



ECOFlow and ECOWind Research Programmes: Offshore Wind Policy and Delivery Landscape

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Acronyms/ Units

ACCELERATE	Accelerated Seabed Mobility around Windfarms
AIM	Annual Impact Meeting
ATSEA	Autonomous Techniques for anthropogenic Structure Ecological Assessment
AUV	Autonomous Underwater Vehicle
BESS	British Energy Security Strategy
BOWIE	Benthic Offshore Wind Interactions Evaluation
CIA	Cumulative Impact Assessment
COWSC	Collaboration on Offshore Wind Strategic Compensation
Defra	Department for Environment, Food and Rural Affairs
DESNZ	Department for Energy Security and Net Zero
ECOFlow	Ecological Consequences of Floating Offshore Wind
EcoSTAR	Ecosystem level importance of Structures as Artificial Reefs
ECOWind	Ecological Consequences of Offshore Wind
ECOWINGS	Ecosystem Change, Offshore Wind, Net Gain and Seabirds
eDNA	Environmental DNA
EIA	Environmental Impact Assessment
EIP	Environmental Improvement Plan
eSWEETS3	Enabling Sustainable Wind Energy Expansion in Seasonally Stratified Seas
FISHSPAMMS	Fish Spillover, Production and Aggregation at Marine Made Structures
FLOW	Floating Offshore Wind
FLOWF	Floating Offshore Wind Farm
FuECoMMS	Functionality and Ecological Connectivity of Man Made Structures
GES	Good Environmental Status
GW	Gigawatts
HPMA	Highly Protected Marine Areas
HRA	Habitat Regulations Assessment
INF4INiTY	Integrated Designs for Future FLOW Technology
INSITE	Influence of man-made structures in the ecosystem
INTOG	Innovation and Targeted Oil and Gas Round
JFS	Joint Fisheries Statement
JNCC	Joint Nature Conservation Committee
MaRePo+	Marine Restoration Potential Mapping + enhancement
MCZ	Marine Conservation Zones

MPA	Marine Protected Area
MMO	Marine Management Organisation
MPS	Marine Policy Statement
MSPri	Marine Spatial Prioritisation Programme
MW	Megawatts
NSIP	Nationally Significant Infrastructure Project
NERC	Natural Environment Research Council
NGO	Non-Governmental Organisations
NPS	National Policy Statements
O&G	Oil & Gas
ORJIP	Offshore Renewables Joint Industry Programme
OWEAP	Offshore Wind Enabling Actions Programme
OWEC	Offshore Wind Evidence and Change programme
OWEKH	Offshore Wind Evidence and Knowledge Hub
OWEIP	Offshore Wind Environmental Improvement Package
OWES	Offshore Wind Environmental Standards
OWF	Offshore Wind Farm
OWF eDNAMonitorBiodiv	Marine microbial and invertebrate meiobenthic diversity in OWF using environmental DNA
OWIC	Offshore Wind Industry Council
P2G	Pathways to Growth
PELAgIO	Physics-to-Ecosystem Level Assessment of Impacts of Offshore Windfarms
POSEIDON	Planning Offshore Wind Strategic Environmental Impact Decisions
PrediCtOr	Prevalence of Seabird Species and Collision Events in OWF
PrePARED	Predators and Prey Around Renewable Energy Developments
ProcBe	Procellariiform Behaviour & Demographics
ReSCUE	Reducing Seabird Collisions Using Evidence
SEA	Strategic Environmental Assessment
ScotMER	Scottish Marine Energy Research
SNCB	Statutory Nature Conservation Bodies
SRA	Strategic Resource Areas
SSEP	Strategic Spatial Energy Plan
TCE	The Crown Estate
UK	United Kingdom
UKMS	UK Marine Strategy

WoS
25YEP

Whole of Seabed Programme
25 Year Environmental Plan

1 Introduction

The UK stands at a critical moment, with ambitious targets set for the expansion of offshore wind to meet the challenges of net zero whilst combating the twin crises of biodiversity loss and climate change. The Ecological Consequences of Floating Offshore Wind (ECOFlow) and the Ecological Consequences of Offshore Wind (ECOWind) research programmes have been designed to bridge the gaps regarding the impacts of Offshore Wind Farm (OWF) development and expansion, to facilitate the achievement of energy and environmental targets.

This report serves as an examination of the existing and upcoming policies and projects that are relevant to offshore wind either directly or indirectly, as of April 2024, and opportunity areas for research impact in the UK. It covers the following:

- An overview of the offshore wind-related policy and project delivery landscape in the UK, setting out key challenges and targets across government departments and delivery bodies.
- Timelines for delivering these policies and projects.
- Key opportunity areas and research programmes for impact creation in relation to the optimal outcomes for fixed and floating offshore wind delivery, climate change adaptation and marine ecosystems.

1.1 ECOFlow

The ECOFlow Programme is a four-year programme (2024 – 2028) which seeks to address critical gaps in understanding how large-scale expansion of floating offshore wind (FLOW) infrastructure affects marine ecosystems. In doing so, the programme seeks to inform decision making and outcomes which minimise negative impacts and harness positive impacts and opportunities. ECOFlow is a co-designed partnership between the Natural Environment Research Council (NERC) and the Crown Estate (TCE).

ECOFlow has three core objectives:

- Enhanced understanding of the novel effects of FLOW on marine ecosystems and, in doing so, transform the approach to deploying FLOW at scale whilst maintaining nature recovery, and its coexistence with other users of the sea, particularly fisheries.
- Utilise autonomous sensing technologies to establish innovative underwater sampling approaches within and around the complex infrastructure associated with FLOW.
- Deliver robust evidence, new approaches and tools that will enable the acceleration of impact in policy and industry, and support government's ambitions in the Celtic Sea and the North Sea's Scottish waters for the deployment of FLOW, nature recovery and fisheries management.

ECOFlow is currently in the process of commissioning projects, the projects will commence by November 2024.

1.2 ECOWind

The ECOWind Programme is similar to ECOFlow but is focussing on fixed offshore wind infrastructure. It is a four-year programme (2022 – 2026) which seeks to address critical gaps in understanding how large-scale expansion of UK fixed offshore wind infrastructure affects marine ecosystems. In doing so, the programme seeks to inform decision making and outcomes which minimise negative impacts and harness positive impacts and opportunities. ECOWind is a co-designed partnership between NERC, Offshore Wind Evidence and Change Programme (OWEC) (Department for Environment, Food and Rural Affairs (Defra), Department for Energy Security and Net Zero (DESNZ), TCE) and the Crown Estate Scotland (CES).

ECOWind has three core objectives:

- To understand how interactions between species are affected by offshore wind, and what this means for populations.
- To enhance marine observations through innovative technology to inform understanding of the effects of offshore wind on marine life.
- To use the knowledge gained from these first two objectives to inform marine policy and management, including net gain and marine environmental restoration.

The ECOWind Programme consists of four projects:

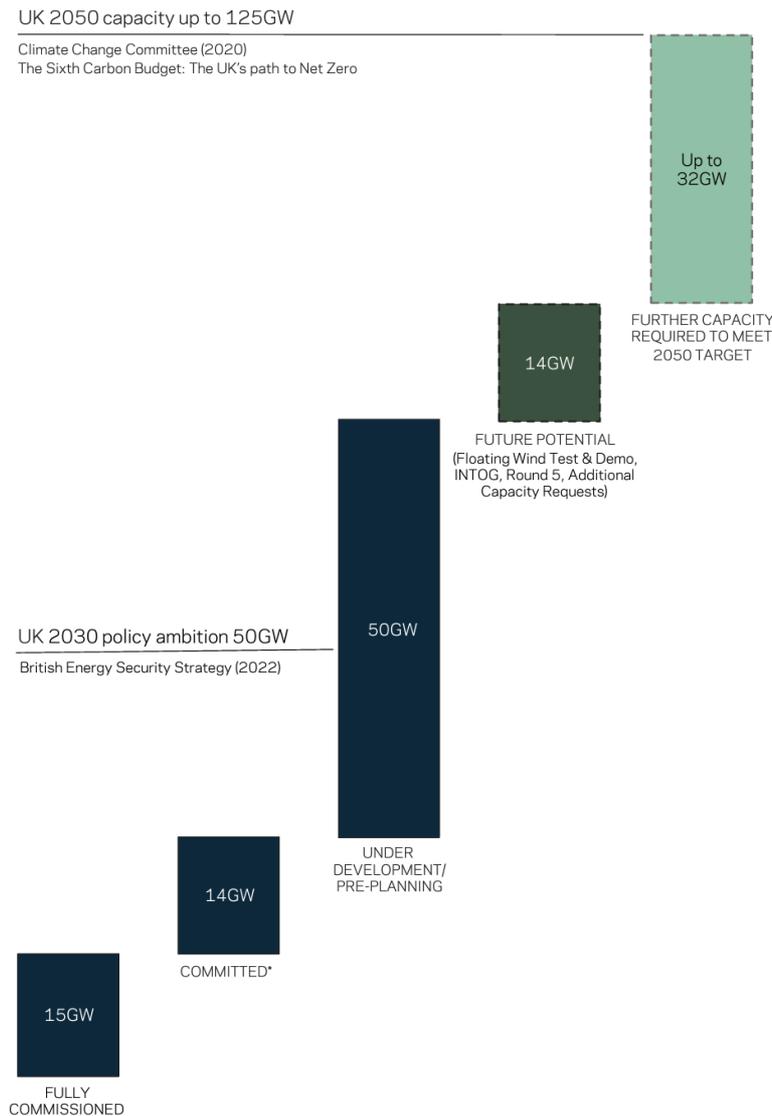
- ACCELERATE (Ecological Implications of Accelerated Seabed Mobility around Windfarms), investigating seabed conditions and how this can impact fish locations and the foraging success of seabirds. (Q1 2023 - Q4 2026)
- ECOWINGS (Ecosystem Change, Offshore Wind, Net Gain and Seabirds), transforming the evidence base on the cumulative effects of offshore wind on key seabird species, establishing pathways for strategic compensation and net gain options. (Q1 2023 - Q4 2025)
- PELAgIO (Physics-to-Ecosystem Level Assessment of Impacts of Offshore Windfarms), investigating the physical effects of OWF structures, changes in primary productivity and fish behaviour and the subsequent impact on seabirds. (Q1 2023 - Q4 2026)
- BOWIE (Benthic Offshore Wind Interactions Evaluation), assessing responses of invertebrates and fish to construction noise and vibration, EMF and elevated temperatures associated with cabling in combination with trawling and climate change stressors. (Q3 2023 – Q1 2027)

1.3 UK Offshore Wind Pipeline

Aspirations for offshore wind in the UK are high to meet the demands of the British Energy Security Strategy (BESS) which aims to deliver up to 50GW of offshore wind capacity by 2030, including 5GW of floating wind. In addition to this government target there is a potential need for up to 140GW of offshore wind by 2050 to meet the requirements identified by the Climate Change Committee¹. As of 2023, there are 51 OWFs either operational or under construction

¹<https://www.theccc.org.uk/wp-content/uploads/2020/12/Sector-summary-Electricity-generation.pdf>

across UK waters, which brings the total operational capacity in the UK to 14.2GW². A total of 78GW capacity has been identified as potential opportunity, with an additional 32GW yet to be identified to reach 2050 target within an increasingly busy sea space (Figure 1). All UK OWF projects from pre-leasing through to operational phases have been listed in the TCE December 2023 Report³.



