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FINAL REPORT //

Territorial cooperation for blue renewable energy (CoBren)

CoBren

D4 Final Report // April 2025

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Coordination:

Michaela Gensheimer (ESPON EGTC)

Outreach:

Nikos Lampropoulos (ESPON EGTC)

Authors

Andreas Steinbach (Deloitte), Frank Holstein (Deloitte), Alexandra Rimpler (Deloitte), Yuki Esser (DMEC), Sander des Tombe (DMEC), Aida Sutopo (DMEC) and Sarah Kluge (DMEC), Marloes Kraan (WUR), Sander van den Burg (WUR), Hatem Chouchane (WUR), Trond Selnes (WUR)

Technical Support

Martin Gauk (ESPON EGTC), Yuki Esser (DMEC), Aida Sutopo (DMEC), Minja Mihajlovic (DMEC)

Advisory group

Frederick Richters (Ministry of Energy and Spatial Planning, Luxembourg), Dr. Josiane Meier (Federal Ministry of Housing, Urban Development and Building, Germany), Alba Villamor Anguiano (Ministry for the Ecological Transition and Demographic Challenge, Spain), Mathilde Konstantopoulou (Ministry of Economy & Development, Greece)

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Disclaimer

This document is a final report.

The information contained herein is subject to change and does not commit the ESPON EGTC and the countries participating in the ESPON 2030 Cooperation Programme.

The final version of the report will be published as soon as approved.

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Abbreviations

EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EU	European Union
EU27	27 Member States of the European Union
GW	Gigawatt
MS	Member State
MSP	Maritime Spatial Planning
MW	Megawatt
ORE	Offshore Renewable Energy
SEA	Strategic Environmental Assessment

1 Introduction

Purpose of this document

This report has been prepared as part of a European research project in the context of the ESPON 2030 Cooperation Programme – Thematic Action Plan (TAP) “*Climate neutral territories*”.

Its aim is to provide territorial evidence to facilitate effective cooperation between European regions and tackle potential sea-use conflicts when producing and providing Offshore Renewable Energy (ORE) in support of reaching European climate and energy goals¹.

The report particularly sheds light on the following aspects:

- **The potential to exploit the capacity and efficiency of ORE resources** in light of sea use conflict and negative externalities of ORE developments and barriers as well as potential synergies with other types of ORE and sea uses offered through co-location.
- **The role of Maritime Spatial Planning (MSP) to enable ORE development** in an integrated manner, solving sea use-conflicts, considering social, economic and environmental impacts of ORE developments and taking the positions of all relevant stakeholders into consideration.
- **The importance of EU instruments** such as sea basin plans and regional sea conventions **as well as of EU cooperation mechanisms** such as territorial cooperation programmes **in supporting regional cooperation in relation to ORE developments**.

The report addresses these topics through a comprehensive mapping of the use of European seas to assess the potential of ORE to contribute to the EU’s renewable energy goals. This analysis is complemented by a review of current maritime spatial planning practices and available EU instruments and cooperation mechanisms to assess their **potential for unlocking the identified ORE potential**. The report includes seven dedicated case studies to further illustrate concrete findings.

Context

The role of Offshore renewable energy to achieve the EU’s climate and energy goals

With the **European Green Deal**² the EU has set ambitious targets to become the *first climate-neutral continent* by reducing net emissions of greenhouse gases to 0 by 2050 and decoupling economic growth from resource use. Against this backdrop, the **2024 State of the Energy Union report**³ highlights that **significant progress has been made on renewable energy** as in the first 6 months of 2024 half of the EU’s electricity generation came from renewable sources with **wind power overtaking gas** and becoming the EU’s second largest source of electricity behind nuclear energy⁴.

Delving further into marine renewable energy, the 2024 edition of the **EU BLUE Economy report**⁵ further highlights that the sector (which is dominated by offshore wind) has experienced and continues to experience growing trends⁶ confirming the EU’s leading role in developing energy from waves, tides and offshore wind and its important contribution towards meeting the EU’s renewable energy targets and climate objectives⁷.

¹ The analysis covers the EU 27 + UK, Iceland, Norway, including all relevant seas and oceans (Atlantic ocean, Baltic sea, Black sea, Mediterranean sea and North sea), as well as insular, coastal and outermost regions.

² https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

³ https://energy.ec.europa.eu/topics/energy-strategy/eighth-report-state-energy-union_en

⁴ https://commission.europa.eu/news/eu-makes-progress-ensuring-secure-and-affordable-energy-all-2024-09-11_en

⁵ <https://op.europa.eu/fr/publication-detail/-/publication/ef90077b-1e82-11ef-a251-01aa75ed71a1>

⁶ with estimated profits of EUR 2.5 billion and GVA of EUR 3.3 billion in 2021 representing an increase of 45% compared to 2020

⁷ https://oceans-and-fisheries.ec.europa.eu/news/eu-blue-economy-report-2024-innovation-and-sustainability-drive-growth-2024-05-30_en

As the global drive toward sustainable energy intensifies, Europe stands at the forefront of offshore renewable energy (ORE) deployment. The diversification of ORE beyond offshore wind, encompassing technologies such as wave, tidal, and offshore solar, does not only represent an economic opportunity but a strategic necessity to enhance energy security and reduce carbon footprints⁸. In this regard, the potential of ORE technologies depends on the alignment between announced deployment targets with the forecasted deployments.

Deployment targets for ORE

There are multiple targets that shed light on the vast political ambitions for ORE in Europe. In the Communication on delivering on the EU's offshore energy ambition that accompanied the Wind Package (2023), the European Commission sets out:

- **targets** for 111 GW in 2030 and 317 GW of **offshore wind** in 2050,
- **targets for wave and tidal energy, offshore solar and offshore hydrogen production.** The European Commission targets 1 GW for 2030 and 40 GW of marine energy (incl. wave and tidal energy) for 2050.

At the national and Sea Basin level, the analysis shows that across most European Sea Basins, with the Black Sea as an exemption, ambitious offshore renewable energy targets for the coming decades were formulated. In this context, Offshore wind remains by far the most prominent technology. Due to the geography, floating wind is also gaining more interest in the Atlantic Ocean and the Mediterranean Sea. Regarding other ORE, targets for wave energy only exist for the Atlantic Ocean, and the Netherlands is the only country with a policy goal for offshore solar. Lastly, only the Netherlands and Germany have targets for offshore hydrogen.

Forecasted ORE deployment

The predicted developments in deployed capacity for ORE technologies⁹ highlight where gaps compared to the identified deployment targets exist:

- **Offshore Wind:** Offshore wind remains the most established and fastest-growing ORE technology. Projections for both floating and fixed-bottom installations estimate installed capacities of 43 GW by 2030, 105 GW by 2040, and 475 GW by 2050. While these figures exceed the EU's targets for 2050 (by one third), due to potential constraints in scaling up deployment, the projected growth for 2030 and 2040 remains below national targets.
- **Wave and Tidal Energy:** Wave energy is in a pre-commercial phase, with several demonstration projects underway. Starting with an expected capacity of 13.2 MW in 2027, it is projected to grow to 37 MW by 2030, 0.9 GW by 2040, and 17.9 GW by 2050. Tidal energy forecasts begin with a base of 3.05 MW installed in 2016. Projections estimate cumulative capacities of up to 600 MW by 2030, 10 GW by 2040, and 19.5 GW by 2050. These figures illustrate steady growth but also a remaining gap with EU targets of 1 GW by 2030 and 40 GW by 2050.
- **Offshore Solar:** Offshore solar is at an early stage of development, with projections showing significant growth potential. Starting from an estimated 10 MW by 2026, capacity is expected to reach 107 MW by 2030, 8.5 GW by 2040, and 41.2 GW by 2050. These forecasts demonstrate the sector's potential as a complementary ORE technology.

Overall, the forecasts for 2050 highlight the growing role of ORE sources other than wind. While these sources are expected to account for 20% of the total installed capacity of ORE, their current contribution remains less than 10% of the most ambitious non-binding targets. **Achieving the EU's ambitious ORE targets will require making efficient use of marine space and addressing overlapping interests.**

⁸ This is also relevant in the context of the daily/seasonal complementarity of the energy profiles of these technologies which reduces the need for short and long-term storage of energy.

⁹ The forecasts are based on DMEC's internal forecasting model. More information can be found in Annex 1

Maritime Spatial Planning as an instrument to support the development of ORE and other sea use activities in an integrated manner

The use of sea space and the development of ORE is an increasingly important area of focus for European policymakers as they seek to balance economic growth, traditional industries, and the ongoing energy transition with environmental sustainability. Apart from ORE activities, European seas are used for other **economic activities** (e.g. aquaculture, fishing, shipping, tourism) and **military activities** and are subject to **environmental protection** (e.g. nature conservation areas, *Natura2000* zones). These different uses and interests can result in a set of spatial challenges.

In response to these challenges, spatial planning practices, notably **maritime spatial planning (MSP)**, provide tools and instruments to balance spatial claims of interest. Maritime spatial planning is the tool to manage the use of seas and oceans coherently and to ensure that human activities take place in an efficient, safe, and sustainable way. In addition, the **EU Maritime Spatial Planning Directive** (2014/89/EU), henceforth "*MSP Directive*" provides tools to encourage coherent management of the EU's seas across national borders.

The MSP process can furthermore influence sea use by identifying **sea use conflicts** and **synergies** and offer mechanisms to develop innovative solutions and approaches to resolve sea use conflicts. An important area to explore in this regard relates to the concept of multi-use of sea space.

Therefore, the maritime spatial planning process is well positioned to have an impact on the development of ORE e.g. through the **provisioning of sea space dedicated to ORE developments**, the involvement of relevant and impacted **stakeholders** and the performance of **environmental impact assessments** related to marine activities.

Unlocking the full potential of ORE requires more knowledge about ORE capacity in an environment where integrated planning is essential

While MSP certainly has the potential to support the EU in unlocking the full potential of ORE, there are several questions that need to be further explored.

These questions relate on the one side to the **potential offered through increasing the overall capacity of ORE resources**. In this regard limitations to this ORE potential e.g. due to sea use conflict and conflicting interests as well as limited space availability need to be analysed and explored. To solve such conflicts, it is vital to identify good practices and synergies with other sea use activities, also in a cross-border setting.

Another set of questions addresses the **role of maritime spatial planning in supporting ORE development via an integrated approach and in line with other sea use activities**. In this regard, it is important to consider how MSP can help resolve spatial conflicts (e.g. between ORE deployment and biodiversity ambitions). Furthermore, good practices concerning the planning process, concertation and consultation mechanisms and an evaluation whether the current requirements of the MSP Directive are sufficient need to be identified.

Finally, the **role of EU cooperation mechanisms** (e.g. European Territorial Cooperation programmes) as well as **EU instruments** such as sea basin plans and regional sea conventions in further supporting the development of ORE need to be explored.

Study objectives

This study aims to contribute to unlocking the potential of ORE by providing evidence on the current and future use of European seas in relation to blue energy deployment and the extent to which maritime spatial planning practices can support this. This report addresses this objective through:

1. **Mapping of current use of European seas and future potential for ORE deployment with a focus on forward looking approaches** to support policy- and decision-making in agenda setting, policy formulation and prioritisation phases of the policy cycle. Moreover, the delivery of innovative mapping of ORE contributes to the monitoring of Member States' and regional contributions to national and European targets on ORE.
2. **Reviewing Maritime Spatial Planning practices, including territorial cooperation in relation to the deployment of ORE.** The report aims to provide policymakers with specific evidence on the potential and challenges for expanding ORE. This includes insights into the potential for multi-use and resolving potential spatial conflicts. A first EU-wide mapping of such potentials aims to support policy- and decision-makers in all EU countries to better embed ORE in maritime spatial planning plans as well as in national and regional plans and strategies laying down objectives to contribute to EU energy and climate objectives.
3. **Illustrating practical insights from projects applying Maritime Spatial Planning practices to advance ORE deployment.** This includes planning practices applied in case studies focusing on ORE development in each European sea basin.

Ultimately, the knowledge and data assembled in this report and the accompanying maps should **support the policy uptake of ORE for the energy transition.**

Method

To fulfil the study objectives, the project has **mapped and analysed the current use of European seas** based on collected marine data. The mapping has been an important input to the analysis of the current state of play and forecasts for ORE deployment as well as for the assessment of prevalent combinations and potential opportunities for multi-use.

In parallel the project has **reviewed Maritime Spatial Plans** of 25 countries and assessed the position of ORE in the planning process based on an extensive documentary review and interviews as well as focus groups with relevant stakeholders.

Finally, **7 cases studies** spanning the 5 sea basins have been prepared to highlight good practices and experience from project holders active in ORE development. The figure below provides an overview, the detailed case studies are included in Annex 3.

Benefit

The report provides a common knowledge base for policy makers across Europe on the current use of European seas as well as insights on maritime spatial planning practices. The findings and conclusions of this report confirm and highlight the potential offered through ORE of contributing to achieving the EU's renewable energy objectives. Unlocking this potential, however, requires holistic and concerted planning of marine space beyond national borders. In this regard, the report offers key recommendations that aim at:

- Strengthening the maritime spatial planning process in the context of ORE development through existing means (i.e. MSP documents)
- Supporting the optimal use of existing sea-space for ORE development in concert with synergies and barriers
- Promoting cross-border territorial cooperation in the context of ORE developments at the sea basin level

The study also highlights a need for further research in specific areas that may further support the planning process and the development of ORE projects.

Figure 1: The 7 CoBren case studies

Project logo, Name & Location	Description
 <p>United, Middelgrunden wind farm Denmark, Baltic Sea</p>	<p>The Middelgrunden wind farm consists of bottom-fixed turbines. Middelgrunden uses wind energy to generate 40 MW from 20 turbines. The Middelgrunden wind farm is located in the <i>Øresund</i>, near Copenhagen, and is part of the Baltic Sea basin.</p>
 <p>Aquawind Spain Canary Islands, Atlantic Ocean (Outermost region)</p>	<p>The <i>Aquawind</i> project is strategically located in the Atlantic Sea Basin, tapping into the region's vast offshore wind potential. This initiative seeks to integrate floating wind technology with sustainable aquaculture, supporting renewable energy generation and enhancing marine biodiversity.</p>
 <p>BLOW Bulgaria, Black Sea</p>	<p><i>BLOW</i> ("<i>Black Sea Floating Offshore Wind</i>") is an innovative project located in the Black Sea, focusing specifically on floating wind technology. The project involves collaboration among countries, including Bulgaria, Turkey, Romania, and Ukraine and aims to implement cutting-edge floating wind technology, prove the economic and technical feasibility for broader commercial use, and contribute to sustainable energy production and greenhouse gas reduction.</p>
 <p>MUSICA Greece, Mediterranean Sea</p>	<p><i>MUSICA</i> ("<i>Multiple Use of Space for Island Clean Economy</i>") is working to develop a one-stop solution for a multi-use platform (MUP). The project is located in the Greek islands and aims to provide a full suite of Blue Growth solutions for a small island, including three forms of renewable energy: wind, Photovoltaic (PV) and wave, innovative energy storage systems on the MUP, smart energy system for the island, desalinated water and green support services for the island's aquaculture.</p>
 <p>EU SCORES, WindFloat Atlantic wind farm Portugal, Atlantic Ocean</p>	<p><i>EU-SCORES</i> is a research project which aims to demonstrate the integration of offshore wind, wave, and solar energy. Located 18 km off the coast of Viana do Castelo in Portugal, which is part of the bigger Iberian Coast, the <i>WindFloat</i> Atlantic wind farm is planned to be interconnected through a floating electrical connection hub (without physical connection).</p>
 <p>ULTFARMS, FINO3 platform Germany, North Sea</p>	<p>The <i>ULTFARMS</i> project focuses on integrating low trophic offshore aquaculture¹⁰ (LTA) systems with offshore wind farms to optimise marine space use. The <i>FINO3</i> platform, positioned 80 km off Sylt in the North Sea serves as a testbed for wind farm technology and provides valuable data that supports the planning, construction, and operation of offshore wind farms.</p>
 <p>EURO-TIDES UK, North Sea</p>	<p><i>EURO-TIDES</i> is a 9.6 MW tidal energy pilot farm deploying four 2.4 MW turbines at Orkney's European Marine Energy Centre's (EMEC) <i>Fall of Warness</i> site. The project seeks to advance tidal energy technology and reduce the levelized cost of energy (LCOE) to accelerate commercialisation.</p>

¹⁰ Low-trophic aquaculture refers to the farming of aquatic organisms that are at the lower end of the food chain. These species typically require fewer resources and have a lesser environmental impact compared to higher-trophic species, such as predatory fish. Examples include mussels, oyster, clams as well as seaweeds and algae.

2 ORE potential in European Seas

2.1 Introduction – the role of European seas to contribute to renewable energy generation

European seas play a pivotal role in the EU's transition to a climate-neutral economy by 2050, serving as hubs for renewable energy generation, biodiversity preservation, and sustainable economic growth. Offshore Renewable Energy (ORE) stands at the forefront of this transformation, offering the potential to decarbonize energy systems, strengthen energy security, and create new economic opportunities. However, the path to maximizing ORE potential is complex, requiring the careful balance of environmental, social, and economic priorities across diverse maritime contexts.

This chapter explores how Europe's seas can contribute to the EU's ambitious energy and climate goals by examining the current state of ORE deployment, its alignment with national, regional, and EU-wide targets, and the potential for growth. It begins with an overview of the EU's policy frameworks, such as the European Green Deal and the Renewable Energy Directive, which set the foundation for ORE development while emphasizing biodiversity, sustainable use of marine resources, and transboundary cooperation.

Building on this foundation, the chapter delves into the specific capacities, targets, and deployment challenges across Europe's sea-basins - including the Atlantic Ocean, Baltic Sea, Black Sea, Mediterranean Sea, and North Sea. Each basin's unique geographic, economic, and policy context shape its progress and potential for offshore wind (bottom-fixed and floating), wave, tidal, and solar energy. The analysis highlights both achievements and barriers, from innovative technologies and co-location strategies to regulatory hurdles and spatial conflicts.

The following sections then focus on unlocking untapped ORE potential through efficient spatial planning and fostering synergies between ORE and other marine activities, such as aquaculture, military operations, and nature conservation. The importance of cross-border collaboration is emphasized as a cornerstone for overcoming fragmented national approaches, enabling Europe to harness its full ORE capacity through interconnected grids, harmonized policies, and shared infrastructure.

By exploring these themes, the chapter provides a comprehensive overview of how European seas can contribute to the EU's energy transition while balancing environmental and socio-economic considerations.

2.2 EU policy frameworks drive the development of ORE in concert with environmental, socio-economic and sustainability considerations

The European Union has established a comprehensive policy framework to drive the deployment of offshore renewable energy (ORE). These policies not only focus on expanding renewable energy capacity but also emphasize environmental protection, socio-economic considerations, and sustainable development. This section explores the key directives and strategies underpinning ORE development, with particular attention to the integration of ecosystem and biodiversity goals alongside energy ambitions¹¹.

¹¹ Please note that the Maritime Spatial Planning Directive (MSP) is not listed here. The Directive and its importance for integrated maritime spatial planning are explored in depth in chapter 3.

2.2.1 The European Green Deal

The European Green Deal provides a transformative vision for achieving climate neutrality by 2050. It places renewable energy, including ORE, at the forefront of decarbonization efforts while simultaneously promoting biodiversity, sustainable economic growth, and resource efficiency. The Green Deal recognizes that large-scale ORE deployment must coexist with other maritime activities and environmental protection goals.

Supporting strategies under the Green Deal include:

- The ***EU Strategy on Offshore Renewable Energy***, which sets ambitious targets for offshore wind, wave, tidal, and solar energy. Specifically:
 - 111 GW of offshore wind capacity by 2030, scaling up to 317 GW by 2050.
 - 1 GW of ocean energy (wave and tidal) by 2030, and 40 GW by 2050, to foster technological diversity.
 - Promoting emerging technologies such as offshore solar and offshore hydrogen production, with the Netherlands pioneering efforts to tender 3 GW of offshore solar by 2031.
 - The EU Wind Power Package supports the deployment of offshore wind and ocean energy by accelerating permitting processes, fostering cross-country collaboration on the offshore grid and maritime spatial planning, and supporting local supply chains.
- The ***Biodiversity Strategy for 2030*** aims to protect 30% of the EU's seas, with 10% under strict protection, while promoting nature-based solutions. Renewable energy can contribute to mitigate the biodiversity crisis, as offshore wind and ocean energy can function as shelter areas for fish. The strategy encourages ORE projects to adopt nature-inclusive designs that enhance marine biodiversity, such as artificial reefs integrated into wind turbine foundations.

2.2.2 Marine Strategy Framework Directive (MSFD)

The *Marine Strategy Framework Directive (MSFD)* focuses explicitly on protecting the health of marine ecosystems, ensuring that human activities, including ORE, do not compromise the environmental status of EU waters. The framework also considers cumulative impacts on the environment to make sure human activities stay within the ecosystem's carrying capacity. It establishes a framework for achieving "Good Environmental Status" (GES) by addressing biodiversity, ecosystem functioning, and pollution.

Under the MSFD, member states are required to:

- Conduct regular assessments of their marine waters to monitor the impact of activities like ORE on ecosystem health.
- Develop action plans that mitigate negative externalities, such as seabed disturbances caused by offshore wind farm installations.
- Foster cross-sector collaboration to achieve environmental and energy goals simultaneously.

Examples of MSFD integration include Belgium's efforts to incorporate biodiversity monitoring into offshore wind farm operations, ensuring that these projects contribute to marine conservation while producing renewable energy^{12,13}. The Netherlands established a framework to assess cumulative environmental effects of all offshore wind farms planned by 2030. It includes measures on how to

¹² <https://odnature.naturalsciences.be/msfd/>

¹³ <https://www.naturalsciences.be/de/wissenschaft/nachrichten/15-years-of-monitoring-the-ecological-effects-of-belgian-offshore-wind-farms-still-yields-new-insights>

reduce negative effects^{14,15}. On a broader scale, the North Sea energy ministers agreed on a Common Environmental Assessment Framework (CEAF) which serves to stimulate collaboration regarding environmental monitoring¹⁶.

2.2.3 Renewable Energy Directive II (amended in 2023)

The directive was amended under the 'Fit for 55' package - which aims to reduce the EU's GHG emissions by 55% by 2030, and the REPower EU plan, which follows the objective of becoming independent from Russian fossil fuels before 2030. The Renewable Energy Directive II sets the target of gross final energy consumption that comes from renewable energy sources to 42.5%. This mandatory target needs to be achieved by 2030.

The primary measures for Member States consist of:

- Accelerate permitting processes for a faster deployment of ORE by assigning particularly suitable areas where no significant environment impact is expected as Acceleration Areas. Streamline permitting procedures with one-stop shops and declare ORE projects to be in the overriding public interest.
- Foster cross-border collaborations via agreeing on ORE goals for Sea Basins and initiating joint ORE projects (see section 3.3.2).
- Provide planning security by integrating space for ORE in maritime spatial plans and informing about planned ORE auction capacities.

2.2.4 Habitats and Birds Directives

The Habitats Directive and the Birds Directive provide legal protection for habitats and species that may be affected by ORE projects. Together, they establish the Natura 2000 network, a cornerstone of the EU's biodiversity conservation strategy.

Key provisions relevant to ORE include:

- Conducting rigorous environmental impact assessments (EIAs) for all ORE projects located near protected habitats or bird migration routes.
- Implementing mitigation measures, such as altering turbine placement or timing construction to avoid sensitive breeding seasons.
- Encouraging adaptive management practices, where ORE developers adjust project operations based on real-time environmental monitoring.

These directives have been instrumental in promoting environmentally sensitive ORE deployment. For instance, in the North Sea, wind farm operators collaborate with conservation groups to monitor the impact of turbines on bird populations, using the findings to refine future projects¹⁷.

¹⁴ <https://www.noordzeeloket.nl/publish/pages/202036/marine-strategy-for-the-dutch-section-of-the-north-sea-2022-2027-part-3.pdf>

¹⁵ <https://www.noordzeeloket.nl/en/functions-and-use/offshore-wind-energy/ecology/accumulation-ecological-effects/framework-assessing-ecological-cumulative-effects/>

¹⁶ <https://www.noordzeeloket.nl/en/functions-and-use/offshore-wind-energy/ecology/accumulation-ecological-effects/ceaf/>

¹⁷ Examples are: the Reducing Seabird Collisions Using Evidence (ReSCUE) project, funded through the Offshore Wind Evidence and Change programme (OWEC): <https://www.thecrownestate.co.uk/news/the-crown-estate-invests-a-further-gbp9m-in-new-research-to-drive-nature>, Joint OSPAR/HELCOM/ICES working groups on Seabirds: ICES Scientific Reports. 5:108. 45 pp. <https://doi.org/10.17895/ices.pub.24591936>; and many scientific studies such as Degraer, S., Brabant, R., Rumes, B. & Vigin, L. (eds). 2023. Environmental Impacts of Offshore Wind Farms in the Belgian Part of the North Sea: Progressive Insights in Changing Species Distribution Patterns Informing Marine Management. *Memoirs on the Marine Environment*. Brussels: Royal Belgian Institute of Natural Sciences, OD Natural Environment, Marine Ecology and Management, 115 pp.

2.2.5 Socio-economic dimensions in ORE policies

In addition to environmental considerations, EU policies emphasize the socio-economic benefits of ORE, such as job creation, regional development, and energy security. The EU Energy System Integration Strategy seeks synergies between offshore wind developments and hydrogen production for lowering emissions and regional economic opportunities. The Blue Economy Strategy integrates ORE into broader maritime activities, ensuring that energy projects support local economies without displacing traditional sectors like fishing and tourism.

Examples of socio-economic integration include:

- Compensation schemes for fisheries affected by ORE projects, as seen in the Baltic Sea, where developers provide financial support to communities impacted by spatial changes.
- Training programs to equip local workers with the skills needed for ORE construction and maintenance, particularly in regions transitioning away from fossil fuel industries.

These frameworks set the foundation for Member States to align their strategies with overarching EU goals. The next section examines how national and regional objectives and targets are currently contributing to these ambitions.

2.3 Comparing the current contribution of deployed ORE to national, regional and EU objectives highlights that more progress is needed

Building on the EU-wide frameworks and targets outlined in the previous section, this section delves into the specific national and regional goals and the current status of ORE deployment across Europe's sea basins. Each basin reflects unique geographical, economic, and policy contexts, contributing to varying degrees of progress and ambition. This analysis offers a comprehensive overview of the capacity goals for offshore wind—both bottom-fixed and floating—and other ORE technologies such as wave, tidal, and offshore solar. It highlights both achievements and gaps, underscoring the critical need for coordinated efforts to achieve the EU's overarching renewable energy goals.

Table 1: ORE targets ESPON countries per sea basin

Country	Sea Basin(s)	Offshore bottom-fixed wind [GW]	Offshore floating wind [GW]	Other ORE [GW]
Ireland	Atlantic Ocean	2030: 5 2040: 20 2050: 37	2030: 2	actively considers wave energy
France	Atlantic Ocean & Mediterranean Sea	2030: 4 2035: 18 2050: 45		Contracts for Difference (CfD) on tidal energy
Portugal	Atlantic Ocean	NA	2030: 2 post 2030: 10	wave energy 2030: 0.2
Spain	Atlantic Ocean & Mediterranean Sea	NA	2030: 1-3 2050: 17	marine energy 2030: 0.04-0.06
Iceland	Atlantic Ocean, Icelandic Sea	NA	NA	NA
Estonia	Baltic Sea	2030: 1		
Denmark	Baltic Sea & North Sea	2030: 5.3 2040: 19.3	NA	2030 offshore hydrogen: 4.6

Country	Sea Basin(s)	Offshore bottom-fixed wind [GW]	Offshore floating wind [GW]	Other ORE [GW]
		2050: 35		
Finland	Baltic Sea	2026: 0.03 2030: 0.1	NA	NA
Germany	Baltic Sea & North Sea	2030: 30 2035: 40-50 2045: 70	NA	2030 offshore hydrogen: 1
Latvia	Baltic Sea	2030: 0.4	NA	NA
Lithuania	Baltic Sea	2030: 1.4	NA	NA
Poland	Baltic Sea	2030: 6 2040: 11	NA	NA
Sweden	Baltic Sea	2030: 0.7 2050: 30	NA	NA
Bulgaria	Black Sea	2030: 0.5	NA	NA
Romania	Black Sea	2032: > 0.001	NA	NA
Croatia	Mediterranean Sea	NA ¹⁸		NA
Cyprus	Mediterranean Sea	NA ¹⁹	NA	NA
Greece	Mediterranean Sea	NA	2030: 1.9-4.9 beyond 2030: 12.4	NA
Italy	Mediterranean Sea	2030: 2.1	2030: 3.5	NA
Malta	Mediterranean Sea	NA	2050: 0.4	NA
Belgium	North Sea	2030: 5.4-5.8 2040: 8	NA	NA

¹⁸ Currently no target, but there are indicative values (2030: 0.51GW 2050: 3GW) derived from the ENTSO-E publication. However, these indicative values should not be interpreted as national targets

https://eepublicdownloads.blob.core.windows.net/public-cdn-container/tyndp-documents/ONDP2024/web_entso-e_ONDP_SE_240226.pdf

¹⁹ Currently no target, but their national energy and climate plans (NECP) announces that they are exploring 100 MW deployment target for offshore wind by 2050 https://commission.europa.eu/document/download/f1fb6321-05b4-4a21-ae78-9a0c7cf27934_en?filename=SWD_Assessment_draft_updated_NECP_Cyprus_2023.pdf

Country	Sea Basin(s)	Offshore bottom-fixed wind [GW]	Offshore floating wind [GW]	Other ORE [GW]
The Netherlands	North Sea	2031: 31 2040: 40 2050: 70	NA	2031 offshore solar tendered: 3 2040 offshore green hydrogen: 1
Norway	North Sea, Norwegian Sea	2040: 30	NA	NA
UK	North Sea & Atlantic Ocean	2030: 45	2030: 5	NA

Source: CoBren research team, based on reviewed national policy documents

Atlantic Ocean: France and Ireland both have very ambitious offshore wind targets. France has about 1.5 GW of offshore wind installed in 2024, with an additional 1.5 GW under construction. France aims for 18 GW in 2035 and 45 GW in 2050, according to the *country's (non-binding) national wind pledges*. Ireland has one operational offshore wind farm, the 25 MW Arklow Bank Wind Park, installed in 2004. However, the country is now scaling up significantly. Ireland aims to achieve 5 GW of offshore bottom-fixed wind and 2 GW of floating wind by the end of the decade, as communicated in their *national wind pledges*. In 2023, Ireland completed its first offshore wind auction, securing approximately 3.1 GW. It has also announced a second auction round, the "*Tonn Nua*" for 2025, which will target an additional 900 MW off the south coast. Post-2030, Ireland aims for a strong increase up to 20 GW in 2040 and 37 GW by 2050. Portugal and Spain both have targets for offshore floating wind and for marine energy by the end of the decade, which makes them frontrunners in that regard. According to the *European Commission's country report 2024*, Portugal aims for 2 GW of floating wind by 2030, a further 10 GW of floating wind post 2030, and 200 MW of wave energy by 2030. In its *Roadmap Offshore Wind and Marine Energy*, Spain details its floating wind ambition of up to 3 GW by 2030 and 17 GW by 2050. The target for marine energy is 40 to 60 MW, without specifying the technologies.

