RE ENERGISE
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CATAPULT
Offshore Renewable Energy

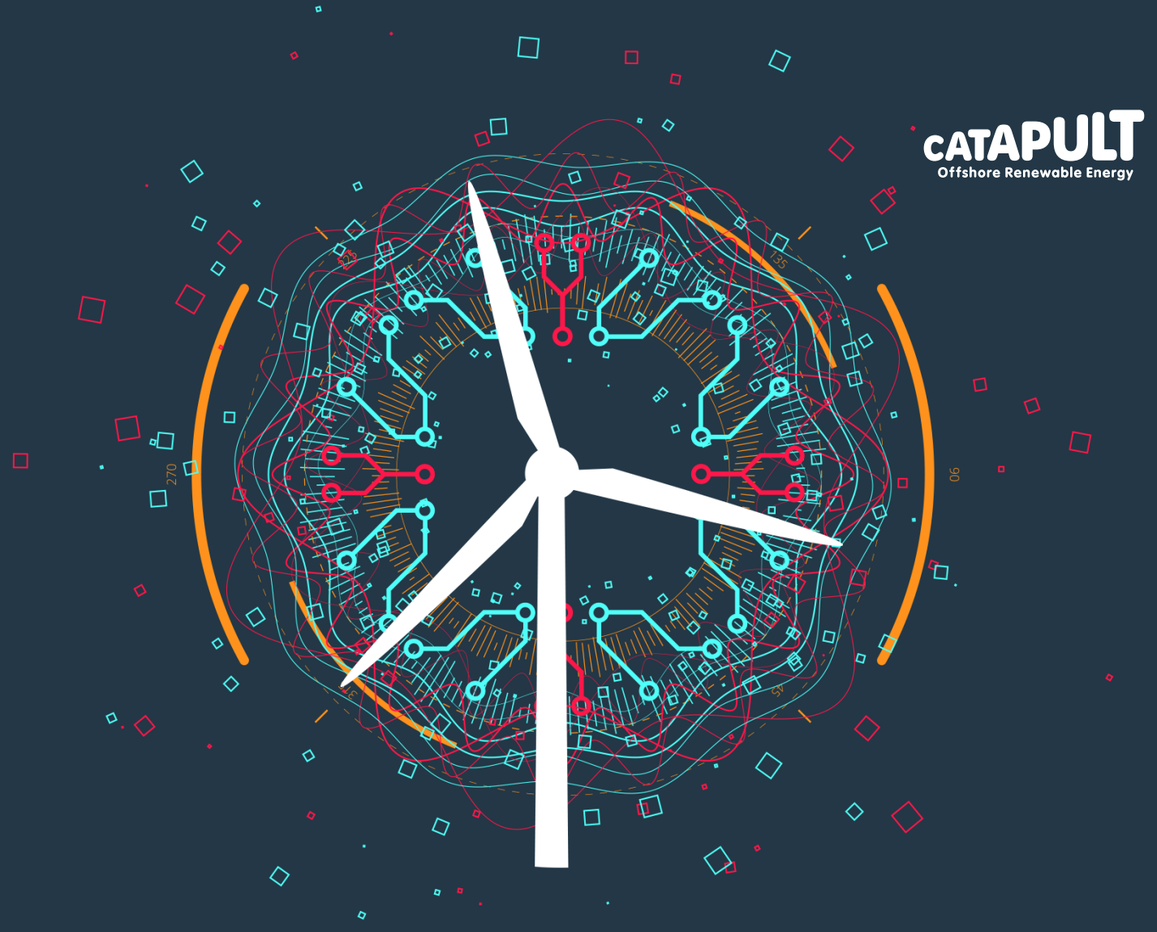
# FLOATING WIND: POWERING OUR FUTURE ENERGY NEEDS

## SETTING THE STRATEGIC SCENE FOR FLOATING WIND IN THE UK

## ORE CATAPULT'S FLOATING WIND OFFERING

## UNDERSTANDING THE UNIQUE ENVIRONMENTAL INTERACTIONS OF FLOATING OFFSHORE WIND

*Photo courtesy of Principle Power. Artist: DOCK90*







# FOREWORD

*By Colin Maciver*
*Head of Offshore Wind Development,*
*Crown Estate Scotland*

**Energy provision is under the spotlight. How it's produced, where it comes from, and at what cost – both in environmental and consumer terms – are issues of concern to all of us. The focus must now be on secure, sustainable, green energy generated responsibly and maximising socio-economic value.**

Crown Estate Scotland has a key role in helping secure a successful offshore wind delivery in the UK as a core part of a Net Zero future. For both ScotWind and the upcoming Innovation and Targeted Oil and Gas (INTOG) round, floating technology will be key. ScotWind projects are set to deliver at a scale which will put the UK at the forefront of this global industry. In conjunction with the development of a new leasing round in the Celtic Sea by our colleagues at The Crown Estate, the sector in the UK looks set to deliver on the ever more ambitious government targets.

Exciting further innovations, such as the production of green hydrogen, are providing new ways of supporting efforts for floating offshore wind to deliver at scale and help create a path for the energy transition we need around the country.

Floating wind technology, in its manufacture, assembly, installation, and operation could act as a catalyst for substantial economic investment. Supply chain commitments from ScotWind developers currently average £1.5bn per project in Scotland alone, with more commitments spread across the UK.

This edition of ReEnergise will take a close look at the economic and supply chain opportunities that the expansion of floating wind has to offer. The magazine also explores how floating wind will play a key role in powering the just energy transition by identifying challenges, as well as providing opportunities for investment and development.

The coming years will challenge all of us - industry, government, and communities – to work together to secure the potential on offer in a way that really delivers for society, the economy, and the environment.

