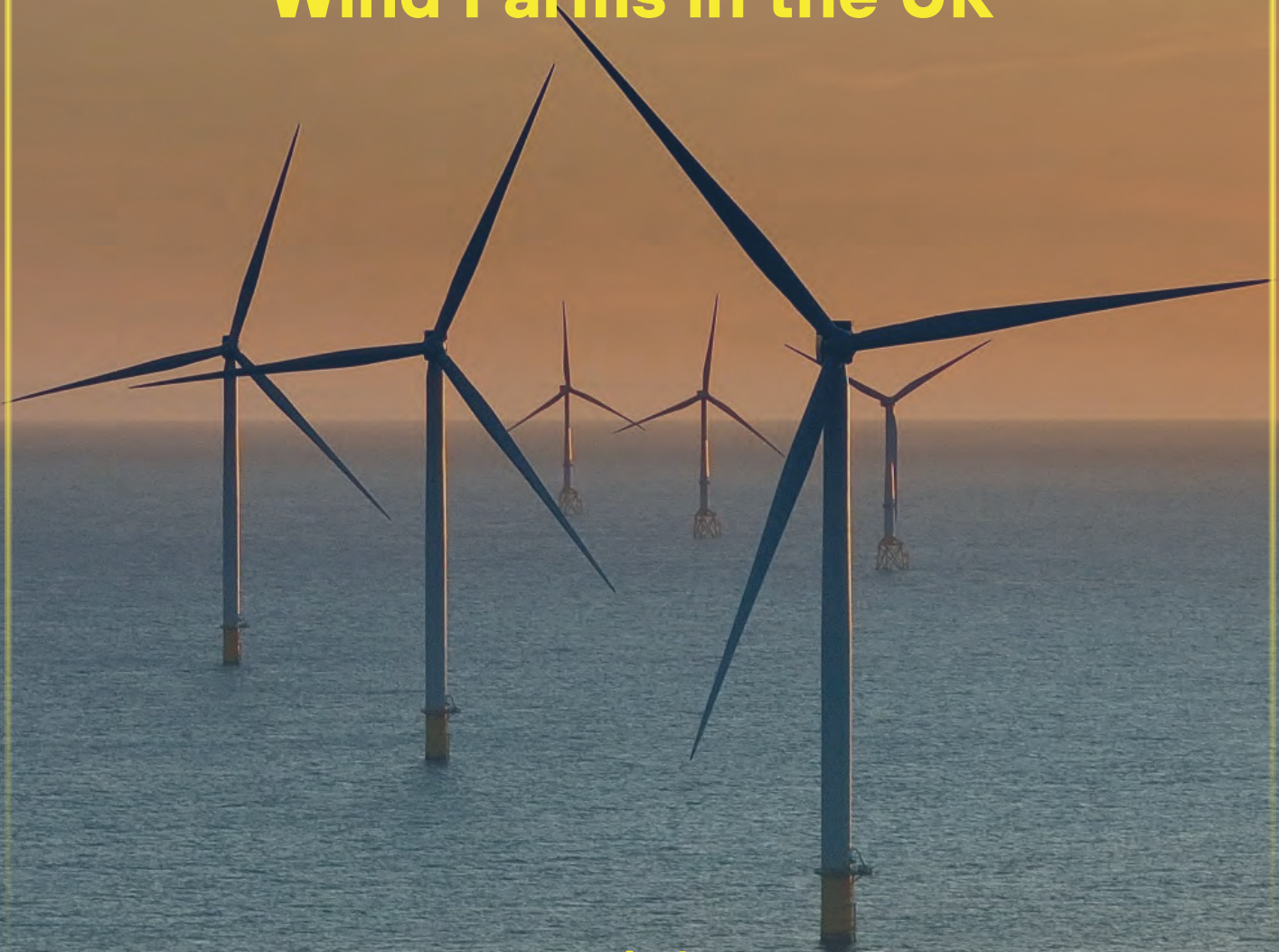


Environmentally Sustainable Development of Offshore Wind Farms in the UK



EXECUTIVE SUMMARY

Ocean Winds, a joint venture between EDPR and ENGIE, develops, finances, builds and operates offshore wind farms around the world. We drive investment and economic prosperity for the people of the regions in which we operate, while delivering clean, secure energy to millions of homes.