Baltic Sea: The only countries that already have remarkable capacities of offshore wind installed in the Baltic Sea are Denmark (2.7 GW in total; about~1.5 GW in the Baltic Sea) and Germany (9.2 GW in total; about 1.8 GW in the Baltic Sea), next to Finland with 0.1 GW and Sweden with 0.2 GW. The *Swedish Wind Energy Association (SWEA)* reports that over 100 GW of offshore wind projects are actively being developed across Sweden. Approximately 2 GW of this capacity have already secured permits, while 52 GW are navigating the permitting process, and an additional 46 GW are in the consultation phase. A significant portion of these projects is concentrated in southern Sweden, a region with particularly high demand for renewable energy.

In the *Marienborg Declaration*, which the Baltic states signed in 2022, they agree on more cooperation for offshore wind and to increase the offshore wind capacity from 2.8 GW in 2022 to 19.6 GW by 2030. Denmark will be the largest contributor to that target aiming for up to 7.9 GW, which is an eightfold increase to its current installed capacity. Poland aims to kick-start its offshore wind installations targeting 6 GW by the end of the decade and a further 4 GW by 2040. While Germany has ambitious national offshore wind targets, the country focuses more on the North Sea, having a more modest expansion target of a 2.5-fold increase for the Baltic Sea, aiming for 3.8 GW installed offshore wind by the end of the decade. Combined, the other Baltic states Estonia, Finland, Latvia, Lithuania, and Sweden commit to 3.6 GW by 2030. In addition, Sweden has a 2050 target of 30 GW.

While not all Baltic countries have ambitious targets in absolute terms, their policy goals nevertheless show that all countries join the trend of offshore wind development. Several factors influence the pace and scale of offshore wind deployment in the Baltic Sea. Geological challenges, such as the presence of ice in northern areas, pose engineering difficulties for offshore installations. Additionally, defence considerations have impacted project approvals; for instance,

Sweden rejected applications for 13 offshore wind farms in the Baltic Sea due to concerns about national security and radar interference, according to the government's official explanation. Regarding floating offshore wind potential, Sweden stands out with significant opportunities for developing this technology in the Baltic Sea region. Floating wind turbines could mitigate some geological challenges by allowing installations in deeper waters where traditional bottom-fixed structures are impractical. Nonetheless, the adoption of floating wind technology in the Baltic Sea is still in early stages, with ongoing research and pilot projects exploring its feasibility.

Black Sea: While previously considered to have the most modest ORE targets, the Black Sea is now seeing a significant shift, with Bulgaria and Romania having considerable offshore wind ambitions. Currently, there is no operational offshore wind capacity in the region, with Bulgaria and Romania in the early stages of developing their ORE sectors. However, Bulgaria has proposed projects totalling up to 3 GW, with policy recommendations suggesting targets of 1 GW by 2027 and an additional 2 GW by 2030. In February 2024, the Bulgarian Parliament passed the first reading of an offshore wind energy bill, proposing a framework for designating offshore wind areas and holding competitive tenders for 30-year concessions. However, the bill has faced opposition from various stakeholders, leading to ongoing debates. In April 2024, Romania's Chamber of Deputies adopted the Offshore Wind Energy Bill, setting the stage for the country's first offshore wind project to be operational by 2032. In addition, a roadmap published in September 2024 highlights the potential for up to 7 GW of offshore wind capacity within Romania's EEZ in the Black Sea by 2035²⁰. These actionable policy recommendations reflect growing recognition of the Black Sea's offshore wind potential, supported by increasing policy commitments and legislative progress. **While the lack of established offshore infrastructure and the geopolitical complexities of the region remain challenging, both Bulgaria and Romania are making legislative progress to facilitate ORE deployment.**

Mediterranean Sea: The Mediterranean Sea's deep waters limit the feasibility of bottom-fixed offshore wind farms, resulting in no operational installations to date. However, countries like Greece and Italy have set ambitious targets to harness offshore wind energy. Greece aims to install up to 5 GW of offshore wind capacity by 2030, with plans to more than double this capacity in subsequent years. In October 2023, the Hellenic Hydrocarbons and Energy Resources Management Company (HEREMA) announced a draft National Development Programme for Offshore Wind Farms, identifying 25 areas with a total estimated capacity of 12.4 GW. Of these, ten areas are prioritized for development by 2030-2032, aiming for approximately 4.9 GW of capacity. Most of Greece's offshore wind is expected to be realised as floating wind, however this was not yet specified in policy targets. Italy, following the publication of its Maritime Spatial Plan designating areas for offshore wind, targets 2.1 GW of bottom-fixed wind and 3.5 GW of floating wind by 2030, marking the third most ambitious floating wind target in Europe, including the UK. In addition to offshore wind, both Italy and Greece are exploring other ORE technologies, such as wave, tidal, and offshore solar energy. Italy has introduced the *FER 2 Decree (2024-2028)*, which supports innovative renewable energy technologies, including wave, tidal and offshore solar energy, through competitive public procedures managed by *Gestore dei Servizi Energetici (GSE)*. However, Italy has not yet set explicit national capacity targets for these technologies. Similarly, Greece has significant potential for other offshore renewables, particularly wave, tidal and offshore solar, but lacks specific national targets. Next to the country's efforts on research and pilot projects, Greece has started to develop policy frameworks for offshore solar. Malta is also advancing in offshore renewable energy. In October 2024, Malta launched its *National Policy for the Deployment of Offshore Renewable Energy*, identifying six strategic zones for development, with one site specifically designated for floating wind energy projects. The policy aims to increase Malta's renewable energy share to 25% by 2030, with floating wind and offshore solar projects playing a crucial role. In 2022, Malta's energy minister communicated that by 2030, the country would deploy up to 50 MW in offshore wind or 65 MW in offshore solar. These ambitions have so far, however, not been formalised in official policy targets. In December 2024, Malta launched its first offshore wind tender for a floating wind farm of 280 to 320 MW capacity.

²⁰<https://documents1.worldbank.org/curated/en/099091924193525285/pdf/P17577416846ad0061bd9311af8d1a82107.pdf>

In addition to national efforts, nine Southern European countries, including Greece, Italy, Malta, Spain, France, Portugal, Cyprus, Slovenia, and Croatia, have joined forces to transform the Mediterranean into a green energy hub. At the MED9 Energy Ministerial Meeting 2024 in Larnaca, Cyprus, representatives from these nations emphasized the need for streamlined regulations, cross-border cooperation, and increased investment in offshore renewable energy, particularly in floating wind and solar projects. This regional collaboration aims to reduce dependence on fossil fuels and accelerate the deployment of clean energy across the Mediterranean²¹.

North Sea: The North Sea, with its relatively shallow and consistent water depths, has been a hub for economic activities for decades, including significant offshore wind development. Despite often challenging weather conditions, **the basin is one of the most promising regions for ORE due to its vast resource potential and strategic importance.** Collaborative initiatives such as the *Greater North Sea Basin Initiative (GNSBI)* and the *Ostend Declaration* underline the commitment of North Sea countries to accelerating offshore wind deployment and advancing transboundary energy projects (see also section 3.3.3). These agreements focus on maximizing the shared potential of the basin while addressing challenges such as environmental impacts, spatial planning, and energy security. In November 2024, the *North Sea Energy Cooperation (NSEC)* published a new tender schedule to support its ambitious offshore wind targets. The schedule provides a clear roadmap for coordinated development, enabling countries to meet their national and regional energy goals efficiently.

The United Kingdom leads the region with the highest installed offshore wind capacity, boasting 13.6 GW as of 2024. Germany follows with about 7.3 GW, while the Netherlands have 4.7 GW. These figures reflect the North Sea's critical role in advancing Europe's renewable energy ambitions. Most North Sea nations have set bold offshore wind targets for the coming years, which are highlighted in sea basin declarations and national strategies. Germany aims to achieve 30 GW by 2030 and 40–50 GW by 2035, with the majority of these installations in the North Sea. The Netherlands target 21 GW by 2032, rising to 70 GW by 2050, including innovative projects such as 3 GW of offshore solar tendered by 2031 and 1 GW of offshore green hydrogen production by 2040. The UK's targets are similarly ambitious, aiming for 45 GW of bottom-fixed wind and 5 GW of floating wind by 2030.

One of the most notable developments in the North Sea is the Dogger Bank Wind Farm in the UK, which is set to become the largest offshore wind farm in the world. The first phase of this groundbreaking project is expected to become operational in 2025, significantly boosting the region's renewable energy output and setting a benchmark for large-scale offshore wind installations. While offshore wind dominates the North Sea's ORE sector, other technologies, such as offshore solar and green hydrogen production, are gaining traction. Countries like the Netherlands are pioneering these areas to diversify their renewable energy portfolios and increase spatial efficiency.

Overall, the analysis shows that across most European Sea Basins ambitious offshore renewable energy targets for the coming decades were formulated. Offshore wind is still by far the most prominent technology. Due to the geography, floating wind is also gaining more attraction in the Atlantic Ocean and the Mediterranean Sea. Regarding other ORE, targets for wave energy only exist for the Atlantic Ocean, and the Netherlands is the only country with a policy goal for offshore solar. Lastly, only the Netherlands and Germany have targets for offshore hydrogen.

At the EU level, there is currently a cumulative installed capacity of offshore wind of 19.4 GW while other European countries (including Norway and United Kingdom) have a total installed capacity of 14.8 GW, bringing the total capacity in Europe to around 32 GW.

With the current capacity still being far from fulfilling the 2030 targets of 111 GW and the 2050 targets of 317 GW for offshore wind, it becomes clear that a steep increase in offshore wind deployments will need to happen to achieve the EU's offshore wind policy goals.

For ORE other than offshore wind, tidal stream installation is leading with 11.75 MW installed capacity, despite the absence of any policy target for tidal energy in Europe. Most of this capacity is

²¹ <https://apnews.com/article/europe-renewable-energy-hub-meeting-larnaca-mediterranean-9deb40e67ddb8839d37a8b5a7c4dfd49>

in the United Kingdom with France contributing a small percentage. Wave energy has 1 MW total installed capacity in 2023, from installations in Portugal, Italy, Spain, and France²². Offshore solar has around 1 MW total installed capacity in 2024, with installations in The Netherlands, Belgium, and France²³. The fact that ORE installations exist in some countries that do not have official targets for them shows that future installed ORE capacities could exceed the countries' announcements. This would also be required to achieve the EU's target of 1 GW of ocean energy by 2030 and 40 GW by 2050, which is significantly above the articulated national targets for these resources.

While the progress across sea basins is promising, significant gaps remain. Understanding how these gaps can be addressed requires a forward-looking analysis of potential trajectories, as outlined in the forecast section.

ORE deployment forecasts highlight the prevailing dominance of offshore wind but also a growing contribution from other ORE technologies.

2.3.1 Forecasting ORE potential in Europe

ORE is a critical component of Europe's strategy to achieve its ambitious climate and energy targets. The previous section highlighted the gap between current deployment levels and these targets, underscoring the scale of progress required. **This section provides a data-driven analysis of how key ORE technologies—offshore wind, wave, tidal, and offshore solar—are expected to develop, presenting forecasts for their cumulative installed capacities by 2030, 2040, and 2050.** These forecasts are grounded in historical data and comparative analyses, providing a realistic perspective on expected progress. The forecasts illustrate how each technology could evolve, considering their current state of development, resource potential, and specific barriers to scaling. This analysis connects the growth trajectories with the EU's targets, revealing areas where further efforts will be necessary. Additionally, the methods used for forecasting reflect the distinct challenges and opportunities of each technology. Detailed technical methodologies and assumptions are included in the annex for further exploration.

This section also sets the stage for subsequent discussions on untapped resource potential, strategies for efficient space use, and the synergies and barriers affecting deployment in different regions.

2.3.2 Forecast results

The forecasted trajectories of ORE technologies reflect their varying levels of maturity and resource availability. Each technology is assessed based on its current development stage and modelled growth potential:

Offshore Wind: Offshore wind remains the most established and fastest-growing ORE technology. Projections for both floating and fixed-bottom installations estimate installed capacities of 43 GW by 2030, 105 GW by 2040, and 475 GW by 2050. **These figures align well with long-term goals, exceeding EU targets for 2050 by one-third. However, the projected growth for 2030 and 2040 remains below national targets,** reflecting potential constraints in scaling up deployment within these shorter timeframes.

Wave and Tidal energy: Wave energy is in a pre-commercial phase, with several demonstration projects underway. Starting with an expected capacity of 13.2 MW in 2027, it is projected to grow to 37 MW by 2030, 0.9 GW by 2040, and 17.9 GW by 2050. Tidal energy forecasts begin with a base of 3.05 MW installed in 2016. Projections estimate cumulative capacities of up to 600 MW by 2030, 10 GW by 2040, and 19.5 GW by 2050. **While these combined projections slightly fall short of meeting the EU targets of 1 GW by 2030 and 40 GW by 2050 for ocean energy, additional forms of ocean energy—such as salinity gradient and ocean thermal energy conversion—are expected to contribute towards closing this gap.** Given that the model references the offshore wind sector,

²² Ocean Energy Europe. (2024). Ocean Energy Stats & Trends 2023. Brussels: Ocean Energy Europe.

²³ DMEC. (2023). Market Report 2023: Innovative Offshore Renewable Energy Technologies in DMEC's Portfolio. The Hague: DMEC.

increased policy support and investment in wave and tidal technologies could accelerate their commercialisation, leading to a faster scale-up to full deployment.

Offshore Solar: Offshore solar is at an early stage of development, with projections showing significant growth potential. Starting from an estimated 10 MW by 2026, capacity is expected to reach 107 MW by 2030, 8.5 GW by 2040, and 41.2 GW by 2050. These forecasts align with early deployment plans in countries like the Netherlands and demonstrate the sector's potential as a complementary ORE technology.

In conclusion, the forecasts for 2050 highlight the growing role of ORE sources other than wind. While these sources are expected to account for 20% of the total installed capacity of ORE their current contribution remains less than 10% of the most ambitious non-binding targets. Achieving these targets will require realignment of policy instruments to prioritize financial incentives, regulatory streamlining, and international collaboration, ensuring a diversified and sustainable energy future for Europe. In addition, **although the forecasted capacities show potential for growth, achieving these targets hinges on the efficient use of marine space and addressing overlapping interests**, as discussed in the following section.

2.4 Mapping ORE potential reveals that significant capacity and efficiency gains are achievable through colocation of ORE

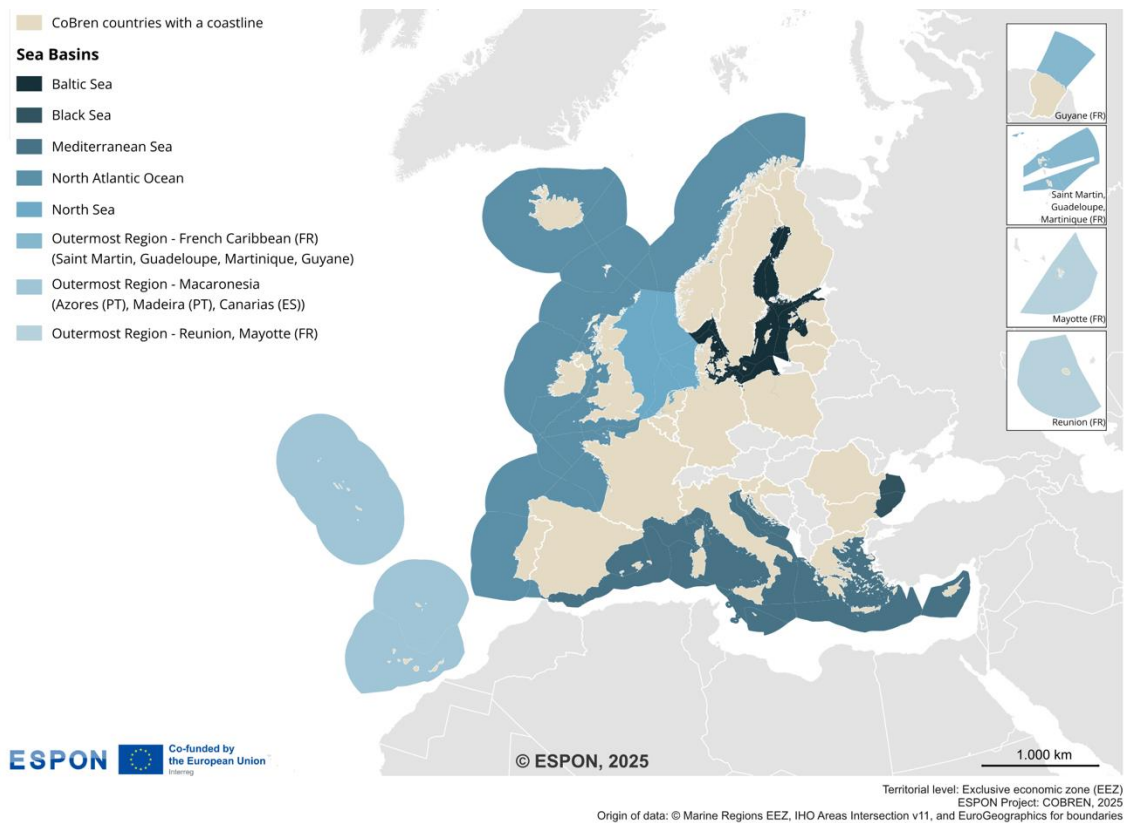
The previous sections of this report outlined the ambitious targets for ORE in Europe, assessed the current state of deployment, and presented forecasted growth trajectories for key technologies such as offshore wind, wave, tidal, and solar energy. **While these forecasts demonstrate potential progress, they also reveal a gap between anticipated growth and the EU's climate and energy goals.** Bridging this gap requires not only accelerating deployment but also making efficient use of the available marine space. This section introduces the first step in addressing these challenges: mapping the untapped ORE potential across Europe's sea basins, focusing on resource availability and the theoretical capacity for each technology. **By examining the potential with and without colocation options, and accounting for exclusion zones, the analysis illustrates how much more capacity could be unlocked with efficient spatial use and strategic planning.** It provides a high-level overview of potential capacity by sea basin, forming a foundation for understanding how these resources can be maximized.

The findings in this section will pave the way for the next chapter, where synergies and barriers to deployment are mapped.

2.4.1 Mapping procedure

Mapping ORE potential involves integrating spatial data, modelling resource availability, and analysing deployment constraints. A systematic, high-level methodology was employed to calculate the theoretical and practical capacity of ORE technologies across European seas. The detailed mapping methodology can be found in Annex 1.

The mapping in this study spans all European sea basins and outermost regions, providing a comprehensive overview of resource availability, constraints, and opportunities. The study area includes the Baltic Sea, Black Sea, Mediterranean Sea, North Atlantic Ocean, and North Sea, as well as the outermost regions of Macaronesia (Azores, Madeira, Canary Islands), Reunion, Mayotte, and the French Caribbean (Saint Martin, Guadeloupe, Martinique, and Guyane).

Map 1: Study area and the sea basin delineations

1. **Data Collection and Integration:**

Data was gathered from a wide array of sources, covering resource availability (wind speed, solar irradiation, wave height), exclusion zones (marine protected areas, shipping lanes, military zones), and physical constraints (water depth, distance from shore). Each dataset was processed to ensure compatibility for geospatial analysis.

2. **Mapping Exclusion Zones:**

Using Geographic Information System (GIS) tools, exclusion zones were overlaid on resource availability maps. Areas within exclusion zones were marked as unavailable for ORE deployment, providing a clear picture of constraints across each sea basin.

3. **Scenario Modelling:**

Two scenarios were developed:

- **Total capacity:** Prioritizing a single technology (e.g., offshore wind over solar) in areas of resource overlap.
- **Co-location Scenarios:** Exploring multi-use energy parks where multiple technologies (e.g., wind and solar) can coexist, maximizing spatial efficiency.

4. **Calculation of Theoretical and Practical Capacity:**

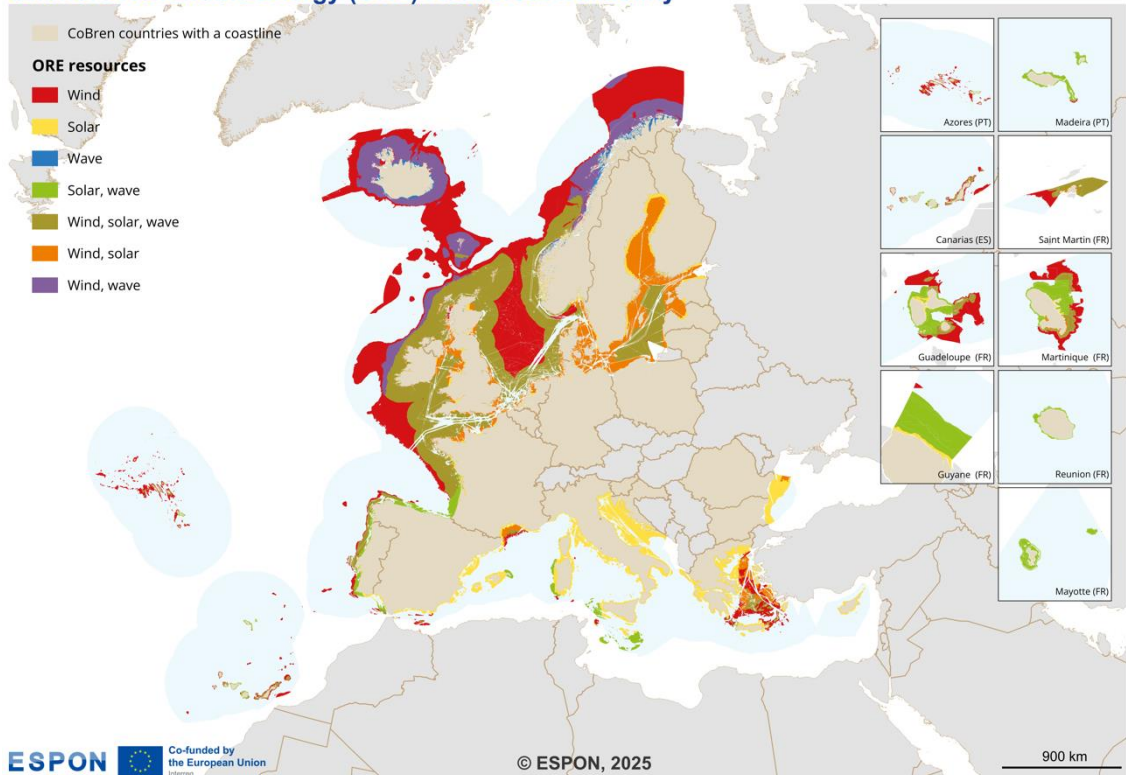
The total capacity was calculated for each sea basin, considering available areas, resource density, and technology-specific factors. Conservative estimates were used by limiting the distance from shore in some cases, though in practice, many offshore wind farms are being developed beyond these limits.

2.4.2 Overview of ORE potential in Europe

The mapping exercise revealed significant variation in offshore wind, wave and solar potential across Europe’s sea basins, driven by geographic, climatic, and environmental factors. Each basin’s unique characteristics were analysed to estimate potential capacities for offshore wind, wave, and solar energy. While this report includes projections for tidal energy growth, tidal energy itself was not mapped due to limitations in available data. This does not indicate a lack of potential but rather underscores the need for improved datasets and further dedicated mapping efforts. As tidal technology advances, addressing these data gaps will be crucial for identifying viable deployment areas and integrating tidal energy into the broader offshore renewable energy mix.

Map 2: ORE resource availability in all ESPON countries and the United Kingdom

Offshore Renewable Energy (ORE) Resource Availability



Territorial level: Exclusive economic zone (EEZ)
 ESPON Project: COBREN, 2025
 Origin of data: Copernicus Climate Change Service ERA5, 2024 for resource data;
 ©Marine Regions EEZ, IHO Areas Intersection v11, and EuroGeographics for boundaries

Baltic Sea

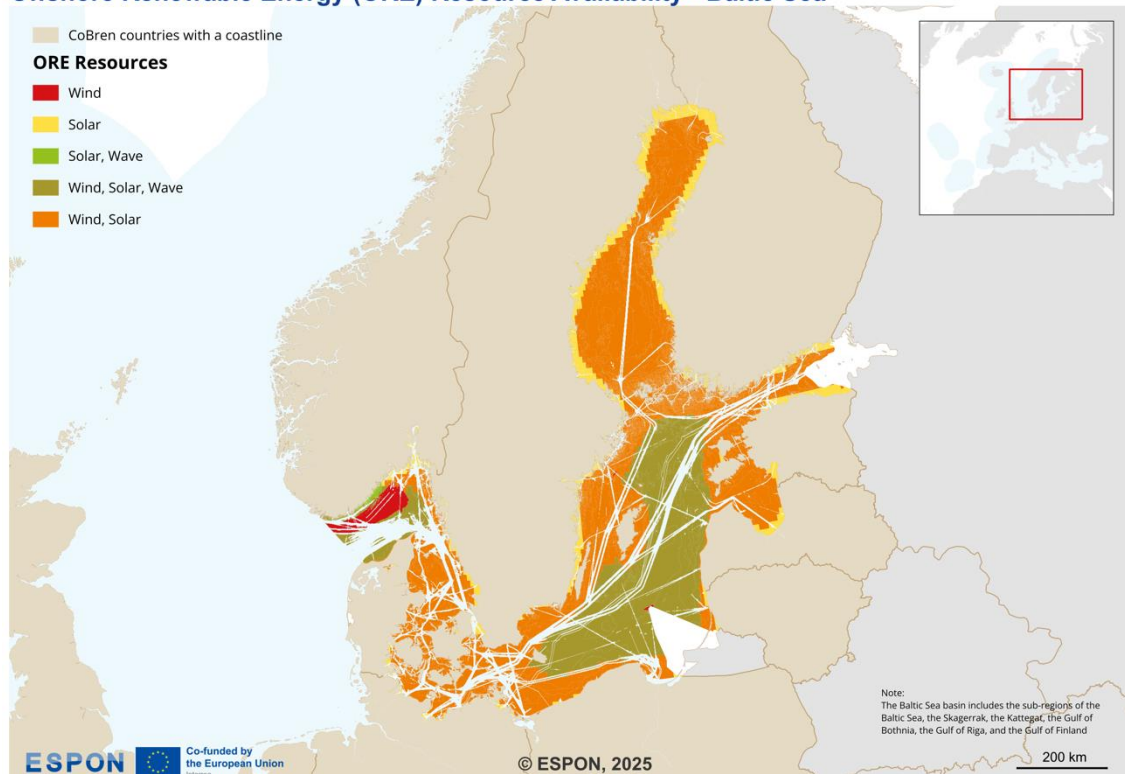
In our analysis, the Baltic Sea basin includes the Baltic Sea, Gulf of Bothnia, Gulf of Finland, Gulf of Riga, Kattegat, and Skagerrak.

In the Baltic Sea, offshore wind dominates as the primary resource, with widespread availability throughout the basin. The second most prominent resource is offshore solar, due to the relatively low wave height especially in the areas closer to the coast. However, while theoretically possible, offshore solar installations in this region would face significantly higher costs and challenges related to ice coverage and floating ice, which could impact their feasibility. Our analysis, based on set boundaries, identifies theoretical wave energy potential in the Baltic Sea. However, in practice, the feasibility of harnessing wave energy is limited due to the low wave height and low wave period, which current technologies are not well-suited to capture. Additionally, the high ice coverage, particularly in the northern part of the Baltic Sea, presents further technical challenges.

The stark seasonal variations in sunlight availability and the presence of ice layers during winter call for efficient use of the sea space. Without co-location, the Baltic Sea can mostly host offshore wind (95%) along with a smaller contribution from offshore solar (5%). Theoretical wave energy potential is identified primarily in areas that also have favourable conditions for offshore wind and offshore solar. The viability of ORE in these zones can be enhanced through co-location of energy resources, allowing for more efficient use of shared infrastructure and optimizing energy output in the Baltic Sea.

Map 3: ORE resource availability in the Baltic Sea

Offshore Renewable Energy (ORE) Resource Availability - Baltic Sea

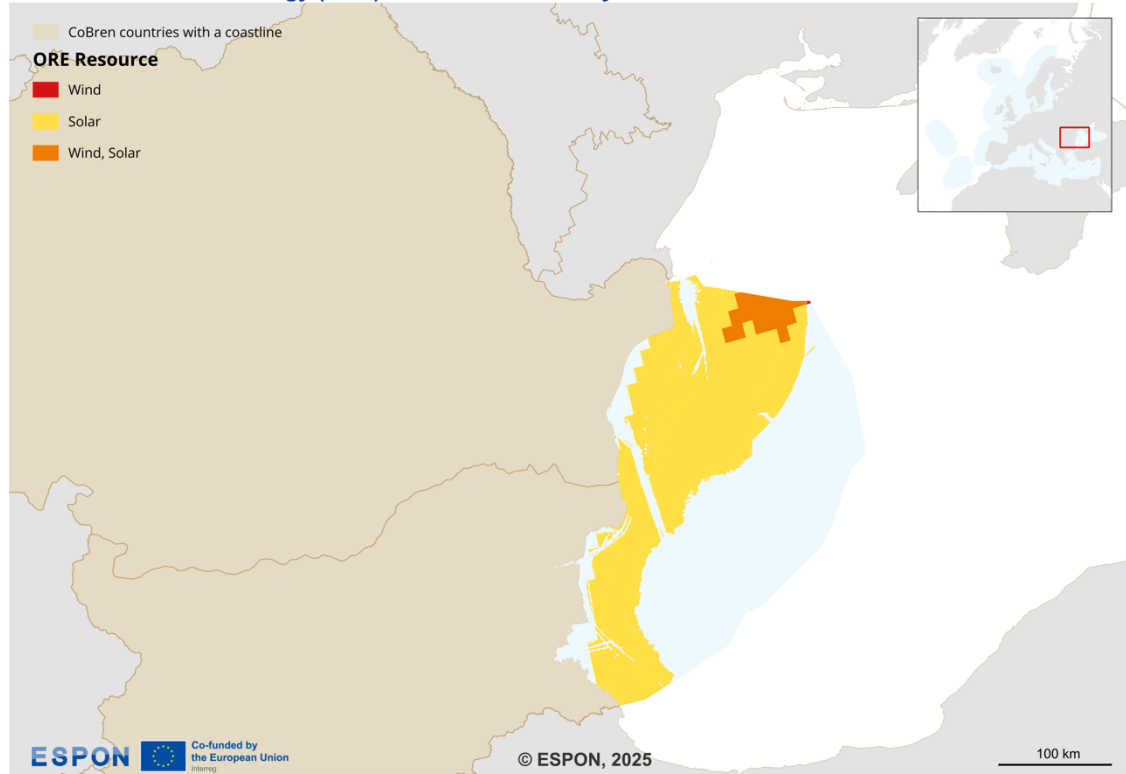


Black Sea

The European marine space in the Black Sea is relatively limited, comprising only two countries: Romania and Bulgaria. Offshore solar is the dominant ORE resource in the region, with Romania exhibiting a small amount of offshore wind potential. However, the low wind speed and minimal wave heights in the area make offshore wind and wave energy deployment largely unfeasible. Due to limited availability of resources, the potential for ORE co-location is also small, with only 6% of the available area deemed suitable for co-location.