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# SETTING THE STRATEGIC SCENE FOR FLOATING WIND IN THE UK

**Around six months ago, 200 countries around the world gathered in Glasgow for COP26 and pledged to accelerate climate action and limit the rise in global temperatures to 1.5C.**

Over 90% of world GDP and around 90% of global emissions are now covered by Net Zero carbon commitments – but the agreements made at COP26 will only be met  if immediate action is taken. In the UK, solutions are evolving quickly to meet our Net Zero targets, and floating offshore wind energy is the latest low carbon technology set for explosive growth. While the UK grasps the opportunity to develop its renewable energy potential, it's already clear that floating offshore wind will have significant global impact.

**Floating wind in the UK**

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.

Floating wind technology is also closely related to technology used by the oil and gas industry, and fixed bottom wind – where the UK boasts world-leading skills and expertise. This positive backdrop means that large-scale floating wind projects can be expected well before the end of this decade. However, the industry must move fast to maximise the benefits available – for the environment and for the economy.

## What is Floating Offshore Wind?

Unlike fixed-bottom wind turbines that are secured directly to the seabed, floating wind turbines sit on floating substructures that are held in situ using an anchoring system. Fixed bottom turbines are typically installed in waters 50-60m in depth, whereas floating turbines can be located at greater depths, including locations farther offshore with stronger wind resources.

*Hywind Scotland. Photo courtesy of Øyvind Gravås - Equinor.*

A healthy pipeline of commercial floating wind projects is crucial to enable future cost reduction in the sector. This pipeline also has the potential to deliver significant supply chain benefits and encourage further investment.

### Economic opportunity

The UK has set a target to deliver at least 100GW of offshore wind by 2050 and the scale of deployment needed over the next 30 years presents a significant industrial challenge as installed capacity increases tenfold. However, this challenge also presents unprecedented economic opportunity.

Gavin Smart, Head of Analysis and Insights at ORE Catapult, has estimated that between now and 2050, the floating wind sector could create up to 37,000 jobs in the UK and could generate a staggering £52bn for the UK economy based on UK reaching 50GW floating wind installed and rest of the world - our potential export - market reaching 190GW by 2050.

In January 2022, the potential for floating offshore wind was turbocharged when Crown Estate Scotland published the ScotWind leasing round results – the first round of offshore wind leasing in Scottish waters in a decade. Seventeen projects were awarded around the Scottish coast, and deployment potential of up to 25GW became available – almost 15GW of which was proposed as floating wind. This represents the single largest floating offshore wind options rights awarded in the world.

Energy harvested from the projects could power up to 29 million homes – roughly the total number of households in the UK. Not only would this ensure security of supply within the UK, it would also open up opportunities for energy export.

### Supply Chain opportunities

The ScotWind option agreements, linked with potential floating wind deployment from the Innovation and Targeted Oil and Gas (INTOG) leasing round and the Crown Estate's Celtic Sea leasing round, provide ample supply chain opportunities for the UK. This opportunity takes the form of between 8 and 12GW of UK floating offshore wind that could be deployed by the mid-2030s, with the vast majority of this in Scottish waters.

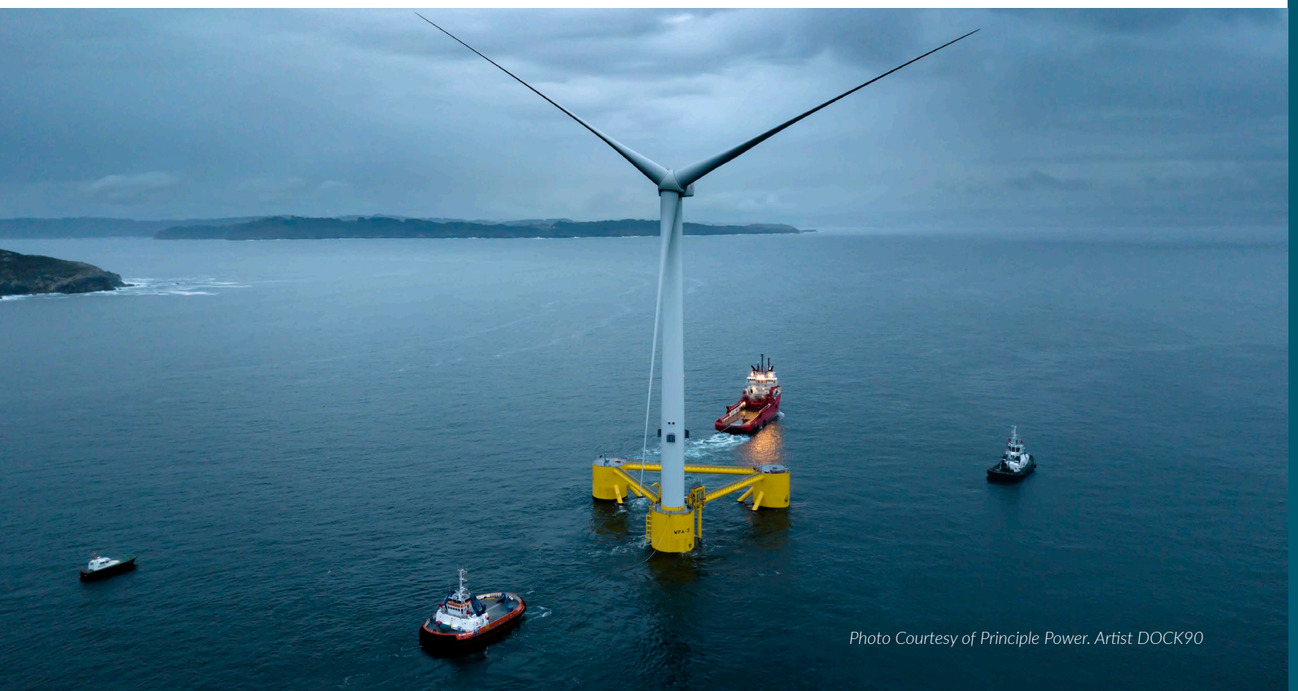


*Photo Courtesy of Principle Power. Artist DOCK90*

*Photo courtesy of TetraSpar Demonstrator ApS*

Demand will create significant investment opportunities for UK supply chains that will be spread across essential components such as turbine blades and towers, substructure fabrication and assembly, anchors and moorings, cables and substations, installation and O&M.