Ocean Winds is committed to being at the forefront of industry to ensure the sustainable development of offshore wind, ensuring that the transition to net zero goes hand in hand with protecting and enhancing the environment. Through pioneering environmental research, innovative technologies, and open collaboration, Ocean Winds is helping to shape industry best practice and set new standards for responsible offshore wind development.

By taking a holistic approach to environmental stewardship, Ocean Winds focuses on three key pillars: scientific research, technology innovation, and knowledge sharing. Extensive surveys and monitoring programmes for key marine species have generated valuable data that has led to the development of industry-leading mitigation measures, improved impact assessment methodologies, and supported the protection of wildlife throughout offshore wind construction and operation.

Ocean Winds recognises that collaboration is essential to achieving sustainable growth in offshore renewables. The company is committed to sharing data, insights, and lessons learned with industry partners, academia, research institutions, regulators, conservation bodies, and local communities to help drive a more sustainable future for offshore wind and the marine ecosystems in which it operates.



INTRODUCTION



Catarina Rei
Permitting & Environment
Director at Ocean Winds

“ Since the development of our UK sites began in 2010 under our sponsors, Ocean Winds, a 50/50 joint venture between EDPR and ENGIE, has placed environmental responsibility and stakeholder engagement at the heart of our approach to developing offshore wind farms. From the outset, we have recognised that successful renewable energy projects must not only deliver clean power but also protect and respect the marine environments in which we operate.

Our ambition is to generate green, renewable energy in a truly sustainable way, minimising environmental impacts while contributing to a greater scientific understanding of how offshore wind can successfully coexist with the natural environment where they sit.

Through long-standing collaborations with leading universities and research institutions, Ocean Winds has gathered advanced knowledge of marine mammals, seabirds, fish and other key species. This knowledge has helped to pioneer innovative approaches to environmental impact assessment, and therefore deeply informed the decision making and mitigation measures to safeguard the environment. Over the past 15 years, these partnerships have supported PhD, MSc and undergraduate research projects, supported academic teaching, contributed data to many scientific publications and reports, and created valuable internship opportunities for students with Ocean Winds. Alongside this research, we have been brave investing in innovative technologies and practical solutions designed to reduce the environmental footprint of offshore wind construction and operations.

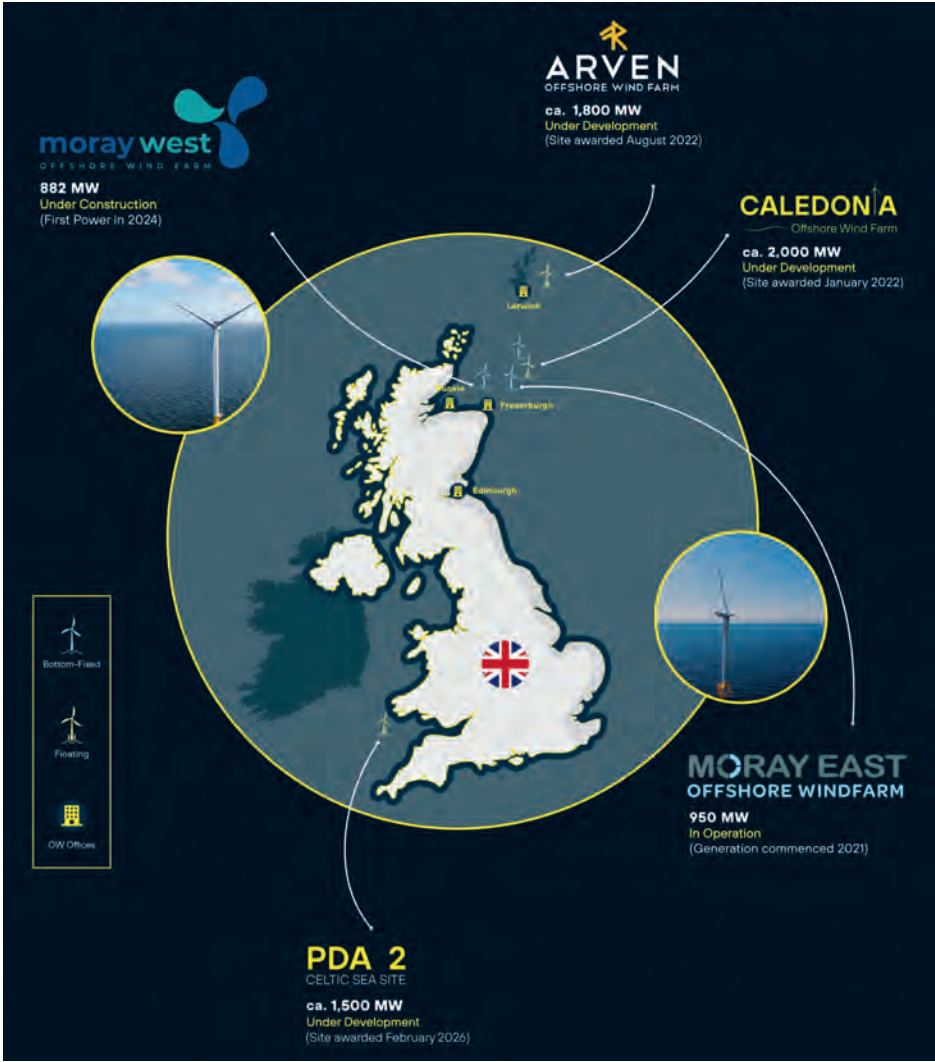
We are proud of the strong relationships we have built with nature conservation bodies, regulators, researchers, local communities and industry partners. These relationships are founded on trust, collaboration, scientific excellence and above all, a shared commitment to ensuring that offshore wind develops in harmony with the natural world.

