

# GREEN ENERGY MEETS BLUE FOOD - SUSTAINABLE COEXISTENCE IN NORDIC SEAS

Kerstin Bly Joyce, Myriam Chilvers,  
Rebecca Eriksson

# Table of Contents

Foreword .....	3
Executive summary .....	4
Sammanfattning .....	5
Introduction .....	6
The “Green Energy Meets Blue Food” project .....	8
Why is this topic relevant for the Nordic countries? .....	12
The concept of sustainable coexistence .....	14
Balancing trade-offs, conflicts and synergies .....	16
Overview of green energy and blue food sectors in the Nordic Region .....	19
MSP and stakeholder engagement in the Nordic Region .....	23
Offshore wind development processes and permitting in the Nordic Region .....	26
Key project outputs .....	29
Concluding remarks .....	34
References .....	35
Appendix I .....	42
About this publication .....	58

This publication is also available online in a web-accessible version at:  
[pub.nordregio.org/r-2025-14-green-energy-meets-blue-food](http://pub.nordregio.org/r-2025-14-green-energy-meets-blue-food)

# Foreword

---

This report documents the “Green Energy Meets Blue Food – Sustainable Coexistence in Nordic Seas” project, funded by the Nordic Council of Ministers for Fisheries, Aquaculture, Food and Forestry (EK-FJLS), and summarises the project’s journey and key outputs.

As offshore wind energy expands across Nordic waters to meet climate and energy targets, this project addresses a critical question: how can the Nordic countries effectively manage the competing demands of renewable energy and traditional marine food production for marine space? Recognising that this challenge cannot be resolved by individual sectors or nations alone, the project explores pathways towards sustainable coexistence between offshore renewable energy (primarily wind) and blue food sectors (particularly fisheries).

The project emerged from a clear policy mandate. At their 2023 summer meeting, the Nordic ministers launched initiatives for sustainable marine economy, including one focused on coexistence between marine-based energy, nature conservation and fishing. This builds upon the 2022 prime ministers’ declaration on strengthening marine cooperation for the green transition. Our project directly responded to these commitments by contributing knowledge to inform policy and practice.

Over two years (2024–2026), we have undertaken comprehensive research and engagement. Through literature reviews, six case studies across the Nordic Region and Scotland and extensive stakeholder involvement, we have examined how Nordic countries navigate the complex governance challenges of marine space allocation. Our work has revealed that long-term sustainable coexistence is less about technical solutions for sharing space and more about building effective collaboration frameworks, policy coherence, establishing trust between sectors and ensuring inclusive decision-making processes.

Throughout the project, our reference group of experts from ministries, planning authorities, research institutions (from the Nordic Region and beyond) and the Nordic Council of Ministers has provided invaluable guidance, ensuring relevance to current policy debates and practical realities.

This report provides a comprehensive account of our research approach, documents the knowledge generated about coexistence challenges and opportunities, and synthesises insights from our key outputs. It serves both as a record of achievement and as a foundation for continued work. We hope that this report and associated outputs provide the Nordic countries with an enhanced knowledge base to navigate the complex interface between green energy ambitions and blue food security, ultimately supporting the sustainable development of Nordic seas for current and future generations.

# Executive summary

---



Image: Karin Beate Nøsterud / norden.org

The “Green Energy Meets Blue Food – Sustainable Coexistence in Nordic Seas” project, funded by the Nordic Council of Ministers for Fisheries, Aquaculture, Food and Forestry (EK-FJLS), explores how Nordic countries can balance offshore renewable energy development – particularly offshore wind power – with the continued vitality of blue food production – focusing on fisheries. As offshore wind expands to meet ambitious climate and energy targets, the project addresses how green energy and blue food systems can coexist sustainably within shared marine spaces.

Between 2024 and 2026, the project has undertaken extensive research and engagement, including six case studies across the Nordic Region and Scotland, a literature review and policy analysis. The findings show that coexistence depends not only on technical or spatial planning solutions but also on collaboration between sectors and effective governance. Success requires coherent policies, transparent decision-making, inclusive stakeholder participation and mutual trust between sectors.

Marine and maritime spatial planning (MSP) and permitting frameworks are essential tools, but must integrate environmental, economic and social objectives while managing trade-offs and adapting to new environmental and societal pressures.

Key project outputs include a scientific literature review, a story map of case studies, a Nordic knowledge exchange workshop and a policy brief offering recommendations to strengthen governance for long-term coexistence.

The project concludes that sustainable marine coexistence requires governance innovation, collaboration and early, continuous stakeholder involvement. By contributing new knowledge and fostering dialogue, the project supports the Nordic Council of Ministers’ goal of advancing a fair, inclusive and sustainable green transition across Nordic seas.

# Sammanfattning

---



Image: Karin Beate Nøsterud / norden.org

Som en del i den gröna omställningen har utbyggnaden av havsbaserad vindkraft i Norden ökat i snabb takt. Det påverkar i sin tur andra marina och maritima aktiviteter, särskilt kommersiellt fiske. I den här rapporten undersöker författarna hur de nordiska länderna kan balansera utbyggnaden av förnybar energi till havs, särskilt vind, med en fortsatt livskraftig produktion av blå mat, med fokus på fiskerinäringen. Syftet är att hitta sätt för grön energi och blå livsmedelssystem att kunna samexistera hållbart inom gemensamma havsområden.

Rapporten är en del av projektet *"Green Energy Meets Blue Food – Sustainable Coexistence in Nordic Seas"*, som finansieras av Nordiska ministerrådet och ger en överblick över projektets resultat och genomförande. Inom projektet har Nordregio mellan 2024 och 2026 bland annat producerat fem fallstudier i Norden och en i Skottland, en litteraturoversikt och en policy brief med rekommendationer till beslutsfattare, havsplanerare, och intressenter.

Resultaten visar att en långsiktigt hållbar marin samexistens mellan havsbaserad vindkraft och fiskerinäringen inte enbart beror på tekniska lösningar eller rumslig planering. Det krävs också samarbete mellan lokala, regionala och nationella aktörer samt en enhetlig och effektiv styrning. För att lyckas krävs samstämmiga policyramverk, transparenta beslutsprocesser, inkluderande dialog med intressenter samt ett ömsesidigt förtroende mellan fiskerinäringen och vindkraftssektorn.

Tydliga ramverk för havsplanering och tillståndsprocesser är centrala verktyg i detta arbete. Samtidigt måste miljömässiga, ekonomiska och sociala mål bättre integreras i de processerna. Samarbete och tidig, kontinuerlig involvering av intressenter är också framgångsfaktorer.

Genom att bidra med ny kunskap och främja dialog stödjer rapporten Nordiska ministerrådets mål om att främja en rättvis, inkluderande och hållbar grön omställning i nordiska havsområden.

# Introduction

---



Image: Hendrik Morkel / Unsplash.com

The Nordic countries have set ambitious climate and energy targets, with offshore wind playing a central role in the green transition. The EU's goals for renewable energy and climate neutrality, including the ambition to achieve 45% renewable energy by 2030,<sup>[1]</sup> are key drivers behind the development of many offshore wind projects in the region. The European Green Deal further emphasises minimal environmental harm and nature conservation, including increased marine protection under the EU Biodiversity Strategy 2030. The Nordic countries are also signatories to global agreements such as the Convention on Biological Diversity (CBD) and the Sustainable Development Goals (SDGs).<sup>[2]</sup> Additionally, Nordic seas are vital for food supply, with fishing and aquaculture serving as important industries, especially for many coastal communities.<sup>[3]</sup> At the Nordic Council of Ministers' 2023 summer meeting, ministers further identified blue food systems and sustainable value creation in the fishing industry as key priorities, emphasising the need to balance marine-based energy production with existing ocean uses.<sup>[4]</sup>

Offshore renewable energy, particularly wind, is crucial for the green transition in the Nordic Region but poses challenges, including conflicts over marine space, complex stakeholder engagement and ecosystem impacts. Most countries have not yet planned offshore wind development in their most valuable fishing areas. However, some countries will be unable to meet their renewable energy targets if wind development is restricted to conflict-free areas alone. As offshore wind expands – often involving large-scale infrastructure that significantly alters marine space use – there will be increasing pressure for coexistence with other sectors, particularly fishing, aquaculture and marine protection.<sup>[5]</sup> Addressing this requires exploring solutions for the sustainable coexistence of different interests.<sup>[6]</sup>

- 
1. The revised Renewable Energy Directive (EU/2023/2413) sets a binding target of at least 42.5% renewable energy in the EU's energy mix by 2030, with an ambition to reach 45% (European Commission, 2023).
  2. European Commission (2019); European Commission (2020a)
  3. Sepponen et al., (2021)
  4. Nordic Co-operation (2023)
  5. Van Hoey et al., (2021); Nordic Energy Research (2022)
  6. Koehler & Bergström (2023)

The allocation of offshore wind areas is guided by marine and maritime spatial planning (MSP) and related policy frameworks, both integrated and sectoral. Each Nordic country (Finland, Sweden, Denmark, Norway, Iceland, the Faroe Islands, Greenland and Åland) has its own approach. The EU Member States among the Nordic countries have implemented the European Maritime Spatial Planning Directive (EU MSPD),<sup>[7]</sup> while other marine legislative tools overlap and are complementary in non-EU regions. Cooperation also occurs at transboundary levels across the Baltic, North Sea and Atlantic Sea spaces within the Nordic Region.

Trade-offs between marine resource users arise due to finite marine areas and multiple stakeholders with competing interests.<sup>[8]</sup> These trade-offs, including those involving the marine ecosystem and its services, are often made within spatial planning frameworks. Recognising them explicitly can help make decisions more transparent and justifiable. However, *“trade-offs are rarely addressed explicitly or transparently and so they often go unrealised or are poorly evaluated”*.<sup>[9]</sup>

Understanding the interplay, conflicts and trade-offs between offshore wind and marine food production is key to coexistence solutions. This is where *“good governance”* becomes relevant and why MSP plays a crucial role in balancing ecological, economic and social considerations. However, gaps in governance systems need to be addressed. Effective frameworks, including MSP and offshore wind development processes like permitting, are vital for managing conflicts, promoting collaboration and enabling sustainable coexistence in Nordic seas. These frameworks should also foster cooperation and be adaptive to rapidly changing conditions affecting marine ecosystem services.<sup>[10]</sup>

The Nordic Council of Ministers is working to reconcile ambitious targets for offshore wind with continued ocean food production, while also safeguarding space for nature.<sup>[11]</sup> As noted by Karen Elleman, Secretary General of the Nordic Council of Ministers: *“The transition to renewable energy is urgent, but the transition needs to be fair in order to be sustainable. That is why we are also looking into best practices for involving local stakeholders and their interests.”*<sup>[12]</sup>

---

7. (2014/89/EU)

8. A trade-off is a situation where an improvement in the status of one aspect – such as the environment or human well-being – is necessarily associated with a decline or loss in a different aspect. As resources are limited, trade-offs must be made that balance the gains with the corresponding losses.

9. Kyriazi, (2018, p.105)

10. Swedish Agency for Marine and Water Management (2023a)

11. Norwegian Office of the Prime Minister (2022)

12. Karen Ellemann. Speech 2024. Nordic Council of Ministers' Office in Latvia (2024)



Image: Paul Einerhand / Unsplash.com

---

# The "Green Energy Meets Blue Food" project

## Overview

Increasing pressure for offshore renewable energy brings a growing need for research and guidance on marine and maritime spatial planning and governance strategies that enable the sustainable coexistence of primarily offshore wind energy and marine food production.

The "Green Energy Meets Blue Food – Sustainable Coexistence in Nordic Seas" project was financed by the Nordic Council of Ministers for Fisheries, Aquaculture, Food and Forestry (EK- FJLS) and ran from 2024 to early 2026.

The overall goal of the project was to contribute to a shared knowledge base for the Nordic countries by enhancing understanding of sustainable coexistence between renewable energy and marine food sectors, with a focus on offshore wind and fisheries. It investigated the existing conditions for managing trade-offs, conflicts and synergies between these sectors – primarily within MSP frameworks – from a governance perspective and in a Nordic context.

The overall aim of the project was to contribute to a common knowledge base for the Nordic countries, by providing an increased understanding of sustainable coexistence between renewable energy and marine food sectors, focusing on offshore wind and fisheries. The project's intention was to provide insights into how Nordic countries can effectively address potential conflicts between green and blue sectors, promote synergies and foster improved cooperation and collaboration. Read more about the project: [Green Energy Meets Blue Food | Nordregio](#)

## Project aim and scope

The project examined how conflicts and synergies between offshore renewable energy and marine food production have been managed within Nordic MSP and governance frameworks. Key questions included how coexistence between these sectors has been described in research, how governance systems have addressed conflicts and synergies, how these issues have been handled in different geographical areas, and what Nordic countries can learn from one another regarding policy frameworks, governance mechanisms and knowledge exchange.