Recent analysis completed by the Floating Offshore Wind Centre of Excellence provides greater insight into the supply chain opportunities. Based on 12GW of floating offshore wind deployed by the mid-2030s:

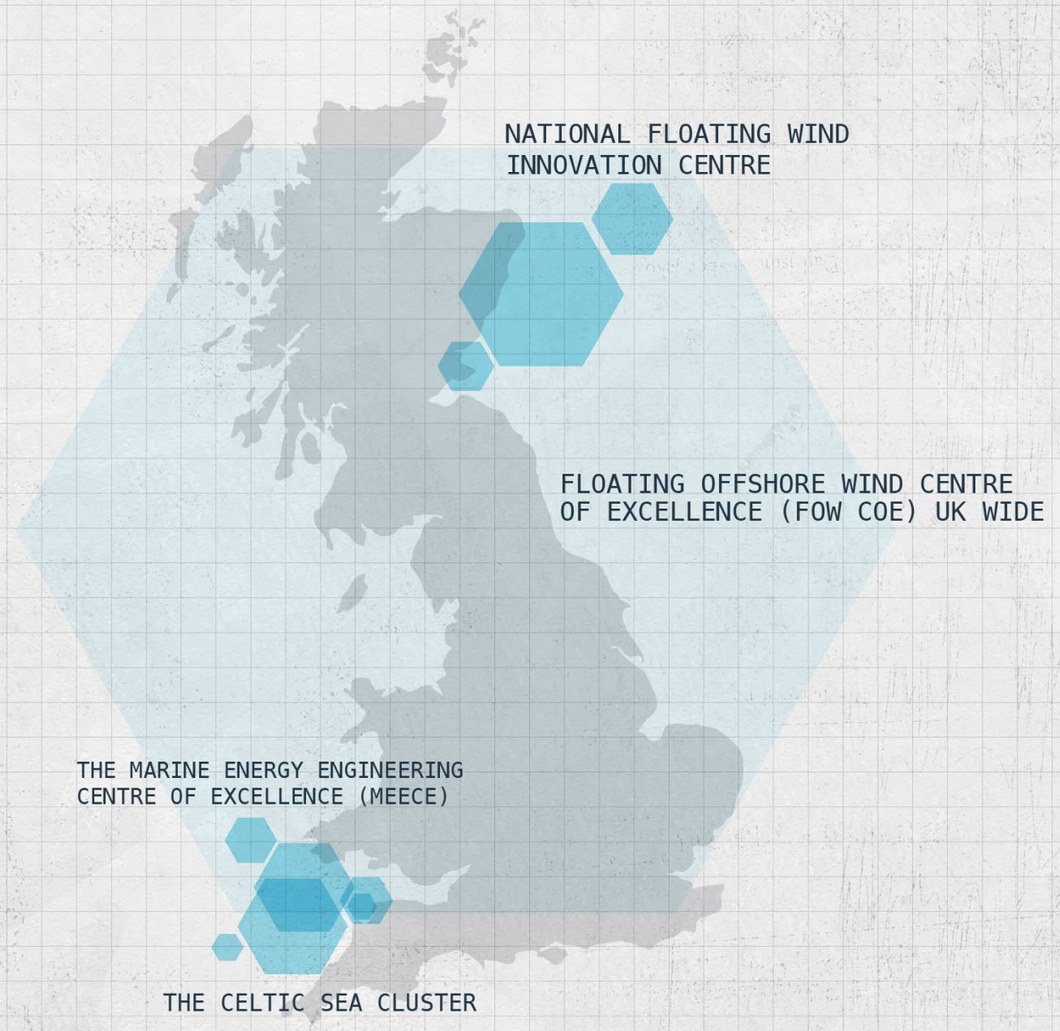
- A total of 670 substructures could be required.
- More than 4,000 mooring lines and anchors, representing more than 2,300km of mooring lines.
- Electrical infrastructure could require approximately 1,300km of dynamic inter-array cables, 17 offshore substations, 36 export cables with a total length of approximately 2,200km.

Delivering technology on this scale will require major development in strategic supply chain and infrastructure capability. Significant gaps between the number of existing supply chain companies with the skills required, and the number of companies required to deliver deployment, will need to be addressed.

However, supply chain investment, appropriately timed and targeted, has the potential to see UK companies secure a significant share of the value associated with floating offshore wind projects and, in doing so, help deliver Net Zero.

*Photo courtesy of TetraSpar Demonstrator ApS*

# ORE CATAPULT'S FLOATING WIND OFFERING




**EST 2019**
Floating Offshore Wind Centre of Excellence

**£9m**
National Floating Wind Innovation Centre

## Floating Offshore Wind Centre of Excellence (FOW CoE)

Established in 2019, our Floating Offshore Wind Centre of Excellence aims to accelerate the commercialisation of floating offshore wind within the UK. Three years on, and 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.

Working across four workstreams – technology, supply chain and operations, development and consenting and delivering Net Zero (policy) – the multi-disciplinary structure of the programme reflects the diverse and inter-related topic areas key to commercialisation and broader industrial strategy.

The centre has cemented ORE Catapult's role as a leading player within floating offshore wind, bringing together developers and consolidating knowledge to influence targets and policies around floating wind at a national Government level.

