Submission from the Offshore Renewable Energy (ORE) Catapult
15 May 2020

ORE Catapult is the UK's leading technology innovation and research centre for offshore renewable energy. We are delivering the UK's largest clean growth opportunity by accelerating the creation and growth of UK companies in offshore renewable energy. Our unique facilities, research and engineering capabilities bring together industry and academia and drive innovation. We deliver products and services in three main areas:
Testing & Validation - We operate the most comprehensive open access, independent test and research facilities anywhere in the world to enable the scale-up of offshore renewable energy technologies;
Research & Innovation - We support the UK's research and innovation community through our R&D, and engineering expertise, to accelerate the commercialisation of the latest new technologies and disruptive innovations;
Operational Performance – We are building on the UK's leading position in operating offshore wind farms, to look at new innovations and ways of working to improve energy production and lower operational costs.

We have aimed to provide the Committee with a high-level view of the main themes and challenges for offshore wind innovation in the UK. We have included some examples of our projects in the hope that these will convey some of the breadth and depth of innovation occurring in the UK, and the expertise, capabilities and facilities necessary to sustain this. Many further examples are available at https://ore.catapult.org.uk/our-impact/our-stories/. We maintain detailed and regularly updated roadmaps of offshore wind innovation challenges via the Offshore Wind Innovation Hub, a BEIS-funded programme to coordinate innovation across the sector, delivered by ORE Catapult and the Knowledge Transfer Network - https://offshorewindinnovationhub.com/about-roadmaps/

1. ***How effective has the Government's offshore wind Sector Deal been in moving the sector towards becoming an integral part of a low-cost, low-carbon, flexible grid system and boosting the productivity and competitiveness of the UK supply chain?***

- *The sector deal has strengthened industry-government dialogue and launched major programmes, including actions for coastal regions*

- *Momentum needs to be maintained, to deliver key initiatives*

The strength of the sector deal is the strong and robust working relationship between Ministers and senior officials in government, and industry, especially in light of the net zero challenge. The sector deal is creating an essential and improved channel for dialogue and better understanding between public and private stakeholders.

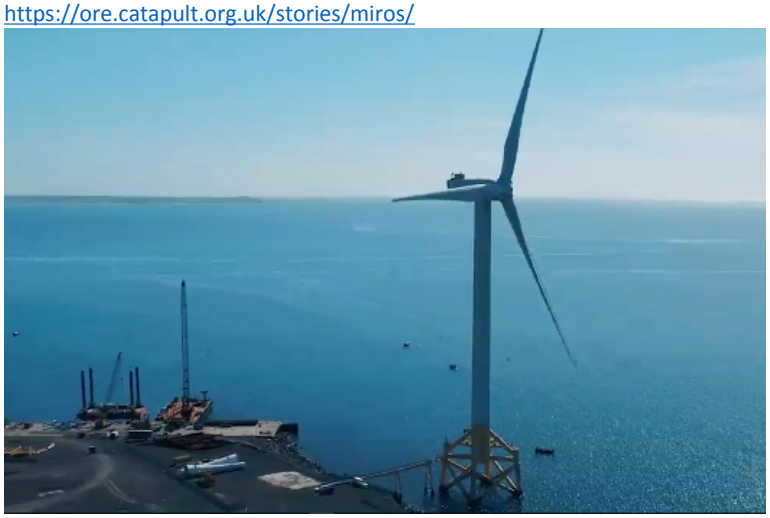
Whilst still early days, the sector deal has already proved itself as a catalyst for increased collaboration between companies in the sector. For example, the Offshore Wind Growth Partnership was established within three months of the sector deal being agreed. OWGP is an independent not-for-profit company dedicated to managing up to £100m of funding from OWIC members to help

develop the supply chain. It has already committed £400k of grant funding and is working to bring the best business transformation programmes from other sectors, such as the Aerospace industry's Sharing in Growth programme, to offshore wind. Over 300 companies have now registered with OWGP and further grant and business transformation programmes will be launched over the next six months.