The project primarily focused on offshore wind energy and its interactions with fisheries, although other marine energy sources were considered where relevant. Both commercial and recreational fisheries were included, depending on context. Governance approaches were studied from a multi-level perspective, covering pan-Nordic, national, regional and local levels. The geographical scope comprised all the Nordic countries, with the final selection defined during the first analytical stage.

## Project design and research methods

The project was organised into four main work packages, complemented by an additional package dedicated to management and administration. Throughout all phases, a reference group of experts – both from the Nordic Region and beyond – actively contributed under the coordination of Nordregio. Their involvement ensured policy relevance, helped identify case study areas, facilitated knowledge exchange and supported both Nordic applicability and scientific rigour. The reference group met digitally five times, participated in workshops and provided feedback on draft outputs.

### **WP 1: Knowledge overview and baseline**

This work package provided the foundation for all subsequent project activities, establishing the core framework for the rest of the project. During this phase, a systematic review of scientific literature and policy documents was conducted in spring 2024 to identify typical trade-offs, conflicts and synergies between offshore wind and marine food production. The review also produced country-specific overviews of relevant targets and governance frameworks. Additionally, key concepts were defined, focal sectors selected and criteria developed for choosing and elaborating case studies. Relevant initial stakeholders were identified to support further project activities. This phase also included establishment of the reference group.

## **WP 2: Case studies**

Under this work package, six case studies were conducted across the Nordic Sea basins in Finland, Sweden, Denmark, Norway, Iceland and Scotland. These studies explored how governance practices – particularly marine and maritime spatial planning – address trade-offs, conflicts and opportunities for collaboration between sectors, with a focus on offshore wind and fisheries. The case studies employed multiple methods, including document reviews, interviews (both in-person and online) and site visits, where applicable. Through interviews with planners, developers, fishers and policymakers, the project documented how different geographical and institutional contexts shape approaches to coexistence. The case studies also provided deeper insights into factors that facilitate or hinder effective collaboration. The main findings were published as an interactive story map in spring 2025.

## **WP 3: Nordic workshop on sustainable coexistence: offshore wind and blue food**

Initially planned as a multi-session series, the workshop was revised into a single, extended event held at Nordregio's Stockholm office on 14–15 April, 2025. Drawing on Nordic experiences, the workshop a diverse group of stakeholders from across the Nordic Region and beyond to explore spatial conflicts and opportunities for collaboration between the green energy and blue food sectors, with a focus on long-term sustainable coexistence. Participants discussed collaboration – primarily between offshore wind developers and fisheries – throughout the offshore wind development lifecycle, contributing to the development of practical pathways for Nordic stakeholders. The workshop emphasised the sharing of experiences, challenges and governance-related solutions while fostering collaboration pathways and building networks. Insights generated during the workshop informed a policy brief in autumn 2025, which included recommendations for Nordic planners and decision-makers.

## **WP 4: Communication and dissemination**

This cross-cutting work package focused primarily on communicating and disseminating the project's outputs. Key activities included publishing story maps based on the case studies, a policy brief and this project background report, complemented by targeted dissemination activities. The project team delivered numerous presentations and participated in relevant events, including a Nordic conference on multi-use under the Swedish chairmanship of the Nordic Council of Ministers (NCM) in autumn 2024, the first-ever Nordic Marine Spatial Planning forum, under the Finnish NCM chairmanship, the 5th Baltic MSP Forum in Riga in autumn 2025, and the Marine Science Conference, held by the Marine Alliance for Science and Technology for Scotland (MAST) in autumn 2025. One or two webinars are scheduled for early 2026.

### **WP 5: Project management and administration**

The aim of this cross-cutting work package was to ensure effective overall project management and coordination. This also included administering the reference group, comprising approximately 10 experts who met digitally throughout the project, and liaising regularly with the project contacts at the Nordic Council of Ministers.



Image: Yadid Levy/norden.org

---

## Why is this topic relevant for the Nordic countries?

Coexistence in MSP is of particular interest to the Nordic countries, which possess unique environmental and geographical characteristics, including diverse landscapes, vast marine areas rich in biodiversity and natural resources, and extensive coastlines. Along these coastlines, communities have developed long-standing traditions in fisheries and coastal livelihoods, relying on the North and Baltic Seas for economic, social and cultural value. These seas have not only sustained livelihoods but also enabled trade, fostered strong regional interconnections and shaped the Nordic countries into historically active seafaring nations, home to diverse populations, cultures and languages – all connected by the oceans.<sup>[13]</sup>

As these traditions continue today, the Nordic countries hold leading positions in several marine industries, including fisheries, fish processing and aquaculture.<sup>[14]</sup> However, like elsewhere, these activities are increasingly required to share ocean space with expanding sectors such as marine traffic, tourism, oil and gas extraction, and renewable energy, creating the need to harmonise competing interests. Growing demand for ocean space also places pressure on marine environments, threatening ecosystem health and impacting both the cultural heritage embedded in these areas and the future of sustainable food production. In response, minimising environmental impacts and protecting marine wildlife have become priorities, with several Nordic countries participating in international frameworks to support conservation efforts.<sup>[15]</sup>

---

13. Karlberg, (n.d.)

14. Sepponen et al., (2021)

15. Nordic Energy Research (2022)

At the same time, shifting geopolitical landscapes have heightened the importance of self-sufficiency and resilience in the Nordic Region. Reducing reliance on single sources of energy or food is becoming increasingly critical. Marine areas present both opportunities and challenges in this regard. Climate change adds further complexity, making the future increasingly uncertain and underscoring the need for adaptive and robust policy frameworks.<sup>[16]</sup>

To support such frameworks, fostering coexistence and collaboration across Nordic nations is essential as countries pursue ambitious green and blue agendas. As noted earlier, this is further reinforced by the Nordic Council of Ministers, which emphasises the need to harmonise competing uses and seize opportunities to integrate economic, social and environmental interests, while promoting sustainable development, protecting marine ecosystems and contributing to regional resilience.<sup>[17]</sup>

---

16. Nordic Co-operation (2023)

17. Norwegian Office of the Prime Minister (2022)



Image: Getty Images / Unsplash.com

---

## The concept of sustainable coexistence

The scientific literature presents various interpretations and definitions of coexistence, along with related concepts such as "co-use", "co-location", "multi-functional", "multi-purpose" and "multi-use". These terms are often used interchangeably, which can lead to confusion. Much of the literature on coexistence in the context of MSP focuses on spatial co-location and multi-use of activities. This approach seeks to move beyond traditional MSP practices, typically characterised by dividing space for single uses – known as "zoning" – and instead promotes co-location and multi-use to address spatial conflicts. However, these concepts lack a universally accepted definition and their practical applications remain limited.<sup>[18]</sup>

For example, Schupp et al. (2019), frequently cited in the literature, define coexistence as a form of multi-use, similar to co-location, in which different activities share the same space and time without interacting or sharing services (such as commercial fisheries within offshore wind farm areas). Co-location refers to placing activities together to improve efficiency, while multi-use involves multiple stakeholders sharing space, resources or functions to enhance synergies.<sup>[19]</sup> According to European Parliament research, coexistence refers to activities existing simultaneously in the same place and/or at the same time, whereas co-location involves actively managing at least two activities sharing marine space. More importantly, *"cooperation reflects an interaction between two or more activities, each benefitting from that relationship, and leading to a growth for both"*.<sup>[20]</sup>

---

18. For example, Bonnevie et al., (2019); Gee & Mikkelsen (2023); Kirkfeldt & Andersen (2021)

19. Schupp et al. (2019)

20. Stelzenmüller et al., (2020, p.2)

A substantial body of literature highlights conflicts among stakeholders within MSP, primarily over space. These spatial conflicts are expected to increase as coastal and offshore areas are used more intensively.<sup>[21]</sup> However, conflicts are not inherently negative, as they can also drive transformative change.<sup>[22]</sup> The literature emphasises the importance of stakeholder collaboration in resolving such conflicts.<sup>[23]</sup> As noted by authors including Kirkfeldt & Andersen (2021), coexistence within MSP requires proactive planning and coordinated management to balance competing interests and conflicts, as well as to identify opportunities.

In the "Green Meets Blue" project, we found that, for the Nordic countries, coexistence is not necessarily about locating activities within the same marine space. Insights from Nordic countries' MSP documents and interviews with stakeholders reveal that sustainable coexistence is more about effective collaboration and inclusive stakeholder engagement in MSP and related governance processes, such as the permitting of offshore wind developments. In other words, it is less about shared marine space and more about coordinated governance.

In the context of offshore wind energy and fisheries, sustainable coexistence requires balancing the interests of diverse stakeholders, including wind developers, fishers, environmental protection actors (for example, authorities and NGOs) and other relevant parties, such as local communities. The goal should be to ensure the sustainable use of marine resources while minimising negative impacts on marine ecosystems and the services they provide.

---

21. For example, Virtanen et al., (2022)

22. For example, European Commission et al., (2019); Giacometti et al., (2018); Tafon et al., (2022)

23. For example, Soma et al., (2019); van den Burg et al., (2019)



Image: Sigurður Ólafsson / Norden.org

---

# Balancing trade-offs, conflicts and synergies

## Trade-offs

Oceans and their resources are used by multiple actors with diverse and often competing interests and objectives. As marine resources are finite, compromises or sacrifices are necessary. Oceans are classical examples of common-pool resources, which, if not properly governed, are susceptible to overexploitation as users seek to maximise their material well-being while neglecting the implications of their decisions on others, such as by failing to cooperate.<sup>[24]</sup> Accordingly, trade-offs are necessary and are often unavoidable to balance gains and losses in decisions aimed at improving economic, social and environmental outcomes. They differ from synergies, which occur when enhancing one desirable outcome also benefits another (“win-win”). Trade-offs are particularly relevant in the MSP context, as they require careful consideration to achieve sustainable and equitable outcomes. Balancing competing interests while minimising negative impacts on ecosystems and communities is inherently complex and almost always involves trade-offs – to some degree – across various spatial and temporal scales.

---

24. A common-pool resource (CPR) is a natural or human-made resource shared by several individuals. CPRs are characterised by difficulty of exclusion (i.e. excluding others from using the resource is not feasible) and rivalry of units of the resource (i.e. one person's consumption subtracts from the total available to others), leading to overuse, congestion or resource degradation (Ostrom, 1990).

## Conflicts and synergies

While spatial conflicts are prominent in MSP literature, it is important to recognise that conflicts also involve complex interactions between actors, shaped by underlying interests, agendas and values.<sup>[25]</sup> Synergies, often viewed as the absence of conflict, aim to generate benefits for various users and the environment, but are equally complex, depending on the mix of uses and their spatial, technological, economic, social, regulatory and political contexts. Focusing solely on spatial conflicts will therefore not lead to sustainable coexistence, as even primarily spatial issues often have deeper root causes. Understanding these dynamics ultimately requires understanding people – their interests, values and interactions.

The most prominent conflicts reported in the literature concern space, particularly between offshore wind and fisheries (particularly commercial fisheries) competing for the same marine areas. Synergies are less commonly reported in the literature but are primarily observed between offshore wind and aquaculture – such as through shared infrastructure – and, to some extent, with the marine ecosystem, for example through habitat creation. Interests in shared marine spaces can manifest as either conflicts or synergies, depending on their impacts and interactions. Conflicts may evolve into synergies through compromise, innovation or changing conditions. For instance, societal values, offshore infrastructure developments and environmental impacts have shifted over time, as has our understanding of combined effects such as artificial reef creation, impacts on fish stocks and pollution. Gee & Mikkelsen note that the key question is whether a conflict reflects a truly unsharable resource, implying a “win-lose” scenario or whether it can be transformed into a “win-win” situation, regarded as a synergy, or if management through certain trade-offs is necessary.<sup>[26]</sup>

Addressing these dynamics requires analysis of the various actors involved and the drivers behind their actions – or inaction. These complexities challenge governance frameworks, including MSP, to adapt both to external pressures, such as climate change, and to internal shifts, such as the emergence of new actors in permitting processes. For the Nordic countries, sustainable coexistence in MSP presents an opportunity to balance competing interests, while promoting sustainable development and protecting marine ecosystems by addressing conflicts and fostering synergies.

## Additional key trends

The scientific literature reveals a number of additional trends in interactions between offshore renewable energy (primarily wind) and the marine food sectors. These trends, summarised below, further complicate how trade-offs, conflicts and synergies are addressed in in MSP settings. An extensive review of the key academic literature is found in Annex I.

