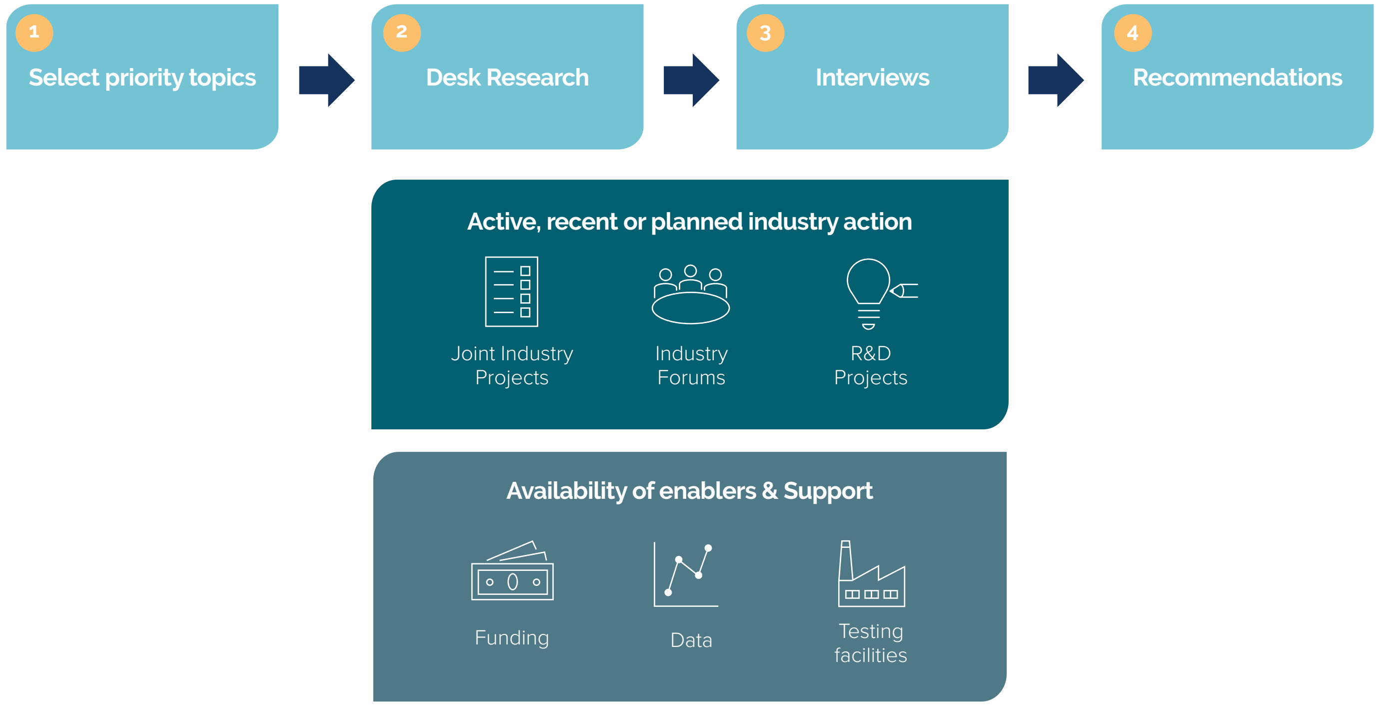


Figure 1 Gap analysis high-level methodology

From these engagement activities, a red, amber, green (RAG) status was assigned to each topic, where:

Green = An area where existing levels of intervention are currently sufficient.

Amber = An area requiring some proactive intervention.

Red = An area demanding significant proactive intervention.

The RAG scale reflects the urgency and value to the UK offshore wind industry of enabling additional intervention. It does not reflect the relative importance of each priority innovation area. A green rating also does not mean that no further innovation is required rather it means innovation needs to continue to be enabled at its current rate.

It should also be noted that the consequences of not resolving a challenge are also taken into account in the RAG status, as despite some topics seeing less effort being undertaken to resolve them, the consequences of this inaction may not be strictly as severe.

Photo: Equinor

For full detail of the gaps identified for each innovation topic, and for the full explanation of the gap analysis methodology, see Appendix A-4 for the report by BVG Associates.