* Projects under construction or that have government support on offer e.g. Contract for Difference OR taken FID

Figure 1. UK Offshore Wind Development Pipeline (December 2023) ⁴

² <https://www.thecrownestate.co.uk/our-business/marine/offshore-wind>

³ https://assets.ctfassets.net/nv65su7t80y5/6jBvwkJ3oY9SRB0oCQcxyr/3a389009172ec5dae05e487b12ae424f/OWProjectListing_DEC2023.pdf

⁴ https://assets.ctfassets.net/nv65su7t80y5/6xodTrV5zszXkBWY7mVZ3v/e4ae4704418d6a1b4feeb0632fe057e6/OWDevWaterfall_DEC2023.pdf

1.4 Floating Offshore Wind

FLOW enables deployment of turbines in deeper waters and the potential to develop where water depths were previously a barrier to fixed-base turbines. This means that new areas of the seabed can be used for the generation of renewable energy, where wind patterns are stronger and more reliable, supporting the UK's move away from fossil fuels and strengthening its energy security.

The UK currently has 78MW of FLOW operational including Hywind Scotland (30MW) and the Kincardine Floating OWF (FLOWF) (48MW)⁵. An additional 200MW is being developed through the construction of the Pentland FLOWF, which will be located offshore Dounreay, Scotland with construction starting in 2024, and operation in 2026, and the Erebus FLOWF which will be located offshore Pembrokeshire, Wales with construction starting in 2026. There are two FLOW demonstrators currently deployed, one in the North Sea (Tetraspar) and one in the southern Bay of Biscay (Demosath). There is also a planned 58.4MW FLOW demonstrator at Blyth off the Northumberland coast.

In the Autumn Statement (November 2023), the UK Government confirmed its intention to work with TCE to bring forward additional floating wind in the Celtic Sea through the 2030s, which could see an additional 12GW of generation deployed⁶.

1.5 Seabed Leasing Rounds

OWF developers must secure a seabed lease from TCE (for England, Wales, and Northern Ireland) or CES (for Scotland), which are granted through periodic leasing rounds.

1.5.1 Round 4

TCE Offshore Wind Leasing Round 4 creates the opportunity for around 8GW of new fixed offshore wind projects in the waters around England and Wales by 2030. The Agreements for Lease process concluded in January 2023, with the addition of six new projects (Figure 2). Three of the six projects are located off the North Wales, Cumbria and Lancashire coast, and three are located in the North Sea off the Yorkshire and Lincolnshire coast. The plan level Habitats Regulations Assessment (HRA) (see [section 2.3.1](#) for details on HRAs) concluded that the possibility of an adverse effect on integrity on protected sites could not be ruled out (see [section 2.2.2.1.2](#)).

⁵ <https://assets.publishing.service.gov.uk/media/64a54c674dd8b3000f7fa4c9/offshore-wind-investment-roadmap.pdf>

⁶ https://assets.publishing.service.gov.uk/media/6568909c5936bb00133167cc/E02982473_Autumn_Statement_Nov_23_Accessible_Final.pdf

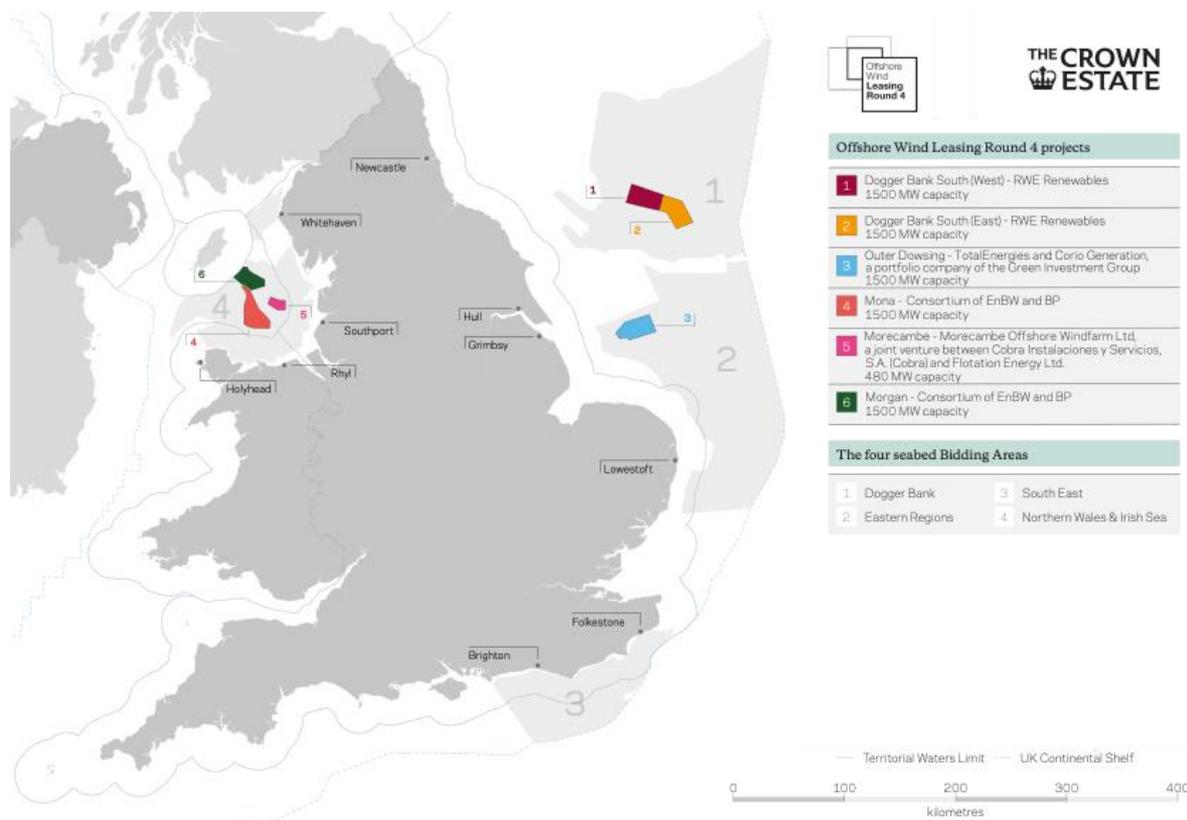


Figure 2. Round 4 Projects⁷

1.5.2 Round 5 Celtic Sea

The Round 5 Celtic Sea FLOW leasing round aims to deliver 4.5GW of floating wind by 2035. Three Project Development Areas, each with a potential capacity of up to 1.5GW have been identified to feed into the Round 5 tender⁸. In addition, the Plan includes three Test and Development sites (Liÿr 1, Liÿr 2 and WhiteCross), each up to 100MW of additional generating capacity, comprising FLOW turbines and associated infrastructure. A plan-level HRA for Offshore Wind Leasing Round 5 concludes that the plan, alone and in-combination, will not have an adverse effect on site integrity on any of the designated sites considered in the array assessment⁹. On 28 February 2024, a Concession Notice confirming the launch of the Round 5 tender process was published and concludes on 18 April 2024.

⁷ <https://www.thecrownestate.co.uk/media/3721/the-crown-estate-offshore-wind-leasing-round-4-selected-projects.pdf>

⁸ https://downloads.ctfassets.net/nv65su7t80y5/5zR4gHuqxjMG9NOK1L12Av/643bfa91696be32408e5e2646c16bbba/Information_Memorandum.pdf

⁹ <https://experience.arcgis.com/experience/c94ca80f13204b92959f999d1d440a9c/>

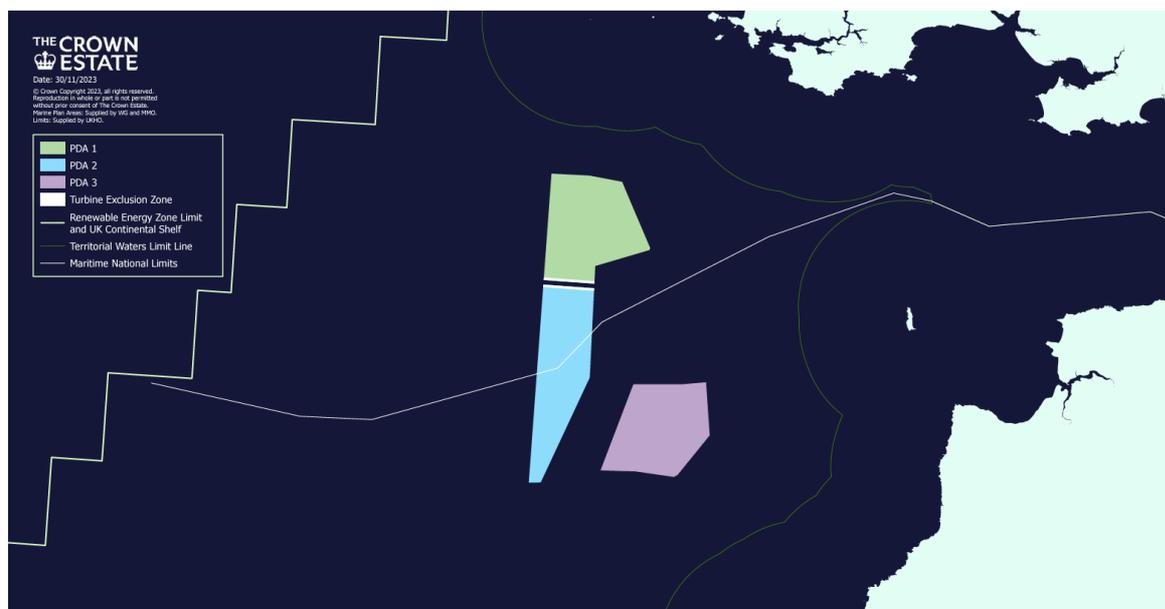


Figure 3. Round 5 Project Development Areas¹⁰

1.5.3 Capacity Increase Programme

TCE is proposing to add an additional 4GW of capacity from seven OWFs that are already in development. This is in recognition that since awarding seabed rights to these projects, offshore wind technology has improved, enabling more energy to be generated from the same seabed area. The OWFs are: Awel y Mor, Dudgeon Extension, Sheringham Shoal Extension, North Falls, Five Estuaries, Rampion 2 and Dogger Bank D. They are currently undertaking a plan level HRA to understand the collective environmental impact of the additional capacity across all seven projects¹¹.