Map 4: ORE resource availability in the Black Sea

Offshore Renewable Energy (ORE) Resource Availability - Black Sea



Territorial level: Exclusive economic zone (EEZ)
 ESPON Project: COBREN, 2025
 Origin of data: Copernicus Climate Change Service ERA5, 2024 for resource data;
 © Marine Regions EEZ, IHO Areas Intersection v11, and EuroGeographics for boundaries

Mediterranean Sea

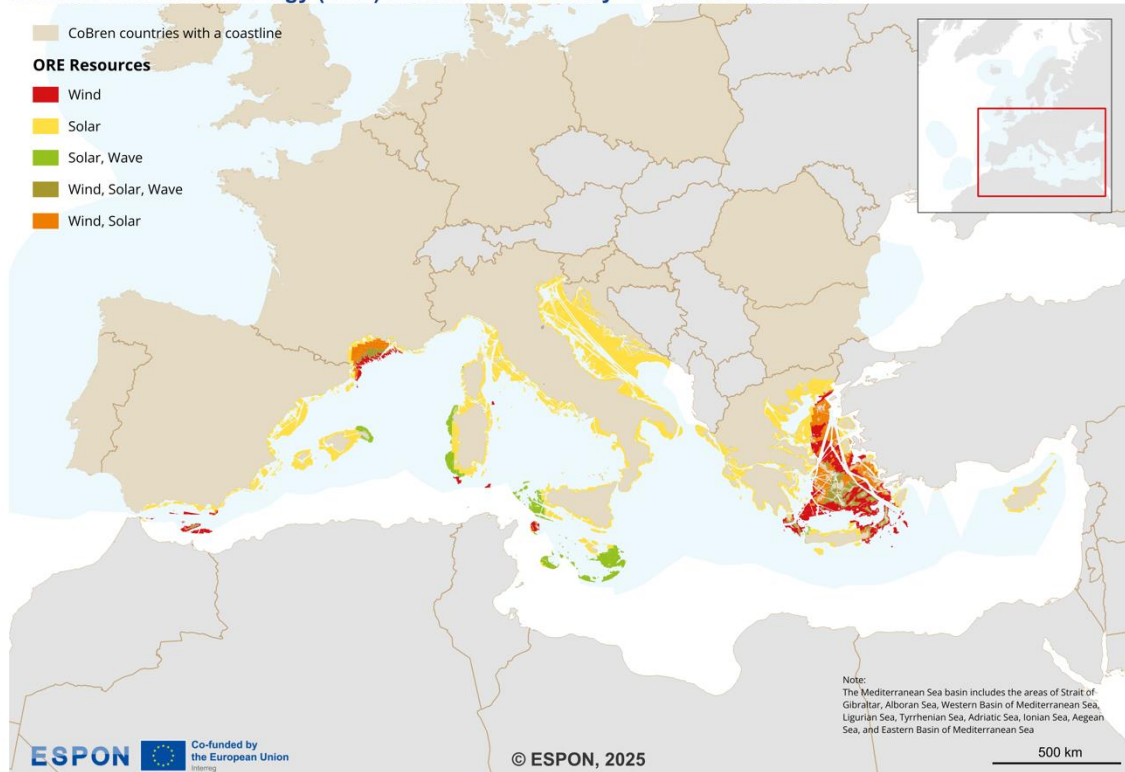
The Mediterranean Sea, the largest sea basin analysed, exhibits substantial ORE potential, particularly from offshore solar energy. A significant portion of the sea basin is excluded in the analysis due to the water depth, yet remaining areas still show high potential for ORE development.

In the West Mediterranean, offshore solar has the highest energy potential compared to other resources. However, there are relatively balanced potentials for offshore wind and wave energy, particularly in Spain and France for offshore wind, and in Italy for wave energy. Co-location potentials are most prominent along the French coast, where offshore wind, offshore solar, and wave energy can be combined.

In the East Mediterranean, offshore solar remains the dominant resource, with enhanced co-location potential, especially in Malta and Greece. Across the Mediterranean Sea, allowing co-location of different ORE will result in a 40% increase in total capacity.

Map 5: ORE resource availability in the Mediterranean Sea

Offshore Renewable Energy (ORE) Resource Availability - Mediterranean Sea

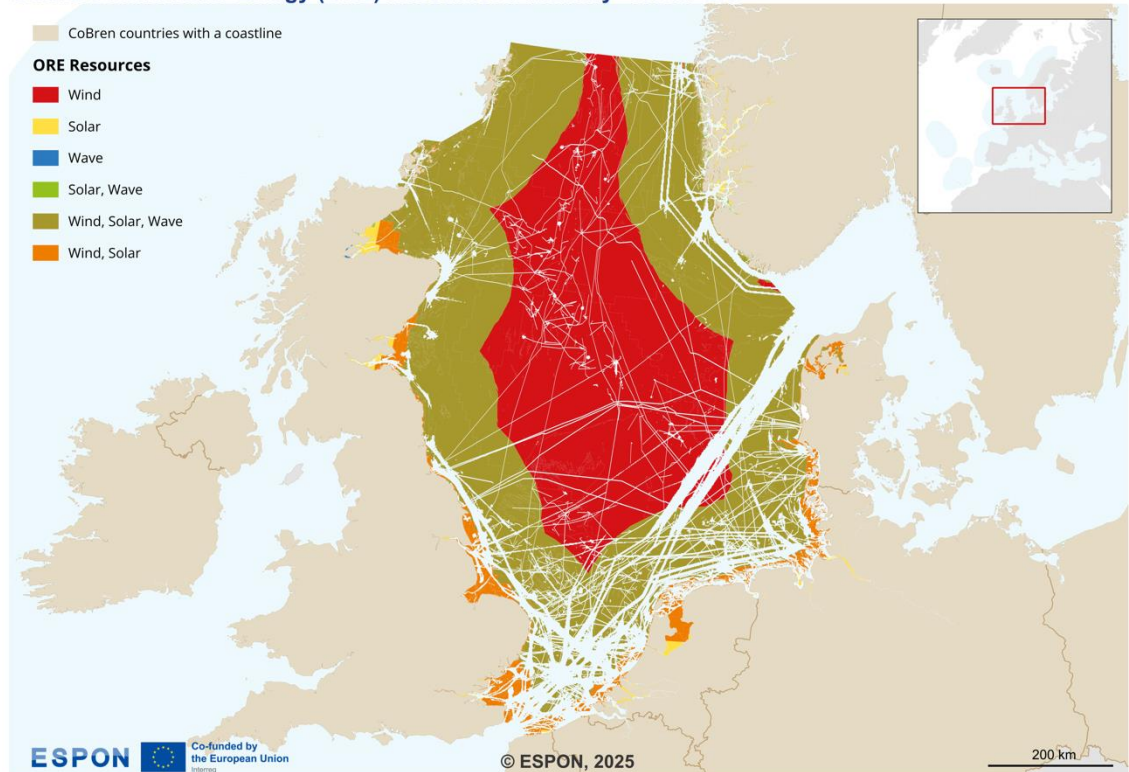


North Sea

In the North Sea, similar to the Baltic Sea, offshore wind is the dominant resource. This is unsurprising, given the region's long-established offshore wind industry. Offshore solar and wave energy potential is identified primarily in areas that also have favourable conditions for other ORE resources. Therefore, co-location of ORE resources presents a significant opportunity to enhance overall energy generation. By integrating these technologies into multi-use energy parks, the region could unlock more than 3.7 TW of additional capacity, effectively doubling the standalone capacity of 2.8 TW and creating a more resilient and efficient offshore energy system.

Map 6: ORE resource availability in the North Sea

Offshore Renewable Energy (ORE) Resource Availability - North Sea

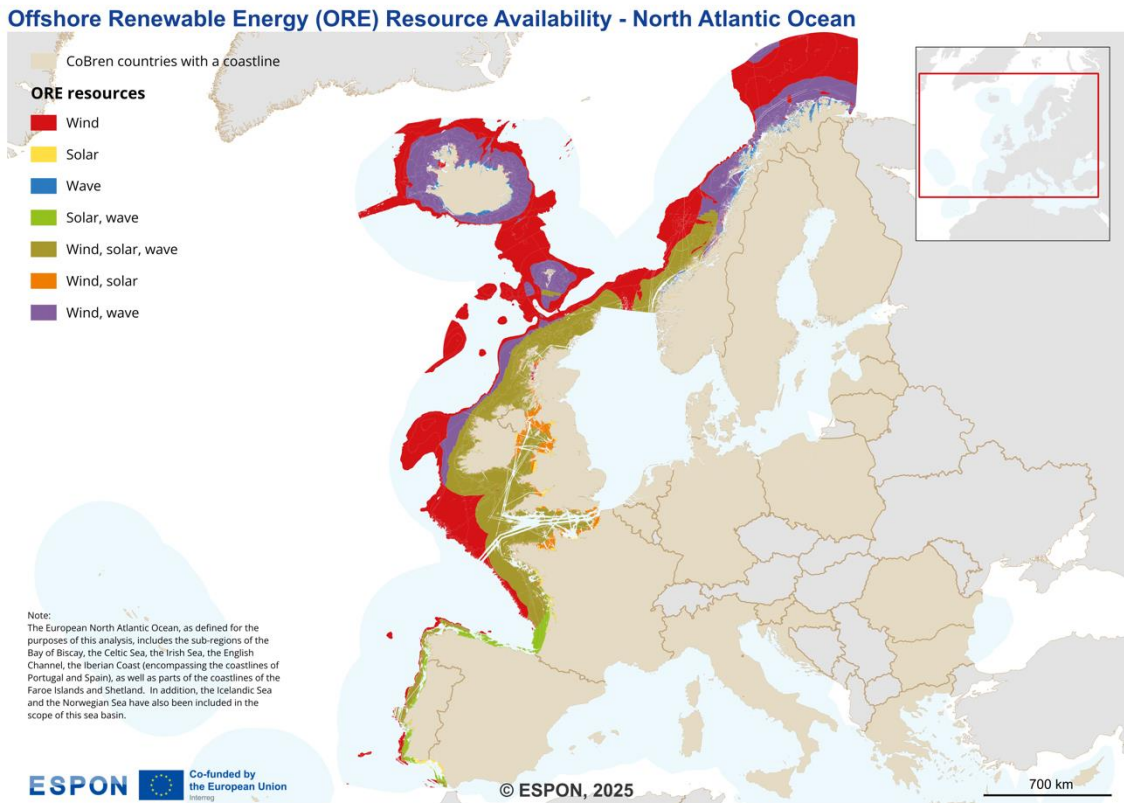


Territorial level: Exclusive economic zone (EEZ)
 ESPON Project: COBREN, 2025
 Origin of data: Copernicus Climate Change Service ERA5, 2024 for resource data;
 © Marine Regions EEZ, IHO Areas Intersection v11, and EuroGeographics for boundaries

North Atlantic Ocean

The North Atlantic Ocean is dominated by offshore wind in standalone scenarios, with relatively limited potential for offshore solar. Similar to the Mediterranean Sea, a large area is excluded in the analysis due to water depth. If co-location of different ORE resources is allowed, wave energy presents almost a similar potential as offshore wind, especially along the Spanish and Portuguese Iberian coast. Both Norway and Iceland have offshore wind and wave potential across both countries' coastlines. For the most part of the analysed area, areas with available offshore wind and wave energy potentials are overlapping, showing that co-location will considerably increase the potential ORE yield. In the southern half of Norway, offshore floating solar potential is also available, despite the capacity being relatively low compared to the offshore wind and wave potential.

Map 7: ORE resource availability in the North Atlantic Ocean



Territorial level: Exclusive economic zone (EEZ)
 ESPON Project: COBREN, 2025
 Origin of data: Copernicus Climate Change Service ERA5, 2024 for resource data;
 © Marine Regions EEZ, IHO Areas Intersection v11, and EuroGeographics for boundaries

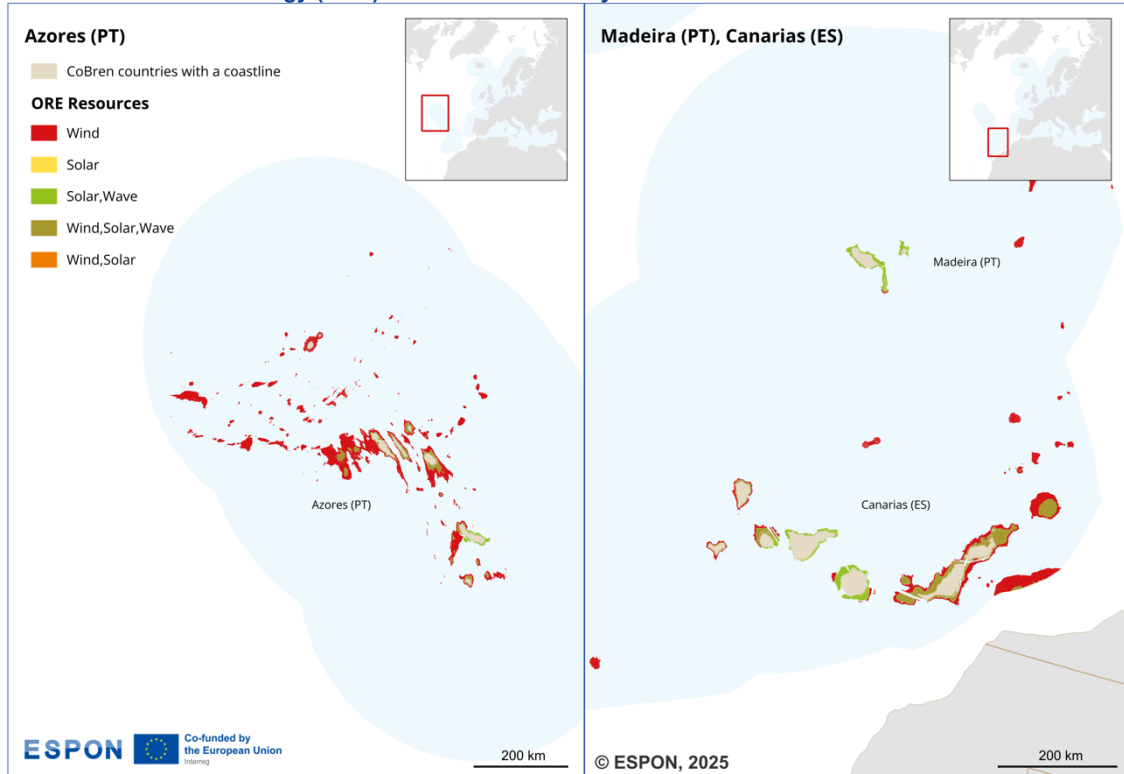
Outermost Regions

Macaronesia (Azores, Madeira, Canarias)

In Macaronesia, offshore wind shows a total theoretical potential of 380 GW. Offshore solar energy has a potential of 56 GW, with 99% of this capacity overlapping with other ORE sources. Wave energy potential in this region is identified primarily in areas that also have favourable conditions for other ORE resources, with a total wave potential of 161 GW. This highlights the benefits of multi-use energy parks in this region, particularly for maximizing wave energy resources.

Map 8: ORE resource availability in Macaronesia

Offshore Renewable Energy (ORE) Resource Availability - Macaronesia



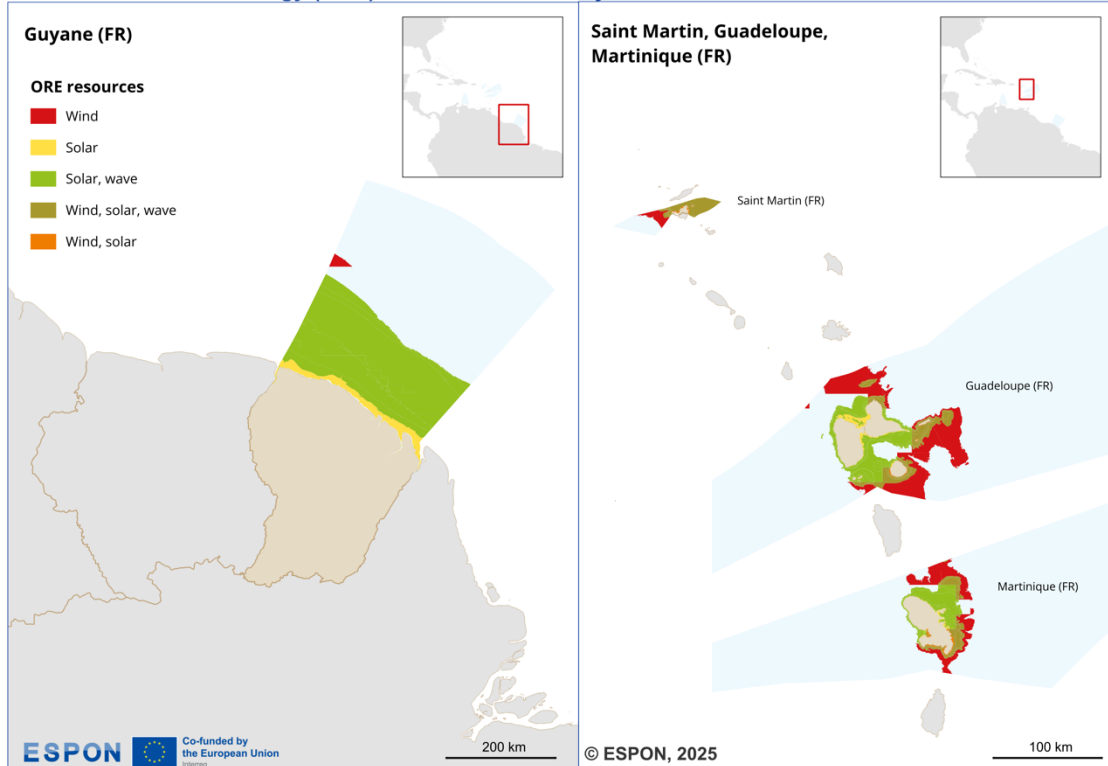
Territorial level: Exclusive economic zone (EEZ)
 ESPON Project: COBREN, 2025
 Origin of data: Copernicus Climate Change Service ERA5, 2024 for resource data;
 © Marine Regions EEZ, IHO Areas Intersection v11, and EuroGeographics for boundaries

French Caribbean (Guyane, Saint Martin, Guadeloupe, Martinique)

In the French Caribbean, offshore solar has a total capacity of 225.86 GW, of which 92% overlaps with other ORE sources. Wave energy has a total potential of 604.50 GW, which is mainly overlapping with areas that also have favourable conditions for other ORE resources. Offshore wind potential is limited to 49.54 GW, reflecting the region’s lower wind speeds. These findings emphasize the importance of co-location to unlock wave energy capacity and complement the strong solar resource.

Map 9: ORE resource availability in the French Caribbean

Offshore Renewable Energy (ORE) Resource Availability - French Caribbean



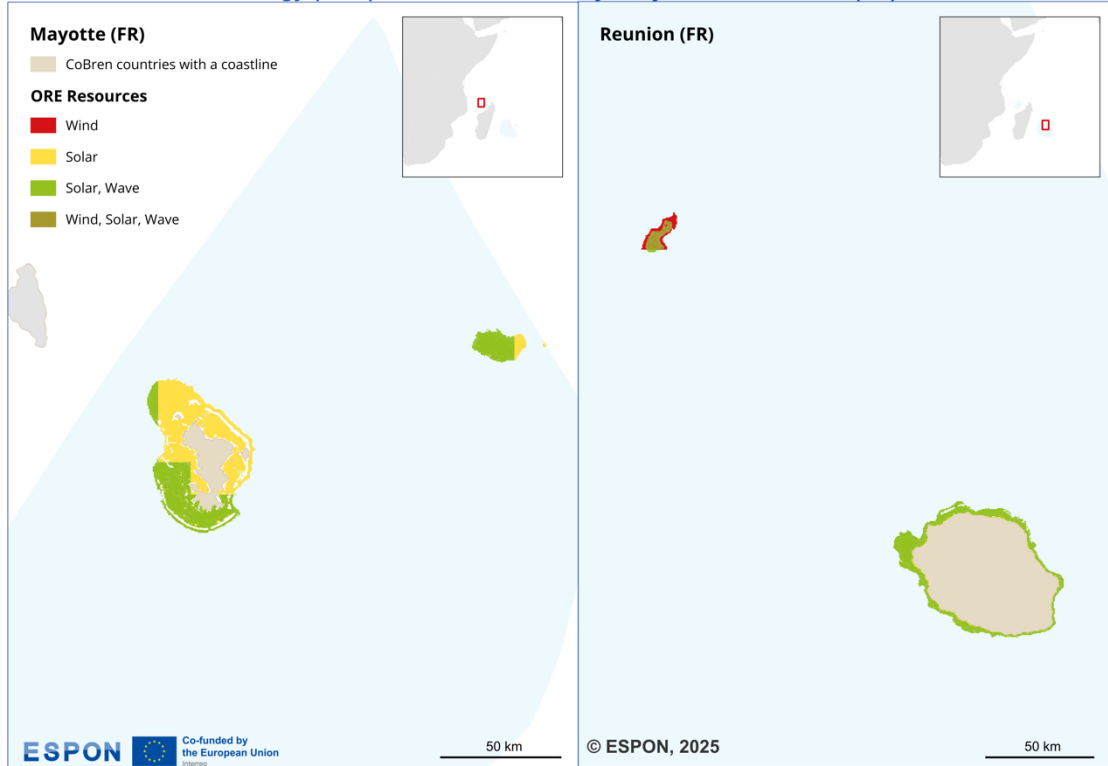
Territorial level: Exclusive economic zone (EEZ)
 ESPON Project: COBREN, 2025
 Origin of data: Copernicus Climate Change Service ERA5, 2024 for resource data;

La Réunion, Mayotte

Réunion and Mayotte exhibit limited offshore wind potential of 0.90 GW. Offshore solar has a total capacity of 8.90 GW, with 60% overlapping with other ORE sources. Wave energy potential reaches 16 GW when co-located with other ORE sources. **These figures highlight the value of integrating solar and wave energy resources to improve energy generation efficiency in these tropical regions.**

Map 10: ORE resource availability in Mayotte and La Réunion

Offshore Renewable Energy (ORE) Resource Availability- Mayotte and Reunion (FR)



Territorial level: Exclusive economic zone (EEZ)
 ESPON Project: COBREN, 2025
 Origin of data: Conemicus Climate Change Service ERA5, 2024 for resource data

Table 6: The ORE potential in Europe per sea basin (with and without co-location)

Sea Basin	Offshore Wind Capacity	Offshore Solar Capacity		Wave Energy Capacity	
	Total capacity (GW)	Total capacity (GW)	Over-lapping with other ORE (%)	Total capacity (GW)	Over-lapping with other ORE (%)
Baltic Sea	3365	1868	91 %	1563	100 %
Black Sea	14	130	6 %	0	N/A
Mediterranean Sea	949	2929	24 %	1410	100 %
North Atlantic Ocean	20288	3075	98 %	15792	98 %
North Sea	2827	1026	98 %	2719	100 %
Macaronesia	380	56	99 %	161	100 %
French Caribbean	50	226	92 %	605	100 %
La Réunion, Mayotte	1	9	60 %	16	0 %

The table above shows the great potential that co-location of offshore wind, offshore solar and wave energy have, especially in the North Atlantic Ocean, the North Sea and Baltic Sea, but also to a lower extent in the Mediterranean Sea and in Macaronesia. It should, however, be noted that the ORE potential values presented in this table represent theoretical potential based on our mapping approach and defined boundaries. **These figures do not directly translate to practical potential, as real-world feasibility is influenced by factors such as ice coverage, technological limitations, environmental constraints, and regulatory considerations.** The primary purpose of this analysis is to illustrate the potential benefits of co-location of ORE for optimizing offshore renewable energy deployment across different European sea basins.

In conclusion, significant potential and efficiency gains are achievable through the integrated deployment of multiple ORE sources in multi-use energy parks. To unlock this potential, it is essential to establish supportive policy and regulatory frameworks that incentivize co-location and multi-use energy parks. Key measures include enhancing infrastructure, investing in shared facilities, and providing financial support mechanisms to accelerate ORE deployment across European sea basins.

2.5 The current use of sea space and land-sea interactions define the spatial context for ORE deployment

The EU's ambitions for ORE are substantial, and the resource potential - as outlined in the previous section - is considerable. However, realising this potential depends not only on technical and natural conditions, but on a clear understanding of the existing use of marine space. European seas are already densely occupied, multifunctional, and shaped by longstanding patterns of use. This section provides a baseline analysis of current sea use and land-sea interaction, with a focus on existing spatial pressures, multifunctionality, and implications for ORE deployment.

2.5.1 A densely used and increasingly multifunctional marine space

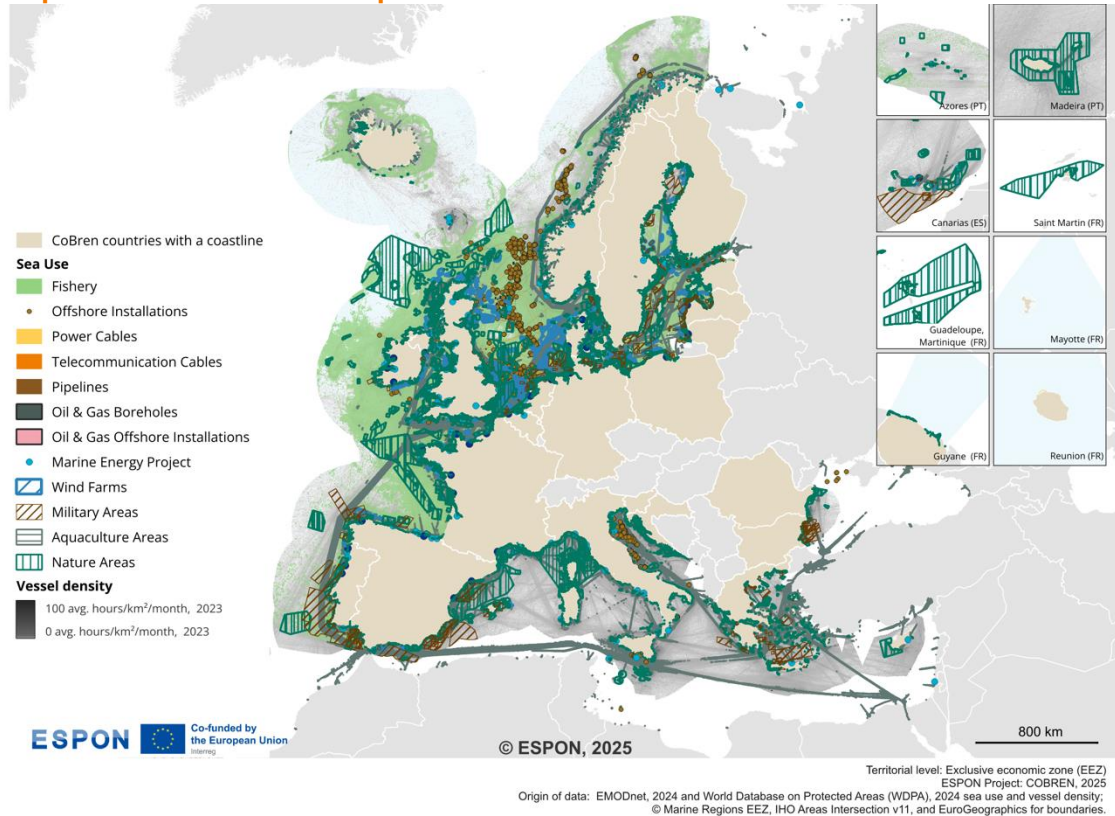
Marine space in Europe is already under substantial and growing pressure. The map on “Current use of sea space” illustrates high levels of spatial intensity across several sea basins, particularly the North Sea and Baltic Sea. These regions accommodate a dense and overlapping configuration of activities, including commercial shipping, fisheries, conservation areas, submarine cables, and ORE installations. The southern North Sea in particular, shows a convergence of these uses within a limited nearshore zone, reflecting both economic concentration and spatial saturation.

In recent years, offshore wind development has introduced a new layer to this already complex spatial environment. Fixed-bottom wind farms have become a dominant feature in the southern North Sea, Irish Sea, and parts of the Baltic. These installations are supported by a growing network of export cables and offshore substations, often located in proximity to major industrial ports. Their placement is not only guided by resource availability but also constrained by existing maritime activities and planning designations.

Across sea basins, ORE development is increasingly co-located with other uses, including fisheries, aquaculture, and shipping routes, either by necessity or through policy ambition for multi-use. The Irish Sea, German Bight, and western Baltic, for example, show active and emerging zones of overlapping use. While multifunctionality has the potential to increase spatial efficiency, it also introduces planning complexity, particularly in contexts where clear governance frameworks for co-location are lacking.

In the Mediterranean Sea, despite high vessel traffic and coastal population density, ORE deployment remains limited. Planning processes must account for significant spatial competition from tourism, conservation, and nearshore aquaculture. In contrast, the Atlantic coast and Black Sea currently exhibit lower levels of spatial saturation and represent emerging zones for future ORE development, particularly where floating wind or marine energy technologies are being considered.

The overall picture is one of spatial convergence: areas that offer the best conditions for offshore energy development - proximity to shore, strong wind resources, and port access - are also the areas of highest spatial constraint. Strategic marine spatial planning, therefore, becomes a prerequisite for scaling ORE deployment in line with the EU's 2030 and 2050 targets.

Map 11: Current use of sea space

More detailed and zoomed-in visualizations per sea basin can be accessed via the ESPON Portal:
<https://gis-portal.espon.eu/arcgis/apps/sites/#/espon-hub>

2.5.2 Land-sea interactions: enabling infrastructure and spatial constraints

The marine dimension alone does not determine the viability of ORE. Equally important is what happens at the land–sea interface: where offshore infrastructure connects to ports, energy grids, and industrial systems onshore. The map on “land–sea interaction” highlights coastal nodes where spatial intensity, infrastructure, and population pressure converge, and where ORE deployment interacts most directly with terrestrial systems and stakeholders.

Grid Connectivity and Cable Landings: Sea-to-shore electricity transport is a core element of ORE deployment. Subsea cables are routed to coastal landing zones with sufficient grid capacity, typically located near substations and industrial areas. However, suitable sites are limited, particularly in high-density coastal regions, due to competing land uses, environmental designations, and societal concerns. Grid integration challenges are compounded in countries with aging onshore infrastructure or limited grid redundancy. As new marine energy projects emerge, pressure will mount on existing grid nodes unless strategic upgrades and spatial coordination are implemented.

Port Infrastructure and Industrial Readiness: Ports serve as assembly, storage, and servicing hubs and are increasingly integrated into offshore energy supply chains. According to WindEurope’s report: *A 2030 Vision for European Offshore Wind Ports*, Europe will need at least €6.5 billion in port investments by 2030 to meet its offshore wind deployment targets. Facilities such as Esbjerg and Eemshaven are already scaling up their capacity to handle larger turbine components and support floating wind technologies. These developments underline that ports are strategic enablers of the energy transition and must be considered in spatial planning as critical infrastructure.