The sector deal has also established an Offshore Wind Innovation Group, chaired by Andrew Jamieson, CEO, ORE Catapult, with industry, academic and public sector representatives, to establish a programme of innovation support. This will target UK IP and job creation, and continued reduction in offshore wind farm lifecycle costs, focusing initially on improvements in Operations & Maintenance, and on leveraging regional clusters to promote innovation in the supply chain.

The challenge now is for the industry, and Government, to take forward the important actions identified in the establishment phase of the sector deal. Momentum needs to be maintained, and sufficient support given to key initiatives, such as development of regional, offshore wind supply chain clusters. We are also keen to pursue opportunities for more collaboration with other sector deals.

https://ore.catapult.org.uk/stories/miros/



In 2019, Aberdeen-based **Miros** trialled its WaveWeather system at the ORE Catapult R&D turbine in Fife. This unique facility proved their product to project developers and investors, allowing Miros to expand from their Oil & Gas background, into offshore wind.

2. ***What level of output can the sector deliver in the UK, and what Government support would be needed to achieve this?***

Offshore wind can provide sufficient low-cost energy for the majority of our electricity, transport and heating needs, and for large, permanent energy exports;

Government support for floating offshore wind innovation is urgently required, to ensure we capture the full UK opportunity for job growth and exports

Government should develop a strategy and integrated innovation programme for technologies to enable a flexible, whole-energy system – in hydrogen

technologies we risk falling behind the very large investments occurring in other nations

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There is sufficient affordable offshore wind available in UK waters for the majority of our energy needs, plus major energy exports to Europe, and globally, via energy carriers such as hydrogen. By 2030, when we expect floating offshore wind to be competitive with fixed installation, hundreds of gigawatts will be available at prices below the government's most recent projections for wholesale electricity prices. We project that, in 2050, this resource should cost in the range of £32-37 per MWh (2012 prices).

Offshore wind is, therefore, a no-regrets, affordable, assured option for building a decarbonised, secure energy supply, with strong potential for large and permanent energy exports. It is less likely to suffer the challenges relating to landscape, heritage or ecology, which block very large scale deployment of other renewables. The government should consider designing energy sector policy, and related innovation programmes, with the aim of ensuring that the pathway to an offshore-wind dominated energy system, meeting the majority of our needs for electricity, transport and heating, is clear.

Major support to accelerate floating offshore wind technology is essential: the majority of the UK resource is at water depths over 50m. Demonstration sites, of ca. 100MW, need to be made available, consenting processes should be streamlined and should recognise the special nature and strategic importance of demonstrations, and generation-based support, such as enhanced CfD payments, should be available to defray costs for project developers and technology innovators.

Other innovation areas requiring public support are:

- Engineering-based simulations of the Whole Energy System
- R&D to generate and validate inputs required for simulations – e.g. energy production profiles for innovative technologies
- Steps to enhance data-sharing, to inform academia, RTOs and innovators
- Scenario generation for energy infrastructure development
- RTO contributions to industry technical committees
- Research into potential blockers to floating offshore wind, especially wildlife impacts and military radar interference
- Research and engineering to support essential regulatory innovation - the government could consider replicating the approach taken for the oil and gas sector, which resulted in simplified and speedier project approvals, concentrated under the authority of the OGA.

https://ore.catapult.org.uk/stories/osbit/

North-east engineering firm Osbit designed and built ORE Catapult's Dynamic Cable Test Rig for floating wind and tidal array cables. The rig is an essential platform for developing the flexible cables required for floating wind turbines.
The contractors on the project – mechanical, electrical and hydraulic – all come from the north-east of England, helping to build a strong regional knowledge base.

Offshore wind is a variable resource. To realise its full potential, a flexible energy system using new technologies, and market mechanisms to balance electricity and gas grids, will be required. For key technologies, including electricity storage, hybrid heat pumps, hydrogen electrolysis and distribution, and many others, integrated government support for R&D, testing, validation, demonstrations and standards development, is necessary. For hydrogen development, in particular, we risk falling behind other nations, where major public investment is moving into R&D, testing and demonstrations.