1.5.4 ScotWind

The ScotWind leasing round was announced in 2022 and resulted in 20 projects securing seabed option agreements, 13 of which are floating and 7 are fixed OWFs. ScotWind is 'plan-led', meaning that all sites are within the areas of seabed identified in the Scottish Government's Sectoral Marine Plan for Offshore Wind.

Several of the developers have also increased the capacity of their ScotWind lease sites with two projects, Ossian and Caledonia, looking to add a further 1GW each and 400MW being added to Broadshore. This has increased the total capacity from Scotwind leasing round to 30GW¹².

¹⁰ <https://www.thecrownestate.co.uk/our-business/marine/project-development-areas>

¹¹ <https://www.thecrownestate.co.uk/news/the-crown-estate-sets-out-plan-to-unlock-enough-new-offshore-wind-capacity>

¹² <https://www.offshorewindscotland.org.uk/the-offshore-wind-market-in-scotland/scotwind-leasing-round/>

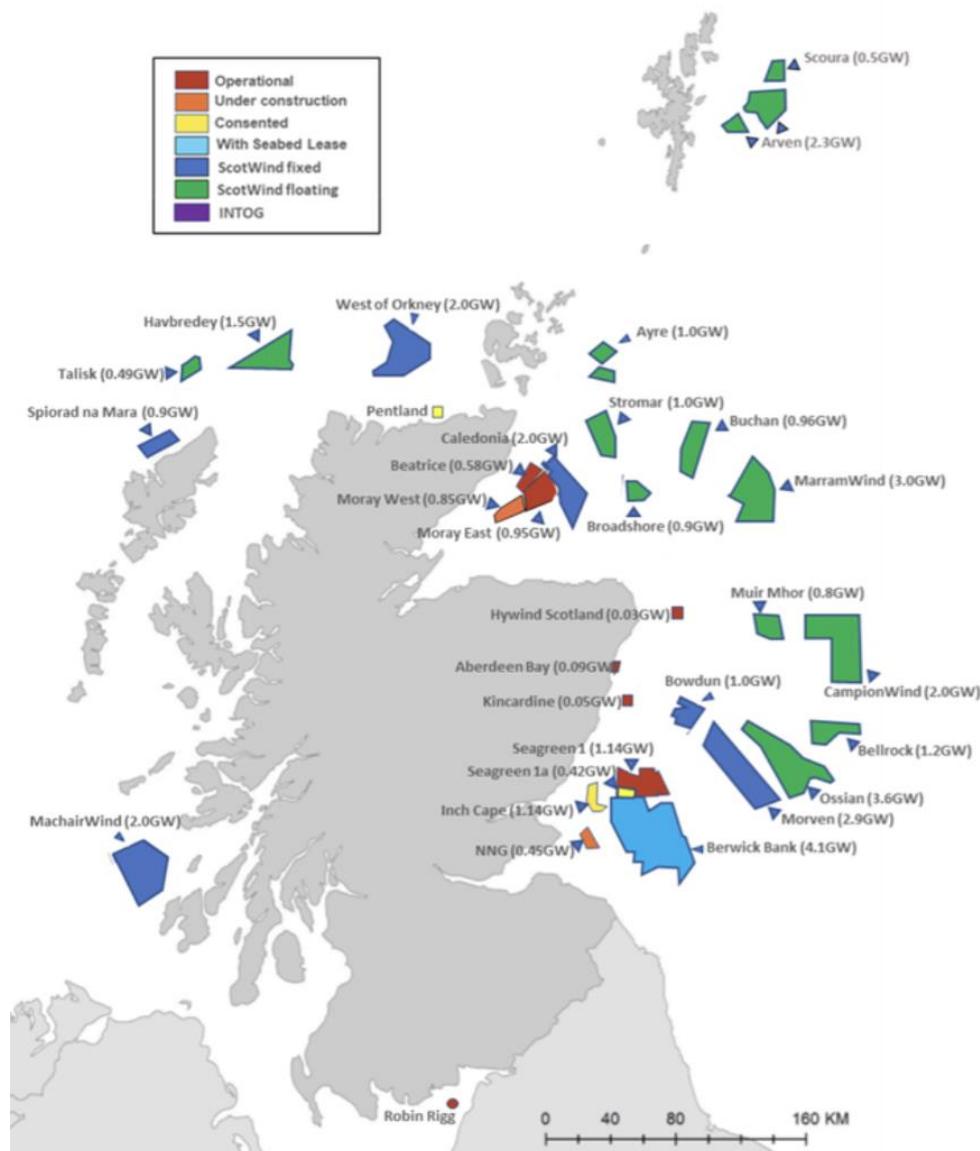


Figure 4. ScotWind Projects

1.5.5 The Innovation and Targeted Oil and Gas Round (INTOG)

The Innovation and Targeted Oil and Gas Round (INTOG) leasing round facilitated applications for seabed rights to develop OWFs in Scottish waters that either supply renewable electricity directly to Oil and Gas (O&G) infrastructure or comprise small-scale innovative projects of 100MW or less. Among the applicants, 5 innovative OWF projects were chosen, alongside 7 targeted O&G leases, potentially adding a total capacity of 4-5.5GW¹³.

¹³ <https://www.offshorewindscotland.org.uk/the-offshore-wind-market-in-scotland/intog-leasing-round/>

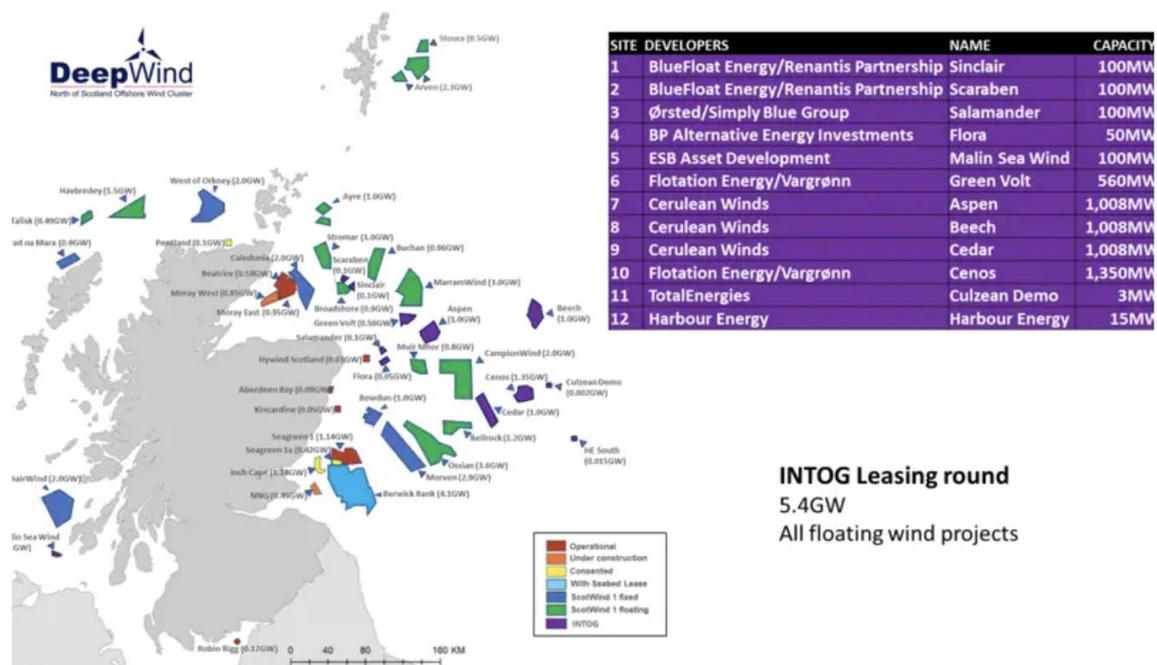


Figure 5. INTOG Projects¹⁴

1.5.6 Opportunities to create impact

The priority opportunities areas where the ECOFlow / ECOWind research can create impact across the leasing round process include:

- Plan level monitoring, modelling and assessment of cumulative impacts.
- Plan level development of mitigation and compensation measures to address potential impacts.
- Development of strategic monitoring approaches and monitoring technologies.
- Plan level SEA / HRA scoping of effects based on enhanced understanding of the ecological impact of FLOW structures.
- Contributing to the evidence base behind plan level SEA/HRA undertaken.
- Contributing to the evidence base behind project level compensation.

2 Offshore Wind Policy and Legislation Landscape

The offshore wind sector relates to multiple policy objectives, including energy, environmental, and fisheries, all of which are considered within sectoral and marine spatial planning and prioritisation. This section provides an overview of the governmental framework, followed by an analysis of relevant policies, legislation, and goals.

Pathways to Growth (P2G) have created an interactive tool to map the relationships between entities working in the offshore wind consenting space. This tool illustrates the interconnections and key stakeholders across government, SNCBs, industry, developers, working groups, programs of work, and more¹⁵. Recognising the collaborative dynamics

¹⁴ <https://www.offshorewindscotland.org.uk/the-offshore-wind-market-in-scotland/intog-leasing-round/>

¹⁵ <https://embed.kumu.io/6aa7584020d2c665393c76122ea99fe6>

among different government entities is essential for developing effective strategies to engage end users.