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, announced the establishment of a £9 million National Floating Wind Innovation Centre last February. This will ensure that the North East of Scotland and the wider UK capitalises on the opportunity created by ScotWind, which will drive development and demand for floating offshore wind.

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 expertise in the area – 75% of the world's subsea engineering capability is there – means there is no stronger region to set up and accelerate the development of floating wind.

THE MARINE ENERGY ENGINEERING CENTRE OF EXCELLENCE (MEECE)

## The Marine Energy Engineering Centre of Excellence (MEECE)

The Offshore Renewable Energy (ORE) Catapult's 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.

Recent MEECE collaborations include supporting Intelligent Moorings in the development and sea testing of their Intelligent Mooring System (IMS), an innovative technology that could enable significant cost cutting by reducing mooring line forces.

MEECE is also supporting companies transition into the sector, including Applied Petroleum Technology (APT) and Bombora, through collaborations that aim to develop their existing products into those tailored to the floating offshore wind market. In the case of APT, this has involved developing a mapping tool to identify and optimise potential offshore wind sites, which is based on a tool used previously to identify oil wells.

THE CELTIC SEA CLUSTER

## The Celtic Sea Cluster

In March 2021, a new floating wind leasing opportunity in the Celtic Sea was launched by The Crown Estate, and was strongly welcomed by ORE Catapult as a key component in the UK's journey to Net Zero by 2050. Last November, The Crown Estate published detailed plans for floating wind leasing in the Celtic Sea, unlocking up to 4GW of new clean energy capacity in England and Wales.

The Celtic Sea Cluster (CSC) was set up in recognition of the need for key stakeholders to work together to maximise the vast opportunity presented. It was tasked with driving market creation for floating wind, accelerating supply chain readiness, and developing a strategy for enhancing regional infrastructure – maximising economic benefit for Wales and the South West of England.

The Cluster was initially formed by Welsh Government, ORE Catapult, Marine Energy Wales, Cornwall & Isles of Scilly LEP and Celtic Sea Power, and there are plans to include Wales and South West local government organisations.

Working groups have been established to address key issues around market creation, industry and infrastructure, research and innovation, training and investment. By working in collaboration, floating offshore wind in the Celtic Sea will be transformational across England and Wales and play a key part in the journey to Net Zero.

# UNDERSTANDING THE UNIQUE ENVIRONMENTAL INTERACTIONS OF FLOATING OFFSHORE WIND

**ORE Catapult's Floating Offshore Wind Centre of Excellence (FOW CoE) has launched the 'Environmental Interactions Roadmap' as part of its 'Environmental Interaction Strategic Programme' alongside the Department for Business, Energy and Industrial Strategy (BEIS), the Department for Environment Food & Rural Affairs (DEFRA), The Crown Estate and Crown Estate Scotland.**

The objective of this roadmap is to identify potential knowledge gaps relating to the specific environmental interactions of floating offshore wind technology. This will enable the industry to develop a portfolio of activities that will mitigate any potential risks and capitalise on opportunities, thereby facilitating an efficient and faster consenting process for future floating offshore wind farms.

This infographic presents a range of opportunities to develop floating wind by highlighting the priority themes and knowledge gaps, identified through engagement with key UK environmental stakeholders during the development of the roadmap. The public summary explores these themes in further detail, and outlines a range of recommended future activities and research in relation to each.

### 1 Aviation Safety

Further work is required to determine the implications of the installation of floating wind in greater areas of the sea on aviation safety procedures and regulations. Also, there are potential evidence gaps associated with understanding the interference generated by floating wind arrays (including the scattering characteristics of floating turbines on radar systems).

### 2 Co-location and Coexistence

There is currently limited understanding on the co-location of floating wind projects with other industries, including commercial fisheries and oil and gas.

### 3 Cumulative Impacts

Cumulative and in-combination impacts are relatively well understood for fixed offshore wind, however there is a potential lack of data associated with the cumulative impacts of multiple floating wind sites on a range of receptors. Although the differences between floating and fixed wind are expected to be minimal, further work is required to confirm this.

### 4 Electro Magnetic Field (EMF)

Although EMF is a recognised area of interest for the existing fixed wind and power transmission industries, there are potential evidence gaps relating to how floating-specific features (such as dynamic cables in the water column) interact with the marine environment.

### 5 Habitats Regulations Assessment (HRA)

A plan-level HRA is required to assess the potential impacts of offshore wind on legally protected habitats and species of importance, however there is currently limited HRA precedent for FOW developments. It is therefore possible that there may be additional uncertainties associated with FOW that the plan-level HRA must consider and accommodate.

### 6 Fisheries Access and Displacement

The more complex subsea infrastructure of floating wind farms (relative to fixed offshore wind) and the ability of the technology to access greater areas of the sea with deeper waters raises additional considerations regarding potential interactions with UK commercial fisheries.

### 7 Navigational Risk

There is currently some uncertainty regarding how floating wind's specific characteristics (including the presence of mooring systems, installation in deeper areas of the sea, towing and wet storage processes etc.) may differ from fixed offshore wind, in terms of navigational risk and marine safety.