I hope you find this document a useful summary of our wide set of activities to drive environmental sustainability in all aspects of offshore wind projects. The examples throughout focus on marine mammals and birds, plus several fish ecology and fisheries initiatives, though our environmental studies cover all aspects of the marine environment that could be affected by our projects.

OUR UK PROJECTS

Ocean Winds is the largest offshore wind operator in Scotland with Moray East and Moray West.

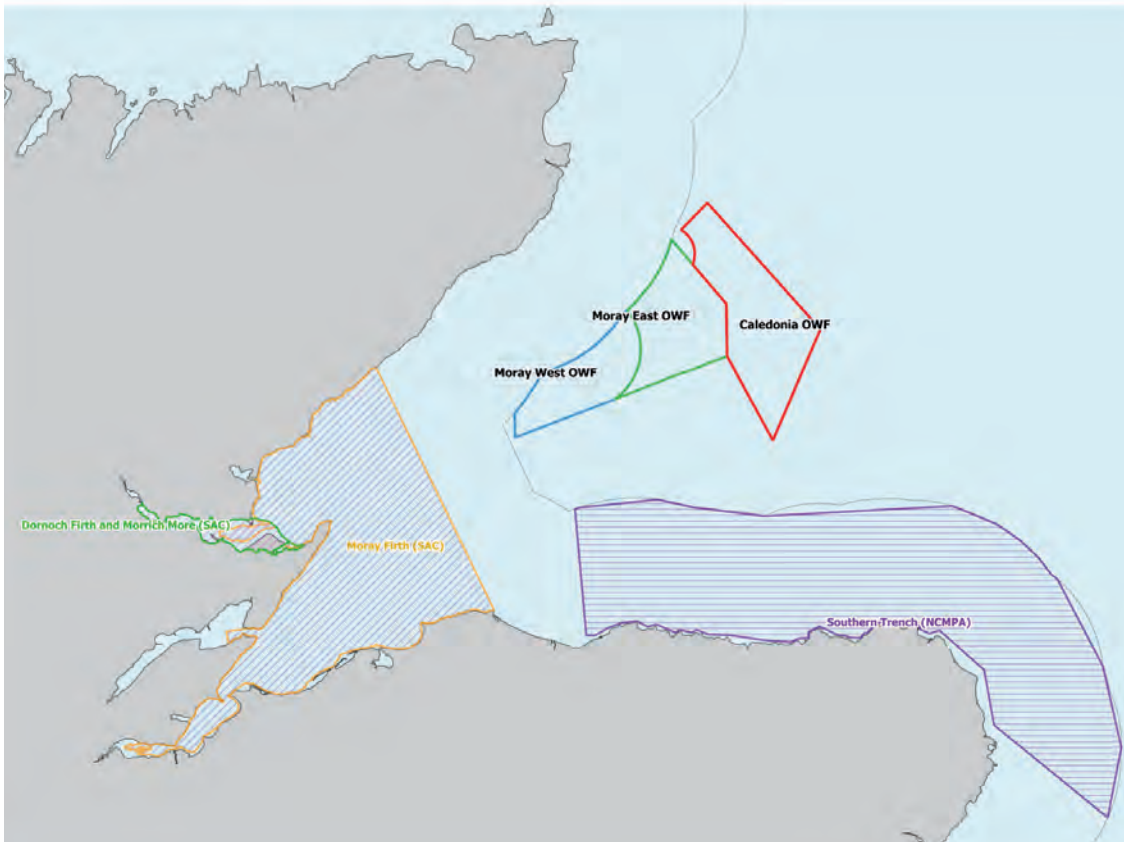
In the UK we have total portfolio of over 7GW, with projects spanning from the far north of Scotland to the Celtic Sea including fixed and floating projects.