---

25. For example, Giacometti et al., (2018)

26. Gee & Mikkelsen (2023)

- **The ocean is a three-dimensional, variable and intertemporal space:** Interactions and overlaps between activities vary in terms of fixed versus mobile structures, seasonality, time and ecological impacts across the water column, seabed and surface. Conflicts can arise within any of these dimensions, and potential trade-offs and synergies extend beyond the visible ocean surface, creating both barriers and opportunities.<sup>[27]</sup>
- **Emerging and traditional sectors meet in MSP:** Emerging sectors, such as offshore wind and aquaculture, increasingly claim marine areas traditionally used by fisheries. For example, the fisheries sector often needs to adapt, potentially losing access to resources or market value, which can lead to conflict. These dynamics places pressure on governance systems to become more adaptive.<sup>[28]</sup>
- **MSP processes often prioritise economic and political objectives:** Particularly in Europe, MSP processes tend to emphasise economic and political objectives, driven in part by pressure to expand renewable energy.<sup>[29]</sup> This prioritisation tends to disadvantage less powerful stakeholders, such as small-scale fisheries.<sup>[30]</sup>
- **Growing awareness of knowledge gaps regarding cumulative pressures on marine environments and their ecosystem services:** From an ecological perspective, the combined impact of multiple activities within a defined space remains largely under-assessed.<sup>[31]</sup> Offshore wind farms, for instance, can have both positive and negative effects, and methodologies to evaluate these impacts are still under development.<sup>[32]</sup>
- **Insufficient and unequal stakeholder engagement in current MSP processes.** Especially in the European context, MSP has often been implemented through a top-down approach, rather than by encouraging democratic planning through active, bottom-up stakeholder engagement and dialogue.<sup>[33]</sup>

---

27. For example, Bonnevie et al., (2019); Jentoft & Knol (2014)

28. For example, Custodio et al., (2022)

29. For example, Flannery et al., (2016); Kyriazi (2018); Quero García et al., (2019); Spijkerboer et al., (2020)

30. For example, Aschenbrenner & Winder, (2019)

31. For example, Bonnevie et al., (2023)

32. For example, Durning & Broderick (2018)

33. For example, Guerreiro (2021); Soma et al., (2019)



Image: Ylona Maria Rybka / Unsplash.com

---

# Overview of green energy and blue food sectors in the Nordic Region

## Offshore wind energy in the Nordic Region

The EU has set targets for offshore wind energy as part of its broader strategy to achieve carbon neutrality by 2050. By the end of 2024, Europe had installed around 37 GW of offshore wind capacity, but it is estimated that 400–450 GW will be needed to reach net-zero carbon emissions by 2045.<sup>[34]</sup>

To meet the EU's energy and climate targets for 2030 and 2050, the Commission published an EU strategy on offshore renewable energy (COM(2020)741) proposing concrete ways to support the long-term sustainable development of this sector. The strategy sets the goals of 60 GW of offshore wind and 1 GW of ocean energy by 2030, and 300 GW and 40 GW, respectively, by 2050.<sup>[35]</sup> The Nordic countries, many of them committed to the Paris Agreement, have also set ambitious renewable energy targets, contributing to the broader European efforts towards a sustainable energy transition. Yet, the Nordic approach to offshore wind energy is diverse, reflecting the region's varying geography, resources and energy profiles. Denmark, with the longest history of offshore wind development in the region, has the most established industry, while Sweden, Finland

---

34. Wind Europe (2025)

35. European Commission (2020b)

and Norway are at various stages of expansion. Meanwhile, the North Atlantic countries – Greenland, Iceland and the Faroe Islands – remain focused on other energy sources.

This variation reflects each nation's unique circumstances. Denmark has established wind power as a crucial component for meeting its renewable energy targets and is accelerating towards an additional 9 GW by 2030.<sup>[36]</sup> Norway, despite modest beginnings with only a few turbines, has set an ambitious national target of 30 GW by 2040 and has designated areas such as Utsira Nord and Sørlige Nordsjø II for development.<sup>[37]</sup> Sweden is in a growth phase, working to identify offshore wind areas that could provide an additional 90 TWh annually as the country pursues 100% renewable energy by 2040 and prepares to double its electricity production to 300 TWh by 2045.<sup>[38]</sup> Finland's offshore wind sector is growing, supported by favourable natural conditions, with the Korsnäs offshore wind farm set to become the country's first large-scale project when operational in 2030.<sup>[39]</sup> Åland is also emerging in this field, developing the Sunnavind project with estimated potential of 4 GW and 20 TWh in annual energy production.<sup>[40]</sup>

However, not all Nordic countries are pursuing offshore wind development. Iceland, whose energy system is primarily based on onshore hydropower and geothermal resources, has not yet prioritised offshore wind energy.<sup>[41]</sup> Similarly, Greenland has transitioned from fossil fuels and now generates a significant portion of its energy from renewable resources like hydropower, but has not established offshore wind installations.<sup>[42]</sup> The Faroe Islands currently rely on onshore wind, hydropower and tidal energy, with uneven wind conditions making offshore wind development more challenging.<sup>[43]</sup>

## Environmental impacts of offshore wind

Offshore wind energy offers significant environmental opportunities but also introduces notable ecological challenges. As a renewable energy source, it plays a key role in reducing greenhouse gas emissions and advancing the Nordic climate and energy goals. Offshore sites benefit from stronger, more stable wind conditions, contributing to higher energy yields and energy security. When carefully planned and properly sited, offshore wind farms can generate positive ecological effects. Turbine foundations can act as artificial reefs, supporting marine biodiversity by providing habitats and spawning grounds for fish and invertebrates. In some areas, offshore wind farms may function similarly to marine protected areas, limiting bottom trawling and promoting the recovery of degraded benthic habitats.<sup>[44]</sup> These outcomes could support synergies between offshore wind and fisheries, particularly if co-location and planning frameworks are designed to enable shared benefits.

---

36. Danish Energy Agency (n.d-a, n.d.-b)

37. Ministry of Energy of Norway (n.d.)

38. Swedish Energy Agency (2025)

39. Metsähallitus (n.d.-a); Ministry of Economic Affairs and Employment of Finland (2024)

40. Government of Åland (2023)

41. National Energy Agency of Iceland. (2023a; 2023b)

42. Galimova et al. (2023); Berlina et al. (2016)

43. Government of the Faroe Islands (n.d.)

44. World Economic Forum (2025)

However, offshore wind farms also pose environmental risks. Construction noise can disturb marine mammals and fish, while turbine structures may pose risks to seabirds and disrupt migration routes. Bottom-fixed installations can alter seabed conditions, disturb sediments and contribute to habitat loss. These risks are especially concerning in ecologically sensitive and already stressed marine environments. Moreover, the cumulative impacts of large-scale offshore wind deployment across multiple sites and over time remain poorly understood, due to limited long-term monitoring and baseline data.<sup>[45]</sup> Uncertainty around ecological outcomes complicates planning and contributes to stakeholder tensions. Addressing these challenges requires coordinated governance, improved environmental data and inclusive planning processes that align ecological sustainability with the needs of the energy and fisheries sectors.

## Blue food in the Nordic Region

Over recent decades, the Nordic fishing industry has evolved from subsistence practices into a high-investment, export-oriented sector. This transformation has shifted the focus from merely avoiding overexploitation to optimising economic returns, with sustainability increasingly integrated into industry practices. Despite the dominance of large-scale operations, small-scale coastal fisheries remain essential for local employment and community development, landing close to 900,000 tonnes annually and generating an estimated EUR 1.2 billion in value.<sup>[46]</sup>

While most countries across the Nordic Region have long-standing fishing traditions and cultures, the nature and scale of their fisheries vary according to marine ecosystems and national priorities. Norway is a global seafood leader, exporting cod, herring and salmon, with fishing deeply embedded in its economy and identity.<sup>[47]</sup> In contrast, Sweden has a small fishing industry, focusing on trout, char and mussels, and is a net importer of seafood,<sup>[48]</sup> while Denmark has a robust fisheries sector and is expanding sustainable aquaculture.<sup>[49]</sup> Finland targets herring and sprat in the Baltic Sea, with increasing export value, and Iceland's fishing industry is a major part of its GDP, exports and culture.<sup>[50]</sup> Greenland's primary industry is fishing, especially shrimp and halibut. The Faroe Islands depend heavily on marine exports and Åland focuses on expanding sustainable aquaculture.<sup>[51]</sup>

To supplement the fishing industry, aquaculture and seaweed cultivation are expanding. Favourable conditions and advances in technology in the Baltic and North Seas, as well as in the Atlantic Ocean, have underscored the critical importance of these alternative methods for securing future food systems.<sup>[52]</sup>

---

45. World Economic Forum (2025); Nordic Energy Research (2022)

46. Viðarsson et al. (2018)

47. Norwegian Fisheries Directorate (n.d.-a; n.d.-b); Sepponen et al. (2021)

48. Sepponen et al. (2021)

49. Danish Agriculture and Fisheries Agency (n.d.); Sepponen et al. (2021)

50. Finnish Ministry for Agriculture and Forestry (n.d.); Metsähallitus. (n.d.-b)

51. Sepponen et al. (2021)

52. Sepponen et al. (2021)

## Environmental impact of fishing

Sustainable blue food systems rely on healthy marine ecosystems. To meet globally agreed biodiversity targets, such as the commitment under the Convention on Biological Diversity of protecting 30% of the oceans, it is essential to minimise current pressures on marine environments, including those in the Nordic seas. These seas are vital not only for biodiversity but also for fisheries and coastal communities. Reducing threats to Nordic blue food systems is therefore crucial for both sustainability and regional resilience. The production of blue food in the Nordic Region depends on marine ecosystems that support essential functions like climate regulation, nutrient cycling and habitat provision.<sup>[53]</sup> However, current fishing practices, particularly bottom trawling techniques, pose significant threats to these ecosystems. Bottom trawling damages seabed habitats, disrupts nursery grounds and undermines ecosystem services critical to fish stocks and biodiversity.<sup>[54]</sup> Overfishing and destructive techniques such as pelagic and bottom trawling are major contributors to the decline of key food fish species, including in the Nordic Region. These pressures, combined with eutrophication in the Baltic Sea, acidification in the North Sea and the overarching impacts of climate change, present a compounded threat to marine biodiversity and food security.<sup>[55]</sup>

## Environmental protection in the Nordic seas

Protecting marine environments in the Nordic Region is essential for maintaining biodiversity, preserving habitats and safeguarding the resilience of marine ecosystems in the face of environmental change. Marine biodiversity protection in the Nordic Region is driven by multilateral agreements, regional initiatives and national policies. In addition, Nordic countries have committed to a range of international agreements and conventions aimed at conserving marine biodiversity.<sup>[56]</sup> Fulfilling these commitments requires the implementation of measures such as the designation of marine protected areas (MPAs) to conserve critical habitats and species.

---

53. OSPAR Commission (2023)

54. ICES (2025)

55. Ottersen et al., (2025)

56. For example, CBD (global), MSFD (EU), HELCOM and OSPAR (regional)



Image: Paul Einerhand / Unsplash.com

---

# MSP and stakeholder engagement in the Nordic Region

Understanding MSP across the Nordic countries is essential for understanding how offshore wind development and other marine uses are coordinated and how stakeholder engagement is managed through different governance frameworks. The Nordic countries exhibit diverse approaches in terms of legal status, oversight, scope and participatory processes, reflecting their varying institutional traditions, political priorities and maritime contexts.