Data Sharing & True Collaboration

One of the key mechanisms to enabling innovation centres around what information and/or data industry is prepared to share with each other. Increased levels of meaningful collaboration across industry will do two things: Firstly, it will open up opportunities for efficiencies and cost reduction in the process, moving away from the need for standalone projects to bear the costs for all related development activities. Secondly it will enable innovators to better understand the nuances of sector challenges far better and give them the insight required to create the solutions industry needs. In many cases this will require leaders to bold and proactive in considering which data sets are not competitively sensitive and are in fact in the interests of the common good to share.

3.2 Gap analysis results

By using the methodology presented above, each innovation topic can be assigned a 'RAG' status, based on their relative need for securing additional intervention.

Table 2 Gap severity of innovation areas

Innovation Area Ranking by Gap Severity (RAG)
Novel Radar & Data Processing Technologies
Design, Manufacturing and Assembly of Floating Substructures
Recyclability of Components
Flexible and Smart Grid System Solutions
Electricity Storage Systems
Minimising Cable Failures
Mitigations for Manufacturing Bottlenecks
Mitigations for Material Bottlenecks
Creation a Central Evidence Base of Environmental Impact
Large Scale, Long-Term Spatial Planning, with Data Shared to Central Repository
Electrolyser Technologies
Installation, Monitoring and Maintenance of Dynamic Cable Systems
Vessel Decarbonisation
O&M Robotics
Advanced Wind Farm CMS and Data Analytics

It is important to understand what the above list in, Table 2, is telling us. Firstly, all topics shown on this list are deemed to be vital for the success of the industry in the UK and are recommended as being areas where the industry should consider focusing effort to further develop innovative solutions.

Secondly, the topics shown near the top of the list are deemed to have the most critical gaps in current activity and support and need the most significant proactive intervention to be properly addressed. This does not mean these are a higher innovation priority, but rather that they are most lacking in the scale and/or nature of activity required in the context of their criticality to the industry's success.

This sentiment can be further expressed in the below diagram, Figure 2, which shows the difference between these two aspects of innovation need.