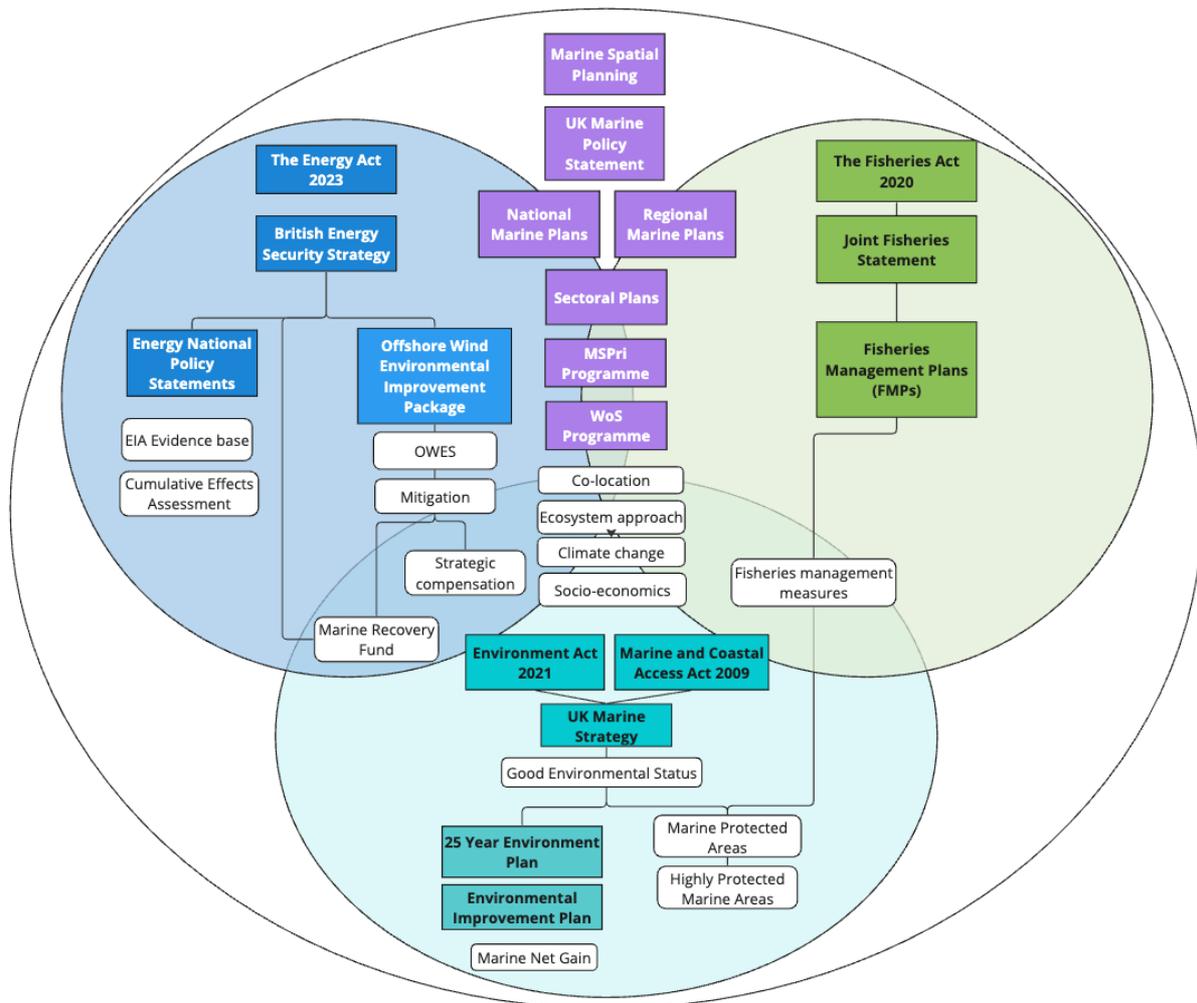


Figure 6. Interconnected policies and objectives across energy, environment, fisheries and marine planning.

2.1 Marine Planning Policy and Legislative Landscape

Significant effort is underway to optimise marine areas to reach energy and environmental ambitions and targets for 2030, 2042 and 2050. This section gives an overview of the marine planning policies, strategies and programmes to be aware of. The section is concluded with how ECOWind and ECOFlow research can contribute to marine planning initiatives.

2.1.1 UK Marine Policy Statement

This Marine Policy Statement (MPS) is the framework for preparing Marine Plans and taking decisions affecting the marine environment across the UK marine areas. The MPS framework is designed to ensure that authorities are considering the economic, social and environmental benefits and adverse effects of plans and proposals for the marine plan areas.

2.1.2 National and Regional Marine Plans

2.1.2.1 England

England has divided marine planning into 11 marine plan areas: South West (inshore and offshore), South (inshore and offshore), South East (inshore), East (inshore and offshore), North East (inshore and offshore) and North West (inshore and offshore)¹⁶. The Explore Marine Plans spatial tool identifies areas of potential conflict, policies to be considered, opportunities for co-existence and relevant stakeholders¹⁷.

The East Marine Plans are being replaced following the 3-year reporting cycle¹⁸ that identified changes in national priorities since 2014. The outputs of the Marine Spatial Prioritisation (MSPri) programme (see [section 2.1.4](#)), will evolve the marine planning approach and inform the development of the East Inshore and East Offshore Marine Plans for adoption by 2027.

2.1.2.2 Scotland

Scotland's National Marine Plan (NMP) establishes how Scottish Ministers intend marine resources to be used and managed. It is complemented by the Sectoral Marine Plan for Offshore Wind Energy (see [section 2.1.3.2](#)). The NMP is currently being updated to the NMP 2 to better address the twin crises of climate change and biodiversity loss through managing the increased competition for space and resources in the marine environment. This process started in 2023 and will take several years to complete¹⁹.

2.1.2.3 Wales

The Welsh National Marine Plan was produced in 2019 and takes a 20-year view, with an objective to develop a sustainable marine economy, living within environmental limits²⁰. The Welsh Marine Planning Portal provides detail on plan areas, policies, and sector policies²¹.

2.1.2.4 Northern Ireland

The Department of Agriculture, Environment and Rural Affairs (DAERA) of Northern Ireland have produced the draft Marine Plan for Northern Ireland which consists of two plans, one for the inshore region and one for the offshore region²².

2.1.3 Sectoral Plans

2.1.3.1 The Strategic Spatial Energy Plan (SSEP)

The SSEP will be a spatial energy plan that sets out the location and timing of energy infrastructure delivery to support the UK's target for a decarbonised energy system. The plan will give increased certainty for investors and industry and provide opportunity for community engagement. It will be produced by the Electricity Systems Operator and National Energy

¹⁶ <https://www.gov.uk/government/publications/marine-plan-areas-in-england>

¹⁷ <https://explore-marine-plans.marineservices.org.uk/>

¹⁸ https://assets.publishing.service.gov.uk/media/6422d1032fa8480013ec0d1b/East_Report_2023.pdf

¹⁹ <https://www.gov.scot/policies/marine-planning/national-marine-planning/>

²⁰ https://www.gov.wales/sites/default/files/publications/2019-11/welsh-national-marine-plan-document_0.pdf

²¹ <https://lle.gov.wales/apps/marineportal/#lat=52.5145&lon=-3.9111&z=8&tgt=false&layers=231,390>

²² <https://www.daera-ni.gov.uk/sites/default/files/consultations/daera/Marine%20Plan%20for%20NI%20final%2016%2004%2018.PDF>

System Operator (NESO) (once established) through close working with the government, including the Marine Spatial Prioritisation (MSPri) (see [section 2.1.4](#)) and Whole of Seabed (WoS) (see [section 2.1.5](#)) Programmes, and in consultation with Ofgem. It forms part of a wider planning reform to accelerate network investment, including connecting offshore wind and is a recommendation from the Electricity Networks Commissioner's report published in August 2023, which makes recommendations on how to accelerate the deployment of transmission infrastructure in Great Britain.

2.1.3.2 Scottish Sectoral Marine Plan for Offshore Wind

The Scottish sectoral marine plan for offshore wind energy was published in 2020 and is now being reviewed with a revised plan expected to be adopted by Spring 2025. It aims to identify the most sustainable options for the future development of offshore wind energy in Scotland, through minimising potential adverse effects on other sea users, economic sectors and the environment and maximising opportunities for commercial scale offshore wind development, including deeper water technologies.

2.1.3.3 Welsh Strategic Resource Areas

Potential Strategic Resource Areas (SRAs) are being mapped in Wales as a mechanism to safeguard areas of natural resource. The intention is that they will ensure that different sectors interests are taken into account by others and encourage dialogue between sectors, including how they can co-exist within the same area. There is a proposed SRA for tidal stream energy, wave energy and floating offshore wind²³.

2.1.3.4 Northern Ireland

An Offshore Renewable Energy Action Plan for Northern Ireland is in development to deliver 1GW of offshore wind from 2030 as set out in Energy Strategy for Northern Ireland^{24 25}.

2.1.4 Marine Spatial Prioritisation Programme

Defra has developed the cross-Government MSPri Programme in England, aiming to address the increasing demand on the use of the sea. The programme will increase understanding of the current and future demands for the sea, how to maximise colocation between all sea users and prioritise use of marine space, to better manage the increasing spatial squeeze on seas.

The programme is undertaking modelling informed by geospatial data on existing and future sea uses across key sectors up to 2050. They are working in close collaboration with the TCE Whole of Seabed (WoS) programme (see [section 2.1.5](#)) to ensure alignment. The MSPri programme will produce maps of optimal areas for marine activities, allowing for improved coordination of infrastructure and deployment of offshore wind and other energy uses. The outputs of the MSPri programme will inform the development of updated Marine Plans for England, starting with the East Inshore and East Offshore Marine Plans.

²³ <https://lle.gov.wales/apps/marineportal/#lat=52.5145&lon=-3.9111&z=8&tgt=false&layers=231,390>

²⁴ <https://www.economy-ni.gov.uk/sites/default/files/consultations/economy/Offshore-Renewable-Energy-Action-Plan-Consultation.pdf>

²⁵ <https://www.economy-ni.gov.uk/publications/offshore-renewable-energy-action-plan-sea-scoping-report>

To represent the demands on marine resources and facilitate trade-off decisions, sectors such as offshore wind, fishing, and nature recovery (treated as a sector) are being considered under the MSPri programme.

2.1.5 Whole of Seabed (WoS) Programme

TCE has developed the WoS programme to catalyse the delivery of multiple priorities including net zero and nature recovery, as well as the enhanced co-ordination of future activities out to 2050. The aim of the programme is to help de-risk and accelerate the ambitions of industry in a way that supports diverse marine environments and other users of the sea.

It is anticipated that the WoS will need to account for a range of factors, including options for expanding offshore wind capacity, infrastructure such as cables and pipelines, nature efforts including habitat restoration, biodiversity enhancement, and nature recovery, coastal development such as ports and harbours, storage solutions including carbon capture, utilisation and storage, hydrogen, and natural gas facilities, as well as considerations related to mineral extraction such as reclamation, aggregate dredging, and marine mining. The WoS programme is developing significant spatial planning capability within TCE that will be supporting other bodies who are delivering marine planning, such as the MMO, MSPri and TCE plan level environmental assessments.