**Denmark** has a single, legally binding maritime spatial plan covering its entire marine territory, adopted under the Maritime Spatial Planning Act, which transposes the EU MSP Directive into Danish law. The plan, accessible via a digital Geographic Information System (GIS) platform, was ratified in 2021, with amendments in 2023 to increase the offshore energy and biodiversity targets. The Danish Maritime Authority, under the Ministry of Industry, Business and Financial Affairs, oversees development, implementation and revision. The plan covers internal waters, territorial sea areas and the Exclusive Economic Zone (EEZ), totalling some 105,000 km<sup>2</sup>. Stakeholders included coastal municipalities, national ministries, universities and business and interest organisations, with a public consultation conducted from November 2023 to February 2024.<sup>[57]</sup>

---

57. Danish Maritime Authority (n.d.)

**Sweden** has three marine spatial plans covering the Gulf of Bothnia, the Baltic Sea and the Skagerrak/Kattegat, aligned with the EU MSP Directive. Plans were adopted in 2022 and amended in 2024 to accommodate additional offshore energy development totalling 90 terawatts. The Swedish Agency for Marine and Water Management oversees the plans, which are formally adopted by the government. Coastal County Administrative Boards provide regional data and support stakeholder engagement, while municipalities manage territorial sea planning. Stakeholders – including industry, NGOs, research institutions and local authorities – contributed through reference groups, thematic working groups and public consultations.<sup>[58]</sup>

**Finland** has three regional, non-binding marine spatial plans for the Bothnian Sea, the Quark and Bothnian Bay, governed by the Land Use and Building Act and aligned with the EU MSP Directive. Adopted in 2020, the plans are overseen by the Ministry of the Environment, with eight coastal Regional Councils responsible for drafting and approving them. A national coordination group ensures coherence and stakeholder participation. The plans cover Finland's territorial waters and EEZ. During the first planning cycle (2017–2021), around 350–380 stakeholders participated through scenario and vision workshops. The second cycle (2024–2028) is guided by the Maritime Spatial Planning Interaction Plan 2024–2027, aiming to ensure comprehensive, fair and timely participation.<sup>[59]</sup>

**Norway** employs Integrated Ocean Management Plans for the Barents Sea–Lofoten area, the Norwegian Sea and the North Sea–Skagerrak, which are endorsed by Parliament to guide sectoral authorities. The initial plans were developed in 2006–2013, with a comprehensive update in 2020 and revision in 2024. The Ministry of Climate and Environment oversee the plans, supported by an inter-ministerial steering group. Covering 1.79 million km<sup>2</sup>, the plans address petroleum, fisheries, maritime transport, environmental protection, renewable energy and defence. Stakeholders – including industry associations, labour organisations, environmental NGOs, local communities and academics – engage through hearings, meetings and written submissions.<sup>[60]</sup>

---

58. Swedish Agency for Marine and Water Management (2023b)

59. Ministry of the Environment of Finland (n.d.)

60. Ministry of Climate and Environment of Norway (2020)

**Åland** has a single non-legally binding maritime spatial plan for public waters, aligned with the EU Directive. Adopted in 2021, it was developed in collaboration with municipalities, regional authorities and relevant external authorities. Two public consultations and a politically appointed reference group informed its revision.<sup>[61]</sup>

**Iceland** established the Act on Coastal and Marine Planning in 2018, initiating coastal zone planning in the Westfjords, Eastfjords and Skjalfandi Bay. Plans focus on aquaculture, shipping, marine traffic, fisheries and nature protection.<sup>[62]</sup>

The **Faroe Islands** and **Greenland** currently have no marine or maritime spatial planning frameworks.

---

61. overnment of Åland (n.d.)

62. Government of Iceland (n.d.)



Image: Nicolas Dohe / Unsplash.com

---

# Offshore wind development processes and permitting in the Nordic Region

Offshore wind development in the Nordic Region is governed by a diverse set of national and regional regulations. While some countries have well-established permitting and tendering procedures, others are still in the early stages of developing regulatory frameworks to facilitate offshore wind projects. The following provides an overview of the permitting processes, licensing requirements and project allocation mechanisms across the Nordic countries, highlighting both similarities and divergences in governance approaches.

In **Denmark**, the Danish Energy Agency (DEA) serves as the primary authority for offshore wind projects, employing a “one-stop-shop” approach to streamline permitting across various agencies. Offshore wind projects can follow two routes: a tendering procedure overseen by the DEA or an open-door procedure initiated by developers. The Promotion of Renewable Energy Act provides the legal framework, affirming that the Danish state holds the rights to harness wind and water energy within its territorial waters and the EEZ. Developers must secure three sequential licences: a licence to conduct preliminary investigations, a licence to establish the offshore wind turbines, granted only if preliminary investigations show compatibility with other maritime interests, and a licence to exploit wind power for a specified duration. The DEA first conducts a preliminary Strategic Environmental Assessment (SEA) to evaluate potential impacts during initial site selection, followed by a more detailed Environmental Impact Assessment (EIA) carried out by the developer during

construction planning. Most new offshore wind farms in Denmark are developed through a tendering process guided by political energy agreements, with the DEA announcing site-specific tenders for designated sizes.<sup>[63]</sup>

In **Sweden**, offshore wind development is managed by the Swedish Energy Agency and governed primarily by the Environmental Code. Projects in the EEZ follow an “open-door” procedure and require permits under the Swedish Economic Zone Act and the Continental Shelf Act. Applications, including a consultation report and EIA, are referred by the government or county administration to the relevant authorities, municipalities and interest organisations for feedback. The applicant addresses these referrals and the government evaluates the application to approve or deny the activity, incorporating conditions to ensure alignment with public interests such as shipping, fishing, environmental protection and defence. A special investigator has recommended introducing a tendering procedure in the EEZ. Projects in Sweden's territorial sea areas follow a process similar to onshore wind, with an environmental permit under Chapter 9 (Environmental Code), managed by the County Administrative Board, and a permit for water activities under Chapter 11 (Environmental Code), reviewed by the Land and Environmental Court. The permit process includes an EIA, consultations with relevant authorities and organisations, early consultation with the Swedish Armed Forces and an airport obstacle analysis. Municipal approval is required if the wind farm is located within a municipality.<sup>[64]</sup>

In **Finland**, the 2025 Offshore Wind Act facilitates offshore wind development in the EEZ and ensures alignment with other marine activities. The government identifies suitable areas and manages a competitive tendering process through the Energy Authority. Successful bidders gain exclusive rights to apply for exploitation permits, conduct seabed surveys and seek necessary construction permits. In territorial waters, the seabed is state-owned and managed by Metsähallitus, which allocates offshore wind areas using its own tendering model and acts as both project developer and lessor. Construction is guided by spatial plans under the Land Use and Building Act and developers must conduct an EIA. The Finnish Energy Authority issues offshore wind farm permits, and other agencies – such as the Finnish Transport Infrastructure Agency and regional environmental authorities – may also require permits.<sup>[65]</sup>

---

63. Danish Energy Agency (n.d.-c)

64. Government Offices of Sweden (n.d.)

65. Metsähallitus (n.d.-a)

In **Norway**, the Ministry of Energy is responsible for issuing licences for offshore wind projects, assisted by the Norwegian Water Resources and Energy Directorate (NVE), which provides technical expertise and approves detailed development plans. Projects within Norway's baseline are regulated by the Energy Act, while projects beyond the baseline fall under the Offshore Energy Act. The Offshore Energy Act requires the government to officially open areas for licence applications following an SEA. It outlines licensing procedures, including EIAs, and governs the development, operation and decommissioning of offshore energy installations. Norway uses an auction-based model for project allocation.<sup>[66]</sup>

In **Åland**, the government is developing an auction system for leasing seabed areas and granting concessions for offshore wind projects in northern maritime zones. This process forms part of the Sunnavind project, initiated in 2021 to promote offshore wind in the region. Preparatory activities include developing land use plans, conducting environmental assessments and creating revenue models to facilitate auctioning of utilisation rights.<sup>[67]</sup>

At present, **Iceland**, the **Faroe Islands** and **Greenland** have no officially planned offshore wind projects or designated development areas.

---

66. Norwegian Offshore Directorate (2025)

67. Government of Åland (2023)



Image: Visit Finland

---

## Key project outputs

### A case studies story map

The story map ["Green energy meets blue food – Moving towards sustainable coexistence? Six cases exploring trade-offs in the use of marine space"](#) presents six case studies examining the coexistence of the green energy sector and blue food production, with a particular focus on offshore wind development and fishing.<sup>[68]</sup> The cases explore the role of governance frameworks, such as marine and maritime spatial planning, in managing competing interests and promoting long-term sustainable coexistence.

The studies emphasise the importance of actors and their interactions, highlighting challenges, drivers and opportunities for collaboration. In-depth interviews with key stakeholders across all countries, conducted in 2024, provide insights into how conflicts and synergies are addressed across different geographical and governance contexts. The cases cover Finland, Sweden, Denmark, Norway, Iceland and Scotland, where offshore energy developments and marine food production – particularly fisheries – often claim shared marine areas and/or sea basins.

The case findings indicate that coexistence between offshore wind and fishing – particularly commercial fishing – may be achievable but requires fundamental shifts in planning approaches. Success depends on early collaboration, transparent governance, high-quality data and a genuine commitment to balancing green energy ambitions with blue economy needs. Countries like Norway demonstrate that structured dialogue and clear principles can facilitate coexistence between these sectors, while cases like Sweden highlight the challenges that arise when such frameworks are absent.

---

68. Nordregio (2025a)

### Key findings include:

- **Challenges in governance:** Conflicting priorities between offshore wind and fisheries, fragmented governance structures and limited coordination, particularly between MSP and permitting processes, are recurring issues. In most cases, governments lack transparent long-term strategies, creating uncertainty for both sectors.
- **Opportunities for collaboration:** Early engagement, transparent dialogue and co-designed consultation processes are effective ways to balance competing interests. A common challenge is that fisheries are often consulted only after wind farm locations have been determined, limiting the influence of their input.
- **Role of spatial planning:** MSP is critical for mediating conflicts, identifying suitable areas for development and integrating environmental, economic and social objectives. However, weak guidance in spatial plans, together with parallel permitting processes in several countries, creates governance gaps and uncertainty for both offshore development and fisheries actors.
- **Lessons and transferable insights:** Experiences across different countries reveal practical strategies for improving governance, fostering collaboration and enabling adaptive management of evolving marine uses. Examples include Finland's participatory planning approach, Norway's coexistence manual and Scotland's best practice guidance for fisheries assessment and offshore wind development.

The story map provides actionable insights for policymakers, practitioners and researchers, supporting the refinement of policies and governance frameworks that reconcile multiple interests in marine spaces. These findings contribute to the "Green Energy Meets Blue Food" project's objective of promoting sustainable coexistence, building a resilient marine economy and fostering inclusive decision-making across the Nordic Region and beyond.

## A Nordic knowledge exchange workshop

The two-day workshop, "Nordic workshop on sustainable coexistence: Offshore wind & blue food", hosted by Nordregio in May 2025, as part of the "Green Meets Blue" project, explored how countries in the Nordic Region can advance towards sustainable coexistence in the Nordic seas, with a focus on enhanced collaboration between offshore wind energy and marine food production sectors, in particular fisheries.

The workshop brought together key stakeholders from across the Nordic Region to discuss challenges and opportunities in stakeholder engagement and collaboration throughout the offshore wind development process, from area designation in marine spatial plans to construction, operation, decommissioning and long-term management. Discussions focused on engagement and dialogue between green and blue sectors through this complex, often fragmented process, examining opportunities for sustainable coexistence at different stages. It was clear that collaboration needs vary by phase, but what actors need are continuity, sustained relationships and clear expectations throughout the entire lifecycle of offshore wind development.

### Key findings include:

- **Challenges in collaboration:** Stakeholders highlighted difficulties in maintaining continuous, structured dialogue across sectors, particularly during early planning and permitting. Limited resources, fragmented governance and unclear leadership further impede collaboration. Additional challenges include insufficient knowledge of cumulative environmental impacts, climate uncertainties and transboundary considerations. Treating each step in isolation reduces transparency and complicates holistic planning.
- **Pathways for improved engagement:** Stronger collaboration can be achieved through early, iterative engagement with all relevant stakeholders. Co-designed consultation processes, structured dialogue platforms and neutral mediator-led forums foster trust and reduce conflicts. Clear communication of planning goals, trade-offs and expected outcomes, along with integration of environmental, economic, social and cultural considerations from the outset, is essential.
- **Knowledge exchange and learning:** Nordic countries use different approaches to balance offshore wind and fisheries, offering opportunities for mutual learning. Norway emphasises structured dialogue guidelines, while Sweden uses cumulative impact tools like Symphony and Denmark employs centralised permitting. Exchanging experiences allows countries to adapt governance models, consultation practices and technical solutions to their own contexts.
- **Governance and policy options:** Adaptive governance and flexible regulatory frameworks are needed to manage uncertainties and cumulative impacts. Formalised collaboration mechanisms, such as structured committees, neutral

mediation platforms and “one-stop-shop” permitting authorities, can ensure accountability and continuity. Government leadership is key to decoupling developer-led processes from decision-making and systematically incorporating stakeholder expertise.

- **Contribution to a Nordic roadmap:** The workshop generated input for a Nordic Roadmap for Collaboration, emphasising binding, iterative engagement processes from strategic planning through decommissioning. Co-design principles, adaptive, data-driven governance, cross-country learning and harmonised regulatory frameworks were highlighted.

Overall, the workshop facilitated a shared understanding of engagement challenges, identified practical pathways for collaboration and contributed to strengthening cross-Nordic networks to support coordinated and sustainable decision-making in the marine sector.

## A policy brief

The “[How can offshore wind energy and fisheries sustainably coexist in the Nordic Seas?](#)” policy brief examines how offshore wind energy expansion in the Nordic Region can coexist with more traditional fisheries. Offshore wind introduces large, static infrastructure into marine areas historically used for mobile fishing practices, creating tensions over space, regulation and sectoral priorities. These tensions arise not only from spatial competition, but also from contrasting values, different operational practices and fundamentally different relationships with the marine environment. All this plays out within fragmented and inconsistent political, planning and permitting systems. The implication is that long-lasting coexistence requires structures for continuous and meaningful collaboration, not just technical spatial solutions.

The policy brief builds on previous findings from the project, including case studies and workshop outcomes.