MARINE MAMMALS

The Moray Firth, which hosts three of Ocean Winds' offshore wind farms - Moray East, Moray West and Caledonia - hosts a large variety of marine mammal species. There are also a number of internationally and nationally important sites for marine mammals in the area:

- **Moray Firth Special Area of Conservation (SAC)** –designated for bottlenose dolphins;
- **Dornoch Firth and Morrich More SAC** –designated for harbour seal; and
- **Southern Trench Marine Protected Area (MPA)** –designated for minke whale.



Map of projects and conservation areas

MARINE MAMMALS

Acknowledging the importance of marine mammal populations in the Moray Firth and their potential interactions with offshore wind farm development, Ocean Winds has an ongoing partnership with University of Aberdeen and its Lighthouse Field Station, formed in 2010, that monitors key marine mammal species including harbour and grey seal, bottlenose dolphins, harbour porpoise and minke whale.

Our key outputs to date include contribution to long term monitoring of marine mammal populations and the development of industry leading mitigation solutions during the construction of offshore wind farms.

Ocean Winds has also developed a framework to assess the potential impacts on harbour seals that was recognised at the time as an important advance in the methodology for assessments of impacts in marine mammals.

This published work is part of a body of 29 Ocean Winds sponsored scientific publications in the UK that have helped share the understandings from the long term and ongoing studies of marine mammals and their interactions with offshore wind farms.



Minke whale and bottlenose dolphin

MARINE MAMMALS - UNEXPLODED ORDNANCE CLEARANCE

During the construction of the Moray West Offshore Wind Farm, Ocean Winds successfully pioneered new technology in the clearance of unexploded ordnance (UXO) using an innovative disposal method that has been marked as a groundbreaking milestone in marine conservation.

Working with the specialist provider EODEX, Ocean Winds has successfully proven the **Low-Order Deflagration method** by safely clearing 82 UXO from the Moray West project site. This technique results in the explosive material inside the UXO being rapidly burned away rather than detonating.

Ocean Winds worked with EODEX, who undertook the low-order deflagration clearance, and Seiche, who undertook marine mammal mitigation and noise monitoring, over a 6-month period. The data showed that measured noise levels for each of the UXO clearance events were consistently below the expected sound levels when using this technique, and that worst case impact ranges for marine mammals were all smaller than 1.5 km. This is compared to the 2.55km - 14.25 km impact ranges predicted for equivalent detonations of these UXOs.

A study of the technique was published to enable regulators and the offshore wind sector to recognise

the environmental benefits of this disposal method and to provide evidence to inform future impact assessments and license applications for UXO clearance and facilitate the licensing decision-making process.

Subsequently a joint position statement developed by the UK government, devolved governments and associated nature conservation bodies, in recognition of the environmental benefits of this disposal method, has set Low-Order Deflagration as the default method of clearing UXOs in the marine environment.

Another objective of the study was to share the lessons learned during the licencing, mitigation, and deployment of the low-order deflagration technique, with the aim of informing the development of robust guidance to improve future assessment, licencing, and mitigation of UXO clearance.



UXO cleared from Moray West project site.