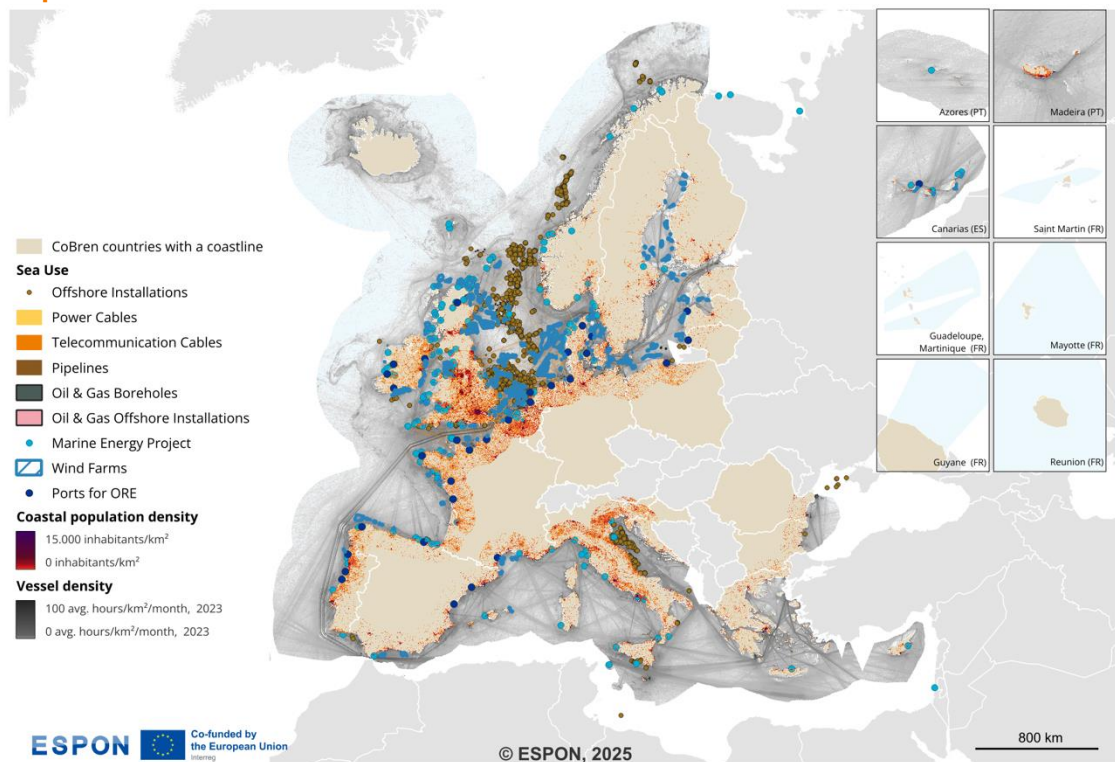
Coastal Population Density and Public Acceptance: Population density and urban development along Europe’s coastlines create both opportunities and constraints. On one hand, proximity to demand centres and skilled labour is advantageous. On the other, public concerns around visual intrusion, navigational safety, and environmental impacts are more acute in populated areas.

Acceptance is particularly relevant for nearshore wind farms and onshore grid infrastructure. However, marine energy technologies (e.g. wave and tidal) often elicit fewer objections, due to their low visibility and limited spatial footprint. In addition, public support increases when ORE projects demonstrate clear local benefits and involve communities early in the planning process.

Recreation, Tourism and Environmental Interfaces: Many coastal regions in Europe are economically dependent on tourism and recreation. While early concerns have focused on the visual impact of offshore wind, properly sited installations, particularly those beyond the visual horizon, tend to have neutral or even positive effects on local tourism. Some regions have capitalised on this, offering boat tours to offshore wind farms as visitor experiences. Environmental concerns, however, remain more complex. Cable landings, substation construction, and dredging can impact sensitive coastal habitats. Environmental Impact Assessments and Strategic Environmental Assessments must therefore incorporate both marine and terrestrial biodiversity to ensure compliance with the EU Birds and Habitats Directives.

This section highlights a central tension: the spatial potential for ORE in Europe is high, but the marine and coastal spaces required for its deployment are already multifunctional and constrained. Stocktaking of current sea use reveals overlapping claims and limited unallocated space nearshore. Coastal infrastructure, especially ports and grid connections, further shapes where and how energy can come ashore. The land–sea interface is not a neutral backdrop, but a determining factor in the success of the energy transition. Going forward, effective deployment of offshore renewables will require integrated spatial strategies that reflect the realities of both sea use and land-based constraints.

Map 12: Land-sea interaction



More detailed and zoomed-in visualizations per sea basin can be accessed via the ESPON Portal:
<https://gis-portal.espon.eu/arcgis/apps/sites/#/espon-hub>

2.6 To unlock the full potential of ORE, synergies and barriers with other sea use activities need to be considered in an integrative manner

Unlocking the full potential of ORE is a complex challenge and requires simultaneous efforts across different fronts. This section explores strategies to achieve this goal through synergies with other sea activities and cross-border collaboration within European sea basins. This integrative approach not only maximizes the use of available marine spaces but also encourages innovation and shared infrastructure. Together, they aim to harness the full capacity of Europe's marine resources, driving forward Europe's transition to a sustainable energy future.

To understand potential synergies and barriers for ORE deployment, data on 'key' activities, based on the activity's total spatial claim at European level²⁴, as well as sea-to-shore infrastructure was collected and mapped.

Next, a country-level analysis was performed on synergies and barriers in ORE potential for European countries (see Annex 1). Overlapping (potential) spatial claims were identified and, if relevant, brief policy recommendations were made. These findings also drew inspiration from a series of stakeholder engagement events focused on different sea basins²⁵.

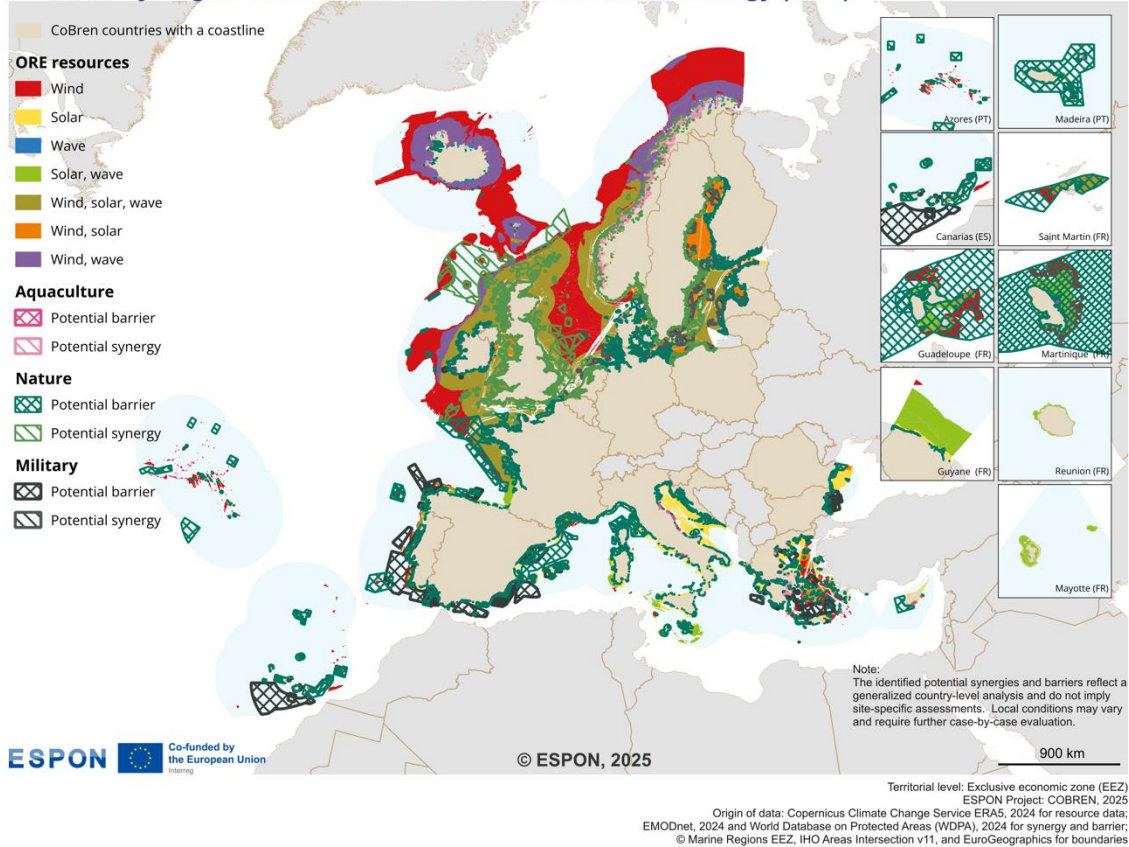
This analysis first aims to provide broad insights into the key activities of interest in the context of ORE deployment, specifically focusing on military activities, aquaculture and fisheries (hereafter: aquaculture), nature conservation, and other ORE (e.g. wind, wave, tidal, offshore solar). It explores how these activities interact with ORE development, identifying both potential conflicts and synergies that could arise. Following this, we dive deeper into the specific findings for each sea basin, offering a detailed examination of regional dynamics and how they influence the integration and co-existence of various blue economy activities with ORE projects.

²⁴ The exception of this is transport, which both holds a significant spatial claim yet the potential for synergies is limited by international obligations. However, multiple countries try to overlap transport routes with subsea infrastructure.

²⁵ Stakeholder events of the EU-SCORES project; Belgium in March 2024 and Portugal in July 2024.

Map 13: ORE resources, synergies and barriers in all European sea basins

Potential Synergies and Barriers for Offshore Renewable Energy (ORE)



Note: The representation of synergies and barriers in this and following maps is based on a qualitative, country-level analysis and is intended to provide an indicative overview of potential interactions between offshore renewable energy and other maritime uses. These classifications do not reflect detailed, site-specific assessments. Actual conditions may differ significantly depending on local context, spatial planning, and regulatory frameworks. Readers are advised to interpret this map as a strategic-level input rather than a definitive spatial designation.

2.6.1 Overview of the impact of key sea use activities on ORE development

If nature, military, aquaculture and other ORE activities overlap with ORE in certain areas based on the country-level analysis (see Annex 1), policy documents such as MSP and ORE strategies are analysed to assess the extent to which the activities are treated as mere obstacles or potential synergies. Further analyses can expand on activities such as tourism, leisure & sport when zooming in on specific countries or sea basins.

2.6.1.1 Nature

The extent to which nature is described in policy documents as an obstacle to or a potential synergy with ORE depends on various factors. The spatial claims of Marine Protected Areas (MPAs) and Natura2000 are often described as limiting factors for ORE development. Spain for instance specifically states that the 30% environmental protection target will be maintained and co-locating with ORE is not mentioned in the MSP. Other countries such as Germany designated offshore wind as an overriding interest, potentially limiting the obstacles from (environmental) permitting. Other countries face similar choices yet have also considered the potential for synergies. Lack of spatial alternatives have for instance pushed Belgium to open the dialogue on how ORE could be deployed responsibly in Natura2000-areas. The synergy derived from nature inclusive design of ORE

has been included in ORE tenders, both in new ORE markets such as Poland and established markets such as the Netherlands²⁶.

2.6.1.2 Military

Geopolitical pressures have underlined the importance of energy security and the necessity of ORE in this regard. At the same time, those pressures have also made the sensitivity of offshore infrastructure a top priority. **Most countries such as Spain designate military areas as no-go zones.** In other countries such as the Netherlands, it is expected that the military zones will require more space to accommodate the growing military capacity and training needs. Belgium may be the only country that recently announced to explore the potential for non-permanent uses of military zones outside training periods. Aside from the UK, only a few countries have rolled out innovation challenges to mitigate obstacles such as radar interference and explore potential synergies such as improved monitoring capabilities. Both at national, sea basin level and NATO-level, alliances have been formed to intensify and strengthen monitoring of offshore assets.

2.6.1.3 Aquaculture

Aside from the market potential of aquaculture, most policy documents also refer to the cultural and socio-economic importance of this sector. A first bottleneck for exploring synergies is that the sector is misidentified as a homogenous sector. However, different sub-sectors that can be categorised under aquaculture and fishery activities also maintain different spatial preferences. Another finding is that in some countries (e.g. Malta), aquaculture zones are defined as ‘no-go’ areas of crucial importance, while other countries aim to explore synergies between either existing or new types of aquaculture and other blue economy sectors.

2.6.1.4 Other ORE

Half of the countries analysed are considering alternative ORE deployment other than offshore wind, such as wave, tidal and offshore solar.²⁷ The main drivers for this include the potential contribution to the stability of the (offshore) grid, efficient use of space and less (visual) impact. Multiple countries consider the combinations wind + solar (e.g. Malta, the Netherlands) and wind + wave (e.g. Portugal, Ireland), but even more countries have a lot to gain by taking these synergies into account.

2.6.1.5 Key findings of sea use activities on ORE deployment

When looking at potential obstacles or synergies for ORE, the differences in approaches make it clear that the perceived level of synergy is not only driven by the activity itself. Even activities that most countries treat as obstacles (e.g. military) still offer a limited level of potential synergy. Closer consideration of the overlapping (potential) spatial claims and regional policy documents such as ORE strategies can further explain why an activity is treated as an obstacle or synergy.

²⁶ A detailed overview per country is provided in Scientific Annex I.

²⁷ There is also an important distinction to be made between floating and fixed-bottom offshore wind, where the floating alternative is designed for deep waters.

2.6.2 Synergy and barrier analysis per sea basin

Regional differences in MSP are often driven by the size or potential of the activities. The country-level analysis that uses the ORE resource potential to map overlapping areas can therefore explain where obstacles or synergies might form. However, policy documents can shed light on how and why certain activities are currently treated as obstacles or synergies. This policy perception is a moving target and only the most recent (draft) policy documents were therefore used. This sea basin analysis can best be used to flag up-to-date opportunities to explore synergies between certain activities and ORE development.

Table 7: Overview of Synergies and Barriers*

	Nature	Military	Aquaculture	Other ORE
Belgium	Synergy	Synergy	Synergy	Synergy
Bulgaria	Barrier	Barrier	Synergy	Barrier
Croatia	Barrier	Barrier	Barrier	Synergy
Cyprus	Barrier	Barrier	Barrier	Synergy
Denmark	Barrier	Synergy	Synergy	Synergy
Estonia	Barrier	Synergy	Synergy	Barrier
Finland	Barrier	Synergy	Barrier	Barrier
France	Barrier	Barrier	Barrier	Barrier
Germany	Barrier	Synergy	Synergy	Barrier
Greece	Barrier	Barrier	Synergy	Synergy
Ireland	Barrier	Barrier	Barrier	Synergy
Italy	Barrier	Barrier	Barrier	Synergy
Latvia	Barrier	Synergy	Barrier	Barrier
Lithuania	Barrier	Synergy	Barrier	Barrier
Malta	Barrier	Barrier	Barrier	Synergy
The Netherlands	Synergy	Synergy	Synergy	Synergy
Poland	Synergy	Synergy	Barrier	Barrier
Portugal	Barrier	Barrier	Barrier	Synergy
Romania	Barrier	Barrier	Barrier	Barrier
Slovenia	Barrier	Barrier	Barrier	Barrier
Spain	Barrier	Barrier	Barrier	Synergy
Sweden	Synergy	Synergy	Synergy	Barrier
Iceland	Barrier	Barrier	Barrier	Barrier
Norway	Synergy	Synergy	Synergy	Barrier
United Kingdom	Synergy	Synergy	Barrier	Barrier

*See Annex 1 for references and underlying research

2.6.2.1 Baltic Sea

Nature - Significant overlap between nature and ORE resources are found in Denmark and Germany. Here, the overlap is often framed as an obstacle for which the legal status of ‘overriding interest’ of ORE is presented as a solution. Less progress is made in identifying the potential for synergies through nature inclusive design. In other countries in the Baltic Sea, nature as a barrier for ORE deployments is less of an obstacle due to limited overlap with the resources.

Military - Concerns over Russia sabotaging offshore energy assets came into the spotlight after the Nordstream explosions. In the Vilnius Declaration, eight Baltic Sea countries pledged to accelerate the deployment of ORE while strengthening the protection of offshore energy assets. The strategic location of the Baltics has already required ORE developers to exchange data, host relevant technology and support the operation of radar for national security. **The significant spatial claim of military areas provides an indirect obstacle for ORE in the Baltic Sea.** In fact, ORE's potential could expand significantly if synergies are explored between military areas and nature. This is especially the case if countries expand their military zones in the upcoming years, as Sweden announced²⁸.

Aquaculture - Aquaculture holds the most significant spatial claim in Poland. The abundance in overlapping areas of interest might require Baltic countries to further explore co-existence and the offshore wind industry already considered this in their 2020 Vision for the Baltic Sea²⁹. While such integrated innovations might also prove relevant to Denmark, most other countries in the Baltic Sea face limited obstacles from (or potential for synergies with) aquaculture in terms of overlapping resources with ORE.

Other ORE - As one of the most Northern Sea basins in Europe, the Baltic sea's seasonal complementarity between solar and wind provides an interesting case for wind+solar³⁰. However, no energy policy initiative to harness this potential has been identified. While out of scope for this study, these policy decisions can be explained by the challenges of sea ice for offshore structures, presence of renewable alternatives (hydro/biomass), seasonal energy demand preferences or absence of industry focus.

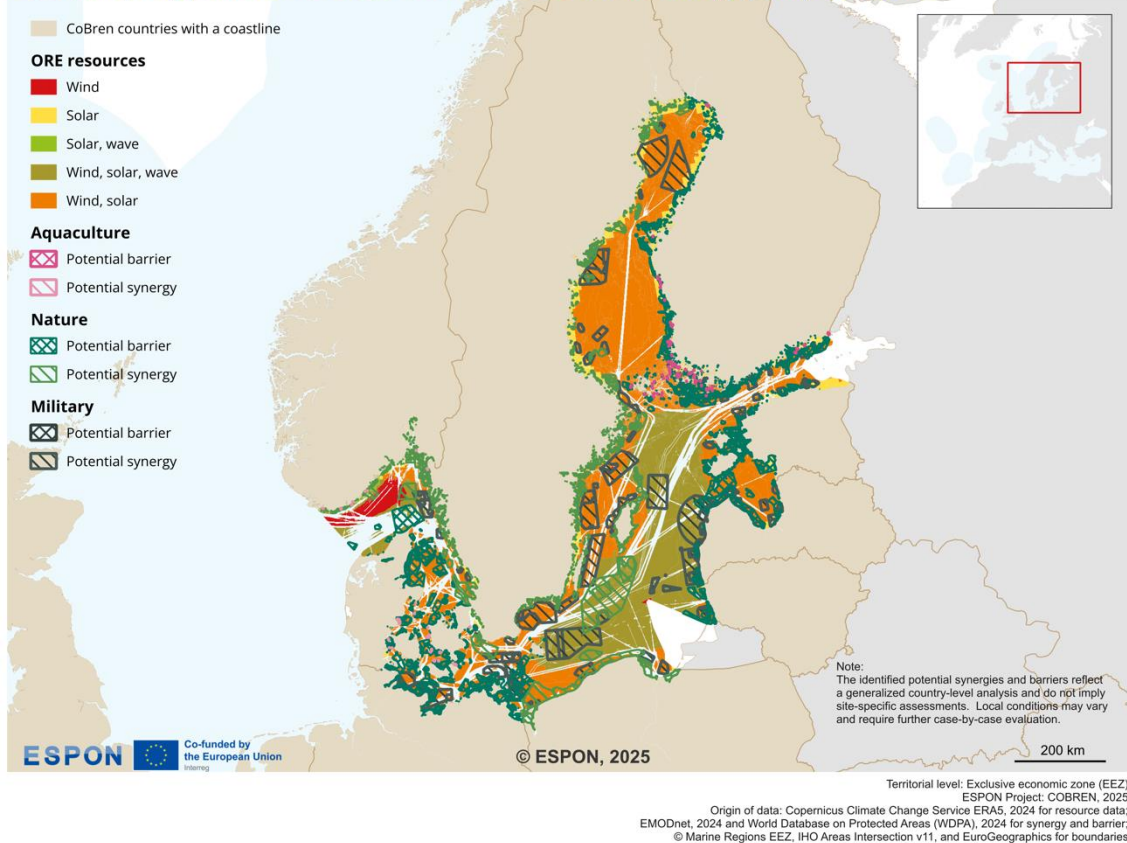
²⁸ <https://www.offshorewind.biz/2023/04/14/swedish-energy-agency-outlines-where-30-gw-of-offshore-wind-could-be-installed-calls-for-prioritising-energy-production-in-marine-planning/>

²⁹ <https://www.psew.pl/>

³⁰ In short, the Baltic winter sees more wind, yet the days are cloudy and shorter meaning less sun, while the summer generally sees less wind and longer days with more sun.

Map 14: ORE resources, synergies and barriers in the Baltic Sea

Potential Synergy and Barrier Areas for Offshore Renewable Energy (ORE) - Baltic Sea



2.6.2.2 North Sea

Nature - Arguably one of the busiest sea basins, countries surrounding the North Sea seem to have realized that the sea basin is not big enough to accommodate all users and activities separately. Inevitably, synergies must also be explored to restore the deteriorated state of nature in the North Sea. Nature conservation, cumulative impacts and multi-use are working tracks in the *Greater North Sea Basin Initiative (GNSBI)*. Most countries already look at nature inclusive design via prequalification and non-price criteria in ORE auctions to strengthen the environment in tandem with ORE deployments. Belgium went further and successfully explored possibilities of responsible ORE deployments in nature sensitive areas with both NGO's and the wind industry.

Military - The importance of identifying synergies between ORE and military can be illustrated with the *North Seas Energy Cooperation (NSEC)* declaration which includes a political commitment to foster stronger collaboration within the sphere of offshore energy security. NSEC countries aim to improve information sharing methodologies, the integration of security by design principles, and the advancement of cutting-edge detection technologies. Four North Sea countries (Denmark, Netherlands, Germany and Norway) joined the *Seabed Security Experimentation Centre (SeaSEC)*-initiative on seabed security, looking in part at potential synergies with ORE.

Aquaculture - Specific types of fisheries are heavily impacted by the increased spatial claims from shipping, sand extraction, nature, military, and ORE in the North Sea. Therefore, initiatives such as *GNSBI* aim to formulate recommendations on long term perspectives for fisheries based on effective maritime spatial planning while considering the various transitions and the carrying capacity of the North Sea. At national level, the Netherlands is experimenting with area passports that aim to facilitate the permitting process needed for certain types of fishing and other types of aquaculture activities such as farmed mussels and seaweed within offshore wind farms OWF.

Other ORE – To go beyond the 300 GW of offshore wind, other types of ORE are needed. No barriers have been identified, as tidal energy provides solutions for areas such as the Danish' Faroe Islands and the UK where OWF are not planned due to the tidal velocity. Offshore solar provides a different

case in point, as the Dutch government is exploring to tender 3 GW of offshore solar within new OWFs. For wave energy, a similar focus on the combination with OWFs is taken by the [industry](#)³¹.

Map 15: ORE resources, synergies and barriers in the North Sea

Potential Synergy and Barrier Areas for Offshore Renewable Energy (ORE) - North Sea



2.6.2.3 Atlantic Ocean

Nature – Existing overlap between nature and ORE in countries such as France suggests that co-existence is possible. However, ORE strategies generally treat nature as a barrier for nearshore ORE in the Atlantic Ocean. This approach seems especially problematic in areas with multiple overlapping areas such as the Spanish coast near Portugal.

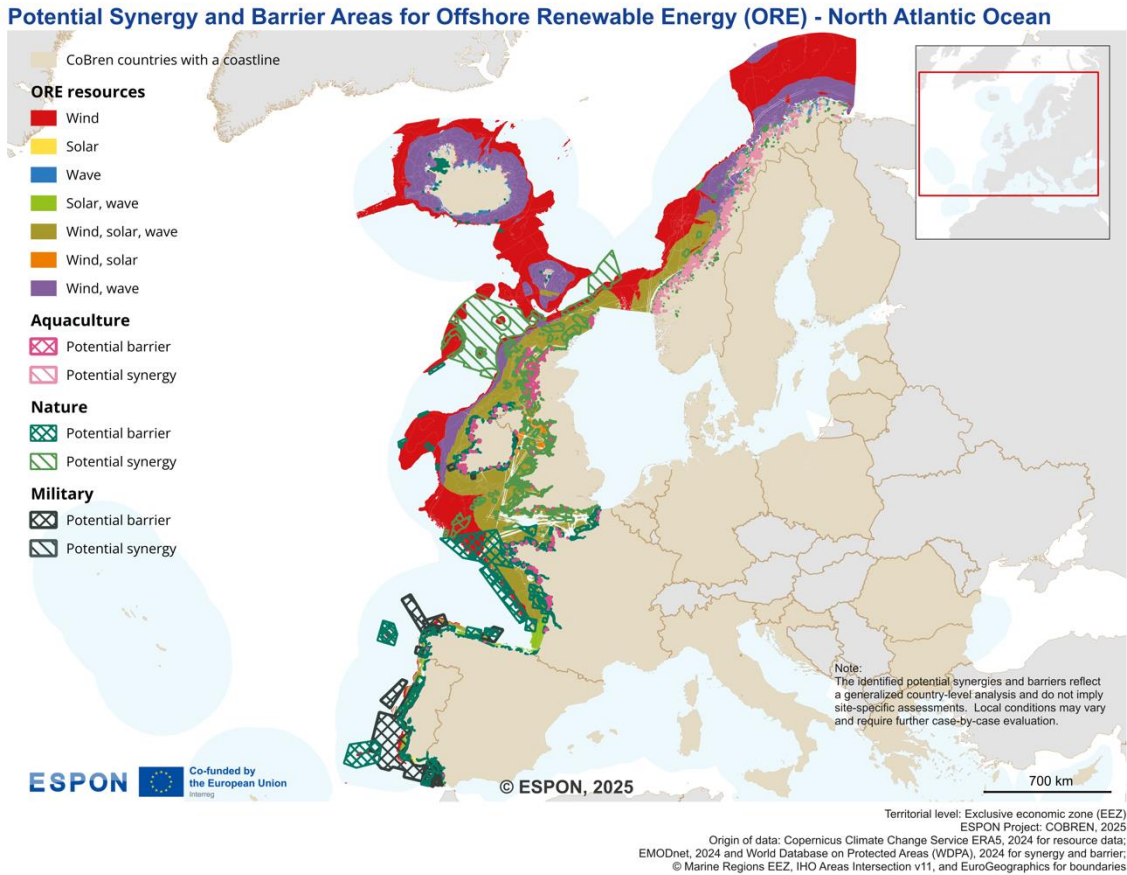
Military – Different conclusions can be drawn on whether military activities provide a barrier or potential synergy for countries neighbouring the Atlantic Ocean. In Ireland, for example, the spatial claim is limited while Portugal could significantly benefit from exploring synergies between military zones.

Aquaculture – Most countries bordering the Atlantic Ocean see aquaculture as a barrier for ORE, as their nearshore application overlaps with the ORE's preference for shallow waters. In some countries, such as Ireland, the limited spatial claim limits the push for co-existence. However, existing overlaps in countries such as Spain suggest that the search for synergies and co-existence might be worthwhile.

Other ORE – Compared to the other sea basins, the Atlantic Ocean holds significant wave + wind potential. For now, Northern Portugal, the west-coast of Ireland and Spain have considered wave energy in most detail in their ORE planning. Despite the significant wave resources and deep waters, there is also potential for offshore solar + wind yet countries have not fully identified this potential in their ORE strategies.

³¹ <https://www.offshore-energy.biz/danish-duo-to-investigate-the-potential-of-wave-wind-combo/>

Map 16: ORE resources, synergies and barriers in the Atlantic Ocean



2.6.2.4 East Mediterranean

Nature – The overlap with ORE is very limited due to the small spatial claim and predominant nearshore location of nature in the East Mediterranean. Some countries (e.g. Slovenia) aim to increase the deployment of renewable energy in Natura 2000 areas, but do not include any policies and measures to support the achievement of such a proposal. Other considerations such as tourism or other ORE could provide an alternative push for co-existence of nature and offshore wind.

Military – Profound differences between countries can be found based on the allocation of military zones alone. In some countries (e.g. Cyprus), these zones take up a large part of the EEZ and often overlap areas with ORE resources, while military zones in other countries (e.g. Greece) rarely overlap with ORE resources and, finally, there are countries (e.g. Croatia) where no information is available on the location of these military zones.

Aquaculture – Especially closer to shore, both Greece and Slovenia generally treat aquaculture more as an obstacle than a synergy. However, enhancing the use of renewable energy to fulfil aquaculture's energy demand is identified as an objective in Greece's aquaculture strategy.

Other ORE - The limited offshore wind potential in certain countries is reflected in the absence of offshore wind targets (Croatia & Slovenia). Most countries (incl. Slovenia and Greece) consider offshore solar, which can also complement limited offshore wind potential, and a few countries also consider wave energy. This could also be explained by the socio-economic importance of activities such as tourism that benefit from the limited visual impact of both technologies compared to offshore wind. Differences exist in the availability of policies and measures to support the ambitions for ORE other than wind.

2.6.2.5 West Mediterranean

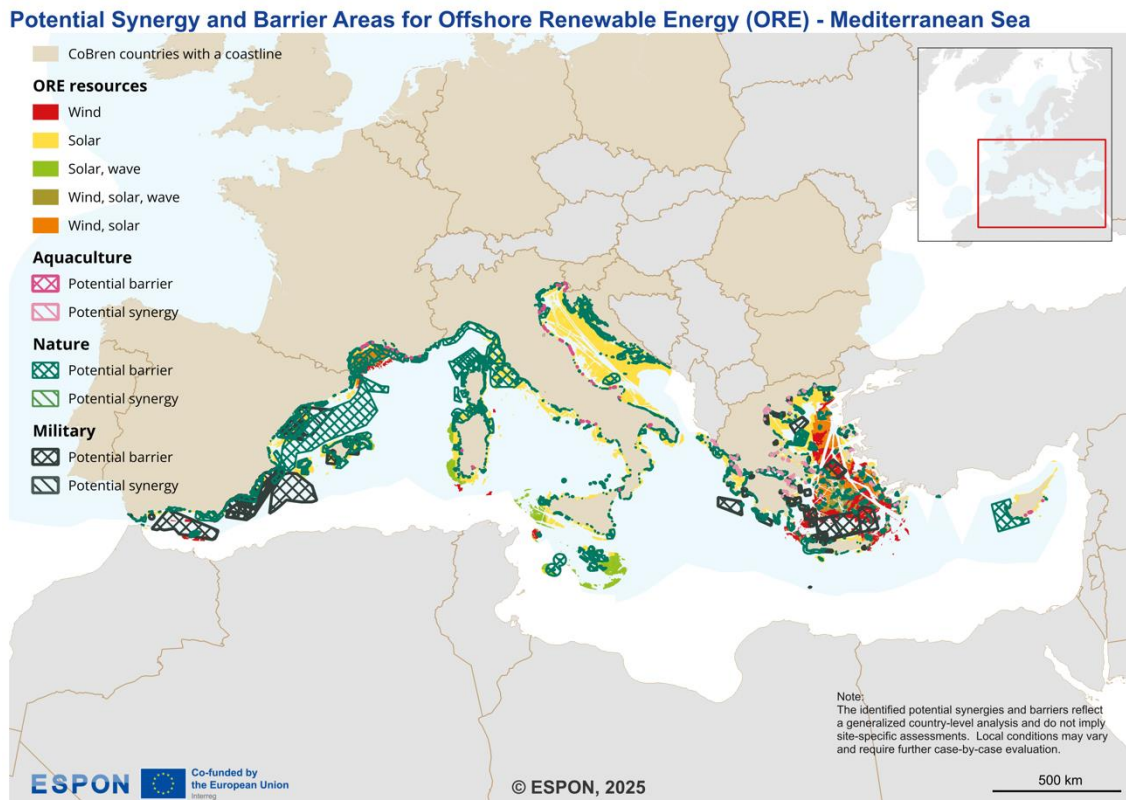
Nature - While nature does not represent an obstacle for some countries (e.g. France), other countries (e.g. Italy) might need to consider co-existence between nature and ORE. Corsica, however, is surrounded by nature zones that will make ORE very difficult if not impossible. In France, 9 out of the 47 offshore wind energy zones and 1 out of the 3 pilot projects overlap or border MPAs that are part of the Natura 2000 Network. Whether this overlap offers potential synergies is assessed on a case-by-case basis.