2.1.6 Consenting Process

There are various routes for obtaining consent for OWF installations depending on the country, power generation capacity, and proximity to shore of the proposed OWF²⁶. All consent applications require an Environmental Impact Assessment (EIA) and Habitats Regulations Assessment (HRA) which involve various statutory consultees and Statutory Nature Conservation Bodies (SNCBs). They are often the primary points of contact for offshore wind developers and consultants providing advice on methodologies for EIAs and HRAs and selecting appropriate research or tools to use in the process.

2.1.7 Entry points for research impact

ECOFlow and ECOWind research will be important to marine spatial planning as the research has the potential to influence the locations of future OWFs through improving the understanding of the potential ecosystem impacts and tools to enable the acceleration in its deployment.

The priority opportunity areas where ECOFlow / ECOWind can create impact include:

- Building evidence for how offshore wind expansion, fisheries, and climate change are going to cumulatively impact marine ecosystems.
- Providing evidence on how ecosystem dynamics and services are effected by different uses of the sea.
- Providing evidence on opportunities for nature restoration and recovery.
- Developing ecosystem, natural capital and socio-economic approaches for optimising marine space and informing trade off decisions.

²⁶ https://splendorous-biscochitos-b07017.netlify.app/#/lessons/uL6st0YyIBL4tS_tkAAq5WJQcTOqWxdF

2.2 Energy Policy and Legislative Landscape

This section provides an overview of energy policies, strategies, and programmes which are developing rapidly to meet evolving energy targets and potential research contributions.

2.2.1 The British Energy Security Strategy (BESS)

The BESS was announced in April 2022 and sets out the UK government's ambition to deliver up to 50GW of offshore wind in the UK by 2030, including up to 5GW of floating wind. It includes commitment to deliver several policy and institutional changes to achieve this target:

- Strengthening the renewable National Policy Statements (NPS) to reflect the importance of energy security and net zero (see [section 2.2.2](#)).
- Reducing consent time from up to four years down to one year and making environmental considerations at a more strategic level allowing the process to be sped up while improving the marine environment. The Department for Levelling Up, Housing and Communities (DLUHC) published a Nationally Significant Infrastructure Project (NSIP) Action Plan in February 2023 and has committed to bringing forward reforms to ensure the existing system can support our future infrastructure needs by making the NSIP consenting process better, faster, greener, fairer and more resilient by 2025.
- The establishment of an offshore wind acceleration task force, which has finished with the production of an independent report from the offshore wind champion²⁷.

2.2.2 The Energy National Policy Statements

The 2023 revised NPS came into force on 17 January 2024.²⁸ These set specific targets for the delivery of renewable energy infrastructure and provide a clear indication of the Government's intention to deliver net zero as well as giving practical guidance to planning authorities and industry to facilitate the delivery of renewable energy infrastructure projects.

The updates that are noteworthy:

- The NPS for Energy (EN-1) 2023²⁹ announced plans to reform EIA and SEA. The update included assessment principles guidance with enhanced focus on avoidance, mitigation, compensation and good design.
- The NPS for Renewable Energy Infrastructure (EN-3) 2023³⁰ refers to the Offshore Wind Environmental Improvement Package (OWEIP) (see [section 2.2.3](#)) and the establishment of Offshore Wind Environmental Design Standards (OWES), the need to have regard to the Environmental Improvement Plan (EIP) and 25 Year Plan (25YEP) (see [section 2.3.3](#)), strategic compensation (see [section 2.2.3.1](#)) and the need for improving the evidence base for future compensation measures.

²⁷ <https://assets.publishing.service.gov.uk/media/65a662c1867cd800135ae90b/offshore-wind-champion-independent-report.pdf> recommending how to accelerate the deployment of offshore wind.

²⁸ <https://www.gov.uk/government/collections/national-policy-statements-for-energy-infrastructure>

²⁹ https://assets.publishing.service.gov.uk/media/64252f3b60a35e00120cb158/NPS_EN-1.pdf

³⁰ https://assets.publishing.service.gov.uk/media/64252f5f2fa848000cec0f52/NPS_EN-3.pdf

- They also note the need to consider the diverse nature of the UK fishing industry when assessing impacts, as well as reflecting that offshore wind developments can have both positive and negative impacts on fisheries³¹.

2.2.3 OWEIP

The Offshore Wind Environmental Improvement Package (OWEIP) was also announced as part of the BESS to help accelerate offshore wind deployment whilst continuing to protect the marine environment. The OWEIP is focussing on:

- Environmental Assessment Reform: to make targeted reforms to environmental assessment (both HRA and MCZ assessments) for offshore wind. In February 2024 Defra consulted on policies to inform updated guidance for MPA assessment and how compensatory measures should be delivered (this applies to all marine industries, not just offshore wind)³².
- Strategic Compensation: to develop strategic compensation measures to reduce consenting delays and improve environmental outcomes. The Collaboration on Offshore Wind Strategic Compensation (COWSC) has been established to develop strategic compensatory measures (see [section 2.2.3.1.1](#)).
- Marine Recovery Fund: establish a fund that offshore wind developers or plan promoters could optionally pay into to deliver strategic compensatory measures. This would enable them to discharge their compensation obligations, should appropriate measures be available to fulfil their mandatory requirement to compensate for negative effects to MPAs that cannot be avoided.
- Offshore Wind Environmental Design Standards (OWES): these will set a minimum common requirement for designing offshore wind projects to provide a standard approach to mitigation and to potentially reduce the need for compensation. Defra is currently developing these and a consultation is expected later this year.
- Strategic monitoring: to enable the collection of new evidence to improve the understanding of the environmental impacts of offshore wind, which will allow for a greater understanding of cumulative environmental impacts.

2.2.3.1 Strategic Compensation

Individual offshore wind projects have faced difficulties in securing suitable compensation measures for impacts to MPAs, largely due to the novelty and uncertainty of offsetting impacts in the marine environment (see [section 2.3.1](#) for information on MPAs and compensation). Strategic compensatory measures are being considered with the intention that they will be more ecologically robust than project level measures and offer better solutions for addressing cumulative effects across various projects and sectors.

³¹<https://assets.publishing.service.gov.uk/media/655ddb1f544aea0019fb323b/national-policy-statement-consultation-government-response.pdf>

³² https://consult.defra.gov.uk/offshore-wind-environmental-improvement-package/consultation-on-updated-guidance-for-environmental/supporting_documents/090224%20OWEIP%20Consultation%20on%20updated%20policies%20to%20inform%20guidance%20for%20MPA%20assessments_.pdf

2.2.3.1.1 COWSC

The Collaboration on Offshore Wind Strategic Compensation working group (COWSC) has been set up by Defra and the Offshore Wind Industry Council (OWIC) and involves the offshore wind industry, Non-Governmental Organisations (NGO), government departments, devolved administrations, TCE and CES to develop strategic compensation measures to include in a government endorsed 'library of measures' which could be used by the MRF.

The first measures for the strategic compensation library have been recommended by COWSC, these are:

- Predator reduction or eradication for seabirds.
- Artificial nesting towers for black legged kittiwakes in the English North Sea.
- Designation of additional MPAs for benthic habitats.

These are to compensate for the impacts of offshore wind plans and projects currently in the consenting pipeline in English Waters e.g. Round 3, Extensions and Round 4. More evidence is needed to support these measures as well as developing additional measures, including other measures that are already being investigated by COWSC, particularly as offshore wind development moves into new locations e.g. the Celtic Sea.

2.2.3.1.2 Leasing Round 4, plan level compensation

The Round 4 plan level HRA concluded that an adverse effect on integrity as a result of the Round 4 plan cannot be ruled out for kittiwakes from the Flamborough and Filey Coast Special Protection Area (SPA) and sandbanks within the Dogger Bank Special Area of Conservation (SAC)³³. A derogation was sought from DESNZ, which would allow the plan to progress if certain tests are met, while ensuring that any impacts to the designated sites are fully offset through environmental compensatory measures. Strategic, plan level compensation measures are being identified by TCE as the plan promoter. The kittiwake plan level compensation plan was published in February 2024³⁴ with the preferred measure of kittiwake prey enhancement through the management of sandeel fisheries. This measure might not be available as a compensation option for Round 4, they are proposing strategic artificial nesting structures as an alternative option.

2.2.4 Cumulative Impact Assessment

Requirements for Cumulative Impact Assessments (CIAs) fall under several legislative frameworks and policies including the Marine and Coastal Access Act 2009, the Habitats Regulations, the UK Marine Policy Statement and the NPS (EN-1). The NPS mandates consenting authorities to consider cumulative effects when assessing individual applications, so developers have to provide project-level EIA and CIA assessments.

There has been criticism that current licencing conditions are inadequate for addressing ecological shifts and lack linking in populations to spatio-temporal changes from local to ecosystem scales.

³³ <https://www.marinedataexchange.co.uk/details/TCE-3582/2022-the-crown-estate-2020-offshore-wind-round-4-plan-habitats-regulations-assessment/packages?type=Report>

³⁴ https://assets.ctfassets.net/nv65su7t80y5/17AnpAwydDxhtwpalkUOzv/0f96aa29b63fa32bf9f500e9a5b5cc32/43569-TCE-DOC-062_Kittiwake_Strategic_Compensation_Plan_FINAL_SIGNED.pdf

Scottish Government and the European Maritime and Fisheries Fund funded the Cumulative Effects Framework for Key Ecological Receptors project led by UK Centre for Ecology and Hydrology. This project is producing an online tool that predicts impacts at a population level for both individual projects and cumulative assessments, with a clear audit trail to provide transparency and reproducibility for evidence in consenting.