Innovations in energy markets and infrastructure planning and development may also be important:
Electricity and gas markets:
Reform of market mechanisms, structures and roles, to allow flexibility mechanisms to operate at short and long timeframes, and seamlessly across energy vectors (electricity, gases)
Energy infrastructure:
De-emphasizing short time-horizon investment decisions for transmission and distribution infrastructure, in favour of long-term, integrated planning and investment in gas (including hydrogen) and electricity infrastructure, to ensure cost-effective adaptation to an offshore wind-dominated energy system.

https://ore.catapult.org.uk/stories/milford-haven-energy-kingdom/

The Milford Haven Energy Kingdom project will design an integrated hydrogen and renewables energy system, by creating diverse, local, community-based seed that integrates the cluster of major energy infrastructure along the Milford Haven Waterway: solar, wind and offshore renewables, natural gas infrastructure, and hydrogen infrastructure.

3. ***How might the UK take advantage of further technological advances in offshore wind technology, particularly in relation to floating arrays?***

The CfD regime should continue to provide enhanced revenue support for pre-commercial scale-up of technologies, in particular for floating offshore wind.

Floating wind also requires supporting investment in port infrastructure, test and validation facilities and full-scale demonstrations of novel technologies

To achieve our ambitions, targeted public R&D funding should be increased to levels comparable with competitor nations.

CfDs have proven to be a very successful mechanism for driving down costs and making offshore wind a competitive energy source. This has driven innovation for larger turbines, new installation methods, higher operating voltages, etc. Government should ensure that incentives and programmes are in place to maintain a pipeline of technology innovations that address other challenges, including sustainability.

Public support is required to accelerate floating offshore wind technology, to enable UK innovators, e.g. O&G suppliers, to benefit from the emerging global opportunity. Support for floating offshore wind should include:

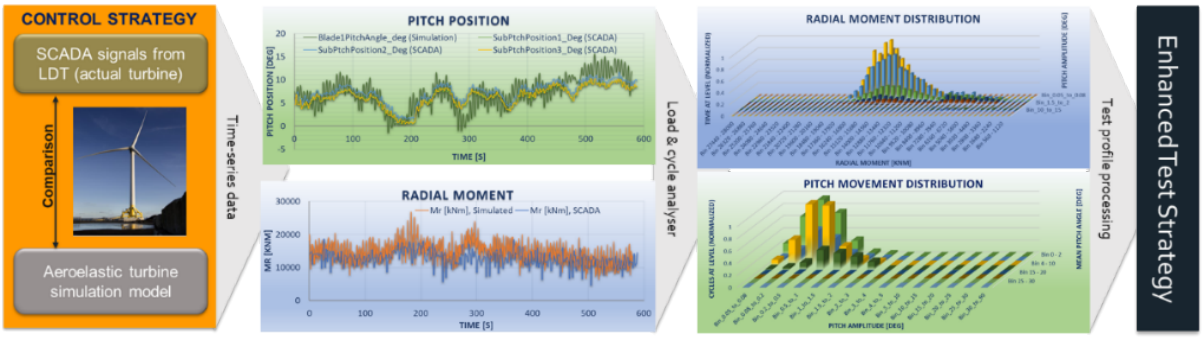
- R&D and demonstrations of turbine technology, e.g. UK-based composite components and dynamic cabling;
- Technology validation at test facilities, including ORE Catapult at Blyth and Levenmouth
- Build-out of low-carbon service infrastructure at ports, and development and demonstration of floating wind farm installation and O&M technologies
- R&D and demonstrations of integration of hydrogen production at turbines and wind farms

On present trends, there is a risk that public funding dedicated to offshore wind innovation will fall short of what is required to take full advantage of its potential for decarbonisation and economic benefit. Renewable UK has highlighted the low level of UK public funding for renewables R&D, relative to comparable nations. It will be increasingly difficult to align innovation with strategic innovation priorities, and with growth objectives for the UK supply chain, if dedicated offshore wind innovation programmes are not made available.