Military - Limited impact is expected based on available information on the spatial claims by the military.

Aquaculture - In the Maltese ORE strategy, aquaculture is considered a ‘no-go zone’ as large floating ORE setups would pose a high degree of risk. While aquaculture does not overlap with Maltese ORE resources, other countries in the West Mediterranean also do not explore the potential synergies in their ORE strategy.

Other ORE - While there are significant ORE resources for wind + solar + wave, the great depth of the West Mediterranean is a limiting factor to the exploitation of these resources far offshore. Therefore, in some countries (e.g. Malta), only floating devices such as offshore solar and floating wind are considered. Italy, Malta and Spain are considering or already planning the deployment of ORE other than offshore wind. Malta specifically mentions hybrid wind + solar projects in their ORE strategy.

Map 17: ORE resources, synergies and barriers in the Mediterranean Sea



2.6.2.6 Black Sea

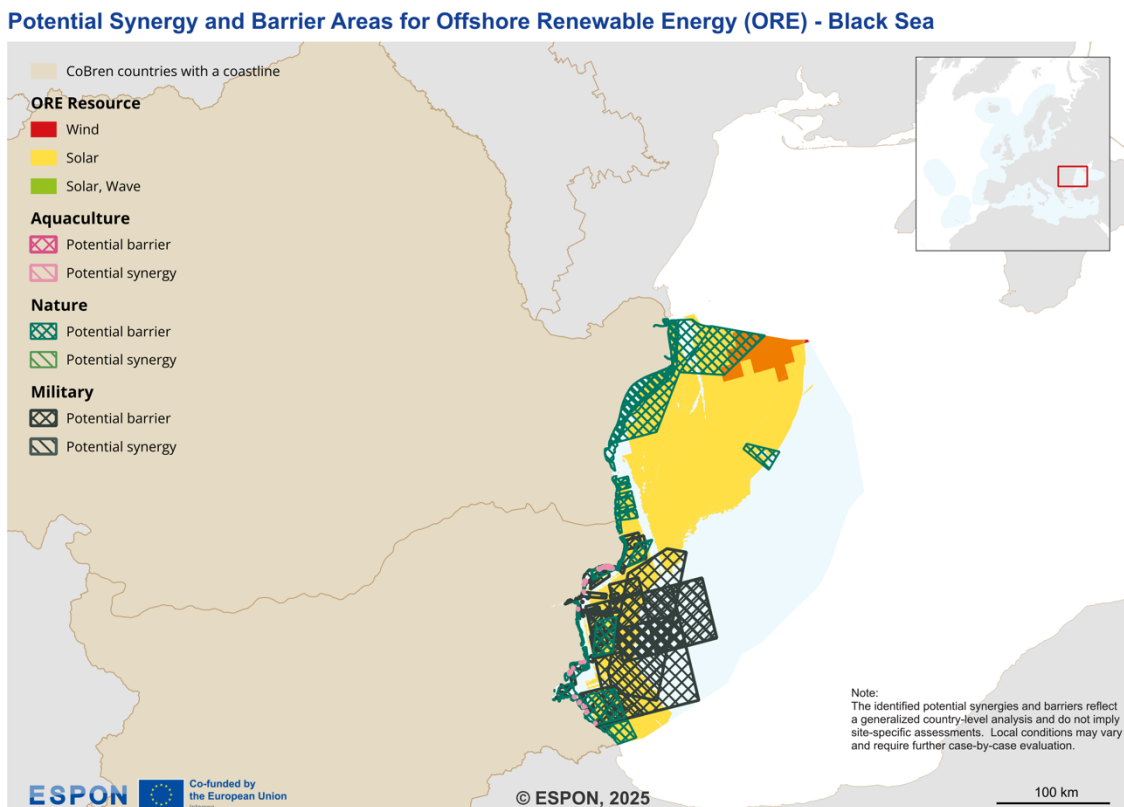
Nature - While the potential ORE resource areas overlap with nature, both Bulgaria and Romania have not allocated ORE deployment zones. As Romania is currently in the process of planning these zones, it will be interesting to see if nature zones closer to shore will be selected.

Military - The sizable military zones in the Black Sea overlap with ORE resources areas. While ORE infrastructure may pose security risks, a potential synergy could arise from using ORE projects when they can contribute to surveillance. Romania’s new offshore wind law, however, focusses only on excluding offshore wind from military zones.

Aquaculture - In Bulgaria, the aquaculture zones overlap with MPAs (part of the mussel farms fall into Natura 2000 zones). While no OWF exists (only one offshore wind turbine is currently used to electrify a Bulgarian O&G platform), responsible co-existence could benefit future ORE deployment as synergies between aquaculture and OWF still require further consideration in the Black Sea.

Other ORE - There is potential for (combinations of) wave, solar and wind, yet resources for solar overlap with nature and military areas. Neither country is exploring these opportunities in their offshore policy strategies. In fact, Bulgaria’s draft NECP does not address offshore renewable development and does not explain how marine environmental objectives will be considered.

Map 18: ORE resources, synergies and barriers in the Black Sea



2.6.2.7 Outermost Regions

There is limited georeferenced data available on the EU outermost regions, which include Macaronesia (Azores, Madeira, Canarias), the French Caribbean (Guyane, Saint Martin, Guadeloupe, Martinique), La Réunion, and Mayotte. A WWF report from May 2024 reveals that the EU's outermost regions are lagging in implementing maritime and environmental policies, leading to fragmented and incomplete MSP³². Consequently, the following assessment focuses only on the mapped data available to date. While there is limited georeferenced data available, an analysis of the Outermost Regions MSP by MSP-OR in October 2024 highlights that all four regions emphasize the integration of various maritime activities to reduce conflicts and, where possible, foster synergies through multi-use approaches³³.

Nature - In most Outermost Regions, such as Guadeloupe, Martinique, Madeira, Saint Martin, and the Canarias, the potential for ORE resources—including wave, solar, and wind—shows significant overlap with nature areas. For Guyane, La Réunion, and Mayotte, there is potential for resource combinations, but information on nature zones is currently unavailable. Given that these Outermost Regions are primarily composed of islands with delicate and often unique ecosystems, sustainable planning must prioritize the protection of their natural environments.

Military - Available data suggests that military zones do not overlap with ORE potential in the Outermost Regions. However, as limited data is available, this should be re-assessed once data is provided.

Aquaculture - For the Outermost Regions, data on aquaculture zones is limited or unavailable. This lack of information creates gaps in understanding potential synergies or conflicts between aquaculture and ORE projects.

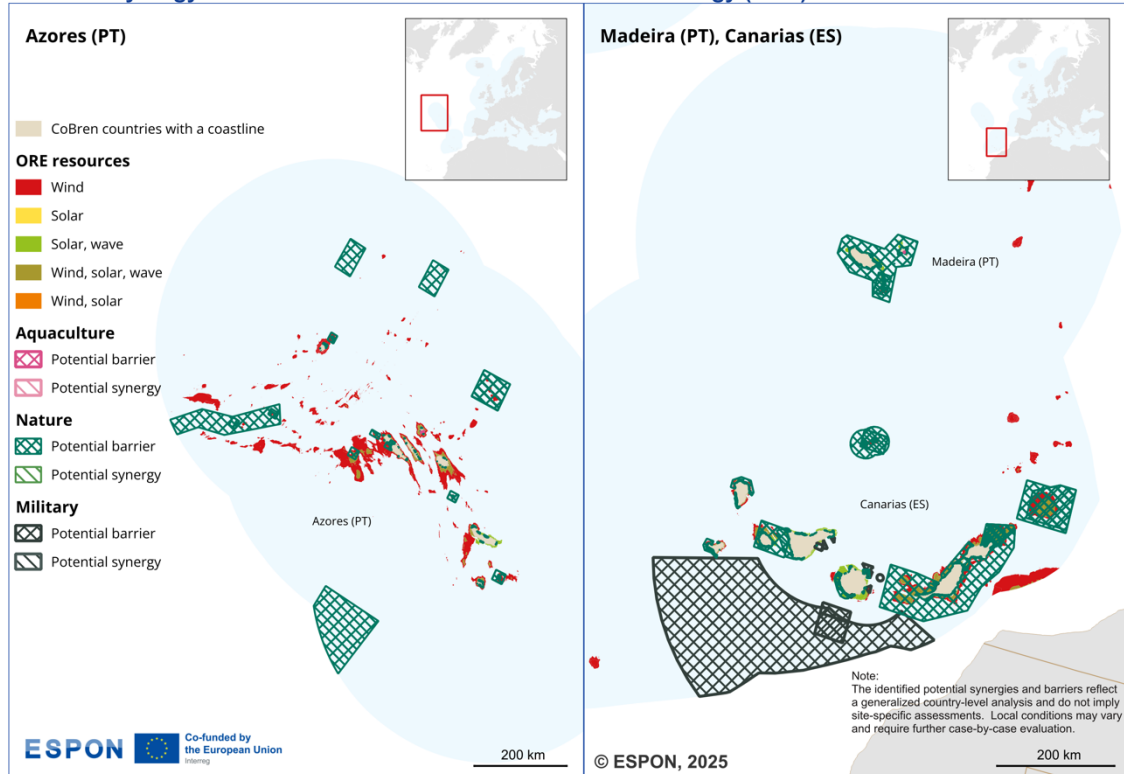
Other ORE - There is significant potential for combinations of wave, solar, and wind energy across these regions. However, for areas such as Guadeloupe, Martinique, Madeira, Saint Martin, and the Canarias, much of this ORE potential overlaps with environmentally sensitive zones, requiring detailed MSP to address these conflicts.

³² <https://wwfeu.awsassets.panda.org/downloads/wwf-eu-outermost-regions-msp-2024.pdf>

³³ <https://msp-or.eu/wp-content/uploads/2024/10/d51-monitoring-guidelines-final-compressed.pdf>

Map 19: ORE resources, synergies and barriers in outermost regions Azores, Madeira, and Canarias (Macaronesia)

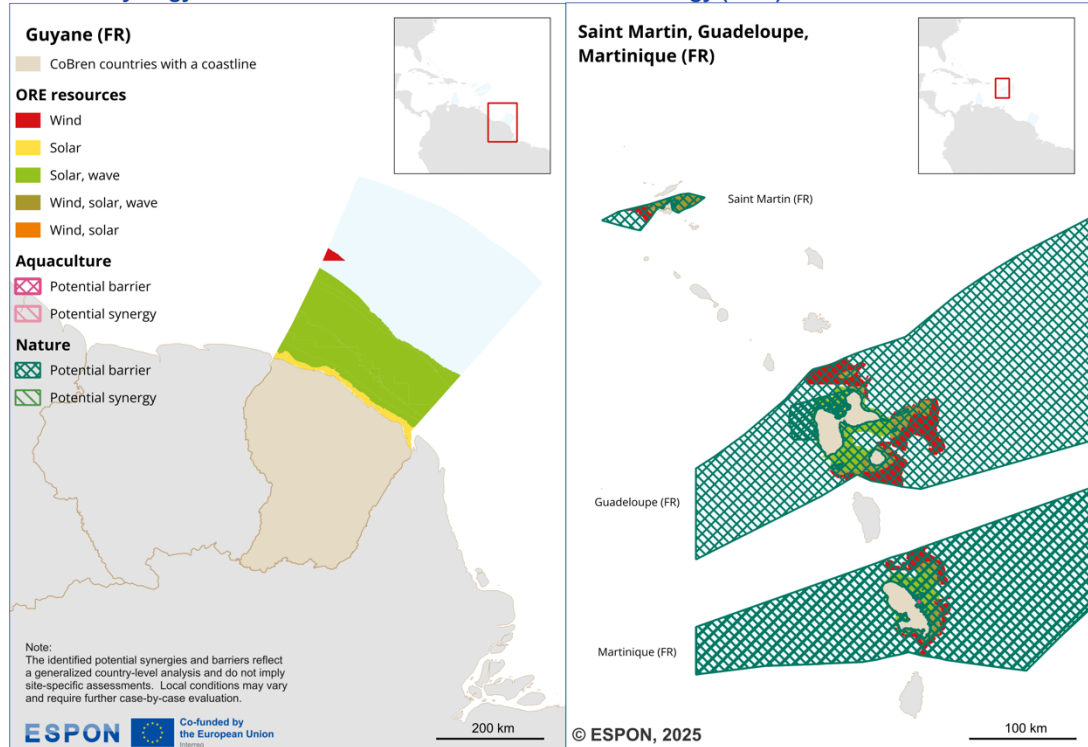
Potential Synergy and Barrier Areas for Offshore Renewable Energy (ORE) - Macaronesia



Territorial level: Exclusive economic zone (EEZ)
 ESPON Project: COBREN, 2025
 Origin of data: Copernicus Climate Change Service ERA5, 2024 for resource data;
 EMODnet, 2024 and World Database on Protected Areas (WDPA), 2024 for synergy and barrier;
 © Marine Regions EEZ, IHO Areas Intersection v11, and EuroGeographics for boundaries

Map 20: ORE resources, synergies and barriers in outermost regions Guyane, Saint Martin, Guadeloupe, Martinique

Potential Synergy and Barrier Areas for Offshore Renewable Energy (ORE) - French Caribbean



2.6.2.8 Key findings on synergies and barriers per sea basin

For the Baltic Sea and the Black Sea, the most significant barriers are posed by the military activities. Countries in the Baltic Sea are, however, also looking increasingly at the potential synergies with those activities in terms of exchanging data and protecting offshore assets. Both the East and West Mediterranean treat aquaculture as an obstacle for ORE development, while this mostly refers to nearshore areas. A notable exception is Greece, as their aquaculture strategy considers enhancing the use of ORE to fulfil the energy demand of the aquaculture sector. Significant resource potential for other ORE in the Atlantic Sea and the North Sea are only partly reflected in policy initiatives. All Outermost Regions emphasize coexistence and compatibility between maritime uses. This potentially includes the currently non-existent ORE, although the Azores have not included ORE in the relevant part of the Portuguese MSP document (i.e. the Plano de Situação do Ordenamento do Espaço Marítimo Nacional para a Subdivisão dos Açores (PSOEM-Açores)).

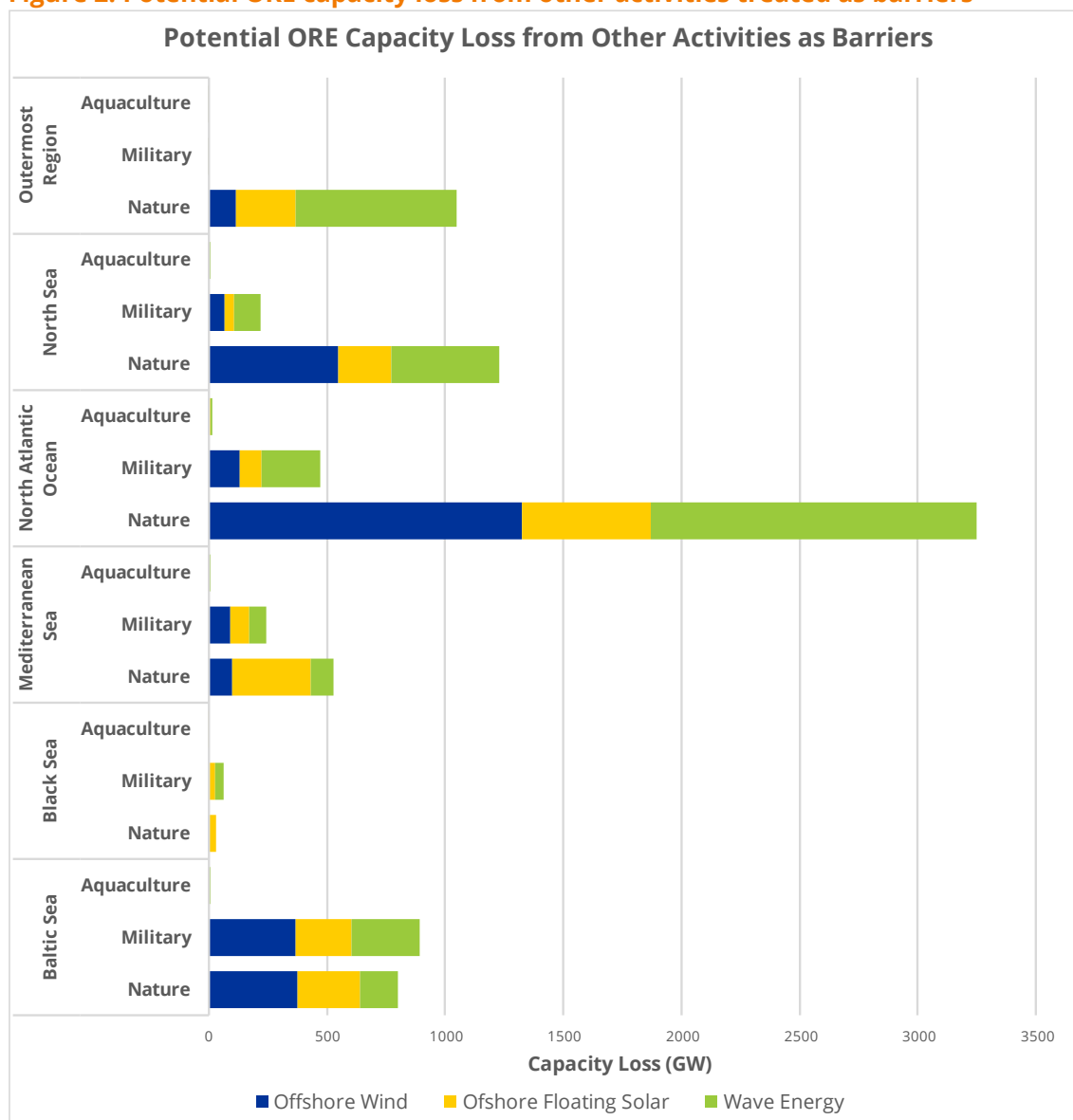
2.6.3 Potential ORE capacity loss from treating activities as barriers

Unlocking the full potential of ORE depends on how effectively marine space is managed. **If overlapping activities, such as military zones, aquaculture, nature conservation, or other marine uses, are treated solely as barriers, substantial portions of the available marine space may be excluded from ORE deployment.** This exclusion would result in significant capacity loss, undermining the EU's climate and energy goals.

The importance of integrating activities and fostering synergies cannot be overstated. **Co-location strategies, which promote the shared use of marine areas for multiple purposes, can minimize conflicts and unlock additional capacity.** For example, carefully planned ORE projects can coexist with MPAs through nature-inclusive designs or align with aquaculture zones to support sustainable food production. These approaches not only optimize space but also ensure that marine ecosystems and socio-economic activities thrive alongside energy generation.

The figure below illustrates the potential capacity loss if all overlapping activities are treated as barriers, excluding the possibility of co-location with ORE. **The data emphasize how adopting integrated spatial planning and multi-use frameworks can drastically reduce capacity losses and enhance the viability of ORE projects.**

Figure 2: Potential ORE capacity loss from other activities treated as barriers



Disclaimer: The potential ORE capacity loss depicted in the figure is based on available data as shown in the maps. These estimates may change as new data becomes available, and the perceived barriers from other activities may evolve over time.

In conclusion, the potential of ORE can be maximized by allowing synergies between different ORE sources and other marine activities. Effective management of these interactions is essential, not only to increase sustainable energy production but also to ensure that other marine activities and ecological functions are preserved. This can be achieved either through national efforts or through coordinated cross-border collaboration within the sea basins, paving the way for a sustainable and efficient use of Europe's marine resources.

3 Integrated Maritime Spatial Planning as an enabler to unlock ORE potential

3.1 Maritime Spatial Planning as a tool to address barriers and facilitate exploiting synergies for ORE development

Maritime spatial planning (MSP) is one of the initial steps to consider for the development of ORE³⁴. MSP can be understood as a process of analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives that are usually specified through a political process. As such, MSP supports dealing with potential barriers and enhancing synergies for ORE development resulting from spatial overlaps with other sea-uses. Therefore, MSP addresses potential conflicts of sea use that may impede ORE development. In more detail, MSP contributes to:

- defining and illustrating the need for ORE development,
- identifying possible locations for ORE by illustrating existing conditions, regulatory frameworks, technical realities and financial possibilities,
- initiating and setting up organisational processes, including stakeholder participation and securing political support (Santos et al. 2018).

The MSP Directive (2014/89/EU) is a cornerstone of the EU's approach to balancing energy production with ecosystem health and socio-economic interests. By requiring Member States to create spatial plans for their maritime zones, the Directive ensures that ORE deployment harmonises with other uses and environmental priorities. Key aspects of the MSP Directive include:

- **Promoting multi-use:** Encouraging the co-location of activities, such as integrating offshore wind farms with aquaculture or marine protected areas, to maximize spatial efficiency.
- **Environmental integration:** Adapting an ecosystem-based approach. Ensuring that MSP frameworks include biodiversity objectives, such as the conservation of Natura 2000 sites. This plays an important role in to protect 30% of EU's seas in 2030³⁵.
- **Cumulative impact management:** Addressing the combined pressures of ORE and other activities to prevent overexploitation of marine ecosystems.

MSP documents by Member States **support thus coordination of the spatial and temporal distribution of human activities in marine areas, including ORE development, to achieve ecological, economic, and social objectives**. The MSP Directive and MSPGlobal³⁶ describe key planning principles that may support ORE development. These include³⁷:

- provision of information on sea uses to encourage coordination of environmental, economic and societal factors,
- alignment with other policy documents,
- establishing stakeholder participation and engagement,
- promotion of transboundary collaboration.

This chapter presents the findings of the review of maritime spatial plans. The review encompasses 25 (EU and non-EU) countries' Maritime Spatial plans. This review provided insights on the proposed

³⁴ Other steps include early site survey work, ensuring permits, performing technology reviews and feasibilities, preparing the detailed design, securing financing and decide for the construction, manufacture and assemble components and monitor and maintain the ORE. WindEurope (2019): <https://windeurope.org/intelligence-platform/product/our-energy-our-future/>

³⁵ EU, 2022, Decision (EU) 2022/591 of the European Parliament and of the Council of 6 April 2022 on a general Union Environment Action Programme to 2030, OJ L 114, 12.4.2022, p. 22–36.

³⁶ MSPGlobal is a joint initiative by UNESCO's Intergovernmental Oceanographic Commission (IOC-UNESCO) and the European Commission's Directorate-General for Maritime Affairs and Fisheries (DG MARE) to develop and implement international guidelines on Marine/Maritime Spatial Planning. One of the outputs of this initiative is "MSPGlobal: international guide on marine/maritime spatial planning. <https://unesdoc.unesco.org/ark:/48223/pf0000379196>

³⁷ See the Technical Annex for more details on the Directive's requirements and the MSPGlobal's guidelines.

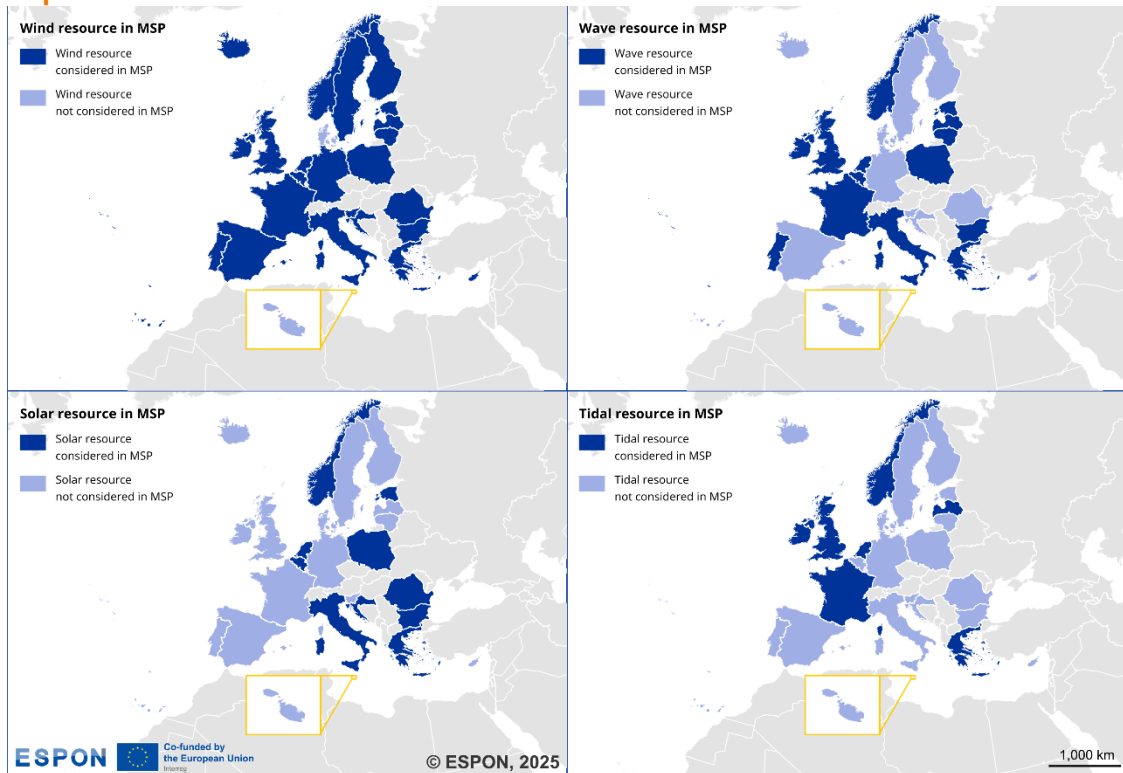
planning practices for ORE development (see also Annex 2). Consideration of the above principles and possible planning practices in European countries have been reviewed to assess the possibilities of MSP to contribute to unlocking the potential of ORE in European Seas.

3.2 Maritime Spatial Plans include planning practices for ORE development

The review of maritime spatial plans illustrates countries' plans to develop ORE in coherence with other sea-uses. Planning for ORE is clearly mentioned in 23 out of the 25 reviewed MSP documents. These countries' MSP documents either present **specific plans with areas allocated to ORE development, or present objectives to explore the possibilities of ORE**. Only the MSP documents for Malta and Iceland do not specifically refer to ORE development. MSP documents most often consider offshore wind, followed by other ORE technologies such as wave and solar. Tidal energy is least often referred to in MSP documents (Map 21).

MSP documents illustrate thus countries' acknowledgement of ORE as an integral part of maritime spatial planning. Moreover, different parts of MSP documents illustrate possible planning practices that may facilitate ORE development as discussed in the next sections.

Map 21: Reference to ORE in national MSP



Territorial level: Country
 ESPON Project: COBREN, 2025
 Origin of data:
 Maritime Spatial Plans, 2024
 © EuroGeographics for administrative boundaries

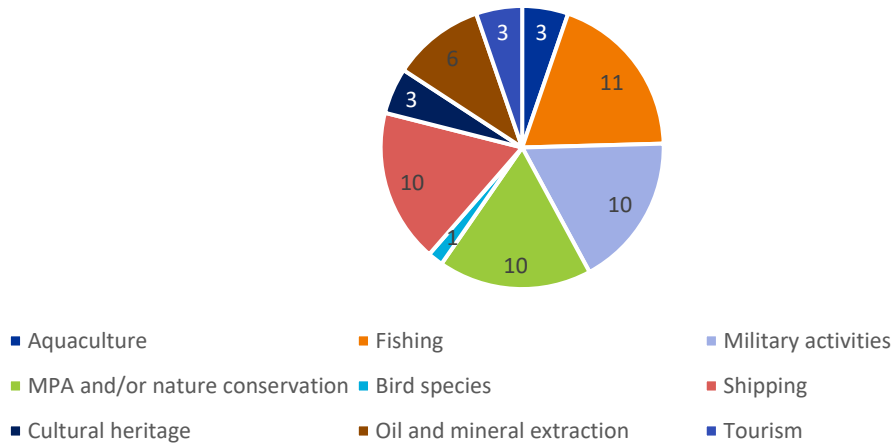
Source: CoBren research team, based on the review of MSP documents

3.2.1 MSP as a planning tool to coordinate the use of sea space and identify a place for ORE development

European countries used the opportunity of developing their MSP documents to map and seek coordination of different sea-uses. In line with the objectives of MSP documents, as outlined in the MSP Directive, European countries have used the development of their MSP documents as a tool to collect information on sea use and engage with relevant stakeholders. Indeed, MSP historically originates from the premise that planning can prevent or resolve conflicts concerning the different spatial requirements and compatibilities of marine activities (Douvere and Ehler 2009).

MSP documents acknowledge potential barriers and synergies for ORE development. The reviewed MSP documents illustrate possible spatial overlaps for sea use hinting at possible conflicts for ORE development. Across Europe, fisheries are most often referred to in the MSP documents as a sector overlapping with ORE (Figure 2). Also, spatial overlaps between ORE and nature, biodiversity, marine protected areas, Natura 2000 areas, as well as shipping and defence and maritime transport are regularly mentioned in the documents³⁸.

Figure 2: Spatial use conflicts with ORE mentioned in reviewed Maritime Spatial Plans³⁸



Source: CoBren research team, based on the review of MSP documents

Spatial conflicts with ORE are place specific. The types of conflicts mentioned in the MSP documents differ per country depending on the presence of certain functions as well as certain restrictions (see also the examples of differences in national legislation defining barriers and synergies in section 2.6). Possibilities for ORE development may differ per country in environmental protected areas or in areas with military activities, depending on local laws and regulations (see also section 0).

Examples of possible conflicts between ORE and other sea-uses include:

- **Potential ecological damage due to the presence of ORE**, as mentioned in the MSP of Estonia, Finland, Lithuania, the Netherlands, Romania, Slovenia and Sweden. In addition, the MSP of the Netherlands specifies potential conflicts of ORE development with bird migration patterns.
- **Potential noise pollution**, as mentioned in the MSP of Estonia, the Netherlands and Sweden.
- **Potential negative impact on tourism**, due to horizon pollution is mentioned in the MSP for Latvia, Estonia and Sweden.

³⁸ The number of observed sea use conflicts reflects all MSP documents that specifically refer to ORE. This includes thus all 25 reviewed MSP, with the exception of Malta and Iceland. All reviewed MSPs refer to spatial use conflicts in relation to ORE development. To clarify: referred sea use conflicts do not highlight all actual conflicts; in some cases the plans are developed to avoid these turning into conflicts. The overview therefore does not present a complete overview of potential conflicts. In various cases, the MSP names some specific sectors that *can* conflict with ORE *as examples*.