### Three interconnected key governance challenges include:

- **Political volatility:** Shifting national priorities, subsidies and regulations undermine trust and cross-sector collaboration.
- **Limitations of marine and maritime spatial planning frameworks:** Unclear mandates on deliverables, inconsistent stakeholder engagement and limited cumulative impact assessments complicate coordination.
- **Fragmented permitting:** Project-specific approvals, overlapping legal frameworks and late stakeholder involvement reduce transparency, increase uncertainty and heighten conflict.

**The policy brief identifies four building blocks for enabling coexistence:**

- **Structured dialogue:** Sustained and institutionalised platforms or forums with skilled facilitation and guidelines foster trust and joint problem-solving.
- **Participatory planning culture:** Iterative, inclusive and responsive planning processes – with dedicated coordinators, feedback loops and accessible information throughout – strengthen legitimacy and responsiveness.
- **Knowledge foundations:** Early, broad and inclusive impact assessments that integrate ecological, economic and social data across multiple scales – including enhanced cumulative and ecosystem-based assessments – support balanced and informed decision-making.
- **Institutional pathways:** Centralised permitting and strategically phased governance – in which public authorities lead early planning, knowledge collection and stakeholder engagement – reduce delays and clarify responsibilities.

**Recommendation**

The policy brief recommends establishing a Nordic-level dialogue platform to navigate sectoral tensions, align governance better, share lessons and develop tools to support sustainable coexistence between offshore wind and fisheries, balancing energy, ecological, economic and social objectives. Such a platform would focus on the four themes above. The brief includes guiding questions that can be used to initiate a Nordic dialogue.



Image: Getty Images / Unsplash.com

---

## Concluding remarks

The “Green Energy Meets Blue Food – Sustainable Coexistence in Nordic Seas” project has shown that the expansion of offshore wind energy and the sustainable development of Nordic blue food systems are not inherently conflicting goals. However, achieving long-term coexistence requires deliberate, coordinated and adaptive governance. Across the Nordic Region, experiences demonstrate that technical solutions alone are insufficient. Success depends on structured and continuous dialogue, early and inclusive stakeholder engagement, robust knowledge foundations, and institutional mechanisms that bridge fragmented marine and maritime spatial planning and permitting processes.

Our research – encompassing literature reviews, six case studies conducted across the Nordic Sea basins in Finland, Sweden, Denmark, Norway, Iceland and Scotland, a cross-sectoral workshop, the development of a policy brief, and input gained from engagement in Nordic and international events – underscores that sustainable coexistence is fundamentally a governance challenge. Key insights reveal that early and continuous collaboration, transparent decision-making and mechanisms for balancing trade-offs and synergies are central to reconciling sectoral priorities while protecting marine ecosystems and supporting coastal communities.

The project’s outputs provide actionable guidance for policymakers, planners and industry actors. They emphasise that long-term coexistence requires not only national-level alignment but also cross-Nordic learning and coordination. By fostering shared understanding, trust and adaptive management, the Nordic Region can advance towards a resilient marine economy in which green energy ambitions and blue food security reinforce rather than undermine each other.

Ultimately, this report serves as both a record of the project’s journey and as a foundation for ongoing efforts, offering a practical knowledge base to inform sustainable policy, planning and collaborative practices across the Nordic seas for the benefit of current and future generations.

# References

- Aschenbrenner, M., & Winder, G. M. (2019). Planning for a sustainable marine future? Marine spatial planning in the German exclusive economic zone of the North Sea. *Applied Geography*, 110, 102050. Available at: <https://doi.org/10.1016/j.apgeog.2019.102050>
- Berlina, A., Giacometti, A., Hagberg, A., Jungsberg, L., Mikkola, N., Randall, L., Rasmussen, R. O., & Teräs, J. (2016). *Green growth in the Nordic Regions - 50 Ways to Make it happen* (No. 978-91-87295-40-9). Nordregio. Available at: <https://archive.nordregio.se/Global/Green%20growth%20in%20Nordic%20regions%2050/NordicGreenGrowth-pages.pdf>
- Bonnevie, I. M., Hansen, H. S., & Schrøder, L. (2019). Assessing use-use interactions at sea: A theoretical framework for spatial decision support tools facilitating co-location in maritime spatial planning. *Marine Policy*, 106, 103533. Available at: <https://doi.org/10.1016/j.marpol.2019.103533>
- Bonnevie, I. M., Hansen, H. S., Schrøder, L., Rønneberg, M., Kettunen, P., Koski, C., & Oksanen, J. (2023). Engaging stakeholders in marine spatial planning for collaborative scoring of conflicts and synergies within a spatial tool environment. *Ocean & Coastal Management*, 233, 106449. Available at: <https://doi.org/10.1016/j.ocecoaman.2022.106449>
- Custodio, M., Moulaert, I., Asselman, J., van der Biest, K., van de Pol, L., Drouillon, M., Hernandez Lucas, S., Taelman, S. E., & Everaert, G. (2022). Prioritizing ecosystem services for marine management through stakeholder engagement. *Ocean & Coastal Management*, 225, 106228. Available at: <https://doi.org/10.1016/j.ocecoaman.2022.106228>
- Danish Agriculture and Fisheries Agency (n.d.). *Commercial fisheries*. Landbrugs- Og Fiskeristyrelsen. Available at: <https://lfst.dk/english/commercial-fisheries> [Accessed 20 October 2025]
- Danish Energy Agency (n.d.-a). *Facts about Offshore Wind Power*. Available at: <https://ens.dk/en/energy-sources/offshore-wind-power/facts-about-offshore-wind-power> [Accessed 7 October 2025]
- Danish Energy Agency (n.d.-b). *Offshore wind farms tendered towards 2030*. Available at: <https://ens.dk/en/energy-sources/offshore-wind-farms-tendered-towards-2030> [Accessed 7 October 2025]
- Danish Energy Agency (n.d.-c). *Procedures and Permits for Offshore Wind Parks*. Available at: <https://ens.dk/en/energy-sources/offshore-procedures-permits>. [Accessed 24 October 2025].
- Danish Maritime Authority (n.d.). *Maritime Spatial Plan: Explanatory Notes*. Available at: <https://havplan.dk/en/page/info>. [Accessed 24 October 2025]

Durning, B., & Broderick, M. (2018). Development of cumulative impact assessment guidelines for offshore wind farms and evaluation of use in project making. *Impact Assessment and Project Appraisal*, 37(2), 124–138. Available at: <https://doi.org/10.1080/14615517.2018.1498186>

European Commission, ECORYS, European MSP Platform, Executive Agency for Small and Medium-sized Enterprises, S.Pro, Thetis, University of Liverpool, Ooms, E., Onwona Ansong, J., Lukic, I., Schultz-Zehden, A., Gee, K., & Passerello, C. (2019). *Addressing conflicting spatial demands in MSP – Considerations for MSP planners – Final technical study*. Publications Office of the European Union Available at: <https://data.europa.eu/doi/10.2826/151447>

European Commission (2019). *The European Green Deal*. COM(2019) 640 final. Available at: [https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal\\_en](https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en) [Accessed 27 January 2025]

European Commission (2020a). Communication from the Commission to the European parliament, the Council, the European economic and social committee and the committee of the regions. *EU Biodiversity Strategy for 2030 - Bringing nature back into our lives*. COM(2020) 380 final. Brussels, 20.5.2020. Available at: [EUR-Lex - 52020DC0380 - EN - EUR-Lex](#)

European Commission (2020b). Communication from the Commission to the European parliament, the Council, the European economic and social committee and the committee of the regions. *An EU Strategy to harness the potential of offshore renewable energy for a climate neutral future*. COM(2020) 741 final. Brussels, 19.11.2020. Available at: [eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0741](http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0741)

European Commission (2023). *Renewable Energy Directive* (EU/2023/2413). Available at: [https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive\\_en](https://energy.ec.europa.eu/topics/renewable-energy/renewable-energy-directive-targets-and-rules/renewable-energy-directive_en) [Accessed 28 January 2025]

Flannery, W., Ellis, G., Ellis, G., Flannery, W., Nursey-Bray, M., van Tatenhove, J. P. M., Kelly, C., Coffen-Smout, S., Fairgrieve, R., Knol, M., Jentoft, S., Bacon, D., & O'Hagan, A. M. (2016). Exploring the winners and losers of marine environmental governance. *Planning Theory & Practice*, 17(1), 121–151. Available at: <https://doi.org/10.1080/14649357.2015.1131482>

Ministry of Economic Affairs and Employment of Finland (2024, December 19). *Act on Offshore Wind Power in the Exclusive Economic Zone enters into force – First tenders could be organised at the end of 2025*. Finnish Government. Available at: <https://valtioneuvosto.fi/en/-/1410877/act-on-offshore-wind-power-in-the-exclusive-economic-zone-enters-into-force-first-tenders-could-be-organised-at-the-end-of-2025> [Accessed 7 October 2025]

Galimova, T., Satymov, R., Keiner, D., & Breyer, C. (2023). Sustainable energy transition of Greenland and its prospects as a potential Arctic e-fuel and e-chemical export hub for Europe and East Asia. *Energy*, 286, 129605. <https://doi.org/10.1016/j.energy.2023.129605>

Gee, K., & Mikkelsen, E. (2023). *Understanding different types of conflicts and coexistence in marine spatial planning (MSP)*. ICES Cooperative Research Reports, No. 357, 55 pp. Available at: <https://doi.org/https://doi.org/10.17895/ices.pub.24598734>

Giacometti, A., Kull, M., Moodie, J., Morf, A., Kaae, B., Schiele, K., von Thenen, M., Reiter, I., Schröder, L., Hansen, H., Dahl, K., Luhtala, H., Erkkilä-Välimäki, A., Armoskaite, A., & Strake, S. (2018). *Thematic Scoping/Vision Document: report outlining the main conflict and potential synergy areas in cross-border MSP*. Deliverable 2.2. Bonus BASMATI. Available at: [www.bonusbasmati.eu](http://www.bonusbasmati.eu)

Government Offices of Sweden (n.d). *Offshore Wind Power*. Available at: <https://www.regeringen.se/regeringens-politik/miljo-och-klimat/havsbaseerad-vindkraft/> [Accessed: 22 October 2025]

Government of Iceland (n.d). *Um skipulag haf- og strandsvæða*. Available at: <https://island.is/v/hafskipulag/um-skipulag-haf-og-strandsvaeda> [Accessed: 20 October 2025]

Government of the Faroe Islands (n.d.). *Energy*. Faroe Islands. Available at: <https://www.faroeislands.fo/economy-business/energy/> [Accessed 20 October 2025]

Government of Åland (2023, April 7). *Projekt sunnanvind*. Ålands Landskapsregering. Available at: <https://www.regeringen.ax/infrastruktur-kommunikationer/projekt-sunnanvind> [Accessed 20 October 2025]

Government of Åland (n.d.). *Åland's maritime spatial plan*. Available at: <https://www.sunnanvind.ax/en/about-project/aland-maritime-spatial-plan> [Accessed 4 November 2025].

Guerreiro, J. (2021). The Blue Growth Challenge to Maritime Governance. *Frontiers in Marine Science*, 8. Available at: <https://doi.org/10.3389/fmars.2021.681546>

ICES (2025). Application of a quantitative framework to estimate trawling impacts on seafloor status under MSFD Descriptor 6. *ICES Journal of Marine Science*, 82(3), pp. 865–879. Available at: <https://academic.oup.com/icesjms/article/82/3/865/8220017>

Jentoft, S., & Knol, M. (2014). Marine spatial planning: risk or opportunity for fisheries in the North Sea? *Maritime Studies*, 12(1), 13. Available at: <https://doi.org/10.1186/2212-9790-12-13>

Karlberg, M. (n.d.). *Nature, climate and the environment in the Nordic Region*. The Nordic Council and the Nordic Council of Ministers. Available at: <https://www.norden.org/en/information/nature-climate-and-environment-nordic-region> [Accessed: 22 October 2025]

Kirkfeldt, T. S., & Andersen, J. H. (2021). Assessment of collective pressure in marine spatial planning: The current approach of EU Member States. *Ocean & Coastal Management*, 203, 105448. Available at: <https://doi.org/10.1016/j.ocecoaman.2020.105448>

Koehler, B., & Bergström, L. (2023). *Havsbaserad vindkraft i samexistens med fiske, vattenbruk och naturvård? En inledande kunskapssammanställning*. Aqua reports, 4. Available at: <https://doi.org/10.54612/a.4or8sfk59u>

Kyriazi, Z. (2018). From identification of compatibilities and conflicts to reaching marine spatial allocation agreements. Review of actions required and relevant tools and processes. *Ocean & Coastal Management*, 166, 103–112. Available at: <https://doi.org/10.1016/j.ocecoaman.2018.03.018>

Metsähallitus (n.d.-a). *Our Offshore Projects*. Available at: <https://www.metsa.fi/en/responsible-business/wind-power/great-potential-in-offshore-wind-power/next-offshore-projects/> [Accessed: 22 October 2025]

Metsähallitus (n.d.-b). *Commercial fishing*. Eräluvut. Available at: <https://www.eraluvat.fi/en/entrepreneurs/commercial-fishing> [Accessed by 20 October 2025]

Ministry of Climate and Environment of Norway (2020). *Meld. St. 20 (2019–2020): Norway's Integrated Ocean Management Plans – Barents Sea–Lofoten Area; the Norwegian Sea; and the North Sea and Skagerrak*. Report to the Storting. Available at: <https://www.regjeringen.no/en/documents/meld.-st.-20-20192020/id2699370/?ch=2> [Accessed: 22 October 2025]

Ministry of Energy of Norway (n.d.). *Offshore wind*. Government.no. Available at: <https://www.regjeringen.no/en/topics/energy/renewable-energy/havvind/id2830329/> [Accessed 7 October 2025]

Ministry of the Environment of Finland (n.d.). *Maritime spatial planning*. Available at: <https://ym.fi/en/maritimespatialplanning> [Accessed 4 November 2025].