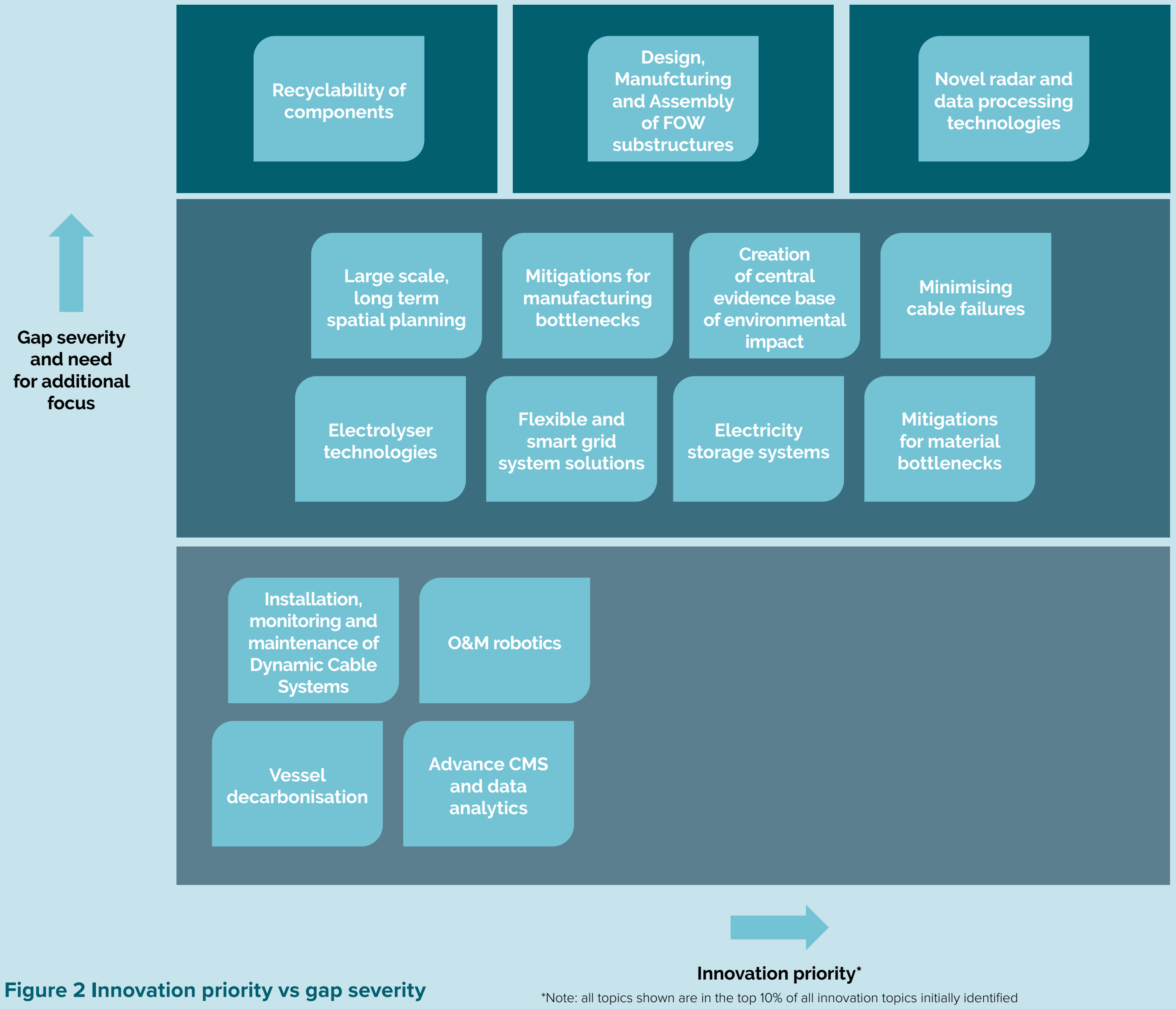


Figure 2 Innovation priority vs gap severity

The details, potential benefits and recommendations for each innovation topic that were assigned a 'red' status are listed below. Specific mechanisms for addressing these, and other priorities, are described in further in Appendix B – Gap Analysis.

Keeping priorities up to date: The innovation landscape and wider industry context is constantly changing and as such it is vital to periodically review and refresh the perspective on these priorities. To do this, OWIC will conduct as a minimum a bi-annual review but will actively consider amendments based on new information received at any time. Regardless of this, live initiatives addressing priority topics will always run their course.

Photo: Equinor

Recyclability of components

Background and potential benefit

As the wind industry grows, the recyclability of wind turbine components is becoming a major focus. Blades are currently one of the least recyclable wind turbine components and most are buried at landfill. The industry must ensure that sustainable recycling solutions exist for all materials used in a wind turbine, to enable progress towards a circular economy and would grow the overall value chains. This provides an opportunity to grow exportable technologies, develop recycling industries in the UK and reduce costs at the decommissioning stage.

Recent commercial innovation activity has been significant, notably including SGRE's recyclable blade and Vestas's recycling solution. These demonstrate important steps forward, but the industry should ensure that focus is kept on progressing this area.

Recommendations

1. Push the industry to continue the innovation already occurring in component recycling. For turbine blades this should include both recyclable blades (like SGRE's recyclable blade) and in recycling technologies (like the SusWIND programme).
2. Support turbine suppliers and blade manufacturers to innovate on blade design. The key focus should be to use less composites and resins, and more easily recycled materials like thermoplastics.
3. Drive the offshore wind industry to commit to a target for blade recycling. The turbine suppliers are more likely to innovate if their customers (developers) are demanding recyclable blades to meet targets or requirements.
4. Ensure a specific working group is established to drive progress in wind turbine blade recycling innovation. This should either become a dedicated OWIC workstream or should be folded into other working group structures like those run by RenewableUK. Working groups should also be established to drive progress in recycling innovation for other components.
5. Develop an action plan of innovation for other components of offshore wind farms, for example batteries from energy storage systems and large volumes of concrete from floating offshore wind farms. Blade recycling might be the biggest recycling issue to address now but the volume of offshore wind build-out expected over the next decades will require recycling solutions for all components.

Photo: Equinor

Novel radar and data processing technologies

Background and potential benefit

When in the line of sight of radar, offshore wind farms have a detrimental effect on the radar systems of both the Ministry of Defence (MOD) and the civil aviation industry. Although reflections from wind turbines can be filtered out, the strength of signal returns from rotating turbine blades can provide a challenge. This has led to objections from MOD to offshore wind farm developments and therefore consenting delays. More than half of current wind farm developments are subject to objections from the aviation sector (civilian and military).