The CoBren case studies highlight additional synergies and barriers for ORE development, specific to the sea basin in which the projects are located (Box 1).

Box 1: Synergies and barriers encountered in ORE projects

Shipping is most often mentioned as a barrier for ORE development in the CoBren case studies. Indeed, the international maritime organisation (IMO) established clear rules to avoid navigational hazards and thus limit ORE development in shipping lanes. Representatives of four case studies referred to shipping and navigation as barrier considered during the planning phases of their project. For example, representatives of *EUROTIDES (North Sea)* assume shipping as a key hampering factor to scale-up their wave technology in the North Sea.

Biodiversity and nature conservation is mentioned in two case studies, namely in the case of *ULTFARMS (North Sea)* and *MUSICA (Mediterranean)*. In the case of *ULTFARMS*, rapid ORE development and nature conservation pose potential conflicts. Draft legislation from 2024 proposed to be less stringent on environmental impact assessments to speed up the development of wind farms. In the case of *MUSICA*, the location for a testing platform for ORE has been carefully selected and considers the natural assets at sea as well as the view of the platform from the shore. The project aims to develop ORE for small islands, places which are often tourism destinations. Therefore, any visibility of the platform from main tourism sights has been considered when selecting the location.

Fishing and aquaculture are mostly considered as potential for synergy with ORE. Combining ORE with fishing and/or aquaculture activities allows to make best use of sea space. For example, representatives from *EU SCORES (Atlantic Ocean)* highlighted the possibilities of creating artificial reefs in areas with wind farms or wave energy systems. Sea life benefits from these reefs which in turn supports local fishing and aquaculture. The *UNITED (Baltic Sea)* case study demonstrates how fishing activities can create possible conflicts for ORE: Representatives of this case study highlight the disturbance to sea life during the construction of ORE (mainly bottom-fixed installations, such as wind turbines). The potential conflict was solved by paying the fishermen compensation for the lost catch during the windfarm construction phase. Representatives of the *BLOW (Black Sea)* and *AQUAWIND (Canary Islands, Atlantic Ocean)* case studies highlight that such potential conflicts are deliberately avoided by focusing on the development of floating wind turbines.

Designation of specific areas for ORE development is one of the proposed planning practices to deal with potential spatial conflicts. MSP documents for 10 countries depict the use of specific zones or the allocation of specific use rights by sea-use to deal with potential conflicts. Box 2 provides some examples concerning the project location from the case study projects.

Box 2: The importance of designating areas for ORE development in CoBren case studies

The CoBren case studies benefit from designated areas for ORE development in the EEZ of their respective countries. For example, the wave technology developed in the framework of the *EUROTIDES (North Sea)* project benefits from an existing, well-established framework for project deployment as it is developed on a site that already hosts a testing and demonstration facility for marine energy technologies.

Within these designated areas, project partners looked for more specific locations, e.g. near power cables to facilitate the transmission of electricity to shore, as demonstrated in the cases of *EU SCORES (Atlantic Ocean)* and *ULTFARMS (North Sea)*.

A lack of designated areas considering multiple sea-uses hampers the implementation of multi-use ORE projects, as illustrated in the case studies. The proposal to use an offshore wind farm for multi-uses, required the *UNITED (Baltic Sea)* project partners to consider multiple regulatory frameworks, including for aviation, and nature and environment protection. The consideration of offering tourism activities in the wind farm required obtaining additional permits. In the case of *BLOW (Black Sea)*, a lack of a designated location for multi-use ORE development forced the project partners to become creative. They therefore proposed a location near a gas platform, which facilitates connecting the floating wind platform to the existing power infrastructure available for the platform.

Strategic impact assessments are a relevant planning practice to depict the above-mentioned spatial conflicts and location strategies. Following the MSP Directive, authorities shall perform an impact assessment while developing their MSP.

15 out of the 25 reviewed MSP documents demonstrate the use of an integrated impact assessment, considering environmental, social, economic and other impacts such as impacts on historical landscape or cultural considerations. For example, the strategic impact assessment described in the Italian MSP focusses on long-term sustainability, with sustainability defined as an integral perspective including social, environmental and economic aspects. Latvia states that an integral perspective is used in the impact assessment. The Spanish MSP includes an analysis of the relationship of the MSP documents with other territorial and sectorial planning instruments and a description of the different sectorial activities on each marine subdivision. Lithuania stands out as a country that undertook a broader range of impact assessments, covering environmental, social, and economic aspects and 'Other' impacts (cultural, landscape/infrastructure). Finally, Sweden's MSP highlights that consequences of multi-use are analysed in a separate environmental impact assessment and sustainability assessment. **The impact assessments performed in preparation of these MSP documents contribute to highlighting the impact of ORE development on various sectors and their relevant communities.**

The remaining reviewed MSP documents demonstrate the use of sector specific impact assessments. For example, the document for Germany illustrates the use of an ecosystem approach, only focusing on environmental impacts. Malta indicates that there is no integral perspective, but they reflect on its importance. The Polish MSP focusses on ecosystems and underwater cultural heritage. Social conflicts were described in Strategic Environmental Assessments (SEAs). At this stage, no other sectors were considered. However, other sectors were analysed and discussed with stakeholders during the planning process of the Polish MSP. In these cases, the development of the MSP and conducting the impact assessment, risks overlooking some of the particularities or specific impacts of ORE development. Box 3 provides some examples of how some of the reviewed projects deal with environmental impact assessments.

Box 3: EIA to identify and monitor impacts of ORE deployment on marine life and to avoid conflicts

Like during the MSP development process, the projects in focus of the case studies were required to conduct an EIA. Even though the scope of the assessments varies, the perceived benefits and challenges experienced at project level may be relevant for MSP in general.

The *EU-SCORES (Atlantic Ocean)* and *EUROTIDES (North Sea)* projects demonstrate the importance of EIAs to highlight positive effects of ORE when deployed. ORE deployment in these cases supports biodiversity by providing artificial reefs and fostering marine life regeneration in traditionally low-biodiversity areas, as specified by the representatives of the *EU-SCORES* project.

In addition, both projects consider the EIA as a baseline assessment of the evolution of environmental quality following the beginning of ORE deployment. Long-term environmental monitoring and data collection contribute to regular risk assessments and to adjusting mitigation measures, when possible, as explained by *EUROTIDES* stakeholders. The EIA thus supports processes to minimize the impact on marine ecosystems and avoids potential conflicts between ORE development and stakeholders representing nature protection and conservation.

The review of MSP documents does not fully reveal the use of innovative practices for conflict resolutions. To better understand potential conflicts and to inform a discussion on those, various tools are available:

- MSP processes can function as a lever to produce socio-economic data that enhances the understanding of the use of sea space, for example by collecting data on the location of fishing grounds and shipping routes. While data scarcity is at times seen as a bottleneck, existing tools such as Automatic Identification System and Vessel Monitoring System data³⁹ can be used to inform MSP (Thoya et al., 2021).
- Spatial decision support tools (such as Marxan, SeaSketch and InVEST)⁴⁰, are proposed by various authors, to facilitate integration of different interests and knowledge (Gee et al., 2019), enable scenario building and multi-criteria analysis (Sutrisno et al., 2018), enable collaborative scoring of conflicts and synergies (Bonnevie et al., 2023), and more.
- Spatial Economic Benefit Analysis is proposed as a method to identify and map the spatial distribution of benefits associated with certain maritime uses (Weig & Schultz-Zehden, 2019)

The Belgian MSP describes the use of risk assessments to map potential conflicts for ORE development. The responsible ministry for each sea use carries out a risk assessment. Each risk assessment forms part of the safety measures to be taken to detect and prevent conflicting situations between economic, environmental, social and safety objectives.

³⁹ The Automatic Identification System (AIS) and Vessel Monitoring System (VMS) both use satellite tracking to transmit vessel locations to monitor fishing activity globally.

⁴⁰ For an inventory of tools, see e.g. <https://dst.azti.es/matrix/>

3.2.2 MSP as a planning tool to encourage ORE multi-use and enhance synergies among sea use functions

The MSP Directive encourages EU Member States to consider multi-use in their MSP documents. As such the development of the MSP documents supported seeking synergies between various sectors and sea use space and/or sharing infrastructure.

European countries adopt different planning practices to consider multi-use, as illustrated through the reviewed MSP documents (Figure 3). 15 MSP documents explicitly refer to multi-use with ORE⁴¹. In some cases, the MSP does not further specify how to promote or support multi-use. In these cases, the MSP documents are used as a planning tool to provide information on possibilities that need to be specified through other means.

Belgium, Denmark, Estonia, Lithuania, Poland and Portugal incorporated multi-use of ORE areas in the designation phase. These are identified zones for multi-use. Hence, these countries encourage **zoning as planning practice for multi-use**. For example, in Belgium existing zones for renewable energy are a location for testing alternative forms of sustainable energy production and the Belgian maritime spatial plan also indicates that concessions could be made for marine aquaculture. For new ORE zones, it is being examined how aquaculture and passive fishing can be authorised. The Netherlands does not specifically refer to designated zones in their MSP. However, it makes use of an Area Passport Guide for ORE locations which encourage co-use (Box 4). Portugal refers to a pilot zone where testing multi-use is possible.

Four countries consider multi-use as a criterion in awarding offshore wind farm (OWF) tenders in their MSP. In these cases, the **MSPs foresee incentives / regulatory requirements (specific requirements during public procurement) as a planning tool to foster ORE multi-use**. In practice, more examples of considering multi-use in OWF tenders have been highlighted by the study's stakeholders:

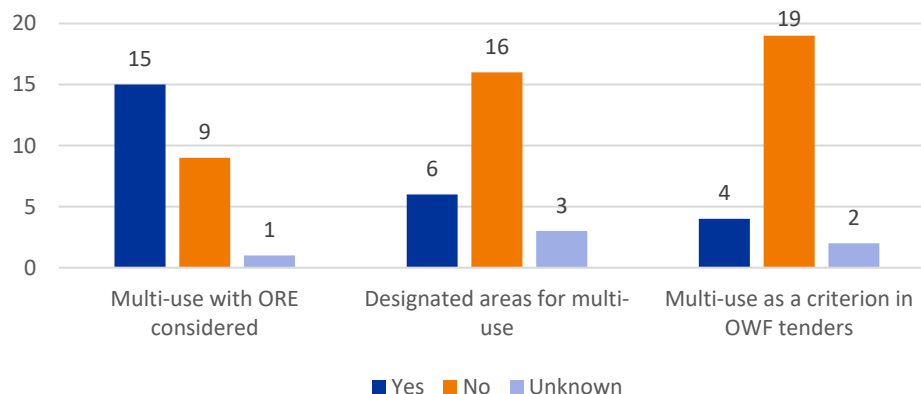
- Belgium and the Netherlands have demonstrated the feasibility of combining OWFs with other maritime activities, including aquaculture and nature conservation. Similar efforts are being explored in countries like Portugal, where wind and wave energy synergies are a priority.
- Poland and the Netherlands are incorporating ecological criteria into ORE tenders to promote biodiversity alongside renewable energy development. These countries consider nature-inclusive designs as planning tools.
- Bulgaria considers using multi-use as a criterion for OWF tenders⁴².

Nine countries⁴³ do not consider multi-use together with ORE in their MSP (Figure 3). An important reason for not referring to it seems to be the designation of ORE areas solely for mono-use. Due to regulation, other activities/users are prohibited or excluded from the ORE locations.

⁴¹ Belgium, Denmark, Estonia, Finland, France, Germany, Ireland, Italy, Latvia, Netherlands, Poland, Portugal, Spain, Sweden and the UK

⁴² Bulgarian stakeholders are considering this option as clarified during an interview. This option is neither presented in the MPS, nor has it been formalised in legislation.

⁴³ Bulgaria, Croatia, Cyprus, Iceland, Lithuania, Malta, Norway, Romania and Slovenia

Figure 3: Consideration of multi-use with ORE deployment in MSP documents

Source: CoBren research team, based on the review of MSP documents

Box 4: The Dutch Area Passport, an innovative planning approach to encourage multi-use in designated sea areas

The **Dutch Area Passport** is a tool developed to support the realisation of multi-use in offshore wind areas in the Netherlands. The objective is to make optimal use of the area within a wind park, preferably for multiple functions at the same time, and to identify opportunities for multi-use in an early stage. The idea of the Area Passport originates from the North Sea Consultation ('Noordzee-overleg'), a consultative body including stakeholders and the central government who are active in the North Sea. As a result, the Dutch government took the initiative to incorporate the Area Passport into the North Sea Programme 2022-2027. A first Area Passport has been published in 2021 for the wind park Borssele, just after the wind park became operational.

Most countries refer to ORE multi-use in combination with fisheries or aquaculture. Other possible multi-uses of ORE considered in the MSP documents are combinations of different ORE technologies (mentioned in four countries) and multi-use of ORE with nature (MPA, nature enhancement, conservation – mentioned in four countries). The Finnish MSP refers to possible ORE multi-use with tourism and cultural heritage.

The Irish MSP foresees multi-use for ORE by sharing infrastructure. In more detail, the Irish MSP mentions that multiple sectors, including ORE, rely on ports for their development. The same may be applicable in Italy. The MSP encourages multi-use solutions but does not specify the sites. Hence, the plan provides the possibilities for multi-use by sharing infrastructure.

Box 5: Examples of ORE multi-use considered in MSP documents

- Seven countries refer to **passive fishing**⁴⁴, namely Belgium, Estonia, Finland, Germany, Italy, Netherlands Sweden).
- Eight countries refer to **aquaculture**, namely Belgium, Finland, Latvia, Italy, Netherlands, Spain and Sweden. Poland states that marine aquaculture and mineral extraction is allowed in the same areas as offshore energy production, to minimize space occupied by immobile uses.
- Finland, Italy and Poland explicitly refer to a **wide variety of activities**: maritime logistics and industry, green hydrogen production, fishing, aquaculture, scientific research, extraction sector, tourism/recreation, cultural heritage, nature conservation/protection.
- Estonia allows **specific combinations of uses that are suitable for the Estonian marine area**, although they may require concessions in development plans or significant changes in existing uses: wind energy production with tourism/aquaculture/fisheries/wave or tidal energy.
- The Netherlands is **specific in assigning ORE areas as multi-use areas and also refers extensively to activities that can take place within ORE areas**. These are, next to fishing and aquaculture, nature conservation, solar, hydrogen tidal energy production and (as the only country) energy storage. They underline that this is in line with the new blue economy by referring to possibilities of co-use.
- Denmark refers to multi-use with **hydrogen technology** in combination with energy islands.
- Latvia makes use of a **license system with OWF where wind turbines can be combined with wave energy and aquaculture production**⁴⁵.
- Sweden is, as the only country, **explicit in nature conservation and refers to artificial reefs in wind farms as feeding grounds for fish**.

Multi-use ORE deployment is not yet commonly applied despite the possibilities offered in the MSP documents. The European Maritime Spatial Planning platform⁴⁶ presents 19 multi-use cases across Europe. These examples, illustrate ORE deployment in combination with nature enhancement and offshore wind energy, fishing and tourism, and fishing and offshore wind energy. UNITED and ULTFARMS are two examples of commercially operational multi-use initiatives (

Box 6). These research pilots demonstrate the combination of low-trophic aquaculture⁴⁷ and offshore wind energy (Belgium, Netherlands, Germany), and the combination of floating solar and offshore wind energy (Netherlands). The small number of multi-use cases may be due to ongoing transdisciplinary challenges resulting from the translation of the policy concept to practical implementation as observed by Gouyot-Téphany et al (2024).

Literature illustrates various other explanations as to why practical implementation of multi-use has proven so difficult:

- Schupp et al (2019) argue that this has to do with the fact that the multi-use concept was frequently framed as ‘co-location’ or ‘coexistence’ and aimed toward mitigating conflicts among users. Practice was ahead of theory with little attention to synergistic and efficiency aspects.
- With a specific focus on fisheries and aquaculture and offshore wind energy, van Hoey et al concluded that there is no general approach on management strategy for fishery and aquaculture in OWFs, that it is regulated on a case-by-case basis and that the concerns of the fishery sector are often not fully considered in designing the OWF areas. There are several hurdles that make co-location with fisheries difficult, such as safety risks (collision, cable

⁴⁴ Passive fishing refers to the practice of leaving gears in place to catch the fish.

⁴⁵ Multi-use is specifically mentioned in the MSP. Moreover, the designation of ORE areas restricts multi-use. Nevertheless, multi-use is promoted through tenders for offshore wind farms.

⁴⁶ <https://maritime-spatial-planning.ec.europa.eu/co-existence-activities-and-multi-use/multi-use-compendium>

⁴⁷ Low-trophic aquaculture refers to the farming of aquatic organisms that are at the lower end of the food chain. These species typically require fewer resources and have a lesser environmental impact compared to higher-trophic species, such as predatory fish. Examples include mussels, oyster, clams as well as seaweeds and algae.

damage) or the distance between turbines (to be larger to allow fishing operations). For instance, in the case of offshore aquaculture, which has a clear co-location potential, too little experimental studies testing its technical and economic feasibility are conducted. In addition to that, the lack of clear licensing procedures and regulations are slowing down the development of offshore aquaculture in OWFs.

- Steins et al (2021) discuss the experiences with the Dutch Community of Practice advancing multi-use. They argue that multi-use is often approached as a 'design question' that can be settled through Maritime Spatial Planning. **In practice, regulatory, technical and socio-economic factors often hinder multi-use.**
- Ciravegna et al (2024) conclude that **to realise multi-use in practice, it is necessary to create a conducive policy environment where multi-use risks and transaction costs become low and competitive.** This is linked to other barriers to multi-use in the socio-economic realm. While various authors emphasize the socio-economic benefits of multi-use, real-life evidence of the creation of synergies that reduce costs of operations at sea or increase revenues through the involvement of the private sector in these activities, is scarce.

Finally, participants of a focus group⁴⁸ organised as part of the CoBren study mentioned **reluctance of investors in ORE as an explanation for the low application of the of multi-use concept in practice.**

At the same time, numerous research and innovation projects⁴⁹ continue to test and demonstrate implementation of multi-use. These research projects may deliver additional insights on possible practices to overcome the key challenges of multi-use.

Box 6: Multi-use in ORE projects offers various benefits but still faces several challenges

All CoBren case studies, except *EUROTIDES (North Sea)*, explore ORE multi-use possibilities. This includes combining different types of ORE technologies, as in the cases of *EU-SCORES (Atlantic Ocean)* and *MUSICA (Mediterranean)*, as well as combining ORE deployment with other sea use functions, mainly fishing and aquaculture.

The case studies demonstrate added value to sharing infrastructure costs and revenues and optimising sea space. For example, *EU-SCORES* reveals possibilities to combine floating wind and wave energy with fishing and marine conservation. The project demonstrates an approach to enhance the overall renewable energy output, increasing the resilience and sustainability of the region's energy mix, and optimising the use of marine spaces.

At the same time, the CoBren cases demonstrate various challenges to implementing multi-use. The combination of different activities at sea requires obtaining permits, licenses or other regulatory approvals from different authorities, e.g. ministries of energy, environment, fishing etc., as illustrated in the cases of *UNITED (Baltic Sea)* and *AQUAWIND (Canary Islands, Atlantic Ocean)*. These aspects make planning processes considerably longer. Moreover, further alignment of regulations for ORE development and multi-use could facilitate scaling up of nascent ORE technologies, such as wave and tidal power, as highlighted by the *UNITED* and *BLOW (Black Sea)* stakeholders.

Representatives of the *ULTFARMS (North Sea)* and *UNITED* case studies illustrate another challenge before deploying multi-use ORE, namely obtaining relevant insurances. Standard insurances for ORE technologies are not adapted to multi-uses and obtaining the correct insurance for the adequate risk combining different functions remains a challenge.

Enhanced MSP processes could address these challenges, e.g. by facilitating multi-use aspects or by supporting one-stop-shops for multi-use of sea space. See also Box 1 which illustrates the lack of designated space for multi-use in MSP documents.

⁴⁸ A focus group with Member State representatives involved in drafting the MSP documents was conducted 16/10/2024. See for more information annex 2.

⁴⁹ To name only a few: TROPOS, H2Ocean, MERMAID, COEXIST, MARIBE, UNITED, MUSES, ULTFARMS

3.2.3 MSP as a planning tool to support policy coherence

Through the mapping of different sea uses, the development of MSP documents provides an opportunity to support coherence with policy documents⁵⁰. Linking proposed planning practices in the MSP to strategic documents may support stakeholders to identify and further define the need for ORE development.

ORE development requires seeking coherence with among others shipping, fisheries and environmental policies and regulation. The review of MSP documents illustrates the relevance of different policy and regulatory frameworks for ORE development. While almost all MSP documents mention coherence with other policy documents (Figure 4), they do not provide further information on the concerned policy areas.

From an international perspective, the following policies provide frameworks for ORE development:

- **International routing measures for shipping** (IMO) establishes international predetermined paths for ships to navigate and avoid navigational hazards. These paths are considered exclusion zones in the sea for ORE development.
- **Regional fisheries management organisations** (RFMOs)⁵¹ establish fishing limits and controlled zones, with respect to sustainable fisheries. RFMO may influence the location of renewable energy.
- **The EU Birds and Habitat Directives**⁵² do not exclude ORE installations in protected areas, however, developers may need to show that the activity does not do harm to birds and their habitats.
- **The Barcelona convention**⁵³ defines specially protected areas of Mediterranean interest (SPAMI). Protection measures for SPAMI shall be considered in MSP and may influence thus location of ORE.
- **The OSPAR commission**⁵⁴ adopts legally binding regulations requiring Member States to adopt procedures and actions for Marine Environmental Protection, which can influence the licensing and permitting of ORE.

14 of the reviewed MSP documents refer to specific ORE policy documents (Figure 4). Such references further embed ORE development in the MSP document. Most MSP documents refer to the European Commission Communication “An EU Strategy to harness the potential of offshore renewable energy for a climate neutral future” (COM 2020/741 final). In few cases, specific strategic documents for ORE development are mentioned. For example, the Danish MSP document specifically

⁵⁰ Policy coherence refers to the systematic promotion of mutually reinforcing policies across government departments and agencies, creating synergies towards achieving agreed objectives and preventing or minimizing negative spillover effects. It involves ensuring that different policies and measures work together to support a common goal, rather than undermining each other (based on the OECD definition of policy coherence - <https://globalnaps.org/issue/policy-coherence/>).

⁵¹ RFMOs are international organisations establishing binding measures for conservation and sustainable management of highly migratory or straddling fish species. See for more details: https://oceans-and-fisheries.ec.europa.eu/fisheries/international-agreements/regional-fisheries-management-organisations-rfmos_en

⁵² The Birds and Habitats Directive form the cornerstones of EU biodiversity policy. They provide a strong legislative framework for all EU countries to protect the most valuable and threatened biodiversity.

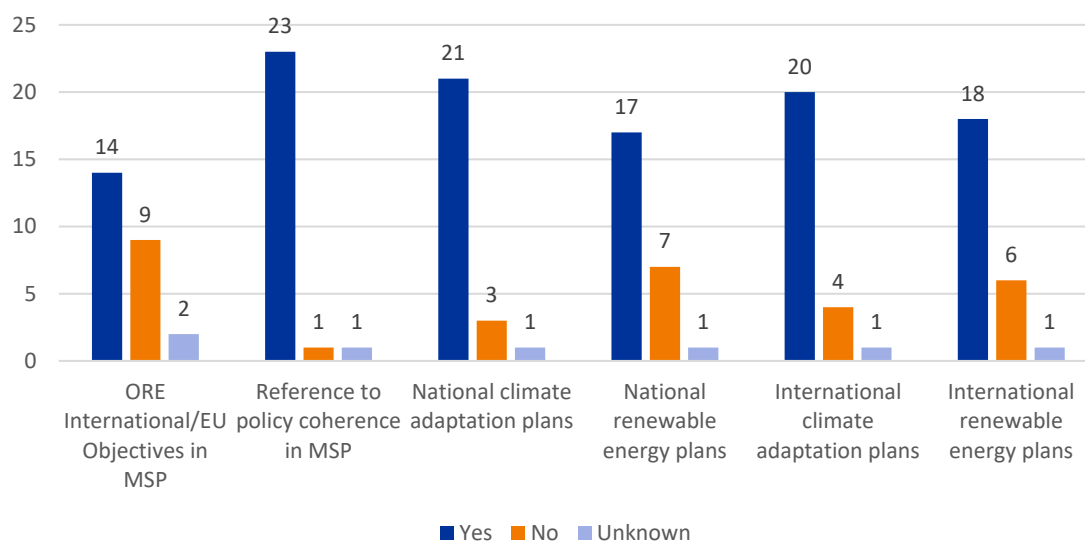
- The Birds Directive aims to protect all naturally occurring wild bird species present in the EU and their most important habitats. In addition to halting the decline or disappearance of bird species, the Directive aims to allow bird species to recover and thrive over the long-term.
- The Habitats Directive aims to protect over a thousand species, including mammals, reptiles, amphibians, fish invertebrates, and plants, and 230 characteristic habitat types.

⁵³ The Barcelona Convention, also known as the Convention for the Protection of the Mediterranean Sea Against Pollution, aims to reduce pollution in the Mediterranean Sea and to protect its marine and coastal environments. See for more information: <https://www.unep.org/unepmap/who-we-are/barcelona-convention-and-protocols>

⁵⁴ The OSPAR Commission for the protection of the marine environment of the North East Atlantic is an intergovernmental regional sea organisation.

refers to the *Esbjerg⁵⁵ and Marienborg declarations⁵⁶*. Such specific references create awareness among relevant stakeholders for ORE development, as well as other stakeholders relevant for maritime spatial planning, on the needs for ORE development and coordinated actions.

Figure 4: Number of MSP documents with references to other policies and goals



Source: CoBren research team, based on the review of MSP documents

References to international/EU objectives for CO₂ reduction and renewable energy shares illustrate the need for ORE development. 13 MSP documents⁵⁷ explicitly refer to the European target of 32% renewable energy of a Member State's total energy consumption by 2030.

Few MSP documents present an ORE capacity target. Most plans refer to other policy documents that further describe these ambitions – most notably the National Energy & Climate plans.

When it comes to which ORE is planned and at what scale, significant differences exist between countries and between sea basins. Plans for offshore wind energy in the North Sea basin are currently furthest developed. The MSP documents for the United Kingdom, Germany, Norway, the Netherlands and France illustrate largest ambitions to generate ORE. However, Norway's target of 30 GW is for 2040, while the other targets are set for 2030. The Netherlands has the ambition to reach 38 GW by 2050, with 21 GW targeted for 2030 and the plan to allocate space for an additional 17 GW through a partial revision of the *Programma Noordzee 2022-2027*⁵⁸ (the Dutch maritime spatial plan). France aims for 18 GW by 2035, but targets further growth after that, as their target for 2050 is 45 GW. The largest target set is from Germany: 70 GW by the year 2045.

⁵⁵ During the Offshore Wind Summit in the Port of Esbjerg, EU Commission President Ursula von der Leyen and the German Chancellor, Belgian, Danish and Dutch Prime Ministers pledged to expand the combined North Sea offshore wind capacities of the four countries to 65 GW by 2030 and 150 GW by 2050. [the-esbjerg-declaration-north-sea-as-green-power-plant-of-europe.pdf](https://www.windeurope.org/the-esbjerg-declaration-north-sea-as-green-power-plant-of-europe.pdf) (windeurope.org)

⁵⁶ In the Marienborg declaration, Denmark, Germany, Estonia, Latvia, Lithuania, Poland, Finland and Sweden declare to phase out Russian energy by replacing fossil fuels with renewables and aim for 19.6 GW by 2030 from offshore wind production in the Baltic. [the-marienborg-declaration-300822.pdf](https://www.regeringen.dk/the-marienborg-declaration-300822.pdf) (regeringen.dk)

⁵⁷ This concerns the MSP documents for Belgium, Bulgaria, Denmark, Estonia, Finland, France, Italy, Latvia, the Netherlands, Portugal, Romania, Spain and the United Kingdom. References may be lacking in other MSP as documents may have been drafted at the time, that EU policies were not concluded yet.

⁵⁸ <https://windopzee.nl/onderwerpen/wind-zee/wanneer-hoeveel/wind-zee-rond-2030/>

Box 7: Political support proofs to be an important factor in driving ORE development

CoBren case studies illustrate the importance of setting clear and ambitious targets for ORE. The acknowledgement of clear targets for ORE in national policy documents provide stakeholders with a lever to initiate and promote their project ideas, as mentioned in the cases of *UNITED (Baltic Sea)*, *BLOW (Black Sea)* and *EUSCORES (Atlantic Ocean)*. Stakeholders of *EUSCORES* mentioned the added value of Portugal's commitment to offshore renewable energy projects as a success factor for the project's initiation and implementation. In this context, the Portuguese government has placed a strong emphasis on offshore wind and wave energy development, which aligns with its broader decarbonisation objectives and the EU Green Deal. As such, Portugal's political backing has facilitated smoother regulatory pathways, enhanced financing opportunities, and fostered collaboration among key stakeholders across the energy and marine sectors. Finally, stakeholders in the cases of *UNITED* and *ULTFARMS (North Sea)* highlight trickling down effects of clear commitments and target setting in national policy documents for offshore renewable energy.

3.2.4 MSP as a means for stakeholder engagement and involvement

The development of MSP documents provided Member States with an opportunity to engage with various stakeholders and enhance the involvement of relevant stakeholders for ORE development.

Involvement of stakeholders is one of the key principles in maritime spatial planning (Quesada-Silva et al., 2019a; Smythe & McCann, 2019). This is confirmed by a systematic literature review conducted by Rafael et al (2024), showing that "stakeholder engagement" is the second most used keyword in the studies and concluding that 83 out of 476 reviewed papers on MSP deal with strategies to involve stakeholders and participation of the civic society in MSP.

24 out of 25 MSP documents explicitly refer to stakeholder participation processes applied in the preparation of the document⁵⁹. Government actors, businesses, communities of interest (NGOs), and researchers have generally been involved in the preparation of the documents (see Box 8 for more details on the type of stakeholders involved in ORE planning/deployment).

The MSP documents illustrate different ways stakeholder participation has been organised, ranging from diverse types of meetings (consultation, online) to workshops, surveys or newsletters. At the same time, the documents do not provide information about whether stakeholders have simply been informed or whether they have actively contributed to the development of the document, including framing of ORE possibilities in a collaborative effort. It is, however, important to consider the meaningfulness of stakeholder involvement as various scholars have stressed that the organisation of meaningful participation is not an easy task and requires a long-term investment⁶⁰. Zauha et al (2021) conclude that advanced forms of stakeholder engagement in the absence of important preconditions for their introduction can be premature and may even halt the MSP process. **Important preconditions for stakeholder engagement include trust and capacity building at all levels to ensure effective partnerships between different actors and institutions** (Ansong et al., 2021). Building such trust and capacity is more likely to happen when stakeholder participation is underpinned by a philosophy that emphasises empowerment, equity, trust and learning (Reed, 2008). The case studies illustrate applying such principles by including a variety of different stakeholders and by providing the stakeholders with (territorial) evidence where possible. For examples, in the case of EU-SCORES, project partners organised various participative events and workshops with affected communities including fishermen and environmental NGOs.