### 8 Ornithology

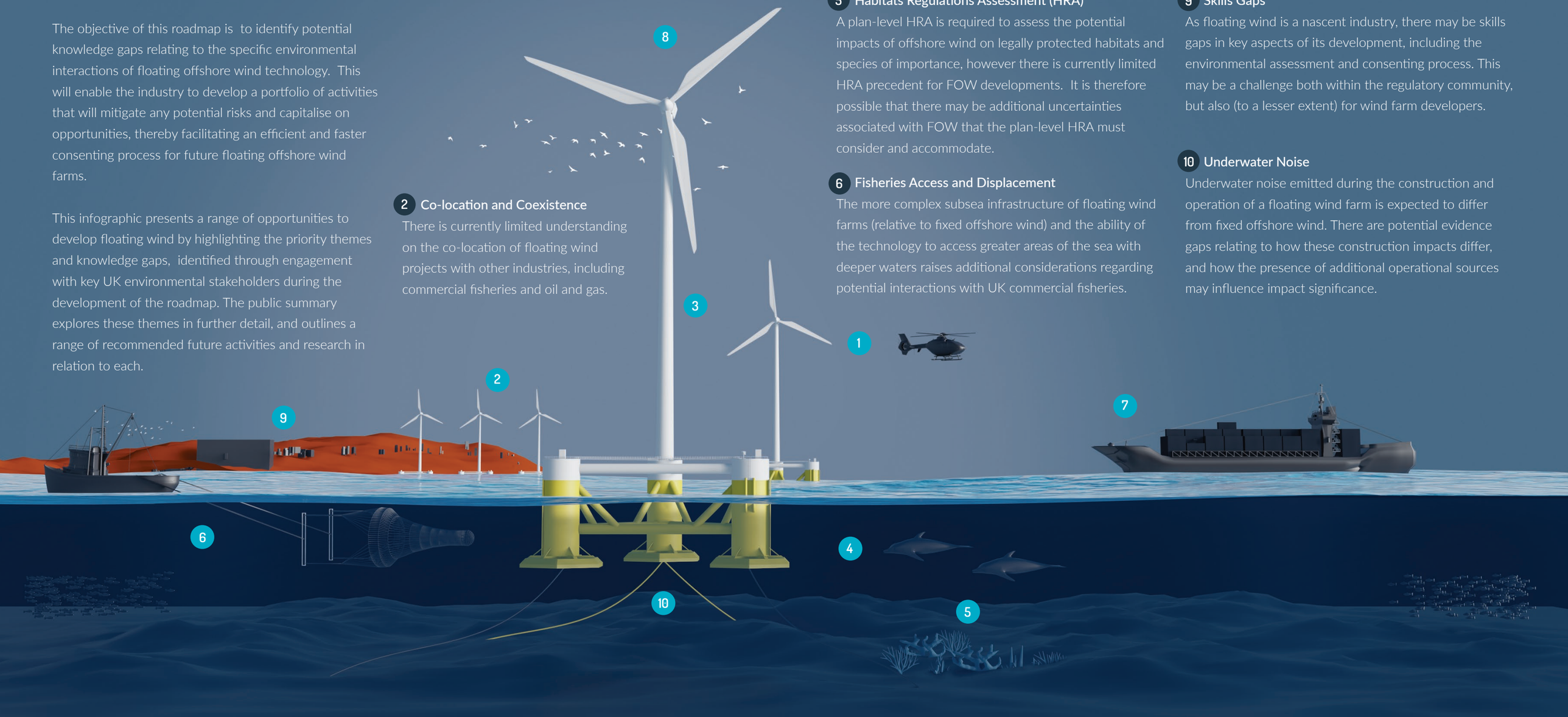
Considerations of the effects of offshore wind development on bird ecology are not unique to floating wind technology. However, there are certain specific characteristics of FOW developments that would benefit from further attention in order to address any existing uncertainty.

### 9 Skills Gaps

As floating wind is a nascent industry, there may be skills gaps in key aspects of its development, including the environmental assessment and consenting process. This may be a challenge both within the regulatory community, but also (to a lesser extent) for wind farm developers.

### 10 Underwater Noise

Underwater noise emitted during the construction and operation of a floating wind farm is expected to differ from fixed offshore wind. There are potential evidence gaps relating to how these construction impacts differ, and how the presence of additional operational sources may influence impact significance.



*TMS Pacific, ORCA. Photo Courtesy of The Crown Estate*

# INVESTING IN INFRASTRUCTURE TO MEET THE NEEDS OF FLOATING WIND

**Floating offshore wind will be essential for the UK to move away from its reliance on fossil fuels and achieve the ambitious Net Zero targets by 2050. Critical to the cost-effective deployment of floating offshore wind is the development of key enabling infrastructure.**

Today, the UK does not possess all of the extensive infrastructure and strategic supply chain capability to deliver large scale floating offshore wind farms. However, this presents an enormous opportunity to adapt and improve a range of relevant infrastructure and supply chain organisations that are well placed to develop the required capacity and capability in advance of large-scale project delivery at the end of the 2020s.

Port infrastructure is a key part of this. According to the FOW CoE's recent report, Strategic Infrastructure and Supply Chain Development, the broader economic impact of strategic infrastructure is significant, with a return of between £10-15 for every £1 invested.

Essentially, the potential economic value from enabling the fabrication, marshalling and assembly of floating substructures in the UK could generate nearly £40 billion in direct and indirect GVA in the period from 2025 to 2050 (averaging over £1.5 billion per year). It would also create a growth in recruitment, permanently employing more than 15,000 full time employees over this timeframe. What's more, this analysis only includes floating wind substructures and does not account for other industries which may benefit from enhanced port and yard facilities.

However, in order to reap the economic benefits that come alongside floating wind and its required port infrastructure, serious investment and build out is needed. Without this, floating wind projects will either become significantly more expensive to deliver and or will be delivered from outside the UK. The latter would both result in the direct loss of value of these activities to the UK and present a significant barrier to the broader supply chain in securing a share of related activity.

So, how can the UK ensure that we do not lose our competitive advantage within floating wind and address this infrastructure challenge? The Strategic Infrastructure and Supply Chain Development report from the FOW CoE has outlined several potential solutions.