MARINE MAMMALS - VIBRO-PILING

During the construction of Moray West, Ocean Winds trialled the use of an innovative technique for wind turbine foundation installation, called vibro piling. Vibro-hammers cause vertical vibrations that allow gravity to sink the foundation into the soil due to its weight. This technology was trialled with the aim of minimising noise, and therefore impact on marine wildlife during the construction of offshore wind farms.

The noise levels recorded during the foundation installation were found to be significantly lower than those recorded on previous projects using traditional hydraulic impact hammers to drive the foundation into the seabed.

Echolocation click detectors were deployed by University of Aberdeen to assess changes in occurrence and feeding activity of harbour porpoises in response to piling noise at Moray West, with [publication of the monitoring results](#) indicating that the observed behavioural responses of harbour porpoises to piling noise are dramatically lower than those predicted in the regulatory assessment and with no discernible long term population decreases in response to wind farm related noise disturbance.



Vibro-pile installation of Moray West foundation

MARINE MAMMALS - NORTH ATLANTIC

MINKE WHALE MONITORING

Ocean Winds has partnered with Scottish Association for Marine Science (SAMS) along with two other offshore wind projects, NatureScot, and Crown Estate Scotland to deploy three Passive Acoustic Monitoring (PAM) devices in the Moray Firth to monitor activity of the North Atlantic Minke Whale during the summer 2025.

The Southern Trench Marine Protected Area (MPA) is an area known to contain minke whales, though there are currently gaps in the data on the time of year they are present and the extent of the area they occupy within the MPA.

The PAM devices have been deployed at strategic locations within the Southern Trench MPA in areas being considered for offshore wind farms export cable routes and will remain in place for 24 months, spanning two summer sessions during peak Minke Whale presence in the region.

The first 4 months of the data collection campaign detected minke whale vocalisations at more than one of the monitoring locations on 42% of the recorded days. The localised long-term data from this campaign will likely show seasonality in minke whale presence, with strong presence expected to be detected between early summer and late autumn.

The results will ultimately help inform the timing and methodology for installing the export cables on Caledonia Offshore Wind Farm and others planned for the area.



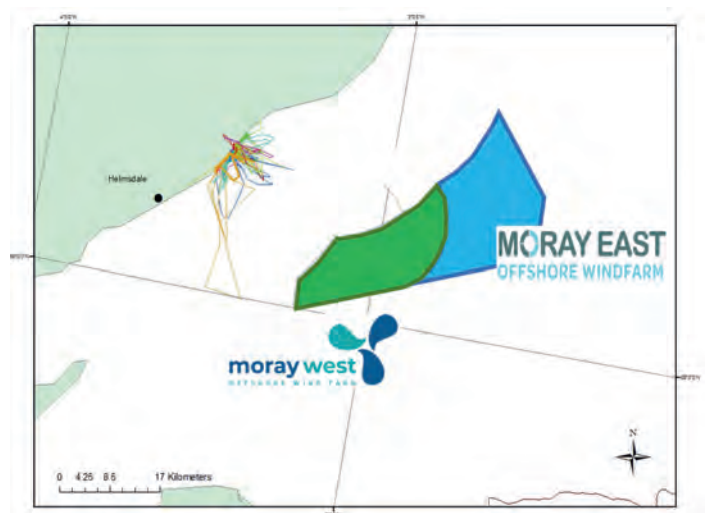
Minke whale monitoring set-up and PAM devices

MARINE BIRDS - GULL TAGGING & STORM PETREL MONITORING

During the initial development of Moray East, the first Ocean Winds wind farm in the Moray Firth, the tagging of Great Black-Backed Gulls and Herring Gulls was completed in partnership with University of Exeter, with the aim of determining the driver's affecting distribution of the gull species and the potential implications for future offshore wind farm sites.

The tagging of the Great Black-Backed Gulls was the first project of its kind in the UK. Monitoring of gulls' movements found the key variables affecting their foraging behaviour were distance to coast, presence of sandy sediments and presence of fishing vessels.

Ocean Winds has also funded Storm Petrel monitoring for the RSPB, and other ornithology work including tagging and colony count work through regional programmes to better understand distributions and any population changes.



Gull tagging

Great black-backed gull foraging behaviour

MARINE BIRDS - CHARACTERISATION OF WIND FARM USAGE BY BIRDS IN FLIGHT

In November 2024, Ocean Winds deployed two high resolution camera systems from Spoor on to the transition pieces of two turbines on our operational Moray East Offshore Wind Farm.