2.2.5 Entry points for research impact

The priority opportunity areas where ECOFlow / ECOWind can create impact include:

- Developing research that supports synergies with existing programmes, both within and outside government (see [section 3](#) and [section 4](#)). This is a fast-moving policy environment and there is an increasing need for expert support to inform policy development. This could be in the form of contribution to expert working groups, shaping emerging research to answer short term policy needs, or providing assurance that evidence needs are being met in the medium to long term.
- Building the evidence base around key gaps on OWF impacts, considering impacts under ecosystem dynamics, cumulative impacts and minimising adverse impacts.
- Providing insights and evidence for potential Offshore Wind Environmental Design Standards (OWES) for floating offshore wind.
- Contributing to key evidence gaps on strategic compensation measures such as:
 - Artificial nesting for seabirds
 - Predator control for seabirds
 - Habitat creation, primarily for benthic ecology benefits
 - Infrastructure repurposing or removal, primarily for benthic ecology benefits
 - Exploring fisheries management measures as strategic compensation options
- Informing future guidance based on site specific evidence, information exchange and engagement with stakeholders.
- Enhancing intergovernmental collaboration by identifying strategic compensation measures across jurisdictions. For example, evidence about the connectivity of bird populations can inform measures across UK waters and beyond.
- Reducing evidence gaps in CIA, such as insights into understanding ecological functions and food webs to better inform CIA.
- Evidence of cumulative impacts at multiple scales and alignment of sectoral and ecological scales to inform trade-offs and planning marine use.
- Provide understanding on best ecological and strategic compensation measures to mitigate CIA.

2.3 Environment Policy and Legislative Landscape

This section provides an overview of key environment and nature legislation, policies, strategies, and programmes, highlighting key updates and potential contributions of research.

2.3.1 Marine Protected Areas (MPAs)

The UK network of MPAs consists of 375 sites and is one of the primary tools for protecting our marine environment and contributes to both national and international targets and

commitments, including the achievement of Good Environmental Status under the UK Marine Strategy (see [section 2.3.4](#)). There are several different types of MPAs within the UK:

- Special Areas of Conservation (SACs) and Special Protection Areas (SPAs) protected under the Habitats Regulations, which together comprise the National Site Network.
- Marine Conservation Zones (MCZs) in England and Wales protected under the Marine and Coastal Access Act and in Northern Ireland under the Marine Act (Northern Ireland).
- Nature Conservation MPAs in Scotland protected under the Marine Scotland Act.

The effects of developments on MPAs must be considered through a Habitats Regulations Assessment (HRA) for SACs and SPAs, or an MCZ assessment for MCZs. The mitigation hierarchy of avoid, reduce, mitigate must be followed. If an HRA of a plan or a project cannot demonstrate that there will be no adverse effect on the integrity of an SAC or SPA, then it cannot be consented unless it is considered necessary for imperative reasons of overriding public interest, there are no alternatives, and compensatory measures have been secured to offset the impact. There are similar requirements in place for impacts to Marine Conservation Zones (MCZs)³⁵.

2.3.2 Environment Act 2021

The Environment Act 2021 sets clear statutory targets for biodiversity, including a legally binding target on reversing species decline by 2030, alongside provisions for new developments to improve or create habitats for nature. This legislation translates the ambitions outlined in the 25 Year Environment Plan (25YEP) into actionable measures through the Environmental Improvement Plan (EIP).

A legally binding target for England was set within the Environmental Target (Marine Protected Areas) Regulations 2023, that requires:

- at least 70% of protected features in English MPAs to be in a favourable condition by 31 December 2042 with the rest in recovering condition,
- all other protected features in English MPAs will be in recovering condition.

2.3.3 25 Year Environment Plan and Environmental Improvement Plan

The 25YEP sets out the Government's vision for action to help the natural world regain and retain good health. The Environmental Improvement Plan³⁶ (EIP) 2023 for England is the first revision of the 25YEP and sets out ten goals and interim targets to measure progress for improving nature. Progress on achieving these goals will be measured in the Outcome Indicator Framework³⁷ which includes the following indicators for Seas and Estuaries which align with UKMS indicators:

- [C1: Clean seas: marine litter](#)
- [C2: Seabed subject to high pressure from human activity](#)
- [C3: Diverse seas: status of marine mammals and marine birds](#)

³⁵ <https://www.gov.uk/government/publications/marine-conservation-zones-mczs-and-marine-licensing>

³⁶ <https://www.gov.uk/government/publications/environmental-improvement-plan>

³⁷ <https://oifdata.defra.gov.uk/>

- [C4: Diverse seas: condition of seafloor habitats](#)
- [C5: Diverse seas: condition of pelagic habitats](#)
- [C6: Diverse seas: status of threatened and declining features](#)
- [C7: Healthy seas: fish and shellfish populations](#)
- [C8: Healthy seas: marine food webs functioning](#)
- [C9: Healthy seas: seafloor habitats functioning](#)
- [C10: Productive seas: fish and shellfish stocks fished sustainably](#)
- [C11: Productive seas: status of sensitive fish and shellfish stocks](#)

2.3.4 UK Marine Strategy

The UK Marine Strategy (UKMS) is derived from the EU Marine Strategy Framework Directive and aims to provide the environmental framework for delivering marine policy at the UK level. It sets out how to achieve the vision of clean, healthy, safe, productive, and biologically diverse oceans and seas across three parts³⁸:

- **Part 1 – UK Assessment & Good Environmental Status (GES):** 11 descriptors of GES, each with targets and indicators for assessing status. Some of these descriptors are further subdivided across key species groups or habitats.
- **Part 2 – UK Monitoring programmes:** An approach to monitoring these key descriptors, targets and indicators across UK administrations, drawing on the existing UK Marine Monitoring and Assessment Strategy.
- **Part 3 – Programme of Measures:** A programme setting out the measures that contribute to the achievement and maintenance of GES in UK seas by 2020.

The initial round of the UKMS Part 1 (initial assessment), Part 2 (monitoring programme) and Part 3 (programme of measures) were published between December 2012 and December 2015. The second implementation cycle Part 1 and Part 2 were published in 2019 and 2020 respectively. Part 3 was expected to be published in 2022/23 and will define a programme of measures for assessing the status of the UK seas up to 2027. Work is ongoing within Defra looking at reform of the UKMS in line with the third implementation cycle in 2024.

2.3.5 Marine Net Gain

The commitments in the 25YEP and the EIP are driving the implementation of biodiversity net gain and Marine Net Gain (MNG) in England. Net gain is an approach to development that aims to leave the natural environment in a measurably better state than beforehand. This means protecting, restoring, or creating environmental features that are of greater ecological value to wildlife, habitats and people than any losses associated with the new development.

MNG is at an early stage of development, the government published its response to its consultation on the principles of MNG in December 2023³⁹, in this it stated that it:

³⁸ <https://moat.cefas.co.uk/introduction-to-uk-marine-strategy/>

³⁹<https://www.gov.uk/government/consultations/consultation-on-the-principles-of-marine-net-gain/outcome/government-response>

- Will include impacts on both habitats and species within the MNG assessment framework.
- Will continue to consider impacts beyond site boundaries in the assessment framework
- Will recognise wider environmental benefits that biodiversity enhancement can deliver when assessing MNG interventions, but will maintain the ‘nature first’ approach, with net gain for biodiversity being the core requirement.
- Will continue to explore the role of positive incidental effects in developing the MNG assessment framework, particularly around artificial reefs and exclusionary effects e.g. fisheries pressure reduction.
- Will continue to explore potential design options for the delivery of MNG including contributions based and metric style approaches.
- Will provide clarity on how MNG will sit alongside Biodiversity Net Gain (BNG) at the coast.

MNG will only apply to developments below the mean low water mark in English waters. This is a developing policy area, but the intention is that MNG interventions will consist of pressure reduction measures as well as active restoration/enhancement interventions and can be delivered at both a site based level and at a strategic scale.

2.3.6 Highly Protected Marine Areas

Highly Protected Marine Areas (HPMAs) are areas of the sea designated to prohibit extractive, destructive, and depositional uses, that will allow the protection and full recovery of marine ecosystems to a more natural state. HPMAs protect all species and habitats and associated ecosystem processes within the site boundary, including the seabed and water column. HPMAs will help the government achieve its key environmental goals and targets, such as in the EIP, 25YEP, 30 by 30 commitment, net zero, sustainable fisheries and marine nature recovery⁴⁰.

The UK Government committed to designating pilot HPMAs in 2022 in English waters based on recommendations of the Benyon Review (Benyon et al., 2020)⁴¹. The first 3 HPMAs in English Waters were designated on 5th July 2023⁴²:

- Allonby Bay
- North East of Farnes Deep
- Dolphin Head

This initial pilot phase of three HPMAs will inform future policy and the exploration of additional sites for consideration as HPMAs. It is expected that fisheries management measures within the HPMAs will be implemented in early 2024. The delivery of the HPMAs will identify areas where development is prohibited as well as defining assessment requirements and evidence needs to allow the protection and recovery of marine ecosystems. It will provide an understanding of the recovery potential of different habitat types and ecosystems and help in defining what ‘good’ looks like in the absence of human activities and pressures.

⁴⁰ <https://www.gov.uk/government/publications/highly-protected-marine-areas/highly-protected-marine-areas-hpmas>

⁴¹ https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/890484/hpma-review-final-report.pdf

⁴² <https://www.gov.uk/government/publications/highly-protected-marine-areas/highly-protected-marine-areas-hpmas#how-we-will-manage-pilot-hpmas>

In 2023 the Scottish Government consulted on proposals to designate at least 10% of Scotland's seas as HPMA's by 2026. In response to the findings of the consultation this proposal is not currently being taken forward⁴³. The Cabinet Secretary therefore announced her intention, that while remaining firmly committed to enhancing marine protection, the Scottish Government will no longer seek to implement HPMA's across 10% of Scotland's seas by 2026.

2.3.7 Entry points for research impact

The priority opportunity areas where ECOFlow / ECOWind can create impact include:

- Generating key evidence to inform UKMS assessments of GES where relevant to offshore wind and directly inform the programme of measures. Key knowledge gaps identified by the UKMS Part 2 where the research can make an impact and contribution include:
 - changes in benthic food web structure (e.g. picoplankton), hydrodynamic conditions and human impact (e.g. on sea floor integrity),
 - the extent of changes in predator-prey interactions,
 - at-sea data collection of the abundance and distribution of sea birds and
 - the inclusion of a wider selection of waterfowl species in the marine birds indicators
- Testing and strengthening the capability and confidence in modelling approaches to assessment and interventions, underpinned by robust monitoring and data collected using innovative methods.
- UKMS processes are delivered jointly by the devolved administrations. There is an opportunity to use the outcomes from the research programmes to inform policy and decision making across UK administrations by facilitating cross-administration discussions and contributing to this joint policy implementation framework.
- Improving the understanding of the baseline and future modelled climate change scenarios for key habitats and species to provide the context within which compensation and MNG may happen, as well as indicate what are impacts from offshore wind development compared to wider climate change impacts.
- Contributing to discussions on the development, monitoring and assessment of a MNG framework and enhancing understanding of the ecological cumulative impacts of offshore wind structures to inform MNG requirements or actions.
- Adding to the evidence base that supports the creation of a directory of strategic MNG interventions.
- Developing evidence to understand the impact of offshore wind development on species and habitats of conservation importance. This can inform decision making around site selection as well as the future monitoring, assessment and management of HPMA's to promote recovery of features and ecosystem services such as blue carbon stocks.
- Identification of the relative contribution of species population trends (e.g. increase or decrease) to the coherence and functioning of the network of MPAs will allow an understanding of where management focus should be directed.