One recommendation from the report is to invest in the development of regional “port clusters” around one or more “hub” facilities that can host substructure and floating wind turbine marshalling, assembly and integration for large scale projects. This is critical for enabling infrastructure around which clusters can be built. It is also highly desirable to develop manufacturing capacity at this same facility to improve the business case for the broader port infrastructure investment (by providing stable revenue from long term leasing arrangements with a manufacturer) as well as enhancing the overall offer of the port cluster.

Another recommendation would be to maximise the scale and speed of private sector investment in port infrastructure by establishing a dedicated scheme to support large scale investment between 2025 and 2030. The primary role of the scheme would be to underwrite any risk associated with port utilisation, leveraging pooled investment from offshore wind developers and the public sector to underwrite risk, with significant private sector investment directly into the infrastructure development.

Finally, any scheme that is introduced to maximise private investment in port infrastructure should coincide with a wider regional influx of investment to ensure an appropriate and sustainable capacity for floating wind and beyond. Many of the infrastructure requirements of other technologies are similar to those for offshore wind. If the UK is able to turn these infrastructure challenges into the incredible opportunity that they are, it will play a major role in the country securing significant economic value from floating offshore wind.

*TMS Pacific, ORCA. Photo Courtesy of The Crown Estate*

# FLOATING WIND: POWERING THE ENERGY TRANSITION

**The Offshore Renewable Energy (ORE) Catapult has been advancing and future proofing technologies in offshore renewables for nearly 10 years. New and developing technologies have emerged in this time that, in combination, could provide an innovative sustainable energy mix for the future.**

## Offshore Wind and Hydrogen

The British Energy Security Strategy, published in 2022, built on the Ten Point Plan for a Green Industrial Revolution launched in 2020, demonstrating the UK Government's ambition to focus on offshore wind and hydrogen as key components in the nation's energy future.

However, while the expansion of offshore wind will secure a low carbon energy source, it raises practical issues of how this new power supply can be integrated into an energy system designed around fossil fuel production and thermal power generation.

Solutions to these integration problems include smart local energy systems and energy storage technologies. Hydrogen is unique as a renewable chemical fuel that can be utilised across a wide range of end uses such as storage, energy transport and industry. Combining smart energy systems and energy storage that uses hydrogen with offshore wind can offer a holistic energy solution.

An example of this can be seen in the Milford Haven: Energy Kingdom (MH:EK) project that is exploring how renewable, or 'green' hydrogen and electricity can meet the future energy demand of Milford Haven.

Milford Haven currently hosts a range of hydrocarbon facilities, including a gas power plant, an oil refinery, and liquified natural gas terminals, which allow it to receive up to 30% of the UK's gas imports. The project scope has been wide-reaching, covering world-first installations, investment development and planning the long-term energy transition, which has been a key focus area for ORE Catapult.

The project has investigated how renewable energy, including future offshore wind, could develop the case for accelerating an economy which would see green hydrogen power buildings, transport and local industry.

ORE Catapult's team have been working to address some of the challenges related to this proposed long-term energy transition, including: technology development and the flow of energy through integrated wind turbine-electrolyser systems; development in the nearby Celtic Sea that holds the potential to unlock tens of gigawatts of new offshore wind; using hydrogen to decarbonise steel production in Wales, and the possibility for larger scale demonstration projects.

Work delivered through the MH:EK project is helping to tackle the questions raised by an integrated wind and hydrogen energy future, and further progress the UK towards achieving Net Zero.

## Offshore Wind and Oil and Gas

What if some of the current substructure that we have in place for oil and gas extraction could be repurposed for the Net Zero generation?

This is a question that was explored in a Net Zero Technology Centre (NZTC) report last year which found that most of the UK's oil and gas installations have traditionally adopted in situ power generation - which has not only proved inefficient but also generates around 70% of offshore CO2 emissions.

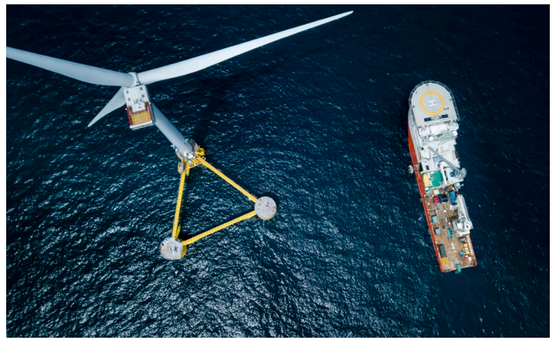


*Photo courtesy of Principle Power. Artist DOCK90*

However, offshore wind and energy storage technologies for deep water are developing rapidly, and this creates a huge opportunity for reducing emissions from operating oil and gas assets, whilst at the same time reducing operational costs.

The NZTC report outlined solutions for the electrification of a wide range of oil and gas installations that included existing and planned UK offshore wind power. These range from powering remote oil and gas platforms by dedicated local offshore wind farms, to importing bulk power from nearby countries. Most of the proposed solutions focused on offshore wind energy utilisation – providing a green and renewable power source for oil and gas platforms, and significantly reducing their CO2 emissions.