The aim of this exercise is to collect video data of flying seabirds to detect and identify the species present, track their flights around and near operational wind turbines and analyse and categories their behaviours. The data collected will help further understanding of bird behaviour within operational offshore wind farms and help to inform the consenting process of future offshore wind projects.



Spoor camera on Moray East transition piece

Analysis of the first year of data is underway and the cameras remain deployed for subsequent data collection. To deepen confidence in the results, the data from Moray East will be analysed alongside similar data being collected at other offshore wind farms.



Kittiwake

SALMON - THE MISSING SALMON PROJECT

The Missing Salmon Project was a multi-agency collaboration led by the Atlantic Salmon Trust (AST) where Ocean Winds worked with University of Glasgow, the six District Salmon Fishery Boards and Trusts, and Marine Scotland.

The aim of the project was to increase smolt survival rates by looking at how smolts migrate down river, through the estuary and across to the outer reaches of the Moray Firth. The information learned is now used to inform local fishery managers to enable management solutions to increase smolt survival.

The project tagged 850 smolts across 7 rivers leading into the Moray Firth to track their movement into the open sea and identify where and why smolt were disappearing.

In its first year, The Missing Salmon Project identified significant fish losses, averaging 49%, were occurring in freshwater. Further investigation determined agricultural runoff and other chemicals presence in the rivers, hydro-electric weirs, and predators were the main cause of salmon smolt disappearance. This information has enabled local fisheries managers to implement informed management solutions.



Atlantic salmon. Upper image: mature stage, lower image: smolt stage

SALMON - PROJECT DEVERON

Ocean Winds has also partnered with the Deveron, Bogie & Isla Rivers Charitable Trust and the Atlantic Salmon Trust via Caledonia Offshore Wind farm to support efforts protecting and restoring populations of the endangered wild Atlantic Salmon.

Project Deveron was formed, on the River Deveron in Aberdeenshire, to help conserve, protect, and restore the wild salmon population and the wider biodiversity. This catchment-scale, long-term restoration project aims to provide wild Atlantic salmon with free access to cold and clean water.

Following a successful trial of employing a state-of-the-art sonar imaging fish counter, which marked a major milestone for Project Deveron as it achieved the first accurate, full-river adult salmon count, Caledonia has supported the build of a flood-resistant structure to house and protect the sonar device, ensuring its ongoing role supporting the work of the Trust.



Flood-resistant structure for sonar device

FISHERIES COEXISTENCE

Ocean Winds is proactive in our engagement and actively seeks to co-exist with other marine users, including the fishing industry. We have shown long term commitment to engaging with the fishing community by employing a Commercial Fishery Manager in UK and Ireland.