A cost-effective solution, or combination of solutions, is needed to enable the co-existence of wind farms and aviation. Mitigations could include developing turbine stealth designs (although this is difficult as different types of radars use different frequencies), low-cost infill radars or radar technologies with the ability to better remove turbine returns from the radar picture.

The innovation activity that has been occurring from the DASA programmes has been successful, but the same issues that have been present for many years are still unresolved. Upgrades have been made to radars but have not been successful enough. A good example of this is the upgrades made to radar systems in the east of the UK at a cost of £30 million, which turned out to be less effective than was needed.

The objection to offshore wind farms on aviation and radar interference grounds is one of the largest risks faced by developers.

It is a complex problem but one where innovation has been ongoing for over 25 years without achieving useable solutions.

Innovation should be led by the military and civil aviation industries and their requirements as they need to be satisfied that solutions work. The offshore wind industry, however, is one that needs the solutions, so it does have a key role to play in pushing the aviation industry to innovate, to engage with ideas and testing, and to provide funding directly and secure funding from government for research and development programmes at a sufficient scale.

Recommendations

1. Reframe problem as a surveillance issue rather than a radar issue. Radar might well be the tool to use but it should encourage innovative thinking.
2. Consider whether surveillance needs to have its own taskforce to reinvigorate and drive change.
3. Continue to promote the joint offshore wind and aviation industry working groups (for example OWIC's Aviation & Radar Workstream that has a Joint Programme Board and Joint Task Force on Air Defence and Offshore Wind mitigation and co-existence)
4. Push to develop joint industry programmes between the offshore wind industry and the civil aviation industry. Traditionally most programmes have worked with military aviation. The civil aviation side is also important and can be difficult to make progress due to its challenging commercial environment.
5. UK Government should continue the DASA funding competitions, and plan future competitions ahead of time.
6. Encourage the UK Government to instruct the MOD and CAA to find a solution and to ensure coexistence between aviation and offshore wind is essential.
7. Coordinate financial support from the offshore wind industry to support surveillance innovation projects. Innovation should be led by the aviation industry, but offshore wind should contribute funding to these and engage in the programmes.
8. Act as a catalyst for innovative thinking in its interaction with the UK Government and the aviation industry. It should push for the aviation industry to think strategically about how to solve the problem. This is particularly important given scale of growth expected for offshore wind industry, which could see installed capacity increase to 100 GW by 2050. There may be alternative options than developing new radar technology.
9. Work with the Air Defence and Offshore Wind task force to look into a more strategic approach to aviation and surveillance applications, by moving them earlier in the development process so that applications are submitted in groups rather than for individual offshore wind farms. This could be undertaken by TCE and CES ahead of leasing rounds.

Design, manufacturing, and assembly of floating substructures

Background and potential benefit	Recommendations
There are currently more than 50 floating wind concepts under development, with new concepts being announced frequently. Only a small number, however, have been demonstrated at full scale. Although it is encouraging to have so many individual floating substructure designs, a number of barriers still exist to industrialisation of floating offshore wind. These barriers are particularly in the area of manufacturing and assembly. If suitable innovation occurs, the UK will be more able to utilise its port facilities to conduct efficient floating substructure manufacturing and assembly. Not only will this enable floating substructures to be manufactured at the rate required to match the significant build-out of floating offshore wind projects currently in development, but it will also bring job creation and other economic benefits to the UK. Innovation is already happening in this area through demonstrator and pre-commercial projects, and research programmes. OWIC should push the UK Government for additional funding for research programmes, for a longer-term funding pipeline and to support floating substructure manufacturing infrastructure.	1. Encourage the UK Government to invest additional funding in key collaborative floating wind initiatives, to increase the scale of activity and maximise impact. This could include, for example, the ORE Catapult-run Floating Offshore Wind Centre of Excellence (FOW CoE). 2. Encourage the UK Government to commit to a pipeline of funding to give the supply chain confidence to match government investment. 3. Promote innovation around manufacturing and assembly more than design, as the large number of different designs that exist currently pose challenges for the industry. 4. The Government should invest financially in upgrading ports for floating offshore wind. This will enable the commercialisation of the floating offshore wind industry in the UK and represents a good ROI in terms of industrial strategy but will require hundreds of millions of pounds of investment. 5. Focus innovation and research efforts into the efficient use of port space for floating substructure manufacturing. This has the potential to increase the suitability of UK ports for manufacturing and construction. 6. Promote investment in a UK floating offshore wind testing facility both for trialling only installation and also for full grid connected operation. This could be similar to the facilities in Spain and the planned EMEC site in Orkney and have grid-connected and non-grid connected options. Test facilities are, however, most likely to be commercially viable when integrated with commercial floating offshore wind projects. In these cases, a proportion of funding should be public to ensure that facilities can operate as open access. Alternatively, test facilities could be developed by organisations like TCE as part of lease areas (for example in the Celtic Sea region as part of TCE's Celtic Sea leasing round).