*Photo courtesy of Equinor*

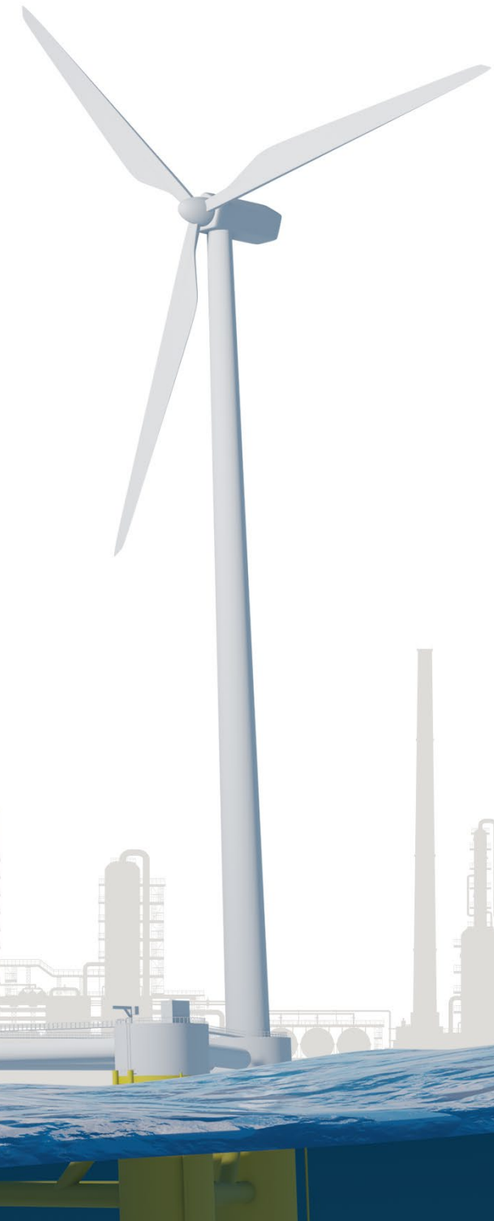
However, electrification solutions do create challenges that need to be addressed.

These include:

- **Energy storage:** As offshore wind capacities reach 60% in the North Sea, it is crucial to provide energy storage. An innovative solution that can be integrated with offshore wind farms is green hydrogen-energy storage, which is not only renewable, but would also provide security of supply for oil and gas operations.

- **Electric component footprint:** Due to the limited space on top of oil and gas platforms, two alternative approaches can be adopted to overcome this - create power hubs using subsea technology or utilise nearby gravity-based decommissioned platforms as a power hub.

- **Regulations:** It needs to be clear who will control and own the operation of these assets and offshore wind farms. A clear pathway for standardisation is needed, as well as flexible and clear industry regulations. While offshore wind, including floating wind, leads the way, it's essential that all parts of the offshore energy system contribute and innovate together in the drive towards a sustainable energy future.



# SUPPLY CHAIN COMPANIES CHAMPIONING FLOATING WIND

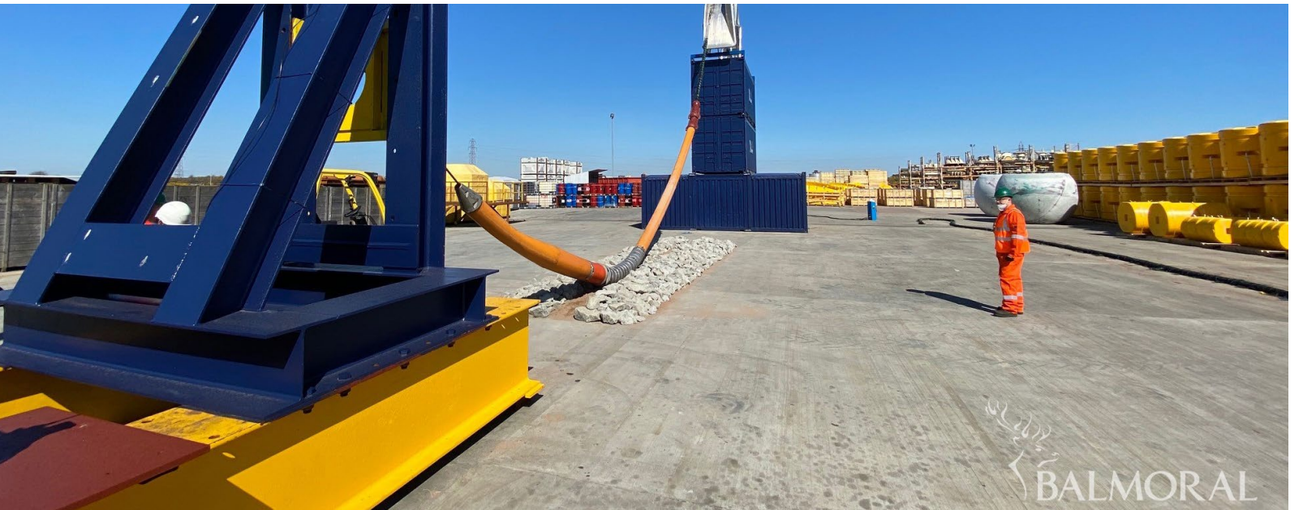
**Behind every successful industry is a strong, competitive supply chain of businesses providing the innovations, products and services needed to make that sector a global success story. As floating wind matures, we must ensure we are well positioned to make the most of the huge opportunities to develop a world-class supply chain here in the UK.**

To do so, ORE Catapult is spearheading supply chain growth through the development of a number of industry programmes. Fit 4 Offshore Renewables (F4OR) is a programme that offers business improvement and sector specific capability building, enabling the UK supply chain to bid for work in the offshore renewable energy sector.

The expansion of floating wind provides an immense opportunity to increase UK content across the sector - an ambition that was highlighted in the offshore wind Sector Deal to increase UK content to 60% by 2030. The ScotWind leasing round results, announced earlier this year, showed how deployment of floating wind in our waters can support a burgeoning supply chain, creating skills and technology that can be exported globally.

In this article, we introduce a selection of the F4OR companies that have successfully attained the F4OR programme's 'Granted Status' and are now well on their way to winning work within the floating offshore wind sector.

*Photo Courtesy of Balmoral*




### Apollo

Apollo's engineering capability is deeply rooted in North Sea marine energy, and as a result it has one of the industry's leading naval architecture and marine engineering teams. It understands the harsh environment of the oceans and how these interact with floating structures. Apollo's team has extensive expertise in the through-life performance of marine assets and their station-keeping systems, including the challenges around integrity, safety, reliability, cost and uptime/availability.