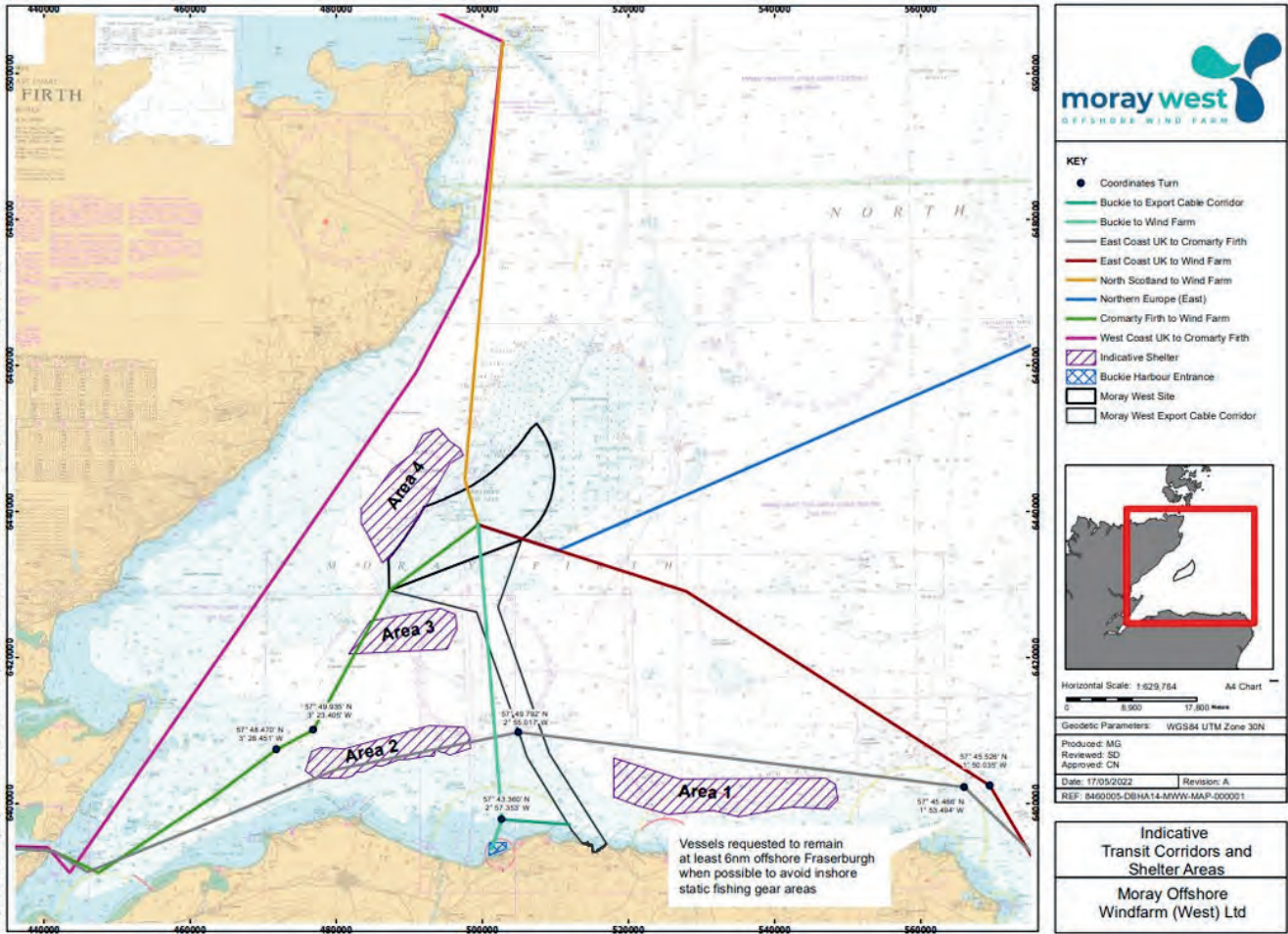
Ocean Winds has a presence on many major fishery related groups in the UK and Ireland including The Commercial Fisheries Working Group, Fishing Liaison with Offshore Wind and Wet Renewables Group, and we have close contact with fishery organisations such as Scottish Fisheries Coordination Centre, Scottish White Fish Producers Association and National Federation of Fishermen's Organisations.

From 2010 when we began the development of our first project in the Moray Firth, we have developed strong links with other developers, research organisations and regulators to ensure solutions are collaborative and research streams deliver the most value to the fishing industry and offshore wind developers.

Innovation has been a key theme as we seek to find the best solutions in how we share the marine space with others and explore new and innovative engineering solutions to encourage co-existence.

FISHERIES COEXISTENCE

The below map shows Indicative Transit Corridors and Shelter Areas (extracted from Moray West Fisheries Management and Mitigation Strategy). A similar approach was followed during the construction of Moray East. Routes and shelter areas were agreed through consultation with fishing industry.



FISHERIES COEXISTENCE - FISHERIES BYCATCH STUDY

Between March and October 2024, Ocean Winds initiated the first year of a self-reporting seabird bycatch study involving ten fishing vessels working in the Moray Firth region including a mixture of static gear boats (three), trawlers (seven), and dredgers (one).

The study looked at seabird interactions with fishing vessels and/or gear, information on seabirds in the proximity of the fishing vessels when engaged in fishing, and measurements of fishing effort (number of days fished and number of gear deployments and retrievals per day) with the target species being gannet and auks.

A similar self-reporting study is currently being carried out to cover the 2025 seabird breeding season. Across the 2024 and 2025 study, hundreds of deployments and retrievals were monitored. To date, no instances of seabird entanglement or bycatch have been self-reported.

In addition, video data collection of gear setting and retrieval on a subset of vessels was undertaken during 2025. The video recordings are being systematically reviewed for evidence of seabird interactions with fishing gear.