Nordic Co-operation (2023, June 21). *Sustainable food systems key to green transition in Nordics*. The Nordic Council and the Nordic Council of Ministers. Available at: <https://www.norden.org/en/news/sustainable-food-systems-key-green-transition-nordics>

Nordic Co-operation (2025). *The Nordic Council of Ministers' political priorities 2025–2030*. Available at: <https://www.norden.org/en/nordic-council-ministers-political-priorities-2025-2030>

Nordic Council of Ministers' Office in Latvia (2024). *Secretary General Karen Ellemann attends the HELCOM event in Riga*. Available at: <https://norden.lv/en/whats-new/news/secretary-general-karen-ellemann-attends-the-helcom-event-in-riga/>

Nordic Energy Research (2022). *Accommodating Biodiversity in Nordic Offshore Wind Projects*. Available at: <https://doi.org/10.6027/NER2022-01>

Nordregio (2025a). *Green energy meets blue food - Moving towards sustainable coexistence? Six cases exploring trade-offs in the use of marine space*. Available at: <https://nordregio.org/publications/green-energy-meets-blue-food-moving-towards-sustainable-coexistence/>

Nordregio (2025b). Towards Sustainable Coexistence – Offshore Wind and Fisheries in the Nordic Seas. Policy Brief. Available at: <https://nordregio.org/publications/how-can-offshore-wind-energy-and-fisheries-sustainably-coexist-in-nordic-seas/>

Norwegian Fisheries Directorate (n.d.-a). *Norwegian Aquaculture: Leading the way in sustainable fish farming*. English. Available at: <https://www.fiskeridir.no/english/aquaculture/norwegian-aquaculture-leading-the-way-in-sustainable-fish-farming> [Accessed 20 October 2025]

Norwegian Fisheries Directorate (n.d.-b). *Ecosystem-based fisheries management in Norway*. English. Available at: <https://www.fiskeridir.no/english/Fisheries/ecosystem-based-fisheries-management-in-norway> [Accessed 20 October 2025]

National Energy Agency of Iceland (2023a). *Geothermal Energy*. Icelandic National Energy Agency. Available at: [https://orkustofnun.is/en/natural\\_resources/geothermal\\_energy](https://orkustofnun.is/en/natural_resources/geothermal_energy) [Accessed 7 October 2025]

National Energy Agency of Iceland (2023b). *Vatn*. Icelandic National Energy Agency. Available at: [https://orkustofnun.is/en/natural\\_resources/water](https://orkustofnun.is/en/natural_resources/water) [Accessed 7 October 2025]

Norwegian Office of the Prime Minister (2022, August 15). *Joint Statement by the Nordic Prime Ministers on a Sustainable Ocean Economy and the Green Transition*. Available at: <https://www.regjeringen.no/contentassets/a8b4842ec38f40b28c0ca1196178c310/joint-statement-on-a-sustainable-ocean-economy-and-the-green-transition.pdf>

Norwegian Offshore Directorate (n.d.). Regulations for Offshore Wind. Available at: <https://www.sodir.no/en/facts/offshore-wind/regulations/> [Accessed 24 October 2025].

OSPAR Commission. (2023). *Quality status report 2023*. London: OSPAR Commission. Available at: <https://oap.ospar.org/en/ospar-assessments/quality-status-reports/qsr-2023/> [Accessed by 20 August 2025]

Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge University Press. Available at: <https://doi.org/https://doi.org/10.1017/CBO9780511807763>

Ottersen, G., Blenckner, T., Hátún, H., Maar, M., Niiranen, S., Schourup-Kristensen, V., & Yletyinen, J. (2025). *Nordic marine ecosystems in a changing climate*. TemaNord, 2025:541. Copenhagen: Nordisk Ministerråd. Available at: <https://pub.norden.org/temanord2025-541/temanord2025-541.pdf>

Quero García, P., García Sanabria, J., & Chica Ruiz, J. A. (2019). The role of maritime spatial planning on the advance of blue energy in the European Union. *Marine Policy*, 99, 123–131. Available at: <https://doi.org/10.1016/j.marpol.2018.10.015>

Schupp, M. F., Bocci, M., Depellegrin, D., Kafas, A., Kyriazi, Z., Lukic, I., Schultz-Zehden, A., Krause, G., Onyango, V., & Buck, B. H. (2019). Toward a common understanding of ocean multi-use. *Frontiers in Marine Science*, 6(APR). Available at: <https://doi.org/10.3389/fmars.2019.00165>

- Sepponen, S., Hjelt, M., Kuusela-Opas, E., Suominen, F., Värre, U., & Gaia Consulting Ltd. (2021). *Sustainable Ocean Economy: Mapping of Nordic Strongholds*. Available at: <https://norden.diva-portal.org/smash/get/diva2:1611425/FULLTEXT01>
- Soma, K., van den Burg, S. W. K., Selnes, T., & van der Heide, C. M. (2019). Assessing social innovation across offshore sectors in the Dutch North Sea. *Ocean & Coastal Management*, 167, 42–51. Available at: <https://doi.org/10.1016/j.ocecoaman.2018.10.003>
- Spijkerboer, R. C., Zuidema, C., Busscher, T., & Arts, J. (2020). The performance of marine spatial planning in coordinating offshore wind energy with other sea-uses: The case of the Dutch North Sea. *Marine Policy*, 115, 103860. Available at: <https://doi.org/10.1016/j.marpol.2020.103860>
- Stelzenmüller, V., Gimpel, A., Letschert, J., Kraan, C., & Däring, R. (2020). *Research for PECH Committee – Impact of the use of offshore wind and other marine renewables on European fisheries*. Brussels: European Parliament. Available at: [https://www.europarl.europa.eu/RegData/etudes/STUD/2020/652212/IPOL\\_STU\(2020\)652212\(SUM01\)\\_EN.pdf](https://www.europarl.europa.eu/RegData/etudes/STUD/2020/652212/IPOL_STU(2020)652212(SUM01)_EN.pdf)
- Swedish Agency for Marine and Water Management (2023a). *Coexistence of offshore wind power with commercial fishing, aquaculture and nature conservation: a synthesis of knowledge about preconditions and measures*. Stockholm: Havs och vattenmyndigheten. Available at: <https://havochvatten.diva-portal.org/smash/get/diva2:1832612/FULLTEXT01.pdf>
- Swedish Agency for Marine and Water Management (2023b). Marine Spatial Plans for the Gulf of Bothnia, the Baltic Sea and the Skagerrak/Kattegat. Available at: <https://www.havochvatten.se/en/our-organization/publications/swam-publications/2023-05-31-marine-spatial--plans.html> [Accessed: 22 October 2025]
- Swedish Energy Agency (2025, February 13). *Energiutvinning i havsplanerna*. Available at: <https://www.energimyndigheten.se/energisystem-och-analys/elproduktion/vindkraft/energiutvinning-i-havsplanerna/> [Accessed 20 October 2025]
- Tafon, R., Glavovic, B., Saunders, F., & Gilek, M. (2022). Oceans of Conflict: Pathways to an Ocean Sustainability PACT. *Planning Practice & Research*, 37(2), 213–230. Available at: <https://doi.org/10.1080/02697459.2021.1918880>
- Van den Burg, S. W. K., Aguilar-Manjarrez, J., Jenness, J., & Torrie, M. (2019). Assessment of the geographical potential for co-use of marine space, based on operational boundaries for Blue Growth sectors. *Marine Policy*, 100, 43–57. Available at: <https://doi.org/10.1016/j.marpol.2018.10.050>
- Van Hoey, G., Bastardie, F., Birchenough, S., De Backer, A., Gill, A., de Koning, S., Hodgson, S., Mangi Chai, S., Steenbergen, J., Termeer, E., Van den Burg, S., & Hintzen, N. (2021). *Overview of the effects of offshore wind farms on fisheries and aquaculture*. Luxembourg: Publications Office of the European Union. Available at: <https://doi.org/10.2826/63640>

Viðarsson, J. R., Einarsson, M. I., Ragnarsson, S. Ö., & Laksá, U., Danielsen, R., Iversen, A., Henriksen, E., Berthelsen, H. M., Bown, T., Decker, D., Lund, H. S., Larson, B., & Ottosson, C.-A. (2018). *Nordic coastal fisheries and communities: Status and future prospects*. Copenhagen: Nordic Council of Ministers. Available at: <https://doi.org/10.6027/TN2018-507>

Virtanen, E. A., Lappalainen, J., Nurmi, M., Viitasalo, M., Tikanmäki, M., Heinonen, J., Atlaskin, E., Kallasvuori, M., Tikkanen, H., & Moilanen, A. (2022). Balancing profitability of energy production, societal impacts and biodiversity in offshore wind farm design. *Renewable and Sustainable Energy Reviews*, 158, 112087. Available at: <https://doi.org/10.1016/j.rser.2022.112087>

Wind Europe (2025). *Wind Energy in Europe: 2024 Statistics and the outlook for 2025-2030*. In [www.windeurope.org](http://www.windeurope.org). Available at: <https://proceedings.windeurope.org/WindEurope-European-Stats-2024.pdf> [Accessed 28 September 2025]

World Economic Forum (2025). *Nature positive: Role of the offshore wind sector*. Nature Positive Transitions: Sectors report series. Available at: [https://reports.weforum.org/docs/WEF\\_Nature\\_Positive\\_Role\\_of\\_the\\_Offshore\\_Wind\\_Sector.pdf](https://reports.weforum.org/docs/WEF_Nature_Positive_Role_of_the_Offshore_Wind_Sector.pdf)

# Appendix I

## Systematic Literature Review for the "Green Energy Meets Blue Food" Project

**Rebecca Eriksson & Tabea Jacob**

8 April 2024, University Centre of the Westfjords

Supervisor: Dr. Matthias Kokorsch

### Introduction

In recent decades, human activities in the seas have intensified and diversified, creating a growing need for cohesive and sustainable solutions to spatial planning. From traditional uses of the sea, such as fisheries, shipping and oil and gas extraction, to more modern sectors, such as aquaculture, tourism and offshore wind energy, the competition for ocean space is increasing (Soma et al., 2019). At the same time, anthropogenic climate change is changing the state of marine ecosystems, and the overexploitation of natural resources has led to resource scarcity, increasing the risk of social conflict (Christie et al., 2014). To mitigate conflicts of ocean use, the EU has taken measures to balance interests, notably through the Maritime Spatial Planning Directive (MSPD), which requires each Member State to establish marine spatial plans by 2021 (Directive 2014/89/EU). Building on earlier international and regional initiatives, the concept of maritime/marine spatial planning (MSP) has gained recognition as a means of reconciling economic, social and environmental interests of marine activities, with the MSPD playing an important role in mainstreaming its application across Europe. Yet, despite increasing experience with MSP, increasingly crowded oceans make it necessary to strengthen and promote potential synergies among marine uses, introducing the concepts of co-location, coexistence and multi-use (Bonnevie et al., 2019). An extensive body of literature has analysed the potential for coexistence (in which different marine activities share the same area with limited interaction), co-location (the physical overlapping of uses) and multi-use (intentional and integrated combinations that foster synergies) in marine spaces, with the aim of informing and supporting synergies in MSP processes (Bonnevie et al., 2019, 2023; Schupp et al., 2019, 2021; Soma et al., 2019; Zanuttigh et al., 2016).

Most prominent is the potential for offshore wind farms, fisheries and aquaculture (Bonsu et al., 2024; Christie et al., 2014; Quero García et al., 2021; Stelzenmüller et al., 2021; Weiss et al., 2018). However, while these concepts have been popularised in the field of MSP,

practical implementations still lack a strong knowledge base, adequate policies and a common agenda. This underscores the need for a holistic understanding of the challenges and opportunities associated with the coexistence of different marine activities.