### Peritus International

Peritus International is a specialist subsea and offshore engineering consultancy that has worked on floating wind projects worldwide. Peritus' capabilities cover the full project lifecycle, from feasibility to decommissioning. This includes project and interface management, with a focus on dynamic cables, verification of cable protection systems, technology readiness assessments, along with engineering and independent design verification.

Peritus would like to replicate its success in the oil and gas sector by leveraging the same skills, procedures and experience in the floating wind sector.

### 2H Offshore

2H is providing independent system design, structural analysis and engineering services for many floating wind projects, including technology selection, coupled analysis, and mooring, anchor and power cable design. It is supporting floating wind's path to commercialisation and aims to be the benchmark for cutting edge offshore engineering solutions for tomorrow's floating wind needs.

### Balmoral

For a recent project, Balmoral was asked to significantly reduce costs during the pilot phase of a major North Sea floating wind development. The company's technical team designed a value-engineered solution which reduced the quantity of subsurface buoyancy modules required and utilised Balmoral's proprietary clamping system to slash installation times by 70%.

### Sealand Projects

Sealand Projects draws on its knowledge of developing solutions for the installation and maintenance of floating assets in harsh marine environments to meet the challenges of floating wind, which will accelerate transition from demonstrator projects to commercial scale floating wind developments.

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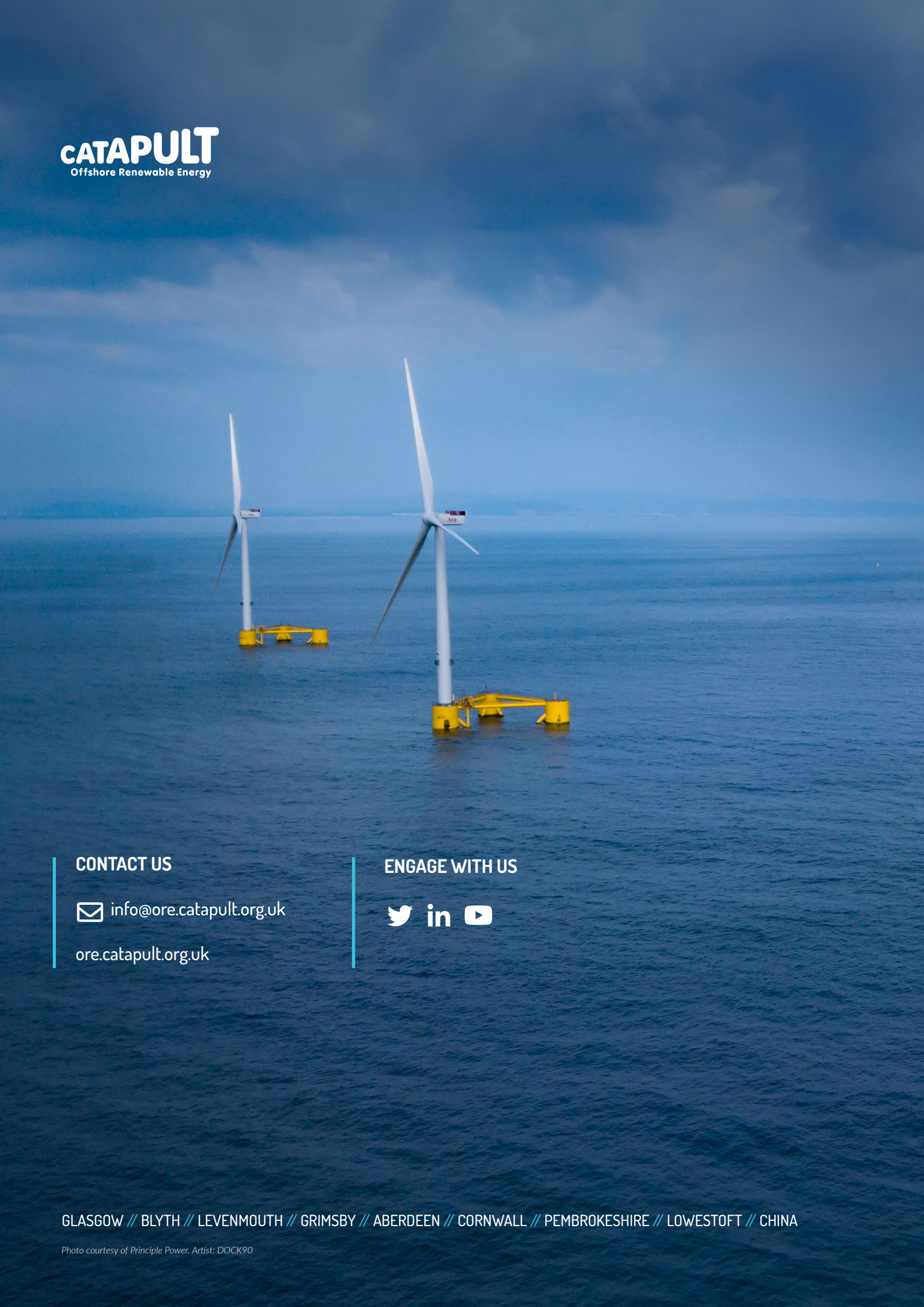

## CONTACT US

info@ore.catapult.org.uk

ore.catapult.org.uk

## ENGAGE WITH US

GLASGOW // BLYTH // LEVENMOUTH // GRIMSBY // ABERDEEN // CORNWALL // PEMBROKESHIRE // LOWESTOFT // CHINA

*Photo courtesy of Principle Power. Artist: DOCK90*