⁴³ <https://www.gov.scot/publications/scottish-highly-protected-marine-areas-hpmas-consultation-scottish-government-response-consultation/>

- Providing insights into optimising environmental design to maximise positive ecosystem impacts of OWF development.

2.4 Fisheries Policy and Legislative Landscape

This section focuses on the fisheries policy and legislation. Providing an overview of key fisheries policies, strategies, and programmes that relate to offshore wind, highlighting key updates and potential contributions of research.

2.4.1 The Fisheries Act 2020

The Fisheries Act 2020 gives the UK full control of its fishing waters. The overall aim of the act is to deliver the following 8 objectives:

- Environmentally, economically, and socially sustainable fisheries.
- The precautionary approach to fisheries management is applied.
- An ecosystem-based approach to management is used.
- Best scientific advice is used to develop management measures.
- Bycatch is minimised and avoided.
- Equal access is applied to all British fishing boats.
- Fishing provides a national social or economic benefit.
- The impacts of fisheries on climate change is reduced and fisheries adapt to the effects of climate change.

The Act creates a legal requirement for the UK's four national fisheries policy authorities (MMO, Scottish Ministers, Welsh Ministers, and DAERA) to produce a Joint Fisheries Statement (JFS) that will lay out how these objectives will be met.

2.4.2 Joint Fisheries Statement

The JFS sets out the policies for achieving the 8 fisheries objectives in the Fisheries Act.⁴⁴ It outlines the responsibilities of the fisheries policy authorities as follows:

- Adopt an ecosystem-based approach to management.
- Implement management measures for protecting spawning and nursery areas of key stocks, reducing seabed abrasion, and reducing unwanted catches.
- Publishing Fisheries Management Plans (FMPs) for stocks of socio-economic importance, at risk of significant over-exploitation or hold ecosystem significance.
- Manage non-quota stocks through catch limits where appropriate, fisheries closures and other technical measures.
- Understand important areas for key fisheries for marine planning considerations and facilitating co-location of activities.
- Align FMPs with Marine Plans for the effective use of the marine space and resources.
- Develop the network of protected sites to protect specific habitats and species of national or international importance.

⁴⁴ https://assets.publishing.service.gov.uk/media/637cee048fa8f53f4af6850b/Joint_Fisheries_Statement_JFS_2022_Final.pdf

- Acknowledge the importance of the protection, restoration and sustainable management of blue carbon habitats to support adaptation and resilience to climate change, alongside benefits for carbon sequestration and biodiversity.

The UK Bycatch Mitigation Initiative outlines how the fisheries policy authorities will achieve the ambitions of the ecosystem objective by improving understanding through scientific monitoring and research, identifying bycatch hotspots of high risk, adopting effective mitigation measures, and working with partners to reduce the bycatch of sensitive species globally⁴⁵.

2.4.3 Fisheries Management Plans (FMPs)

The JFS commits the UK fisheries policy authorities (Defra, and the devolved administrations in Northern Ireland, Scotland and Wales) to publish 43 FMPs setting out policies and measures to manage fishing activity to restore and/or maintain fish stocks at sustainable levels⁴⁶.

The first 5 Defra-led FMPs were published in December 2023, covering bass, Channel demersal non quota species, crab and lobster, king scallop and whelk⁴⁷. The next 6 Defra-led FMPs will be published by the end of 2024, covering Southern North Sea and Eastern Channel mixed flatfish, cockle, North Sea and Channel sprat, queen scallop, Southern North Sea and Channel skates and rays and Southern North Sea demersal non-quota species.

Defra is preparing a further 4 FMPs which will be published by the end of 2025, which include:

- Black seabream.
- Celtic Sea and Western Channel demersal for species.
- Celtic Sea and Western Channel pelagic species.
- Wrasses complex.

2.4.4 National Adaptation Plan

The third National Adaptation Programme lays out the UK government's approach to adaptively manage fisheries and increase their resilience to climate change⁴⁸. Policy makers and fisheries managers are now seeking to integrate climate change into fisheries management.

Defra has in publication a Climate Adaptive Fisheries report pinpointing evidence gaps for integrating ecosystem and climate change considerations into management strategies.

Highlighted evidence gaps include:

- Identifying marine habitat and species location, extent and abundance.
- Metrics to assess the condition or health of marine habitats and species.
- Ecosystem dynamics including interactions, life history traits, habitat characteristics and primary productivity.
- The causal effects of species range shifts.
- Assessing short term socio-economic impacts on fishers.

⁴⁵<https://www.gov.uk/government/publications/marine-wildlife-bycatch-mitigation-initiative/marine-wildlife-bycatch-mitigation-initiative>

⁴⁶ <https://www.gov.uk/government/publications/fisheries-management-plans/fisheries-management-plans>

⁴⁷ <https://www.gov.uk/government/collections/fisheries-management-plans>

⁴⁸ <https://www.gov.uk/government/publications/third-national-adaptation-programme-nap3>

- Designating areas for offshore developments.
- Monitoring the effectiveness of the interventions addressing biodiversity and climate change.

The report concludes that ecosystem-focused management including climate-induced impacts, can contribute to more adaptive and sustainable fisheries management. Recommendations include:

1. Embedding climate change at all steps of the fisheries management process, including demonstrating how climate change risks have been assessed and how management measures address those risks.
2. Viewing fisheries adaptation to climate change within an operating systemic framework.
3. Implementing adaptation measures as a package, a suite of measures that work together and build towards climate adaptive fisheries.

2.4.5 Entry points for research impact

ECOFLOW and ECOWIND research hold potential to build evidence for fisheries and offshore wind co-existence opportunities and contribute to understanding ecosystem dynamics for fisheries.

The priority opportunity areas where ECOFLOW / ECOWIND can create impact include:

- Understanding ecosystem dynamics, predator-prey interactions and bottom up and top-down processes to inform fisheries management measures.
- Identify key areas that hold ecosystem significance or restoration and compensation potential.
- Build on understanding on how climate change will affect fisheries and ecosystems, predict population distribution changes, and inform on climate adaptive and resilient measures.
- Identify fisheries and offshore wind co-existence opportunities, build information on socio-economic impacts, and natural capital elements to identify best options for marine use and spatial planning.

3 Government Research Programmes

3.1 Offshore Wind Evidence and Change Programme

The Offshore Wind Evidence and Change Programme (OWEC) brings together a coalition of 27 government organisations, industry bodies, and environmental NGOs to collaborate and act as agents for change in the face of climate and biodiversity crises.

This is achieved through a range of prioritised projects at a national scale, that will create a shared data and evidence base held on the Marine Data Exchange, that can be used to shape the future of offshore wind and the marine environment.

Projects, which are led by individual members of the UK-wide programme and other important partners, are made possible through drawing down from a £50m funding commitment by The Crown Estate, who lead the programme. It is delivered in partnership with DESNZ and Defra.

Through its strategically selected research and evidence driven initiatives, the programme is filling critical knowledge gaps that aims to help speed up the consenting process by reducing uncertainties. The areas of focus include improving understanding of environmental impacts and benefits, improving the derogation process, spatial co-ordination and co-location opportunities and delivering net environmental gains.

Noteworthy achievements from the OWEC Programme in 2023 include⁴⁹:

- November 2023 the ECOWind programme and OWEC held its first Annual Impact Meeting (AIM) welcoming policy experts, scientists, academics, and industry stakeholders to discuss work underway to understand how offshore wind affects ecosystems around the UK and identify key impact actions for the next 12 months.
- The launch of the Offshore Wind Evidence and Knowledge Hub (OWEKH)⁵⁰. This digital knowledge hub is set to accelerate the consenting process by streamlining EIA and providing a collaborative space where experts from across industry and academia can join forces to shape the future of offshore wind across the UK.

OWEC has funded a total of 35 projects, with project details available online⁵¹. Key projects of relevance include:

- Prevalence of Seabird Species and Collision Events in OWF (PrediCtOr) which is developing a coordinated approach for reducing uncertainty surrounding bird collision risk.
- Procellariiform Behaviour & Demographics (ProcBe) which is filling evidence gaps on seabird interactions with OWFs and improving and population modelling approaches.
- Reducing Seabird Collisions Using Evidence (ReSCUE) which is investigating seabird flight heights and collision risk with offshore wind turbines.
- Planning Offshore Wind Strategic Environmental Impact Decisions (POSEIDON) which will improve the knowledge of environmental risks across UK waters and provide new mapping tools⁵².
- Predators and Prey Around Renewable Energy Developments (PrePARED) which will improve understanding of how seabirds, marine mammals and fish change their behaviour in response to offshore wind farms⁵³.
- eSWEETS3 (Enabling Sustainable Wind Energy Expansion in Seasonally Stratified Seas) will observe the effects of FLOW water column mixing effects. eSWEETS3 will run from May 2024 to February 2027.

In 2024, the following projects have so far received funding:

⁴⁹https://downloads.ctfassets.net/nv65su7t80y5/3RKVaoWfldYoTIUAgVEncP/a7dca066cade4d843cb03a08d0947664/TCE_OWEC_Annual_report_2023.pdf

⁵⁰ <https://owekh.com/home>

⁵¹https://assets.ctfassets.net/nv65su7t80y5/4LFcE6T6rOVPk3LWqG5u0y/122544182bb7864e0ef2c2e6baf6ee84/OWEC_Projects.pdf

⁵²<https://mcas-proxyweb.mcas.ms/certificate-checker?login=false&originalUri=https%3A%2F%2Fnaturalengland.blog.gov.uk.mcas.ms%2F2023%2F02%2F01%2Fposeidon-offshore-wind-and-nature%2F%3FMcasTsid%3D20892&McasCSRF=9fb91da87629f22f92c849a48837ee73ee5f1044411f779877cf4c9e56582b38>

⁵³<https://mcas-proxyweb.mcas.ms/certificate-checker?login=false&originalUri=https%3A%2F%2Fowecprepared.org.mcas.ms%2F%3FMcasTsid%3D20892&McasCSRF=9fb91da87629f22f92c849a48837ee73ee5f1044411f779877cf4c9e56582b38>

- Marine microbial and invertebrate meiobenthic diversity in OWF using environmental DNA (OWF eDNAMonitorBiodiv) - Cefas
- Marine Restoration Potential Mapping + enhancement (MaRePo+) – Natural England
- Quarry trials of quieter technologies to clear unexploded ordnance from the seabed, to minimise impacts on marine mammals (Unexploded Ordnance Clearance Technology Trial) - Defra

Collaboration between projects has been evident, for example, the joint AIM event included ECOWind, POSEIDON and PrePARED. A key part of the OWEC programme is to foster synergy among the projects, maximise the impact of the programme and contribute effectively to the broader energy and environment goals. Researchers should actively seek opportunities for collaboration, whether through survey efforts, data sharing or stakeholder engagement. This collaboration between the projects ensures that the project outcomes are beneficial and avoids duplication of efforts.