⁵⁹ The MSP for Malta does not explicitly mention stakeholder involvement. Nevertheless, stakeholder participation may have been organised for the development of its Spatial Plan for Environment and Development (SPED).

⁶⁰ In literature, it is argued that all too often stakeholder participation itself (with the help of decision support tools to present available data and information to different users) is approached as a toolkit-approach (focusing on selecting the relevant tools for the job). However, seeing stakeholder participation as a long-term *process* emphasising the long-term relationship where parties develop mutual trust and respect whilst learning from each other and seeking solutions is better as argued by Reed (2008). Such a process needs to be well facilitated (which requires skills and experience, intuition and empathy) and have clear objectives (Reed 2008). This perspective is also underlined by Quesada-Silva et al (2019b) who present a Stakeholder Participation Assessment Framework, which can be used to evaluate but also plan stakeholder involvement in MSP.

Five MSPs specifically refer to stakeholder involvement to overcome spatial conflicts. However, the documents do not explicitly specify how to do this in practice. Indeed, a participatory approach can contribute to address the needs of affected communities of ORE development, create awareness and political willingness for an ORE project⁶¹. Noble et al (2019) have used GIS and social network analysis to identify the spatial demands of various stakeholders, to conclude that spatial conflicts typically occur in areas of high biodiversity and areas with easy access to marine infrastructure. The conflict between ORE and fisheries is much discussed, with a drastic increase of potential conflict predicted by Stelzenmuller et al (2022). Fisheries with bottom contacting gears will be affected by ORE development.

Box 8: Practices to inform affected communities on the effects of ORE development and involve them in fact-based decision making

Case studies demonstrate the consultation and involvement of directly impacted communities, mainly representatives of the fisheries and tourism sectors. Involving these directly impacted communities from the stage of the ORE development raises awareness about ORE, facilitates social acceptance and allows ORE developers to better understand concerns to be considered during the development stage, as highlighted in the case studies.

The case study of *EU-SCORES (Atlantic Ocean)* illustrates practices for broad support to ORE development and trust building. The project fostered dialogues between a variety of stakeholders namely local communities, policymakers, environmental NGOs, and industry representatives from fisheries, aquaculture and ORE sectors. The organisation of joint dialogues aimed at establishing transparent communication and fact-based discussions for site selection, assessing environmental impacts and integration of energy infrastructure in existing MSP.

Regardless the extent of stakeholder involvement, the case studies illustrated the use of different means to involve stakeholders. Affected stakeholders have been informed via communication campaigns through local traditional media and social media. Information (e.g. for impact assessments) have been collected through surveys. And views have been exchanged through workshops. During the latter, affected communities from the case studies mainly raised questions to better understand the benefits of ORE development, particularly in terms of jobs created, as highlighted in the cases of *EU-SCORES*, *BLOW (Black Sea)* and *EUROTIDES (North Sea)*.

3.2.5 MSP encourages integrated planning for ORE development and provides a framework to specify planning practices

The development of MSP documents contributes to making different sea use space allocations visible to relevant stakeholders. As such, MSP documents are important policy documents to support an integrated planning for ORE development.

MSP documents provide ORE developers with a comprehensive overview of the possibilities for development, notably possible barriers and possibilities for synergies. Planning practices facilitate unlocking the ORE potential inter alia by designating specific areas for ORE development; assessing impacts of marine activities; and stakeholder engagement and involvement. At the same time, **little evidence for implementation of the planning practices has been identified through this study**. Practical implementation of the MSP is required to pave the way for sustainable, efficient, and equitable energy generation across European waters.

Further research is required on the practical implementation of planning practices proposed in the MSP documents, moving beyond case study research. This should consider potential differences on the status of national plans. Today, stakeholders involved in the preparation or follow-up of MSP documents observe differences among Member States applying the requirements of the MSP Directive. Whereas some countries consider the MSP as a guidance document, other countries

⁶¹ The MSP documents provide the possibility of participatory approaches for conflict resolution. At the same time, the MSP documents do not describe how to organise these. Neither do the plans differ between spatial conflicts, non-spatial conflicts (i.e. competing interests, competing policies, worldviews that are difficult to align, or individual (dis)likes) nor process based conflicts (i.e. related to power issues, (in)justice, communication, prior experiences of participants) (ICES 2023).

consider their MSP and its provisions more stringent for any marine activity, including ORE development. This difference is partially embedded in the EU Directive on MSP and the guidance from MSPGlobal whose formulations are left open for interpretation. Provisions of the MSP Directive and recommendations from MSPGlobal use mostly encouragements for countries developing their plans, e.g. using words such as “consider” and “take into account”. As a result, some of the MSP documents provide guidance for dealing with barriers and enhancing synergies, rather than being prescriptive. In these cases, additional policy documents or action plans may be needed to clarify distribution of human activities in marine areas.

3.3 Territorial cooperation to drive ORE development

The MSP Directive requires EU Member States to address territorial cooperation and to promote cooperation with non-EU Member States⁶². Key areas where territorial cooperation can drive ORE development include:

- **Interconnecting grid infrastructure:** Countries sharing the same sea basin can develop interconnected electrical grids that allow for energy sharing and distribution beyond national borders. This type of collaboration already exists in two sea basins, enabled through the North Sea Energy Cooperation (NSEC) and Baltic Energy Market Interconnection Plan (BEMIP), where grid development and interconnections within the respective sea basins are the focus. The European Network of Transmission System Operators for Electricity (ENTSO-E) provides an overview of the offshore transmission system needs for the different European sea basins.
- **Coordinating maritime spatial planning:** To seize the full ORE potential in Europe’s sea basins, countries should collaborate when allocating areas for ORE deployment in their maritime spatial plans. Maximum cost-effectiveness and resource output requires that adjacent activities -also in other jurisdictions- are considered. This can prevent that cross-border wake effects of offshore wind farms limit the electricity generation of neighbouring farms⁶³. Without proper international coordination and policies, the development and operation of one country's offshore wind farm can inadvertently impact the wind resource availability and economic viability of another country's offshore wind farms.
- **Legal and administrative harmonisation:** Countries can develop mutual agreements and facilitate the exchange of permits, licenses, and other legal requisites. A simplified and well-aligned legal and administrative procedure for cross-border offshore projects will streamline deployment of new energy parks.
- **Standardising regulatory framework:** Following the harmonisation of legal and administrative requirements, countries should establish common standards and protocols for the construction, operation, and maintenance of offshore renewable energy installations. This will ensure that projects within a sea basin fulfil the same level of compliance in safety, environmental, and technical aspects.
- **Economic and financial cooperation:** Countries can enable joint investment strategies and financial frameworks to support offshore renewable energy projects. Mechanisms such as shared subsidies, tax incentives, and joint venture agreements can attract investment and reduce financial risk.
- **Environmental and social impact coordination:** Lastly, countries should conduct joint environmental and social impact assessments to address concerns related to the marine ecosystem and coastal communities specific to their sea basin. This is because the impact of

⁶² The Directive refers to transboundary cooperation in articles 11 and 12. For simplicity we refer to territorial cooperation only. See also the Annex 2 for more information on the terminology.

⁶³ A cross-border wake effect of offshore wind farms refers to the phenomena where the operation of an offshore wind farm in one country's waters affects the wind conditions in another country's maritime territory. This typically happens due to the following reasons:

1. Wind Turbulence: Offshore wind farms can create turbulence, reducing wind speeds downwind of the turbines. This reduced wind speed affects the performance of other wind farms located in the downstream wind path.
2. Energy Extraction: The extraction of kinetic energy by wind turbines can cause a wake, which is a region of slower and more turbulent air. This wake effect can extend for several kilometres beyond the boundary of the wind farm.

These effects are significant because they can impact the efficiency and productivity of wind energy generation in neighbouring regions, potentially leading to reduced power output and economic implications.

(large-scale) offshore installations is not restricted to the boundaries of individual countries and can extend across the sea basin.

As we transition from mapping ORE potential to the practicalities of deployment, the importance of cooperation becomes increasingly evident. By fostering partnerships, harmonising policies, and leveraging shared resources, Europe can maximize the efficiency, sustainability, and fairness of its ORE expansion. This collective effort not only advances the achievement of energy targets but also strengthens regional ties and sets a global benchmark for territorial cooperation in marine governance.

3.3.1 MSP as a planning tool to enhance territorial cooperation

In preparation of national MSP documents, country representatives consulted representatives from neighbouring countries, as illustrated through the review of MSP documents. For example, consultations took place between Germany, Denmark and the Netherlands, as well as between Bulgaria and Romania. **Germany and Denmark have developed MSP frameworks that facilitate ORE development while respecting biodiversity hotspots in the Baltic Sea.** The European Court of Auditors (ECA, 2023), also observed consultation between neighbouring countries when establishing their maritime spatial plans. At the same time, the ECA observed little take up of the opportunity to plan common offshore renewable energy projects, thus missing opportunities to use scarce sea space more efficiently.

Box 9: Considering cross-border effects in the Dutch and UK MSP documents

Specific examples of territorial cooperation confirm that stakeholders involved in compiling MSP documents merely informed neighbouring countries on possible cross-border effects of ORE deployment in their respective sea space.

The Netherlands' MSP mentions that the accumulation of the effects of all plans and projects must be assessed in respect of the functioning of the entire North Sea ecosystem. The SEA for the draft North Sea Programme 2022-2027 explicitly focuses on possible cross-border effects. The findings from the SEA have been shared with the neighbouring countries. Examples are wind farm zones that share a boundary with shipping routes towards Germany and the Baltic Sea.

The United Kingdom refers to the UK Offshore Energy Strategic Environmental Assessment 4 (OESEA4), which includes activities that could take place in countries surrounding the waters of the United Kingdom. Specific transboundary effects that are mentioned by the United Kingdom include underwater noise, marine discharges, hydrodynamic changes, atmospheric emissions, impact mortality on migrating birds and bats, and accidental events.

Whereas these examples illustrate little evidence for territorial cooperation, it illustrates first efforts of national actors to apply a more comprehensive approach to maritime spatial planning going beyond national borders. In this context, **acknowledging possible effects of sea uses beyond national borders may be considered as a first step toward territorial cooperation.**

MSP documents illustrate the use of impact assessments to depict potentials or needs for territorial cooperation. The consideration in an MSP of potential effects of measures that go beyond the country's exclusive economic zone (EEZ) illustrates a need or potential for territorial cooperation⁶⁴. Fifteen out of 25 countries evaluated environmental, social and economic impacts on areas outside their EEZ. In seven countries⁶⁵, the review of MSPs illustrates extended impact assessments for ORE.

⁶⁴ Espoo convention – promotes consultation and cross-border cooperation in the planning process to be incorporated in national environmental impact assessment procedures.

⁶⁵ Belgium, Denmark, Estonia, Latvia, the Netherlands, Poland and Portugal

Countries apply different approaches to assess the impacts of ORE deployment beyond national borders:

- In Denmark, potential impacts of ORE deployment beyond the national border have been assessed through desk research. The impact assessment illustrates negative effects on the Danish economy (via tourism) as well as possible issues with offshore wind areas in Sweden in the approach zone to the Copenhagen Airport.
- In Italy, an online consultation meeting on transboundary effects was organised with relevant stakeholders from neighbouring countries. This meeting resulted in comments from a handful of other countries, but nothing specifically related to ORE deployment emerged.
- Estonia and Latvia account for impacts of their ORE development within the Baltic Sea, linked to their joint development of a wind park (see also 3.3.3).

3.3.2 Territorial cooperation to coordinate actions for ORE development

The European Commission communication on delivering EU offshore renewable energy ambitions highlights the benefits of (transnational) cooperation to enhance the development, deployment, and management of ORE. At sea basin level cooperation may be formalised in sea basin strategies, action plans, conventions and other joint initiatives. Such transnational cooperation enables the EU to move towards an integrated and efficient offshore and onshore energy grid (COM/2023/668).

Transnational cooperation supporting ORE development can be found in all European sea basins. Key strategic documents per sea basin illustrate prioritisation of offshore renewable energy (Box 10). They provide relevant stakeholders with a framework to set policy priorities and to align their approaches to ORE development.

Transnational cooperation per sea basin is in many cases supported by broader initiatives, such as the *Central and Southeastern Europe Energy Connectivity* (CESEC) initiative, which covers countries around the eastern Mediterranean and Black Sea, as well as the OSPAR convention for countries along the north-east Atlantic, whose procedures for marine environmental protection influence licensing and permitting for ORE.

Another initiative at a broader level concerns the Memorandum of Split on Clean Energy for EU Islands. This regional cooperation provides a long-term cooperation framework for EU islands to promote replicable and scalable projects with funding from private sector investors, relevant EU support instruments, and technical assistance, to accelerate clean energy transition on all EU islands.

Transnational cooperation is well developed in the North Sea. Cooperation in the North Sea illustrates an integrated planning approach at sea basin level through the Great North Sea Basin Initiative (Box 10). This initiative aims to coordinate planning practices which support ORE development by offering a platform to align legal and administrative procedures and coordinate regulatory frameworks.

The initiative is further supported by clear political support to ORE development from all countries relevant to the North Sea as well as specific regional cooperation initiatives:

- **North Sea Wind Power Hub (NSWPH)** a collaboration between Denmark, the Netherlands, Germany, and Belgium, aims to build a central offshore wind energy hub. This hub will connect to multiple countries, creating an integrated energy grid for the North Sea. The goal is to deliver large-scale, cost-efficient offshore wind energy to the region and beyond, including possible connections to the UK and Norway.⁶⁶

⁶⁶ <https://northseawindpowerhub.eu/>

- **The Offshore Grid Initiative** is a project aimed at creating a coordinated offshore grid network in the North Sea. This initiative promotes the development of offshore grids to connect offshore wind farms and other renewable energy sources to the onshore energy systems of multiple countries. The initiative focuses on improving energy transmission infrastructure and creating a resilient and integrated energy market across the North Sea region.⁶⁷

Such initiatives support the coordination of infrastructure and energy grids and provide thus a key enabling factor for ORE development. France, Spain and Portugal have also established good regional cooperation in the *High-Level Group for south-west Europe* on interconnections. Yet, the cooperation has not yet materialised in specific initiatives.

Box 10: Key strategic documents supporting regional cooperation by sea basin

North Sea

- **The Greater North Sea Basin Initiative (GNSBI)** was established in November 2023, setting the framework for the collaboration between nine countries bordering the North Sea⁶⁸ to strengthen cooperation on maritime spatial planning. The GNSBI provides a regional platform for spatial integration of all maritime uses by making proposals for better aligning national MSPs, to tackle the spatial and ecological challenges of the Greater North Sea Basin.
- **The Ostend Declaration** was signed in April 2023 between the heads of state of Belgium, Denmark, Germany, the Netherlands, Luxembourg, France, Ireland and the UK. The heads of state expressed the ambition to double offshore wind power generation and strengthen joint actions towards greater energy independence towards 2050.
- Regional cooperation on ORE in the North Sea gained increasing attention with the formalisation of the **North Sea Energy Cooperation** and its Action Plan (NSEC). The NSEC aims to increase offshore wind capacity in the region to 260 GW by 2050, which would play a key role in meeting the EU's renewable energy targets. The cooperation facilitates joint efforts on offshore wind, grid interconnections, and energy storage.

Baltic Sea

- **Baltic Energy Market Interconnection Plan (BEMIP)** is a comprehensive initiative involving the Baltic Sea countries and the European Commission. It aims to enhance energy integration and infrastructure in the region. A significant aspect of BEMIP is the work programme for offshore wind development, which focuses on coordination for offshore grid development, maritime spatial planning, financing, and accelerating specific offshore wind projects.
- **Baltic Offshore Grid Initiative** aims to strengthen cooperation among Transmission System Operators (TSOs) to develop a future offshore grid in the Baltic Sea, facilitating the integration of renewable energy sources.
- The **Marienburg Declaration** from 2022 is a collaborative effort among Baltic Sea countries to advance offshore wind energy, focusing on sustainable development and regional cooperation to maximize the deployment of renewable resources (see also section 2.3).

Atlantic Ocean

- The revised **Atlantic Action Plan** outlines strategic priorities for the sustainable development of the Atlantic region. The plan promotes collaboration between the EU's Atlantic states, including Portugal, Spain, France, and Ireland, to optimise maritime space for energy production, particularly offshore wind. The plan supports the creation of a coordinated approach to energy infrastructure, ensuring that offshore wind farms do not interfere with shipping lanes, fishing zones, or protected marine areas.

⁶⁷ [The North Seas Countries' Offshore Grid Initiative \(NSCOGI\) | The European Maritime Spatial Planning Platform](#)

⁶⁸ Belgium, Denmark, France, Germany, Ireland, Netherlands, Norway, Sweden, United Kingdom

Mediterranean

- Regional cooperation on offshore renewables is organised under the **Barcelona Convention** and the **WestMed initiative**. The Barcelona Convention defines a specially protected area of Mediterranean interest (SPAMI), which shall be considered in MSP and may thus influence the location of ORE. The WestMed Initiative for the Sustainable Development of the Blue Economy aims to enhance maritime safety, promote sustainable economic growth, and foster job creation. It involves Italy, Spain, and France and focuses on integrating ORE solutions like offshore wind and solar energy. The **MED7 Alliance** specifically refers to support for the development of offshore renewable energy in the Mediterranean Sea and in the Atlantic

Black Sea

- **The Common Maritime Agenda (CMA) for the Black Sea**, established in 2019, promotes a sustainable Blue Economy through collaboration between countries like Bulgaria, Romania, Turkey, and Ukraine. Supported by the Black Sea Strategic Research and Innovation Agenda (SRIA), the CMA prioritises innovation in offshore wind and wave energy. These initiatives help align regional efforts with EU sustainability goals and emphasize joint environmental protection measures and economic growth opportunities.

Transnational cooperation in the Baltic Sea does not yet consider an integrated planning approach as in the North Sea but focuses rather on ORE development specifically. These forms of cooperation enable interconnecting grid infrastructure which support more efficient use of ORE.

Other strategies support the implementation of the strategic actions for ORE regional cooperation. A variety of other regional cooperations exists in each sea basin. These strategies may address renewable energy, alongside other priorities. Despite being less targeted to ORE, these forms of regional cooperation are relevant to initiate projects or processes to address barriers or enhance synergies for ORE development. Examples of such forms of regional cooperation include:

- The “*Vision And Strategies Around the Baltic Sea*” initiative (VASAB), the Baltic Marine Environment Protection Commission, (Helsinki Commission - HELCOM) in the Baltic Sea.
- The BlueMed initiative in the Mediterranean promotes cooperation for research and innovation in the Mediterranean, focusing on the sustainable development of marine and maritime sectors. It aims to enhance the integration of ORE technologies and addresses shared environmental challenges.
- The Black Sea Economic Cooperation (BSEC), which fosters collaboration among its 13 member states in areas such as energy, environment, and trade. It supports ORE development by encouraging knowledge sharing, harmonising policies, and promoting joint strategies.

In addition, EU macro-regional strategies⁶⁹ highlight the importance of coordinated efforts and reinforced regional governance practice for offshore energy development. The implementation of these strategies is supported by the Interreg transnational cooperation programmes with the same geography.

Territorial cooperation projects on ORE development benefit from sea basin strategies. The presence of sea basin strategies, or similar documents at sea basin level act as an enabling factor for concrete actions for ORE development. The joint initiative between Estonia and Latvia to develop a hybrid offshore wind park and the joint electricity certificate market set up between Norway and Sweden are two examples of projects directly benefiting from transnational cooperation (EEA, 2023). Other examples may be present across Europe, yet the relation between regional cooperation and specific actions for ORE development is often not made explicit (Studzieniecki & Palmowski, 2022). The CoBren case studies illustrate possible benefits of regional cooperation for the initiation and development of ORE projects, yet these benefits are not yet exploited to the fullest potential.

⁶⁹ The EU macro-regional strategies for the Baltic Sea, Adriatic-Ionian Sea and Danube Region include priorities for offshore renewable energy: https://ec.europa.eu/regional_policy/policy/cooperation/macro-regional-strategies_en

3.3.3 EU cooperation mechanisms supporting ORE development

Different tools and mechanisms are available at European level that enable and support territorial cooperation. This includes financial support through EU (co-)funded programmes as well as cooperation mechanism encouraging Member States to jointly unlock the potential of ORE. Desk research illustrates different levels of uptake of the opportunities offered at EU level.

Interreg is a main lever to enhance territorial cooperation and unlock the potential for ORE development. At least 93 Interreg projects have been implemented with a focus on ORE development from 2000 until today⁷⁰. Most of the projects are situated in the North Sea, Atlantic Ocean and Baltic Sea. The projects support ORE development in various ways. The assessment illustrates the enabling character of Interreg projects for ORE development:

- research projects delivering feasibility studies for ORE,
- studies depicting the needs, challenges and barriers for ORE,
- awareness raising campaigns to enhance political support for ORE development and improved collaboration efforts,
- projects establishing partnerships to test and demonstrate ORE,
- project developing tools and services facilitating the commercialisation of ORE, e.g. systems for data exchange.

Financial support through Interreg thus allows initial steps to develop ORE, ensuring involvement and commitment from relevant partners, providing stakeholders with relevant (territorial) evidence, illustrating the feasibility of technologies in different locations. The CoBren case studies highlight similar enabling conditions from territorial cooperation (

Box 11).

Box 11: Territorial cooperation advancing multi-use ORE projects

AquaWind's (Canary Islands, Atlantic Ocean) pilot in Gran Canaria exemplifies strong cross-border cooperation within the Atlantic sea basin. By engaging stakeholders from Spain, Portugal, and France, the project benefitted from shared expertise and resources, facilitating the integration of floating wind technology with aquaculture. This cooperation highlighted the importance of regional partnerships in advancing multi-use marine projects and promoting sustainable energy practices.

MUSICA's (Mediterranean Sea) pilot on Inousses Island in Greece used initiatives like the WestMED Initiative to align its sustainability objectives with regional goals. This engagement enabled the project to benefit from a broader network of Mediterranean stakeholders, enhancing support for integrating wave, wind, and solar energy systems. By aligning with these initiatives, MUSICA strengthened its regional impact and contributed to shared sustainability aims across the Mediterranean.

Currently, 35 out of 53 Interreg programmes of regions with sea access⁷¹ support ORE development. This concerns cooperation programmes that:

- aim to promote renewable energy in accordance with the EU Renewable Energy Directive (13 programmes)⁷²,
- consider relevant fields of intervention⁷³ for ORE development (35 programmes).

⁷⁰ 93 Interreg projects have been identified in the "keep"-database by using the following key words: offshore renewable energy, offshore energy, offshore wind, marine energy, tidal energy, ocean energy, wave energy, offshore grid, blue energy, offshore wind farms / turbines and offshore solar.

⁷¹ The analysis is based on 2021-2027 programmes including, Interreg NEXT programmes, of which one or more regions have sea access enabling offshore activities. In total 53 out of the 85 Interreg programmes have sea access.

⁷² More specifically this refers to Cooperation Programmes that selected the Specific Objective 2.2. as one of the priorities in their programme. This provides thus explicitly the opportunity for stakeholders to use Interreg Funding.

⁷³ The following fields of intervention have been identified as relevant for ORE development:

- 029 Research and innovation processes, technology transfer and cooperation between enterprises, research centres and universities, focusing on the low carbon economy, resilience and adaptation to climate change

A majority of these programmes share a coast with the Mediterranean Sea, followed by the Atlantic and Baltic seas. The potential for stakeholders to use Interreg is thus relatively higher in these sea basins, based on the thematic focus of the cooperation programme. At the same time, only a few programmes specifically enable renewable energy development (through Specific Objective 2.2⁷²) or with explicit reference to intervention field 051 – renewable energy marine. **Most Interreg programmes with sea access focus on research and innovation processes, technology transfer and cooperation between enterprises, research centres and universities, focusing on the low carbon economy, resilience and adaptation to climate change.** As such, support may be mostly indirect, similarly as for the initiatives under the communities of practice for smart specialisation (Box 12).

Box 12: S3 Communities of Practice for ORE

S3 Communities of Practice aim to advance guidance, networking and peer-learning on smart specialisation strategies (S3), one of the enabling conditions for innovative actions supported through Cohesion Policy. In more detail, the Communities of Practice aim to reach out to all quadruple-helix stakeholders⁷⁴ interested in smart specialisation and create a space for learning and advancing together. Two communities have a specific focus on energy.

- *BlueXChange* aims to contribute through interregional collaboration to a faster up-scaling of Marine Renewable Energy (MRE) by enhancing MRE supply chain development, strengthening the coordination of test facilities and R&D activities speeding up market entry of innovations, as well as by enhancing enabling factors such as marine spatial planning, skills and marine robotics.
- The *ADMA Energy Pilot* aims to create new value chains in the growing offshore energy industry through the provision of support for advanced manufacturing technologies across traditional and emerging sectors and technologies – as well as disruptive innovations related to design, functionality, integration, automation, material, communication etc. of the components/systems in Blue Sustainable Economy. This includes new innovations and materials for products, services and processes.

Projects funded by Horizon⁷⁵ contribute to advancing Europe’s technical capabilities on ORE development. Horizon encourages territorial collaboration between research institutes, as well as private entities, NGOs and public sector players to join resources. According to a review of Horizon projects by the European Commission, an increasing number of projects were funded under Horizon 2020 for the years 2014-2020 (64 projects), compared to the 7th framework programme for 2007-2013 (22 projects). Horizon 2020 mobilised 185 million euros for ocean energy projects (+83% compared to the 7th framework programme for research projects preceding Horizon programmes), including 92 million euros for tidal energy (+73%) and 86 million euros for wave energy (+93%)⁷⁶. The increase of projects in these fields illustrates Europe’s leading role in developing green technologies, including ORE technologies, as also highlighted in the Draghi report (Draghi, 2024).

-
- 047 Renewable energy: wind
 - 048 Renewable energy: solar
 - 051 Renewable energy: marine
 - 052 Other renewable energy (including geothermal energy)
 - 053 Smart Energy Systems (including smart grids and ICT systems) and related storage
 - 054 High efficiency co-generation, district heating and cooling
 - 055 High efficiency co-generation, efficient district heating and cooling with low lifecycle emissions

⁷⁴ Stakeholders from research, industry, public sector and citizens / society

⁷⁵ Cluster 5 of Horizon Europe aims to fight climate change by better understanding its causes, evolution, risks, impacts and opportunities, and by making the energy and transport sectors more climate and environment-friendly, more efficient and competitive, smarter, safer and more resilient.

⁷⁶ EU Blue Economy Observatory: https://blue-economy-observatory.ec.europa.eu/eu-blue-economy-sectors/marine-renewable-energy_en

The uptake of funding from EMFAF, LIFE and CEF⁷⁷ is challenged mainly by low priority given to ORE in these programmes. The European Maritime Fisheries and Aquaculture Fund (EMFAF) supports cross-border cooperation for ORE development via its direct management component. The fund enables cross-border coordination through its support to innovation projects on offshore renewables. Another part of the fund is dedicated to support policies including MSP and the sea-basin strategies. While for EMFAF about EUR 20 million has been granted to innovative ORE projects, EUR 797 million can be invested by the European Commission in total. This illustrates the niche position of projects supporting ORE development.

15% of the total budget of the CEF Energy is allocated to cross-border projects in the field of renewable energy, this includes onshore renewable energy projects which are more numerous than offshore renewable energy projects⁷⁸. A review of projects funded through the first 3 calls illustrates three out of the eight projects focus on ORE development:

- ELWIND is a joint hybrid offshore wind park⁷⁹ between Estonia and Latvia with a total capacity of up to 1 GW,
- SLOWP (Saare-Liivi Offshore Wind Park) is a joint hybrid offshore wind park between Estonia and Luxembourg⁸⁰, with a total capacity of 1.2 GW,
- BEI (Bornholm Energy Island) is a hybrid project that consists of 2 offshore wind farms of 3 GW each, to be connected to converter stations on the Danish island of Bornholm. The island will be connected to both Denmark (mainland) and Germany through high-voltage direct current cables.

The LIFE Clean Energy Transition sub-programme aims at facilitating the transition towards an energy-efficient, renewable energy-based, climate-neutral and resilient economy by funding coordination and supporting actions across Europe. Its objective is to break market barriers that hamper the socio-economic transition to sustainable energy by engaging multiple small and medium-size stakeholders, actors including local and regional public authorities, non-profit organisations and consumers. The sub-programme allows for cross-border collaboration through its support mechanisms for the development of local renewable energy communities, its technical support to clean energy transition strategies and plans in municipalities and regions and its project development assistance for local sustainable energy investments. However, no evidence has been found on ongoing LIFE projects in support of ORE with a territorial cooperation component.

The uptake of the cooperation mechanisms enabled through the Renewable Energy Directive is challenged by the complexity to reach agreements. These mechanisms provide Member States with tools for territorial cooperation for ORE development (see also Box 13). Despite the benefits of territorial cooperation, few Member States have applied such cooperation mechanisms. **In this regard, an EEA analysis of projects applying cooperation mechanisms illustrates barriers to reach agreements that shall underpin the joint actions⁸¹** (EEA, 2023). The barriers relate to

⁷⁷ Connecting Europe Facility (CEF) are a key instrument at European level supporting territorial cooperation in this phase. This includes support through the CEF Transport and CEF Energy programmes.

- The CEF Energy programme enables cross-border projects of common interest in the field of renewable energy. The programme supports the development of high performing, sustainable and efficiently interconnected trans-European networks and provides financial support for studies to prepare and implement projects of common interest and projects of mutual interest.
- The CEF Transport programme aims to build, develop, modernise and complete the trans-European transport network (TEN-T). It contributes to the development of projects of common interest on efficient, interconnected and multimodal networks and infrastructure for sustainable, smart, interoperable, inclusive, accessible, resilient, safe and secure mobility. It also contributes to the adaptation of the TEN-T network to the civilian-defence dual use. Eligible investments include the development of basic maritime port infrastructure to improve port capacities and facilities in relation to offshore wind farms. Examples of such interventions are the development of quays, berths and utilities installations for the pre-assembly, construction, operation, maintenance and decommissioning of offshore wind farms.

⁷⁸ The Commission has possibilities to increase this share to 20%.

⁷⁹ A hybrid offshore wind park connects the wind park to the electric power grid of both countries through interconnectors. This supports making efficient use of energy generated by allowing distribution per country based on their needs..

⁸⁰ Luxembourg is co-investing in the development of the wind park.

⁸¹ The European Environmental Agency (EEA) reviewed lessons learnt from three specific projects, making use of the mechanisms of two joint support schemes (the joint electricity certificate market set up between Norway and Sweden, and the joint auction for ground-mounted solar photovoltaic (PV) energy between Denmark and Germany), and one joint project on wind energy between Ireland and the UK, which had to be abandoned.

concerns with incoherent national measures for permits and licences, uncertainty on sharing costs and benefits, and public acceptance. In addition, stakeholders expressed **challenges related to ensuring sufficient political support through the duration of the project**, building mutual trust, and remaining flexible to adapt to changing contexts, including renewed political priorities, and changing energy prices. Different national energy systems as well as regulatory frameworks are the root cause for some of these challenges. The same EEA analysis also illustrates the relevance of sea basin strategies and similar documents to facilitate benefiting from cooperation mechanisms (see section 3.3.2).