UK innovators in the offshore wind supply chain are clustered strongly in economically-deprived, coastal regions, although the opportunity is UK-wide. To seize the full jobs and exports potential, Government may need to match the strategies of our competitor nations:

- incentive packages for OEMs and major component suppliers, to attract both manufacturing and high-value design work
- ensuring availability of first commercial demonstrations of indigenous technologies, at scale
- synchronising economic development incentives with targeted innovation programmes and infrastructure development

https://ore.catapult.org.uk/stories/bearing-accelerated-and-representative-testing/



If bearings fail less often, turbines will produce more energy and cost less to maintain. In an industry first, we are using detailed information from a real turbine (our test and demo turbine at Levenmouth), to create more realistic tests for new turbine designs.

4. ***What support does the sector require to keep pace with the most cutting-edge innovations, such as in blade technology?***

There is a window of opportunity to greatly increase the UK share of high-value components

Government should provide support to turn the industry's comprehensive technology roadmaps into a fully operational strategy that draws on strong UK capabilities, and enhances them

To increase the success of innovative SMEs, Government should continue to support open-access research and testing facilities

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The industry's drive for a new generation of larger turbines is a window of opportunity for a step-change increase in the UK's share of high value turbine components. This next generation of turbines will likely be the workhorse for a massive global expansion of offshore wind. The UK has strong, relevant capabilities – e.g. lightweight composites in the aerospace industry, or next generation power electronics. Government should provide support for the industry to develop a comprehensive strategy for building our capabilities in next-generation technologies.

The Offshore Wind Innovation Hub, funded by BEIS, has been highly successful in identifying the required linkages between early stage R&D, and industry priorities. To transform these roadmaps into an operational strategy for the UK, Government should create a dedicated offshore wind innovation fund, and encourage alignment of Research Council funding for universities, with the sector's innovation priorities. For a new technology to be accepted by project developers, large-scale demonstrations are essential. Government support will continue to be required to meet some of these costs, but also to ensure test facilities, and offshore sites, are available.

Government can support innovation from SMEs in the UK's supply chain through:

- Continuing to invest in open-access, technology testing infrastructure, and associated research resources
- Improving the effectiveness of financial support mechanisms for innovators, to mitigate the risk of technology investment for SMEs

- Providing funding to support cross-sectoral innovation (as outlined in the Whitmarsh review) to pull across the UK's world-leading capabilities, e.g. in composites and power electronics
- Provide supportive regional infrastructure for SMEs (Broadband, local innovation advisors, etc.)

https://ore.catapult.org.uk/stories/ge-testing-research-development-programme/

GE Renewable Energy is proving its new Haliade-X 12MW wind turbine at ORE Catapult's blade test and turbine test facilities in Blyth, and has partnered with ORE Catapult on a related R&D programme that will bring opportunities for more UK innovators to supply high-value components for GE's next-generation turbines.
https://www.youtube.com/watch?v=ZlkimO8e2_A

5. What is the UK industry doing to promote the sustainability of offshore wind arrays throughout their entire life-cycle, from development through to decommissioning, and to improve maintenance and end-of-life repair?

The Government could trial a mission-oriented programme to create new solutions to sustainability challenges

The tendency of competitive auctions to prioritise cost-reducing innovations, over any others, e.g. more sustainable technologies, needs to be addressed

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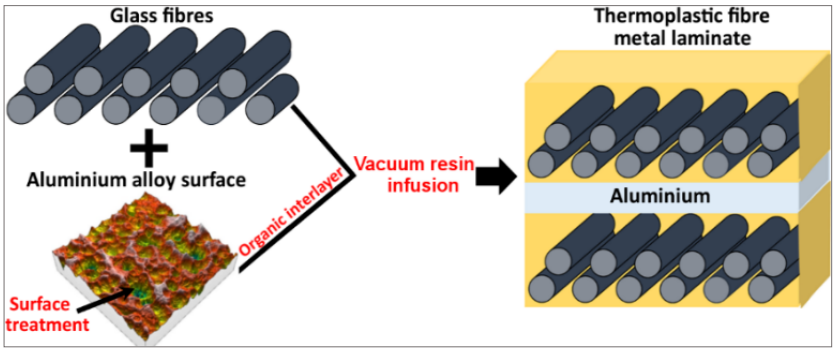
For many sustainability challenges, early stage R&D may hold the greatest potential. Government should consider adopting a strategic, mission-oriented approach to R&D, along the lines of the US ARPA programme, for example, application of thermoplastics to improve end-of-life disposal of blades.