3.2 Scottish Marine Energy Research (ScotMER) Programme

Scotland's National Marine Plan commits the Scottish Government to make decisions on the best available scientific evidence. Where knowledge gaps and uncertainties exist, the ScotMER programme seeks to address these evidence gaps, where it is most needed, and use the new information to inform planning, licencing, consenting and policy decisions. As an example, new evidence produced by the ScotMER programme is now feeding into the Sectoral Marine Plan for Offshore Wind Energy Iterative Plan Review process, and will be used in environmental assessments for new ScotWind developments.

The Scottish Government has worked with industry, environmental NGOs, SNCBs, and other interested stakeholders, to map out the gaps in knowledge when assessing the environmental and socio-economic impacts of offshore renewable developments. The evidence maps guide the ScotMER research projects, with the highest priority projects taken forward by the programme. A updated version (March 2024) of the evidence maps for all groups can be accessed online.⁵⁴

ScotMER ongoing projects of relevance include:

- Development of a framework to evaluate ornithological compensatory measures.
- Salmonid tracking to inform spatial movements around OWFs in the Moray Firth.
- Developing a population model for Rum Manx shearwaters for assessing OWF impacts and conservation measures.
- Tracking petrels to understand distributions and behaviours at sea and potential interactions with planned OWFs on the West Coast of Scotland.
- Seabird Sensitivity Mapping Tool.
- Diadromous fish in the context of OWF – review of current knowledge and future research.
- Foraging ecology of guillemots and razorbills in the non-breeding season to understand consequences of potential displacement.

⁵⁴<https://www.gov.scot/policies/marine-renewable-energy/science-and-research/>

- Recommendations to design effective monitoring approaches for commercial fisheries in relation to offshore wind farms.

All published project outputs can be accessed on the website⁵⁵.

3.3 Offshore Energy Strategic Environmental Assessment (SEA) research programme

Strategic Environmental Assessment (SEA) is the process of appraisal through which environmental protection and sustainable development may be considered and factored into national and local decisions regarding Government (and other) plans and programmes, such as offshore energy production. DESNZ as the principal regulator of the UK's energy resources within UK offshore waters and English and Welsh territorial waters has undertaken a series of offshore energy SEAs (OESEA) since 2001. To inform this process they maintain an active SEA research programme⁵⁶, identifying information gaps and commissioning new research where appropriate. Recent research⁵⁷ covers marine mammals, birds, seabed and water column, cultural, socio-economic and others.

4 Offshore Wind Research Programmes

4.1 SuperGen

The Supergen programme was set up in 2001 by the Engineering and Physical Sciences Research Council to deliver sustained and coordinated research on sustainable power generation and supply. The programme focused on several key research areas, including bioenergy; energy networks; energy storage; fuel cells; hydrogen and other vectors; marine, wave and tidal; solar technology; and wind power.

For phase four of the programme, the Supergen Wind and Supergen Marine Hubs were combined into one Offshore Renewable Energy Hub, following consultation with the wider research community and EPSRC. The Supergen Offshore Renewable Energy Hub⁵⁸ builds on the work of the former Hubs, and looks at synergies between offshore wind, wave and tidal technologies as well as building on current research in each area.

The Hub has eight research themes⁵⁹ across the current offshore renewable energy landscape, many of which are directly relevant to the work of the ECOWind projects:

- Resource and environment characterisation
- Fluid-structure seabed interaction
- Materials and manufacturing
- Sensing, control and electromechanics

⁵⁵ <https://www.gov.scot/policies/marine-renewable-energy/science-and-research/>

⁵⁶ <https://www.gov.uk/guidance/offshore-energy-strategic-environmental-assessment-sea-an-overview-of-the-sea-process#offshore-energy-sea-research-programme>

⁵⁷ https://assets.publishing.service.gov.uk/media/6465d688d3231e000c32dbb8/Offshore_Energy_SEA_-_Recent_Research_Summary_May_2023.pdf

⁵⁸ <https://supergen-ore.net/>

⁵⁹ <https://landscape.supergen-ore.net/>

- Survivability, reliability and design
- Operations, management, maintenance and safety
- Environmental and ecosystem aspects
- Marine planning and governance

4.2 INF4INiTY

INF4INiTY⁶⁰ (Integrated Designs for Future FLOW Technology) is a 48-month project funded by the Horizon-Europe framework programme, launched January 2024.

By combining modelling expertise with leading industrial technology development, INF4INiTY provides solutions for the current techno-socio-enviro-economic challenges of FLOW. INF4INiTY specifically contributes to reducing the possible impacts of offshore wind turbines on protected species and habitats and improve the use of marine space.

In particular, INF4INiTY delivers two major technology innovations:

- An innovative nature inclusive design for gravity anchors and their associated scour protection system.
- An innovative primary artificial reef structure combined with the structure of a FLOW turbine.

4.3 INSITE

The Influence of man-made structures in the ecosystem (INSITE) programme is funded by NERC, Cefas and is sponsored by an industry partnership of North Sea asset operations. It seeks to provide all stakeholders with the science needed to better understand the effect of man-made structures on the North Sea and hence better inform any decision-making process.

All project information can be accessed on the website⁶¹, ongoing projects of relevance include:

- Autonomous Techniques for anthropogenic Structure Ecological Assessment (ATSEA), combining Autonomous Underwater Vehicle (AUV) with mapping and water column sensors to produce an integrated environmental assessment at sites.
- Ecosystem level importance of Structures as Artificial Reefs (EcoSTAR), improving understanding of structures for benthic communities, patterns and consumption of marine mammals.
- Fish Spillover, Production and Aggregation at Marine Made Structures (FISHSPAMMS), using AUV to determine the extent of enhanced productivity or the protection from fishing afforded.
- Functionality and Ecological Connectivity of Man Made Structures (FuECoMMS), uses AUV and eDNA to identify the roles of structures for marine ecosystem processes, carbon storage and biodiversity within the sediments.

⁶⁰ <https://inf4inity.com/>

⁶¹ <https://insitenorthsea.org/research-projects>

4.4 Offshore Renewable Energy (ORE) Catapult Floating Offshore Wind Centre of Excellence (FOW CoE)

FOW CoE⁶² has been established by ORE Catapult to develop an internationally recognised initiative to reduce the cost of energy from floating wind. It is a collaborative programme with industry, academic and other stakeholders, with the intention of accelerating the build-out of floating farms, creating opportunities for the UK supply chain and driving innovations in manufacturing, installation and operations & maintenance.

The centre is running several strategic programmes one of which is on environmental interaction to consider opportunities for floating offshore wind that have a broader positive impact on biodiversity and health of the marine environment through:

- Identifying and prioritising key knowledge gaps associated with FLOW environmental interactions.
- Close knowledge gaps through research and testing.
- Assess and communicate project development risks and opportunities through research.
- Support innovative solutions and supply chain through communication, research and challenges.

4.5 Offshore Renewables Joint Industry Programme (ORJIP) for Offshore Wind

ORJIP⁶³ is a collaborative initiative that brings together industry, regulators, statutory nature conservation bodies, academics, NGOs and others with the aim of funding research to improve the understanding of the effects of offshore wind on the marine environment, in order to reduce consenting risk for offshore wind farm developments.

Stage 1 of the programme ran from 2013 to 2018 and included studies on the investigation into the efficacy of acoustic deterrent devices on different marine mammals and a study to record and quantify the avoidance behaviour of seabirds around offshore windfarms. Stage 2 ran from 2019 to 2023, with the option to extend until 2025, it has funded 10 different research projects ranging from understanding the impacts of offshore wind on seabirds, improving evidence base for co-existence of commercial fishing and offshore renewables, underwater noise, impact of cable protection measures.

5 Existing data tools used in Offshore Wind

It is important to understand the differing needs of end users, taking into consideration the existing data tools that are used and access and accessibility needs. Across the spectrum of end users, there is a vast array of data tools that exist including:

- Marine Data Exchange⁶⁴

⁶² <https://fowcoe.co.uk/>

⁶³ <https://www.carbontrust.com/our-work-and-impact/impact-stories/offshore-renewables-joint-industry-programme-orjip-for-offshore-wind>

⁶⁴ <https://www.marinedataexchange.co.uk/>

- Natural England Designated Sites View⁶⁵
- JNCC Seabird monitoring⁶⁶
- JNCC Marine mammal and noise mitigation⁶⁷
- Marine Environmental Data and Information Network⁶⁸
- Cefas OneBenthic⁶⁹
- Marine Life Information Network⁷⁰
- TCE Open Data⁷¹
- Natural England Seabird Mapping & Sensitivity Tool
- Marine plans and marine activity data⁷²
- Marine Scotland map layers⁷³
- JNCC Offshore Wind Environmental Evidence Register⁷⁴
- JNCC UK Marine Noise Registry⁷⁵

⁶⁵ <https://designatedsites.naturalengland.org.uk/>

⁶⁶ <https://jncc.gov.uk/our-work/seabird-monitoring/>

⁶⁷ <https://jncc.gov.uk/our-work/marine-mammals-and-noise-mitigation/>

⁶⁸ <https://medin.org.uk/>

⁶⁹ https://rconnect.cefas.co.uk/onebenthic_portal/

⁷⁰ <https://www.marlin.ac.uk/data-extract>

⁷¹ <https://opendata-thecrownestate.opendata.arcgis.com/>

⁷² <https://www.gov.uk/guidance/explore-marine-plans>

⁷³ <https://marine.gov.scot/maps/nmpi>

⁷⁴ <https://beta.marinedataexchange.co.uk/details/TCE-3480/2021-jncc-offshore-wind-evidence-and-change-programme-offshore-wind-environmental-evidence-register-summary>

⁷⁵ <https://mnr.jncc.gov.uk/>

Appendix A: Research Project Contacts

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