Photo: ORE Catapult

Table 3 below shows the nature of the priority intervention that should be applied to each innovation topic, in order to drive their development forward.

Table 3 Priority Intervention Type

Innovation Area Ranking by GAP Severity (RAG)	Main Interventions to Drive Innovation				
	Greater data sharing	Develop new test facilities and technology demonstration	Enhanced and targeted R&D funding	Removal of market barriers	Greater stakeholder leadership and coordination
Novel Radar & Data Processing Technologies	√	√	√		√
Design, Manuf. and Assembly of Floating Substructures		√	√		
Recyclability of Components		√	√		√
Flexible and Smart Grid System Solutions					√
Electricity Storage Systems				√	√
Minimising Cable Failures	√				
Mitigations for Manufacturing Bottlenec ks			√		
Mitigations for Material Bottlenecks	√		√		
Creation a Central Evidence Base of Environmental Impact	√				√
Large Scale, Long-Term Spatial Planning, with Data Shared to Central Repository	√				√
Electrolyser Technologies				√	√
Installation, Monitoring and Maintenance of Dynamic Cable Systems		√			√
Vessel Decarbonisation					√
O&M Robotics			√		√
Advanced Wind Farm CMS and Data Analytics*					

* This area will likely not be impacted significantly by any of the main interventions listed. Innovation will be enabled largely by commercial drivers.

04 What does great innovation look like?

A picture says a thousand words, and the below case studies give colour to what we mean by great innovation. All of these companies have found a niche and leant on a range of support mechanisms to enable them to develop potentially game changing solutions.

Case Study: Proserv and ECG™: a disruptive subsea cable monitoring system

Related innovation priority: Minimising Cable Failures

Key enabler: Public R&D funding, Industrial Sponsorship

The ECG™ holistic cable monitoring system enables anomalies in cable performance at offshore wind farms to be automatically detected before faults occur.

A single cable failure in an offshore wind farm can cost £12 m to fix and lead to two months of downtime. An industry consortium led by Proserv set out to apply diverse expertise to address these challenges in offshore wind. With around £1m grant funding from InnovateUK and support from Offshore Renewable Energy Catapult (OREC), the consortium combined the expertise of Proserv, Strathclyde University spin-out Synaptec and BPP Renewables. The collaboration led to the development of a successful product which, in 2022 secured a contract to monitor inter-array cables on phases A and B of Dogger Bank wind farm – among the World's largest. The cable monitoring system will be utilised later in 2023 on export and inter array cables at Hywind Scotland floating wind farm – the first of its kind in the World. .

Case Study: BladeBUG

Related innovation priority: O&M Robotics

Key enabler: Access to Test Facilities; Public R&D Funding

BladeBUG is a multifunctional compact robot designed to accelerate the green energy transition and presents its solution as a safe and efficient platform for inspecting and repairing wind turbine blades.

The roadmap to achieving commercial acceptance of their unique technology requires rigorous testing, verification and validation prior to piloting their technology with end users. BladeBUG has worked closely with the Offshore Renewable Energy Catapult to test and validate their prototype robots by utilising the open access Levenmouth Demonstration Turbine and the Blyth test facilities. As part of this collaboration, BladeBUG successfully performed the world's first robotic blade walk on an offshore wind turbine and were able to validate a lightning protection test on an offshore wind turbine whilst being operated remotely.