The industry has very successfully reduced the costs of offshore wind. However, this has created intense cost pressures for technology developers throughout the supply chain. As a result, innovation that is not directly related to cost reduction has been difficult to justify. The government should examine how the CfD auction process can be operated so as to strike a balance between price competition, and incentives for investment in innovations that can reduce the environmental impact of offshore wind.

The government should be cautious about drawing broader conclusions from the recent Blyth decommissioning project. The Blyth demonstration site was unique, regarding distance to shore, water depth, foundation type, and number of turbines.

https://ore.catapult.org.uk/stories/thermoplastic-fibre-metal-laminates-for-blade-applications/



ORE Catapult is investigating the performance of fibre-and-metal composite materials and thermoplastics, developed specifically for offshore wind turbine blades. Thermoplastic FMLs will be simpler to recycle than current, fibreglass blades, and will have a longer useful life, reducing the environmental footprint of future turbines.

6. ***How well is the UK industry managing the environmental and social impacts of offshore wind installations, particularly on coastal communities with transmission-cable landing sites?***

The current model of building an onshore substation for each windfarm is unsustainable. Government must lead a master-planning approach to providing the infrastructure required for an offshore-wind dominated energy sector.

Modelling of high offshore wind scenarios shows we need new technologies and larger-scale planning and development for the grid. The current approach of *1-windfarm, 1-wire*, leads to an unsustainable demand for large substations on the coast. An environmentally and socially just transition to an offshore wind-dominated future energy system requires government-led master-planning of infrastructure (across the whole energy system, including hydrogen).

The required technologies are not available, off-the-shelf. Funding for the innovation required to give sufficient confidence to Government to shift to major, long-term infrastructure investment, is now urgent and critical. The alternative is that the current pattern of piecemeal investment will continue by default, and that this could undermine the economic case for a strategic, lower-cost approach.

7. ***How well is Government policy supporting innovation in transmission technology to improve the efficiency of electricity transmission?***

Allocation of risk to project developers reduces their appetite for innovative transmission technology.

Government support for international research and collaboration would be required, to make progress towards integrated, planned 'supergrid'-type solutions.

The OFTO regime encourages developers to take a low-risk approach, to ensure that incurred costs are accepted as economic and efficient and so avoid the risk of having to write off expenditure. It is

not commercially feasible for any party to build a transmission connection large enough to accommodate multiple future projects (eg. East Anglia zone), as projects receive a CfD award one at a time. This leads to inefficiencies in duplication of costs and infrastructure. ORE Catapult analysis of European projects indicates that national regimes that master-plan infrastructure, may be achieving energy prices of the order of £10 per MWh lower than UK projects.

Public support is required for international research and collaboration on more efficient, integrated approaches (e.g. a European supergrid), to support the scale and pace of the UK's offshore wind ambitions.

8. ***Looking to the future, what can the onshore wind sector learn from the offshore success story?***

Offshore technologies can find new successful markets onshore, especially to increase energy yields and extend operational lifetimes

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Recently, the offshore wind success story has been rapid cost reduction, large-scale projects with larger turbines, and global momentum.

Restrictions onshore, arising from land-use competition, and low wind speeds, place a high value on maximising energy yields and extending the lifetime of onshore windfarms. Technologies developed for the offshore industry, e.g. longer-lasting blade materials, or drones to reduce O&M costs, can successfully spill over to the onshore wind market, and to other industries, too.

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