To address this knowledge gap, the “Green Energy Meets Blue Food – Sustainable Coexistence in Nordic Seas” project was initiated by the research institution Nordregio and funded by the Nordic Council of Ministers. The project seeks to advance understanding of the possibilities for coexistence between offshore wind energy and marine food sectors in the Nordic Region. In line with this objective, this report examines the potential for co-location, coexistence and multi-use concepts through an assessment of existing trade-offs, conflicts and synergies between offshore renewable energy and marine food industries. To provide a comprehensive overview and synthesise existing research, a systematic literature review was conducted.

## Method

A systematic literature search was conducted to identify, summarise and evaluate the existing literature on MSP, the potential challenges and benefits of coexistence, and conflicts between marine food systems and offshore renewable energies. The search was carried out in the Elsevier Scopus database to ensure coverage across multiple journals, publication types and scientific fields. The time frame was set to cover a 10-year period (2014–2024), beginning with the introduction of the MSPD (Directive 2014/89/EU), in order to capture a decade of development in the field and to include the most recent and relevant literature. To align with the project’s objective of generating insights applicable to the Nordic context, the search was restricted to European countries, providing an inclusive yet slightly broader perspective on the topic. Furthermore, as the literature review aimed to assess scientific literature, the search was limited to journal articles. Only literature published in English was included.

Guided by Kimjeon and Davidsson (2021) and Tranfield et al. (2003), a principle-based search strategy was employed to identify relevant literature. Accordingly, four principles were developed based on the project aims: (1) Aggregate theme, (2) Conflict types, (3) Offshore wind energy and (4) Blue food activities (see Table 1). The complete search with relevant search words can be seen below (see section, “Systematic search”). The initial search yielded 185 articles on the topic. To identify the final set of articles, a screening process was conducted following the steps (1) Screening of title and abstract and (2) Screening of full text. As presented below, both steps included an assessment of the literature against developed exclusion criteria. The first screening resulted in 94 articles and the full-text screening produced the final set of 81 articles. Articles that were inaccessible or met the exclusion criteria were removed. The exact screening process is presented in Figure 1. To ensure applicability of the articles, the exclusion criteria were developed in accordance with Rafael et al. (2024) and are presented as follows:

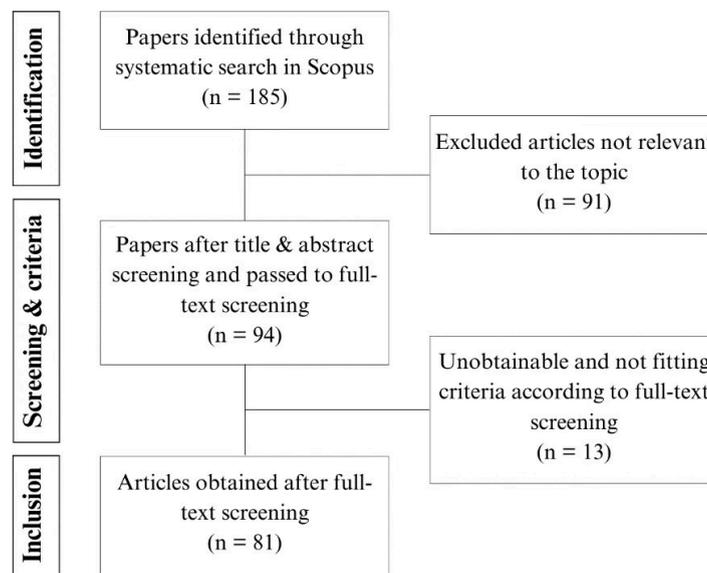
1. No focus on MSP discussions.
2. A focus on single management approaches to MSP.

3. A focus on marine activities related to neither offshore renewable energies nor marine food sectors.
4. A focus on terrestrial planning in relation to marine spatial planning (land –sea interactions).

It is important to recognise the limitations of this methodology. While the systematic approach offered advantages, such as a transparent and informative representation of the state of existing knowledge (Kimjeon & Davidsson, 2021), the manual screening conducted by the authors may have introduced a degree of subjectivity.

Aggregate theme	Conflict types	Offshore Wind Energy	Blue food activities
("marine spatial planning") OR ("maritime spatial planning") OR ("marine spatial management") OR ("maritime spatial management")	("conflict*") OR ("trade-off*") OR ("trade off*") OR ("synerg*") OR ("coexistence") OR ("overlap*") OR ("competition")	("offshore wind") OR ("offshore wind farm") OR ("off-shore wind farm") OR ("off-shore windfarm")	("aquaculture") OR ("aqua farm*") OR ("aqua-farm*") OR ("fisher*") OR ("protected area*") OR ("analytical framework*")

**Table 1:** Search terms for the systematic search



**Figure 1:** Flow of the systematic literature review process (adapted from Rafael et al. (2024))

## Systematic search

```
TITLE-ABS-KEY ( ( "marine spatial planning" ) OR ( "maritime spatial planning" ) OR ( "marine spatial management" ) OR ( "maritime spatial management" ) ) AND ( ( "conflict*" ) OR ( "trade-off*" ) OR ( "trade off*" ) OR ( "synerg*" ) OR ( "coexistence" ) OR ( "overlap*" ) OR ( "competition" ) ) AND ( ( "offshore wind" ) OR ( "offshore wind farm" ) OR ( "off-shore wind farm" ) OR ( "off-shore windfarm" ) ) AND ( ( "aquaculture" ) OR ( "aqua farm*" ) OR ( "aqua-farm*" ) OR ( "fisher*" ) OR ( "protected area*" ) OR ( "analytical framework*" ) ) AND PUBYEAR > 2013 AND PUBYEAR < 2025 AND ( LIMIT-TO ( AFFILCOUNTRY , "United Kingdom" ) OR LIMIT-TO ( AFFILCOUNTRY , "Germany" ) OR LIMIT-TO ( AFFILCOUNTRY , "Spain" ) OR LIMIT-TO ( AFFILCOUNTRY , "Italy" ) OR LIMIT-TO ( AFFILCOUNTRY , "Netherlands" ) OR LIMIT-TO ( AFFILCOUNTRY , "Denmark" ) OR LIMIT-TO ( AFFILCOUNTRY , "Greece" ) OR LIMIT-TO ( AFFILCOUNTRY , "France" ) OR LIMIT-TO ( AFFILCOUNTRY , "Sweden" ) OR LIMIT-TO ( AFFILCOUNTRY , "Ireland" ) OR LIMIT-TO ( AFFILCOUNTRY , "Portugal" ) OR LIMIT-TO ( AFFILCOUNTRY , "Belgium" ) OR LIMIT-TO ( AFFILCOUNTRY , "Norway" ) OR LIMIT-TO ( AFFILCOUNTRY , "Poland" ) OR LIMIT-TO ( AFFILCOUNTRY , "Finland" ) OR LIMIT-TO ( AFFILCOUNTRY , "Latvia" ) OR LIMIT-TO ( AFFILCOUNTRY , "Estonia" ) OR LIMIT-TO ( AFFILCOUNTRY , "Cyprus" ) OR LIMIT-TO ( AFFILCOUNTRY , "Croatia" ) OR LIMIT-TO ( AFFILCOUNTRY , "Lithuania" ) OR LIMIT-TO ( AFFILCOUNTRY , "Russian Federation" ) OR LIMIT-TO ( AFFILCOUNTRY , "Romania" ) OR LIMIT-TO ( AFFILCOUNTRY , "Malta" ) OR LIMIT-TO ( AFFILCOUNTRY , "Ukraine" ) OR LIMIT-TO ( AFFILCOUNTRY , "Serbia" ) OR LIMIT-TO ( AFFILCOUNTRY , "Montenegro" ) OR LIMIT-TO ( AFFILCOUNTRY , "Czech Republic" ) OR LIMIT-TO ( AFFILCOUNTRY , "Bulgaria" ) OR LIMIT-TO ( AFFILCOUNTRY , "Austria" ) OR LIMIT-TO ( AFFILCOUNTRY , "Albania" ) ) AND ( LIMIT-TO ( DOCTYPE , "ar" ) ) AND ( LIMIT-TO ( PUBSTAGE , "final" ) ) AND ( LIMIT-TO ( LANGUAGE , "English" ) ) AND ( LIMIT-TO ( SRCTYPE , "j" ) ) ) 18
```

## Results

### **Marine spatial planning in a three-dimensional ocean space**

As terrestrial resources come under increasing pressure due to population growth, expanding industrialisation and unsustainable land use, attention has turned towards the ocean as a source of energy, food and other essential resources. This shift is often discussed in the context of the blue economy, which promotes the sustainable use of ocean resources (Guerreiro, 2021; Knol- Kauffman et al., 2023). In practice, however, scholars have observed that the blue economy has frequently been implemented through "Blue Growth" initiatives, which have attracted new spatial claims from emerging industries in marine settings, underscoring the need for planning and management approaches to mitigate conflicts (Aschenbrenner & Winder, 2019). One such approach is MSP, which has gained increasing recognition for its key role in decision-making.

At first glance, the reviewed literature largely adopts the definition of the MSPD and therefore commonly refers to MSP as “...a process by which the relevant Member State’s authorities analyse and organise human activities in marine areas to achieve ecological, economic and social objectives” (Directive 2014/89/EU, p.6, Article 3). However, deeper analysis of the literature indicates that researchers recognise MSP as a politically driven process, often designed or implemented to fulfil specific objectives. Accordingly, many scholars advocate using the definition of MSP introduced by Douvere and Ehler (2009), which underlines the inherently political nature of the MSP process and calls for planning in a three-dimensional space encompassing the water surface, water column and seafloor (Bonnieve et al., 2019; Jentoft & Knol, 2014; Knol-Kauffman et al., 2023; Tafon et al., 2022; Tafon, 2019).

*“MSP is defined as a process of analysing and allocating parts of three-dimensional marine spaces to specific uses, to achieve ecological, economic, and social objectives that are usually specified through the political process” (Douvere and Ehler 2009, p.78).*

Accordingly, the first key theme emerging from the literature is recognition of the ocean as a three-dimensional and variable space. Several articles emphasise that MSP processes should aim to understand use of the physical ocean space in terms of fixed versus mobile structures, seasonality, time and impacts in the entire water column, sea floor and surface area (Jentoft & Knol, 2014; Rempis & Tsilimigkas, 2023; Schupp et al., 2021). This perspective is especially prominent when considering possibilities for multi-use and co-location, as proposed projects and activities should consider maximising synergies of activities while lowering environmental impacts (Bonnieve et al., 2020).

Considering the ocean as a three-dimensional space highlights the complexity of managing multiple human activities operating across different layers of the marine environment. Within this spatial and temporal context, several studies note that MSP often encounters tensions among stakeholders due to conflicting interests, values, priorities and beliefs (Bonnieve et al., 2020; Tafon et al., 2022, 2023). These tensions are sometimes classified within ecosystem-based MSP frameworks as either use–use interactions, referring to competition between human activities or use–environment interactions, describing how human activities affect ecological systems (Bonnieve et al., 2019). Across the assessed literature on MSP, the most prominent interactions are of the use–use type between offshore wind and fisheries. This category describes how conflicts arise due, for example, to loss of fishing grounds and dislocation of fish stocks (Erkkilä-Välimäki et al., 2022; Schupp et al., 2021), disproportionate representation and limited inclusion of fisheries in stakeholder discussions (Bastardie et al., 2015; Bergh et al., 2023; Jentoft & Knol, 2014; Tafon et al., 2022), hierarchical perceptions and power relations, and general incompatibility between mobile fishing activities and static activities such as offshore wind (Janßen et al., 2018; Schupp et al., 2021).

### **Spatial overlaps between fisheries and offshore wind**

As new marine sectors such as offshore renewable energy and aquaculture expand, they increasingly compete for space with traditional activities like fisheries. This spatial overlap often requires traditional sectors to adapt, sometimes resulting in reduced access to

resources, loss of market value and emerging conflicts (Custodio et al., 2022). As a mobile sector, fisheries are particularly affected by spatial boundaries that restrict access to their fishing grounds. Consequently, the expansion of static structures, such as offshore wind energy (OWE), along with restrictions or closures related to marine protection, leads to spatial conflicts with fisheries and is likely to continue doing so in the future (Letschert et al., 2021; Janßen et al., 2018).

Within the existing literature, spatial overlaps vary depending on location. For example, in parts of the North Sea, spatial overlaps between implemented and proposed OWE installations and fishing grounds ranges from less than 1% in some parts to almost 45% in other parts (Letschert et al., 2021). At the same time, fisheries are constrained by prohibitions on fishing in offshore wind farms during construction and operation (Schupp et al., 2021), especially for bottom trawling equipment due to the placement of underwater cables (Letschert et al., 2021), as well as by policy restrictions and insurance considerations (Christie et al., 2014). As a potential solution, the existing literature advocates permitting fishing activities in offshore wind farms under certain conditions, such as the use of passive and sustainable fishing gear. Additionally, further empirical research is expected to help reduce uncertainties related to co-location and, in turn, lower insurance costs (Letschert et al., 2021; Lloret et al., 2022; Schupp et al., 2021). However, the ability to contribute to or benefit from such research is not equally distributed among sectors. The assessed literature recognises the disadvantage of the fisheries sector relative to the offshore wind sector, especially in stakeholder and area designation processes, due to constraints in knowledge, capacity and willingness to participate, as well as power imbalances (Flannery et al., 2016; Piwowarczyk et al., 2019).