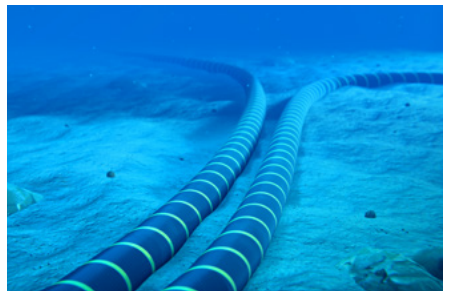
Case Study: ELECTRODE

Related innovation priority: Minimise Cable Failures

Key enabler: Data sharing & coordination

ELECTRODE is a mechanism for the collection of anonymous data around subsea cable failures in offshore wind.

This data will provide insight that will pave the way for advancements and innovative solutions. The new platform will track failures, service downtime, as well as the effectiveness of the repair and monitoring procedures, and use of technology in cable failures with anonymity as the core principle. Owner/ Operators will be able to identify recurring issues, accelerate innovation in reliability, and benchmark themselves against an industry average.



Case Study: Supergen ORE

Related innovation priority: Various

Key enabler: Stakeholder leadership and coordination

Established in 2018, the Supergen Offshore Renewable Energy (ORE) Hub is a £9m Engineering and Physical Research Council (EPSRC) funded programme providing research leadership to connect academia, industry, policy and public stakeholders, inspiring innovation and maximising societal value in offshore wind, wave and tidal energy.

Led by the University of Plymouth, the Supergen ORE Hub brings together expertise from multiple UK institutions including University of Edinburgh, University of Aberdeen, University of Exeter, University of Hull, University of Manchester, University of Oxford, University of Southampton, University of Strathclyde and University of Warwick. The Supergen ORE Hub vision is to bring together and stimulate synergistic adventurous research that supports and accelerates the development of offshore wind, wave and tidal technologies.

05 General Recommendations

Through the research conducted in the priority innovation areas, four common themes emerged that should be addressed.

1 Develop a plan and pipeline for a greatly increased scale innovation funding.

Develop a plan and pipeline:
The urgency of driving innovation in the industry means that it is crucial to avoid unnecessary delays. There have been occasions when funding or research programmes have ended without a clear plan or direction of the next steps. This leads to unnecessary periods of lost time. It is crucial to both identify the steps for future support before innovation programmes end and develop and establish new innovation programmes early to ensure next steps can be taken immediately with no unnecessary delays.

Increase the scale of funding:
A large part of innovation naturally takes place in commercial environments as part of product development cycles. There is still an important role to be played by external funding, both to stimulate innovation at low TRLs and to increase the speed and scale of higher-TRL technologies or processes.

Greater amounts of funding for offshore wind is critical given the value of the pipeline of projects currently in development. The UK could reach as much as 160 GW of installed offshore wind capacity by 2050 equivalent to an investment of £450 billion. A significant proportion of this capacity is expected to be used to generate energy for export especially to other European countries.

Innovation is required to enable this volume, enable cost-reduction, and enable UK opportunities. Greater funding is needed throughout the innovation supply chain including growing academia, growing the applied research done with companies by Centres for Doctoral Training (CDTs), test centres and well structured, comprehensive and ongoing funding to small, medium and large enterprises. Given the capacity likely to be installed, return on investment of public funding is likely to be high.

Offshore wind is also now an important part of the UK's energy and industrial strategies. The drive to increase manufacturing capacity in the UK, for example, has the potential to create thousands of additional jobs, and therefore the innovation required to enable that should be given the corresponding levels of funding far beyond what has been seen to date.

All of this leads to the recommendation that the innovation fund that should be established is committed over a 10-year period, and of a scale comparable to other nationally strategic industries such as aerospace, as is outlined in the 2023 OWAT report.

Create urgency
The offshore wind industry has advanced significantly over the past few years, but the industry could grow over ten-fold in the coming decades. A great deal of innovation needs to be accomplished to achieve this, so it is vital the industry shows greater urgency towards accelerating innovation.

Photo: EnBW

2 Create powerful mechanisms to share data & knowledge

In many areas of innovation where challenges are commonly seen across the industry, it is in the broader interests of all to work collaboratively on solutions, outside of areas of primary competition. This could, for example, be in the fields of environmental interactions or floating wind development.

If such collaboration is to materialise however at the scale and depth required, structures or incentives will need to be established. Data collection and knowledge sharing should form an integral requirement of innovation funding mechanisms and support for test and demonstration activities.