Data from the self-reporting and video studies are being processed and will be used to inform subsequent data collection and refinement of the planned location(s), methodology and implementation of the bycatch measure. As such, appropriate mitigation methods and implementation locations are still under development.



Puffin with sandeels

INDUSTRY COLLABORATION

Ocean Winds has formed strategic partnerships with a number of environmental groups across industry, regulators, SNCBs, and academia including Offshore Renewables Joint Industry Programme (ORJIP), Floating Offshore Wind Centre of Excellence (FOW CoE), The Predators and Prey Around Renewable Energy Developments (PrePared), University of Aberdeen, St Andrews University, Heriot-Watt University, University of Exeter, and University of Glasgow.

Together we work on key environmental and consenting issues to share knowledge and best practice and so minimise the environmental impact of offshore wind.



Marine mammal survey work

Some key outputs have included:

ORJIP for Offshore Wind:

- Use of Deterrent Devices and Improvements to Standard Mitigation during Piling.
- The use of Acoustic Deterrents for the mitigation of injury to marine mammals during pile driving for offshore wind farm construction.



FOW CoE Environmental Interaction Strategic Programme

- FOW Development & Consent Risks & Opportunities
- FOW & Fishing Interaction
- FOW Environmental Interactions

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Offshore Renewable Energy

- Using modelled sandeel distribution maps to characterise spatio-temporal variation in the occurrence and foraging behaviour of harbour porpoises around offshore windfarms (PrePARED Report No. 001)
- Changes in the occurrence of harbour porpoises following the construction of Moray Firth offshore windfarms (PrePARED Report No. 002)
- Challenges and Solutions for Offshore Wind Farm Cumulative Effects Assessments for Marine Mammals (PrePARED Report No. 007)
- Predicted and observed responses of harbour porpoises to pile driving noise at Moray West Offshore Wind Farm (PrePARED Report No. 008)
- Offshore Wind Farm Cumulative Effects Assessments – Case Study 1: Including projects without an EIA (PrePARED Report No. 009)
- Harbour Porpoise Population Response to Windfarm Construction, Service Traffic and changes in Prey Availability (PrePARED Report No. 010)
- Harbour porpoise responses to the installation of XXL monopiles without noise abatement; implications for noise management in the Southern North Sea (PrePARED Report No. 004)



ACADEMIA

To date, in the UK, Ocean Winds has provided data for 29 peer reviewed, published papers: [Ocean Winds Scientific Contributions](#)

Ocean Winds' ongoing collaboration with University of Aberdeen, in partnership with St Andrews University, has supported 8 PhD students, 22 Masters projects, and 12 Hons student projects with research.

Additionally, Ocean Winds has funded two PhDs with Heriot-Watt University focused on scallop research, one of the key fisheries in the Moray Firth, looking at scallop dredge bycatch quantification using AI imaging, population structure and genetics connectivity. [Genomic and biogeochemical methods to understand marine connectivity in the king scallop \(*Pecten maximus*, L.\)](#).



ENVIRONMENTALLY SUSTAINABLE DEVELOPMENT OF OFFSHORE WIND FARMS

This leaflet summarises a range of initiatives to ensure sustainable development is integral to Ocean Winds projects. Ocean Winds is advancing best practice in the sustainable development, deployment and operation of offshore wind farms through relentless innovation and collaboration with expert partners. Detailed long-term datasets for marine mammals and seabirds have been funded from inception, with the results informing developments across the UK sector. Engagement with fisheries has progressed understanding, as well as the implementation of real world measures to support sustainability in fisheries.

To date, the focus of environmental efforts for Ocean Winds in the UK has been the Moray Firth in North-east Scotland. As other Ocean Winds' projects are progressed through development to deployment, our leading approach to sustainability and engagement with environmental stakeholders is being applied.

Ocean Winds is proud of our track record but won't be standing still in our pursuit of environmental excellence. As the imperative to deliver more large-scale offshore wind farms continues, so Ocean Winds will use our expertise to better understand the key environmental questions around the sustainable development of offshore wind, and champion innovation in research, assessment and technology. Ocean Winds will continue to be central to environmental sustainability in the offshore wind sector through deep understanding and discussion with stakeholders.



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General Overview



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