Box 13: Cooperation mechanisms for ORE enabled through the EU Renewable Energy Directive

The Renewable Energy Directive (EC/2018/2001) enables three cooperation mechanisms, namely statistical transfers, joint projects, and joint support schemes:

- **Statistical transfers** allow EU Member States to deduct an amount of renewable energy generated from one country's and add it to another country's balance to demonstrate attaining EU renewable energy production targets. This cooperation mechanism incentivises EU countries to exceed their targets, because they can receive a payment for energy they transfer to other countries. It also allows countries with less cost-effective renewable energy sources at their disposal to achieve their targets at a lower cost
- **Joint projects** enable two or more EU Member States to fund a renewable energy project in electricity or heating and cooling and share the energy to meet their targets. These projects can, but do not have to, involve the physical transfer of energy from one country to another. In a joint project, cooperating parties negotiate the details of cooperation and have high control over project selection.
- **Joint support schemes** enable two or more EU Member States to fund a joint support scheme to encourage renewable energy production in one or both of their territories. This form of cooperation can involve measures such as a common feed-in tariff, a common feed-in premium, or a common quota and certificate trading regime. Another possibility for cooperation on renewable energy support schemes is the **opening of national support schemes** for producers located in other Member States, in line with Article 5 of the Renewable Energy Directive. The advantages of this mechanism are the reduced negotiation requirements and the decreased administrative burdens compared to a bilateral cooperation mechanism.

3.3.4 Enhancing territorial cooperation in support of unlocking ORE potential

Unlocking the full potential of ORE in European seas demands a commitment to territorial cooperation and policy alignment. The EU's overarching policy frameworks, including the European Green Deal, Renewable Energy Directive, and Biodiversity Strategy, provide the vision and tools for this alignment. However, their success relies on Member States translating high-level objectives into coordinated actions at the sea basin level.

European countries engage in transnational cooperation, resulting in the compilation of strategic documents for ORE in each sea basin. The multitude of strategies, action plans and initiatives in each sea basin illustrates the output of this transnational cooperation. These strategic documents provide relevant stakeholders with a framework to set policy priorities and to align their approaches to ORE development. In addition, they support the implementation of territorial cooperation projects (at cross-border, transnational, and interregional levels), even if the relation between concrete projects and the presence of sea basin strategies is not made explicit.

At the same time, the number of concrete actions and collaboration projects is relatively low. Examples illustrate a need for further policy coordination between different stakeholders representing sectors of different sea uses to enhance the uptake of some territorial cooperation mechanisms. Also, territorial cooperation projects could put more emphasis on key challenges to maximise efficiency of ORE, namely coordinating regulatory frameworks, considering cross-border elements in environmental impact assessments, feasibility studies, data exchange, sharing of costs and benefits, building good governance (mutual trust, political will). The CoBren case studies illustrate first initiatives for joint actions on these topics, examples that could be further promoted to encourage higher uptake.

Box 14: ORE projects share data to support the development of the sector

CoBren case studies illustrate the importance of sharing data to advance the development of ORE at different stages of their development cycle and to raise public support.

For instance, during the development stage of an ORE project, enhanced data sharing and research initiatives, supported by relevant government bodies, can help to close knowledge gaps and operational planning. In this context, the *Middelgrunden* pilot (*Baltic Sea*), had to overcome some knowledge gaps during the development stage, e.g. differences in wind stability between Denmark's east and west coasts impacting turbine operation and efficiency.

Another example relates to sharing data collected during environmental impact assessments. In the context of the *AquaWind* (*Canary Islands, Atlantic Ocean*) project, environmental monitoring data is shared with broader EU research networks to further advance marine science and encourage marine biodiversity while offering an opportunity to study the long-term ecological impacts of integrated offshore systems.

Finally, sharing relevant data and information between relevant stakeholders is an important lever for ORE projects during the development stage and to strengthen public support. Data sharing includes technical knowledge, financial investments, and access to unique environmental data. Such resource sharing has proven to be critical in overcoming the logistical and technical challenges of deploying renewable energy technologies in island settings (e.g. *MUSICA*, *Mediterranean Sea*) and to ensure public support from local communities.

4 Conclusions

This chapter presents the main conclusions that can be drawn from the CoBren study.

4.1 EU policy frameworks provide a vision for ORE development in close alignment with environmental, socio-economic and sustainability considerations

There is a comprehensive policy framework in the European Union to drive the deployment of offshore renewable energy. Apart from supporting the expansion of renewable energy capacity, these policies also emphasize environmental protection, socio-economic considerations, and sustainable development. Key initiatives include the *EU Green Deal*, the *Marine Strategy Framework Directive (MSFD)*, the *Renewable Energy Directive II* and the *Habitats and Birds Directives*. On top of environmental considerations, these policies support the socio-economic benefits of ORE, such as job creation, regional development, and energy security. Member States can align their strategies and ORE objectives based on these overarching EU level targets.

4.2 In light of current ORE deployment levels and forecasts, more progress is needed to achieve national, regional and EU targets

Ambitious offshore renewable energy targets have been formulated for the coming decade at sea basin level for all sea basins, except for the Black Sea. Offshore wind is still by far the most prominent technology. Due to the geography, floating wind is also gaining more attraction in the Atlantic Ocean and the Mediterranean Sea. At the EU level, the EU-27 currently has a cumulative installed capacity of offshore wind of 19.4 GW while other European countries (including Norway and the United Kingdom) have a total installed capacity of 14.8 GW, bringing the total capacity in Europe to around 32 GW⁸². With the current capacity still being far from fulfilling the 2030 targets of 111 GW and the 2050 targets of 317 GW for offshore wind, it becomes clear that **a steep increase in offshore wind deployments will need to happen to achieve the EU's offshore wind policy goals**. For ORE other than offshore wind, tidal stream installation is leading with 11.75 MW installed capacity, despite the absence of any policy target for tidal energy in Europe. Most of this capacity is in the United Kingdom with France contributing a small percentage. Wave energy has 1 MW total installed capacity in 2023, from installations in Portugal, Italy, Spain, and France⁸³. Offshore solar has around 1 MW total installed capacity in 2024, with installations in The Netherlands, Belgium, and France⁸⁴. Currently the EU's target of 1 GW of ocean energy (wave and tidal) by 2030 and 40 GW by 2050 remains above the articulated national targets for these resources⁸⁵. Therefore, while the progress across sea basins is promising, with ORE deployment forecasts highlighting the prevailing dominance of offshore wind but also a growing contribution from other ORE technologies, **significant gaps between current deployment levels of ORE and the set targets remain. Achieving these ambitious targets will depend to a large extent on the efficient use of marine space, addressing overlapping interests as well as increased policy support and investment in wave and tidal technologies to further accelerate their commercialisation and scale-up.**

⁸² Source: Analysis based on installed ORE capacity and targets for the countries in scope of this study (see also table 1).

⁸³ Ocean Energy Europe. (2024). *Ocean Energy Stats & Trends 2023*. Brussels: Ocean Energy Europe.

⁸⁴ DMEC. (2023). *Market Report 2023: Innovative Offshore Renewable Energy Technologies in DMEC's Portfolio*. The Hague: DMEC.

⁸⁵ It should, however, be noted that developments in additional forms of energy such as salinity gradient and ocean thermal energy conversion are expected to contribute toward closing this gap.

4.3 Co-location of different types of ORE reveals potential in terms of capacity and efficiency gains towards achieving energy targets

The mapping of ORE potential revealed significant variation across Europe's sea basins, driven by geographic, climatic, and environmental factors. Co-location of offshore wind, offshore solar and wave energy offer great potential, especially in the North Atlantic Ocean, the North Sea and Norwegian Sea, but also to a lesser extent in the Mediterranean Sea and in Macaronesia.

Additionally, integrating activities and fostering synergies in the form of co-location strategies of ORE with other sea uses, promoting the shared use of marine areas for multiple purposes, can minimize conflicts and unlock additional capacity. For instance, ORE projects can coexist within MPAs through nature-inclusive designs or align with aquaculture zones to support sustainable food production.

In this regard, analysing the ORE potential with and without co-location with other sea-uses, and accounting for exclusion zones, illustrates how much ORE capacity could be lost if such co-location opportunities are not exploited. For instance, the analysis has shown that significant potential and efficiency gains would be lost in all sea basins if nature protection areas are exclusively treated as barriers.

Therefore, to exploit this theoretical potential, it is essential to establish supportive policy and regulatory frameworks that incentivize co-location and multi-use considering both, synergies and barriers that ORE developments face in practice.

4.4 Integrative spatial planning that considers synergies and barriers posed by other sea use activities is needed to fully exploit the co-location potential with ORE

The management of marine space is key to unlocking the full potential of ORE. This becomes apparent when considering the role of other sea activities:

- If overlapping activities, such as military zones, aquaculture, nature conservation, or other marine uses, are treated solely as barriers, substantial portions of the available marine space may be excluded from ORE deployment.
- This exclusion would result in significant capacity loss, undermining the EU's climate and energy goals.

This highlights the important role of integrated maritime spatial planning to foster and exploit synergies, reduce capacity losses and enhance the viability of ORE projects. In this regard, co-location strategies, which promote the shared use of marine areas for multiple purposes, can minimize conflicts and unlock additional capacity. For example, carefully planned ORE projects can coexist with marine protected areas through nature-inclusive designs or align with aquaculture zones to support sustainable food production. These approaches not only optimize space but also ensure that marine ecosystems and socio-economic activities thrive alongside energy generation.

4.5 Maritime Spatial Planning practices can help stakeholders to exploit the potential of ORE

The development of national Maritime Spatial Planning encouraged Member States to enhance their approach to balancing marine energy production with ecosystem health and socio-economic interests. All EU Member States, as well as the UK, Norway and Iceland have adopted national MSP documents and consider ORE development. Most of the MSP documents clearly refer to ORE.

The MSP documents complement other policy documents advancing ORE development, including national energy and climate plans as well as national and international climate adaptation and renewable energy plans. The MSP documents refer mostly to climate adaptation plans to a lesser degree to renewable energy plan. These references provide the linkages between documents and encourage policy coherence, which reduces conflicting outcomes and contributes to making governance more efficient and effective.

Planning practices presented in the MSP documents typically follow the requirements prescribed by the MSP Directive (2014/89/EU) and guidelines on MSP by MSPGlobal. This means countries consider coherence with other policies and action plans, consult stakeholders in developing their MSPs, conduct the required impact assessments, consider diverse types of impact and discuss the prospect of multi-use. As such, the requirements formulated in the MSP Directive guide planning practices through Europe. In more detail, MSP provides guidance for ORE development by

- mapping and visualising synergies and barriers,
- designating areas for ORE specifically or for ORE in combination with other sea uses (multi-use),
- illustrating effects of ORE development and potential conflicts through impact assessments,
- providing means for conflict resolution, including possibilities for multi-use and serving as a platform for stakeholder engagement, offering affected communities of ORE development a means to engage with ORE developers.

Whereas MSP documents provide guidance for ORE development, little evidence is available on the implementation of the planning practices foreseen in the MSP. Therefore, there appears to be room for improvement to encourage the monitoring of the implementation of planning practices for the benefit of ORE deployment.

4.5.1 Improving planning practices: more emphasis on territorial cooperation

Territorial cooperation is not fully explored in the MSP documents. While neighbouring countries are generally consulted when an MSP document is drafted, the review of MSP documents illustrates that **cooperation for interconnecting grid infrastructure, coordinating spatial planning, and legal and administrative harmonisation remains limited**. First initiatives for each of these cooperation practices can be observed across Europe, yet their application is limited.

Territorial cooperation is mainly foreseen by considering effects of sea uses beyond the EEZ. Limited references to other potential cooperation practices are made in national MSP documents. Moreover, MSP at sea basin level is not yet common practice.

In recent years, transnational cooperation initiatives have been concluded in all sea basins. These concern ORE specific strategies, conventions, and action plans at sea basin levels. Even though these documents support the development of ORE at sea basin level, only the Greater North Sea Basin Initiative considers an integrated planning approach considering ORE as well as other sea-uses. Such an integrated approach could further enable cooperation practices in the North Sea region. Specific initiatives exist in other sea basins, notably the Baltic Sea. Yet **transnational cooperation at sea basin level is not fully exploited to maximize the efficiency, sustainability, and fairness of ORE expansion**. To do so, reinforced effort is required to foster partnerships, harmonise sector policies, and leverage shared resources. This collective effort not only advances energy targets but also strengthens regional ties and sets a global benchmark for cross-border cooperation in marine governance.

Analysis performed by EEA illustrates barriers to reach agreements that shall underpin the joint actions. The barriers relate to concerns with incoherent national measures for permits and licences, uncertainty on sharing costs and benefits, limited exchanges of data and public acceptance.

The scientific literature highlights the need for international good practices that can illustrate how transboundary collaboration in MSP can take place. MSP is taken up by some regional sea conventions, such as the Baltic SCOPE project (Kull et al., 2021) and the eMSP NSBR project (North Sea and Baltic Sea region).

4.5.2 Improving planning practices: further development mechanisms for conflict resolution in MSP

By analysing and allocating the spatial and temporal distribution of human activities in marine areas to achieve ecological, economic and social objectives Maritime Spatial Planning supports avoiding conflicts between different sea-uses. Yet, the development of ORE shows that conflicts arise between users of the sea. Impact assessments conducted for the development of MSP documents highlight, among others, possible conflicts between ORE and fisheries and aquaculture, nature conservation as well as tourism, military activities and shipping.

The designation of specific ORE or multi-use areas is one of the planning practices proposed in MSP documents to address potential conflicts. In practice, **experience with the development of multi-use shows that combining different functions, whether that is limited to co-use of space or includes the shared use of physical infrastructure, is difficult.** There are only a few examples of multi-use in European seas, including fisheries (in some MS allowed), nature conservation and tourism, as various barriers stand in the way of implementing multi-use at large scale. Numerous research and innovation projects⁸⁶ have focussed, and still focus, on combinations with aquaculture, seaweed and other ORE technologies.

Participation and stakeholder consultation are seen as key to resolve spatial conflicts in the planning process. Yet only five member states directly refer to stakeholder involvement as a conflict resolution strategy in their MSP documents. Enhanced participatory approaches can contribute to address the needs of affected communities of ORE development, create awareness and create political willingness for the project.

4.5.3 Improving planning practices: towards dynamic planning

The review of MSP documents aimed to discover whether these documents include references to other policies, in particular energy and climate plans. This link is made in some of the documents but not all. A simple explanation for this can be that some documents were adopted before the introduction of the energy and climate plans, and before the growth of ORE in the late 2010s. As the revision of these MSPs takes place every 5 to 10 years (the period varies per country), it becomes clear that the latest technological and political developments may not be reflected in the regulatory framework. It would therefore be beneficial to work on a dynamic maritime spatial planning framework that would incorporate new developments easily – without necessarily revising the full MSP. This could then be accompanied by a dynamic and integral impact assessment methodology.

⁸⁶ To name only a few: TROPOS, H2Ocean, MERMAID, COEXIST, MARIBE, UNITED, MUSES, ULTFARMS

5 Recommendations

This chapter presents the recommendations which are based on the conclusions drawn from the CoBren study. The recommendations are oriented toward:

- Strengthening the maritime spatial planning process in the context of ORE development through existing means (i.e. MSP documents).
- Supporting the optimal use of existing sea-space for ORE development in concert with synergies and barriers.
- Promoting cross-border and transnational cooperation in the context of ORE developments at the sea basin level.

We have identified several key stakeholders who are addressed by these recommendations and who should be involved in their implementation:

- **Policymakers:** National and regional authorities involved in/responsible for maritime spatial planning.
- **ORE developers:** Engineers, technicians, companies involved in developing and implementing ORE projects.
- **Affected communities and stakeholders:** Operators of other sea use activities e.g. fisheries, aquaculture, military, environmental protection areas/zones.
- **Researchers and data holders:** Researchers in the field of ORE, collectors of data (e.g. maritime, environmental data).
- **Investors:** Private sector stakeholders and institutional funds (e.g. pension funds)

To ensure recommendations are actionable and clearly assigned to relevant stakeholders we have applied the RACI principle:

Table 1: RACI matrix

R - Responsible	A - Accountable	C - Consulted	I - Informed
Stakeholders actively involved in carrying out the activities described in the recommendation	Stakeholder taking the decision on the implementation of the recommendation (decision-maker)	Stakeholder providing input for the implementation of the recommendation	Stakeholder informed about the progress/ implementation of the recommendation

The detailed recommendations are presented in the next section.

5.1 Strengthen MSP as a toolkit for strategic planning

The CoBren study has shown that integrated maritime spatial planning i.e. an approach that considers different sea-uses and related synergies and barriers, affected communities and stakeholders as well as environmental impacts of developing ORE, is needed to exploit the full potential of European seas in the context of ORE development. The review of MSP documents highlights the potential of such documents as a supporting toolkit in the planning process. To further strengthen this toolkit several actions could be pursued:

- **Quantify ORE targets in MSP documents:** Clearly state and quantify ORE targets, ideally by ORE technology (e.g. wind, wave, tidal, solar etc.) and thereby strengthen the political commitment to supporting the development of ORE. Consider latest technological developments that may have an impact on achievable targets.

Implementation: This recommendation should be implemented by policymakers responsible for the MSP document. In the process, ORE developers and researchers/data holders should be consulted to provide relevant data to identify quantified ORE targets. Other relevant stakeholders such as affected communities and investors should be informed.

- **Engage with stakeholders in the MSP process:** Facilitate the participation and exchange between all relevant stakeholders (e.g. ORE developers, affected businesses and communities, researchers in the field and data holders) in the MSP process. This may be particularly relevant in the Black Sea, Atlantic Sea and Mediterranean Sea as the study illustrate less cooperation experience in these sea basins, based on the presence of specific strategic MSP documents at sea basin level facilitating ORE development.

Projects such as *EU-SCORES* provide relevant examples of participative stakeholder engagement to discuss relevant topics such as the coherency of regulatory networks, future grid capacity planning and supply chain related challenges for ORE development or possibilities of multi-use. Such an exchange can be further supported via dedicated platforms (e.g. the *European Maritime Spatial Planning Platform*⁸⁷ at EU level, or specific platforms such as the *eMSP platform*⁸⁸ active at the sea basin level). These platforms serve the purpose of sharing information between relevant stakeholders and offering the opportunity to engage in specific discussions concerning MSP and ORE development (e.g. topics such as ocean governance or data-sharing as in the case of the eMSP platform).

Implementation: The recommendation should be initiated and driven by policymakers at national and regional levels working with ORE and MSP. ORE developers, including investors, and stakeholders from affected communities should actively participate in the discussion and information sharing activities. Researchers and data holders may also be consulted on specific topics if necessary.

- **Collect, analyse and update MSP data:** Collect, analyse and update relevant data (e.g. spatial data on sea use, ORE relevant factors such as windspeed, bathymetry, currents, synergies/barriers, latest technological developments in relation to ORE, etc.) to support decision-making in the planning process.

Implementation: The collection, analysis and update of data could be performed by ORE developers, including investors, and researchers/data holders on the initiative of the policymaker.

⁸⁷ Source: [Homepage | The European Maritime Spatial Planning Platform](#)

⁸⁸ Source: [eMSP NBSR – eMSPproject.eu](#)

- **Monitor the implementation and update of MSP documents:** Strengthen MSP through monitoring of the implementation of maritime spatial plans and drawing regular lessons learned on identified best practices and problems/issues encountered in ORE developments when applying maritime spatial plans. Performing regular updates of planning documents based on new data, identified lessons learned and best practices.

Implementation: This activity should be implemented by national or regional policymakers responsible for MSP. In this context, ORE developers, stakeholders from affected communities as well as researchers and data holders should be consulted to gather relevant information and provide feedback. Investors should be informed to align their priorities with possible changes of the MSP document.

The table below provides a succinct overview of the expected involvement of each type of stakeholder for the implementation of the recommendations.

Table 2: RACI matrix "Strengthen MPS as a toolkit for strategic planning"

Stakeholder / Recommendation	Quantify ORE targets in MSP Documents	Stakeholder engagement in MSP process	Collect, analyse and update MSP data	Monitoring, implementation and update of MSP documents
Policymaker	R, A	R, A	A	R, A
ORE Developer	C	R	R	C
Affected Communities	I	R	C	C
Researcher / data holder	C	C	R	C
Investors	I	C	C	I

5.2 Facilitate optimal use of available sea space

To fully exploit the potential of ORE in contributing to the EU's green energy objectives, a more efficient use of available sea space is needed. To achieve this, maritime spatial planning practices must consider how to resolve conflicts and barriers posed by overlapping sea uses and how to exploit potential synergies with other sea uses. To this end we recommend the following actions:

- **Map synergies and barriers** based on recent available territorial evidence: Map the different sea uses to identify synergies and barriers for ORE development. This should include identifying:
 - The theoretical potential of ORE for the sea space (for different technologies e.g. wind, wave, tidal, solar).
 - Current use of sea space for non-ORE related activities such as aquaculture, fishery, military activities, environmental protection zones.

Based on the collected data, identify overlaps between areas with ORE potential and other sea uses. Update the analysis on a regular basis to take technological developments or changing sea uses into account.

Implementation: The implementation of this recommendation should be performed by ORE developers and researchers/data holders under the authority of the policymaker who should set the key parameters to be considered for the mapping of synergies and barriers. Stakeholders from affected communities should be consulted and provide relevant input. Investors should be informed to align their priorities with possible changes of the MSP document.

- **Identify co-location potential:** Analyse identified synergies and barriers to ORE development and evaluate the potential for co-location with other sea use activities (ORE or non-ORE related activities). To assess the co-location potential in relation to other sea uses and stakeholders, perform a comprehensive impact assessment on environment, society and local/regional economy. **Implementation:** Similarly to the previous recommendation, ORE developers and researchers/data holders should perform the colocation analysis. Based on the identified co-location sites, the policymaker should then ensure that a comprehensive impact assessment is performed.
- **Allocate sea space to ORE:** Based on the co-location analysis, allocate sea space to ORE and if applicable other sea uses. The allocation should define areas for ORE deployment in a way that avoids conflicts. Specifically for co-location include multiuse as a requirement in offshore wind farm tenders (from the early stages of development). For the delivery of licences/approvals, consider establishing a one-stop shop as illustrated by the UNITED case study to streamline the approval/licensing process and ensure that all relevant authorities are involved. **Implementation:** The policymaker bears the responsibility of allocating sea space to ORE (and other sea use activities) through the MSP process. Co-location potential may also be translated to criteria for ORE tenders. For example, Poland and the Netherlands are incorporating ecological criteria into ORE tenders to promote biodiversity alongside renewable energy development. Investors could be informed to align their priorities with possible changes of ORE development. All other stakeholders should, however, be consulted to strengthen societal acceptance.
- **Facilitate targeted stakeholder dialogue to promote multi-use:** To support the uptake of multi-use for ORE developments, engage in targeted stakeholder discussions to:
 - Discuss and find solutions for identified sea-use conflicts (e.g. compensation mechanisms if applicable).
 - Raise the level of societal acceptance for multi-use among affected stakeholders by highlighting benefits of shared infrastructure, renewable energy and to the local/regional economy.

Implementation: The stakeholder dialogue should be driven by the policymaker and actively involve all relevant stakeholders i.e. ORE developers, investors, stakeholders from affected communities and researchers/data holders.

The table below provides a succinct overview of the expected involvement of each type of stakeholder for the implementation of the recommendations.

Table 3: RACI matrix “Facilitate optimal use of available sea space”

Stakeholder / Recommendation	Map synergies and barriers	Identify co-location potential	Allocate sea space to ORE	Facilitate targeted stakeholder dialogue to promote multi-use
Policymaker	A	R, A	R, A	R, A
ORE developer	R	R	C	C
Affected communities	C	C	C	C
Researcher / data holder	R	R	C	C
Investors	I	C	I	C

5.3 Enhance territorial cooperation at sea basin level

The findings of this study suggest limited uptake of territorial cooperation mechanisms in fostering ORE deployment across Europe. To fully exploit the potential of ORE enhancing territorial cooperation is required to enable interconnecting grid infrastructure, coordination of spatial planning, and addressing legal, administrative and regulatory challenges. Despite well-established transnational cooperation in the North Sea basin and to a lesser extent in the Baltic Sea, few mechanisms are utilised by respective stakeholders. To increase the uptake of cooperation mechanisms, we recommend the following actions:

- **Enhance territorial cooperation in national MSP processes:** Putting more emphasis on cooperation in national MSP processes makes relevant planning practices more visible for relevant stakeholders. This may be particularly relevant in the Black Sea, Atlantic Sea and Mediterranean Sea as the study illustrate less cooperation experience in these sea basins, based on the presence of specific strategic MSP documents at sea basin level facilitating ORE development. In general emphasis on cooperation may focus on:
 - Collecting and sharing data to support decision-making at sea basin level.
 - Assessing cross-border effects in environmental impact assessments. As recommended in the *Espoo convention*, regional cooperation at sea basin level could support such assessments, e.g. by encouraging relevant stakeholders from neighbouring countries to be involved in the processes.

Implementation: A working group of relevant policymakers, representing each country in a sea basin, may be established to implement this recommendation. This could be representatives of national institutions responsible for MSP, supported by colleagues representing various line ministries that are affected by various types of sea use. Policymakers could facilitate the collection of data and data sharing beyond their country's EEZ. To this end, ORE developers, including investors, and researchers/data holders should be consulted to obtain relevant data.

- **Develop sea basin level MSP documents:** Leverage existing sea basin strategies and instruments to coordinate use of sea space in an integrated manner. This should build upon enhanced territorial cooperation in national MSP processes and could serve as a platform for stakeholder engagement. The process could be implemented via a dedicated governance structure to be set up at the sea basin level with representative stakeholders from all relevant countries. **Implementation:** As was the case for the previous recommendation, relevant policymakers for the sea basin should set up or use an existing governance structure (such as existing sea basin strategies/committees if applicable) to steer the development of a sea-basin wide MSP document to support the planning of ORE developments for the entire sea basin. All relevant stakeholders i.e. ORE developers, investors, stakeholders from affected communities and researchers/data holders should be consulted in the drafting of the MSP at the sea basin level.
- **Promote good practices of territorial cooperation.** Encourage Interreg project partners to focus their activities on coordinating regulatory frameworks, considering cross-border elements in environmental impact assessments, feasibility studies, data exchange, sharing of costs and benefits, and building good governance, including mutual trust and political will. This could be supported by the responsible policy maker (e.g. Interreg programme authority) through:
 - A comprehensive assessment of hampering factors for potential project partners to utilise Interreg in support of ORE development.
 - A comprehensive assessment of qualitative results, including the durability of results, of past projects in the field of ORE development. This could include an assessment of whether projects and obtained results including formed partnerships continue once EU funding has ended and whether a strategy allowing the project/project results to continue once EU-funding has ended has been identified.

- Leveraging opportunities to share experiences across Europe e.g. through S3 communities of practice, Interreg Europe, INTERACT and ESPON initiatives and use of the lessons learnt for further initiation and promotion of projects in the field of ORE.

Implementation: Driven by policymakers (representatives of Interreg programme authorities), researchers and data holders should perform assessments of ORE project results obtained under EU funding schemes and their durability. ORE developers and stakeholders from affected communities should support the identification of best practices for ORE development and hampering factors. Investors could be consulted, highlighting any relevant ORE project that they have financed in recent years, or provide lessons on initiatives that were deemed not viable.

The table below provides a succinct overview of the expected involvement of each type of stakeholder for the implementation of the recommendations.

Table 4: RACI matrix “Enhance territorial cooperation at sea basin level”

Stakeholder / Recommendation	Enhance territorial cooperation in MSP	Develop sea basin level MSP documents	Promote good practices
Policymaker	R, A	R, A	A
ORE developer	C	C	R, I
Affected communities	I	C	R, I
Researcher / data holder	C	C	R, I
Investors	C	C	C

5.4 Conduct further research

While the CoBren study has revealed several findings on the current use of European seas, their theoretical ORE potential and the role that maritime spatial planning can play in unlocking this potential, there remain several areas and topics that could benefit from further research. The topics for further research included in this recommendation have been selected in relation to several key topics addressed by the study, namely conflicting interests between users of maritime space, potential for co-location and the need for territorial cooperation:

- **Assess distributional effects of MSP:** Maritime spatial planning deals with competing spatial claims and conflicting interests. The study has shown that engaging with stakeholders and resolving potential conflicts is a key aspect to ensure that ORE projects can develop in alignment with the activities of other actors. In this context, stakeholders and sectors that feel that their interests are not sufficiently considered in the planning process may lead to societal resistance toward ORE projects⁸⁹. Further research on such distributional effects could potentially support the planning process by increasing overall societal acceptance of those stakeholders who may otherwise be in opposition to ORE developments.

⁸⁹ As argued by Flannery, Ellis, Nursey-Bray and van Tatenhove in “Exploring the winners and losers of marine environmental governance” https://www.researchgate.net/publication/299368541_Exploring_the_winners_and_losers_of_marine_environmental_governance_Edited_Interface_Collection

- **Dealing with “mobile” actors (e.g. shipping, tourism/recreation, fisheries):** Maritime spatial planning has been criticized for failing to include so-called “mobile users” of sea space. This includes users that do not have a fixed place to operate (e.g. tourism and fisheries) and therefore, do not have an interest in claiming a particular part of the sea for their use, which is, however, typically what the MSP process leads to. While multi-use and co-location (as argued by this report) can help solving the issue of overlapping interests, this typically considers stationary activities rather than mobile activities. Therefore, further research on the potential of combining stationary and mobile users in a multi-use concept could support maritime spatial planning in general and the development of ORE projects.
- **Incentives for territorial cooperation:** The analysis in the report has shown that while support for territorial cooperation through EU instruments and regional cooperation mechanisms exists, the application of territorial cooperation practices is hindered by limited consideration of such practices in the MSP document, with maritime spatial planning at the sea basin level not being a common practice yet. To support maritime spatial planning at the sea basin level, further research towards identifying and promoting the economic benefits of territorial cooperation (e.g. through sharing/lowering of costs through shared infrastructure projects) could be beneficial.

Implementation: The three recommendations should be implemented by researchers and data holders under the guidance of policymakers at national and regional level dealing with ORE and MSP. ORE developers, investors, and stakeholders from affected communities should be consulted and provide qualitative as well as quantitative data supporting the research.

The table below provides a succinct overview of the expected involvement of each type of stakeholder for the implementation of the recommendations.

Table 5: RACI matrix “Perform further research”

Stakeholder / Recommendation	Research on: Assess distributional effects of MSP	Research on: Dealing with “mobile” actors	Research on: Incentives for territorial cooperation
Policymaker	A	A	A
ORE Developer	C	C	C
Affected Communities	C	C	C
Researcher / data holder	R	R	R
Investors	R	R	R

6 Annexes

Annex 1 – Forecast & mapping methodology and results

See separate document.

Annex 2 - Review of MSP documents, EU cooperation mechanisms and instruments

See separate document.

Annex 3 - CoBren case studies

See separate document.

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ESPON EGTC
11 Avenue John F. Kennedy
L-1855 Luxembourg
Grand Duchy of Luxembourg
Phone: +352 20 600 280
Email: info@espon.eu
www.espon.eu

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