3 Build on UK capabilities in academia and supply chain.

The UK has a rich history of academic prowess and extensive experience in our existing supply chain, both of which can be better utilised to create the new technological solutions we need. Understanding clearly what this capability consists of and where it is located, is a powerful first step in this endeavour. The Supply Chain Capability Assessment being conducted by OWIC and the Offshore Wind Growth Partnership is seeking to do just this. Then by linking this up with the main innovation needs for the sector, it will give greater clarity of where innovation investment should best be placed. Similarly, understanding the specific areas of academic competence and ensuring that these align well to the needs of the industry is imperative. Close coordination with SuperGen ORE and relevant CDTs should be continued and enhanced. Such activities form a vital input to the contribution of a plan for industrial-scale growth, to embed the UK supply chain at the heart of the offshore wind industry.

06 How can we take action?

This report and the associated work conducted has identified priority innovation focus areas and enabling actions to address these. With this narrowed focus and direction, the Offshore Wind Industry Council (OWIC) will turn its attention, in the field of innovation, to ensuring there are new initiatives and actions put in place to cater to these.

The first step in this process will be to re-engage with existing expert groups and to convene new groups where they do not yet exist, in order to build on the report recommendations and refine the specifics of that is needed.

OWIC will...	• Continue to work with industry, innovators and academia to champion the creation and extension of key enablers that address the innovation priorities identified. • Map innovation priorities to existing specific supply chain and academic strength, identifying opportunities. • Work closely with industry to build on the outcomes of the OWAT report and inform the Industrial Growth Plan. • Support data-sharing as an enabler to resolving common industry challenges.
We encourage industry to...	• Be open to meaningful collaboration on innovation, and proactively seek it out. • Think about which existing datasets might be valuable to others, but which are not of primary competitive value to you as an organisation. • Pursue innovation with urgency.
We encourage UK and devolved governments to...	• Work with OWIC and industry to create a long term, targeted innovation fund, supporting the priorities identified by OWIC. • Identify the steps for future support before any innovation programme concludes.
We encourage academic institutions to...	• Continue and enhance the close alignment with industry on sector priorities, including by growing the scale of applied research done with companies by Centres for Doctoral Training (CDTs).

For the three topics assigned a 'red' RAG status, OWIC will actively endeavour to work with relevant stakeholders to address them as a priority. These focus areas are diverse in the way in which they affect the offshore wind sector. Radar interference poses a real risk to current project development and will require cross-sector collaboration and disruptive innovation to resolve. Optimisation in floating substructures is critical to successfully enabling the scale of floating wind and supporting local content. Recyclability and the wider decarbonisation agenda are baked in to the 'green' credentials of our industry and is something that we need to find solutions to as it becomes ever more important in the future. Key recommendations for these are summarised in the below table.

Priority Innovation Areas Requiring Support	Key mechanisms to address sector needs
Novel Radar & Data Processing Technologies	• Continue the joint offshore wind and aviation industry working groups. • Reframe discussion to a 'surveillance' issue, considering the creation of alternative, individual taskforces. • New initiatives to improve coordination with commercial aviation sector. • Continuation of DASA fund as priority in short to medium term. • Governmental action to drive and enable coexistence between offshore wind and aviation sectors. • Investigate opportunities for multi-offshore-wind-project analysis at earlier stage in development process.
Design, Manufacturing and Assembly of Floating Substructures	• Champion the need for increased innovation funding, through both existing programmes and dedicated government schemes, targeting manufacture and assembly. • Governmental investment in port facilities, enabling the commercialisation of floating offshore wind in the UK, and providing richer environment for home-grown innovation to flourish. • Invest in mechanisms to enable the creation UK-based offshore wind farm test environments.
Recyclability of Components	• Support blade manufacturers to innovate designs with more recyclable materials. • Set targets for blade recycling and form industry working group to explore further opportunities. • Define and agree other priority carbon-reducing components, creatin a clear industrial action plan.

OWIC as a body can and will coordinate stakeholders, undertake enabling research and advocate for change, but it should be recognised that each and every organisation involved in offshore wind in the UK should play a role in overcoming industry challenges, if we are to achieve Net Zero.

Photo: EnBW

Photo: Equinor

Offshore Wind Industry Council