Multiple studies note the influence of political and economic drivers on MSP, particularly in the European context, where MSP processes often reflect broader societal objectives (Flannery et al., 2016). For example, the EU's renewable energy targets created incentives for the development of OWE as part of the green transition and the drive for increased renewable energy production (Flannery et al., 2016; Kyriazi, 2018). As a result, OWE development appears to be prioritised in MSP processes due to political pressures, placing less organised and supported stakeholders, such as the fisheries sector, at a relative disadvantage in decision-making and access to marine space (Aschenbrenner & Winder, 2019; Spijkerboer et al., 2020).

### **Barriers to aquaculture**

Aquaculture is mentioned in the assessed literature, mainly in relation to its potential for multi-use and co-location opportunities with other activities (Calado et al., 2019; Quero García et al., 2019). As shown by Calado et al. (2019), synergies between aquaculture and offshore wind farms include direct attachments, the sharing of marine spaces and shared resources like vessels, onshore infrastructure, human labour and technologies. However, multi-use involving aquaculture and other activities faces various barriers and restraints. First and foremost, legal administration of the operational process and safety measures, including insurance matters, is not yet fully established, leaving considerable uncertainties in MSP processes and multi-use development (Bonsu et al., 2024; Calado et al., 2019; Steins et al., 2021). Second, negative ecological impacts have not been studied sufficiently,

both for singular activities and cumulative impacts. Finally, a disparity exists between larger corporations, which have the capacity to invest in multi-use projects but often choose not to due to risk aversion and uncertainty, and smaller enterprises, which demonstrate strong interest but lack the necessary financial resources. (Schupp et al., 2021).

### **Concepts of coexistence, co-location and multi-use**

When reviewing the literature on coexistence, the most frequently encountered terms are co-location and multi-use. Although coexistence, multi-use and co-location have distinct conceptual meanings, they are often used interchangeably, revealing a lack of clarity and consistency in how these terms are defined and applied. Despite this ambiguity, scholars increasingly promote, in particular, co-location and multi-use as promising strategies for addressing spatial conflicts as traditional single-use activities show their limitations (Bonnevie et al., 2019; Kirkfeldt & Andersen, 2021). However, consensus on the definitions of these concepts has yet to be reached and practical examples of same-space usage remain limited (Bonnevie et al., 2019).

A synthesis of the literature indicates that co-location is frequently explained as the act of locating activities within the same physical space to allow for increased efficiency (Calado et al., 2019; Schupp et al., 2019). In contrast, multi-use can either be viewed as the combined efforts of multiple stakeholders to use the same space or as the sharing and use of multiple resources among several users (Schupp et al., 2019). Furthermore, Schupp et al. (2019) conclude that multi-use may occur across spatial, temporal, provisional or functional dimensions to allow for synergies and fewer conflicts around space allocation.

Following Christie et al. (2014), co-location and multi-use potential are almost exclusively discussed in relation to offshore wind farms, aquaculture and sometimes fisheries (Calado et al., 2019; Stelzenmüller et al., 2021, 2022; Weiss et al., 2018). Offshore wind farms and aquaculture industries share similar operations and facilities that are fixed within the ocean space. Aquaculture could therefore benefit from the development of offshore wind through the creation of artificial reefs, shared gears and vessels and the possibility of attaching aquaculture structures to preexisting wind platforms (Bonnevie et al., 2019). However, it is important to note that, at present, aquaculture may only be co-located with fixed offshore wind farms located closer to shore due to high costs and safety concerns (van den Burg et al., 2019). In turn, offshore wind farms could profit from co-location by greening their operations and gaining support from local communities and the public (Calado et al., 2019). Beyond aquaculture, the literature suggests permitting fishing within offshore wind farms to mitigate the loss of fishing grounds (Bonsu et al., 2024). Under such arrangements, fishing activities would maintain a specified distance from wind turbines and be limited to passive fishing gear, such as pot fishing (Bonsu et al., 2024; Stelzenmüller et al., 2021; van den Burg et al., 2023). Passive fisheries in offshore wind farms could in turn provide benefits such as efficient use of space and support the transition towards sustainable fishing practices and gears (Schupp et al., 2021; Stelzenmüller et al., 2021). However, the existing literature identified barriers to co-location of fisheries and offshore wind, including safety liabilities and insurance concerns, increased costs for fuel and gear adjustments, and the potential for cumulative impacts on the natural environment (Bonnevie et al., 2019; Kotta et al., 2020).

The literature shows how co-location and multi-use present not only opportunities but also face regulatory barriers. Poor policy and planning processes, along with a lack of frameworks and insurance mechanisms, make co-location and multi-use challenging (Bonnievie et al., 2019; Bonsu et al., 2024). To effectively incorporate various activities within the same space or create synergies between operations, cooperation and strong relations between users should be established to ensure that the space is managed safely and does not pose risks to people or the local environment. Moreover, the concepts of multi-use and co-location remains relatively novel and the associated uncertainties may discourage stakeholders (Bonnievie et al., 2019). For instance, while co-location of activities has the potential to generate economic benefits, the cumulative ecological impacts are not yet fully understood and warrant further investigation. In particular, the integration of offshore wind farms with aquaculture requires MSP processes to take into account not only surface-level interactions but also the implications for the water column and seabed (Bonnievie et al., 2023). Accordingly, although co-location and multi-use can be seen as a milestone for MSP (Weiss et al., 2018), they also demand more complex planning processes involving cooperation with all affected stakeholders. In addition, there is a need to remedy the lack of legislative synergies. The existing literature commonly identifies uncertainty as a key barrier to the implementation of both co-location and multi-use approaches. In the absence of comprehensive legislation to support these concepts across diverse contexts, their practical application remains limited and largely theoretical (Quero García et al., 2021).

### **Stakeholder participation and engagement**

The reviewed literature indicates that, particularly in the European context, MSP has frequently been applied with a strong focus on economic development (Flannery et al., 2016) and often implemented using top-down approaches, with varying levels of stakeholder participation and engagement (Guerreiro, 2021; Soma et al., 2019). While stakeholder participation and engagement refer broadly to the inclusion of stakeholders in MSP processes, equitable participation specifically considers whether all stakeholders have fair opportunities to influence decisions. Although equity in stakeholder participation and engagement processes is not always explicitly addressed in MSP frameworks, much of the reviewed literature emphasises its importance (van den Burg et al., 2023), taking into account emerging conflicts and the potential environmental and social consequences of MSP decisions (Saunders et al., 2020; Tafon et al., 2022). Building on these principles, several studies discuss how to design active and meaningful participation processes, in which stakeholders are not only consulted but are also able, as active partners, to contribute knowledge and perspectives that inform decision-making (Custodio et al., 2022; Piwowarczyk et al., 2019; Spijkerboer, 2021). However, these studies also identify challenges and barriers that explain why current stakeholder participation and engagement often fall short of expectations. Most frequently mentioned are small-scale fishers, as weakly-positioned stakeholders compared to the politically backed offshore wind industry. This position of small-scale fisheries is reflected in their limited access to resources such as financial and human resources to participate in MSP, as well as education and knowledge of planning processes. These factors limit small-scale fisheries' capacity to voice their concerns and needs in an institutional context, thereby limiting

their influence over decision-making (Flannery et al., 2016; Piwowarczyk et al., 2019; Schupp et al., 2021; Tafon et al., 2019).

Another barrier to stakeholder participation and engagement arises both from perceptions on fisheries and the design of the MSP processes. The literature indicates that planners may have a limited understanding of fisheries' knowledge, practices and considerations, such as seasonality or gear use, and differing perspectives on the marine environment and how these relate to MSP (Schupp et al., 2021; Piwowarczyk et al., 2019). Conversely, some fisheries perceive that their interests are given less priority than those of other actors, such as the offshore wind industry, particularly in contexts where MSP has become closely associated with the development of renewable energy infrastructure (Erkkilä-Välimäki et al., 2022; Jentoft & Knol, 2014; Piwowarczyk et al., 2019). Additional factors affecting the participation and engagement of fisheries include previous negative experiences with authorities and governments, along with regulatory uncertainty and top-down planning approaches. These factors have often resulted in conflicts and low trust in institutions, sometimes leading fisheries to withdraw from stakeholder participation and engagement processes altogether (Erkkilä-Välimäki et al., 2022; Piwowarczyk et al., 2019). Additionally, in some cases, stakeholder participation and engagement in MSP processes are reduced to an initial consultation and remain detached from decision-making processes, resulting in a negative impression that MSP favours larger, more organised stakeholders and industries (Flannery et al., 2016). The assessed literature recognises meaningful participation processes within MSP as the main enabler for the co-production of knowledge, which is essential to ensure equity within MSP processes and to close existing knowledge and data gaps – factors which are fundamental for coexistence, co-location and multi-use activities (Depellegrin et al., 2021; Flannery et al., 2016).

### **Regulations, policy and politics**

The existing literature highlights substantial differences among governments and political agendas, reflecting varying approaches to MSP. As each nation is responsible for developing, managing and governing its territorial waters and exclusive economic zone, countries leverage their distinct conditions and resources, leading to fundamental differences in the preconditions for MSP (Knol-Kauffman et al., 2023; Rempis & Tsilimigkas, 2023; Salvador & Ribeiro, 2023; Spijkerboer, 2021). Countries that share common seas may have diverging priorities due to political agendas, making cohesion in cross-border MSP challenging. Additionally, variations in natural conditions across countries can enable or limit the implementation of certain activities and opportunities for multi-use and co-location. For instance, countries surrounding the Mediterranean Sea face challenges in implementing fixed offshore wind energy due to sea depth (Maldonado et al., 2022; Pinarbaşı et al., 2019; Pulselli et al., 2022; Quero García et al., 2021; Tercan et al., 2020), whereas North Sea countries benefit from shallow waters more suitable for fixed structures (Astariz & Iglesias, 2017; Gusatu et al., 2020). Diverging political goals may further influence the available financial resources for developing co-located activities or multi-use. The reviewed literature highlights that the economic significance of different sectors can influence investment allocation. Industries aligned with political agendas, such as OWE tend to receive greater investment in countries prioritising a renewable energy

transition (Soma et al., 2019). In contrast, countries whose economies rely heavily on other sectors, such as tourism, may invest less in OWE, as the infrastructure can affect visual aesthetics and restrict marine traffic (Pulselli et al., 2022; Tercan et al., 2020).

Within the regulatory landscape, MSP is embedded within what has been described in the literature as “a patchwork of existing sectorial policies” (Spijkerboer et al., 2020, p.1). Navigating MSP processes can therefore be challenging, as some sectors have greater capacity to influence decision-making. The literature shows how these dynamics are compounded by differences in knowledge and the availability of technical tools, with political processes often relying heavily on data and digital systems (Kusters et al., 2023). Moreover, scholars point to hierarchical structures within MSP and decision-making, which, together with mistrust in government and management authorities and technically driven processes, can affect stakeholder participation (Bergh et al., 2023; Saunders et al., 2020; Tafon et al., 2022).

## Conclusion

This systematic literature review revealed that research on MSP has increasingly focused on conceptualising coexistence between OWE, fisheries and aquaculture. The growing body of literature on conflicts and synergies between these activities reflects both the intensifying competition for ocean space and the emerging recognition that actors should find ways to share marine environments. Indeed, as terrestrial resources face mounting pressures and attention turns towards ocean-based solutions, the question is no longer whether different marine activities will compete for space, but how they can coexist sustainably.

However, this analysis demonstrates that research on coexistence remains largely in its infancy, with the terms and concepts of coexistence, multi-use and co-location used interchangeably and without clear distinction. Nevertheless, the literature positions co-location and multi-use as central strategies for achieving coexistence in increasingly contested marine spaces. These concepts recognise the three-dimensional nature of the ocean environment and seek to maximise synergies between activities while reducing spatial conflicts and environmental impacts. While co-location enables activities to occupy the same physical space to increase efficiency, multi-use facilitates the sharing of resources, infrastructure and facilities among multiple stakeholders. The literature review identified, in particular, possibilities for coexistence between offshore wind farms and aquaculture, with potential benefits including artificial reef effects, shared vessels and onshore infrastructure, ultimately resulting in more efficient use of limited ocean space. Regarding interactions between offshore wind and fisheries, permitting passive fishing gear within wind farm areas could offset the loss of traditional fishing grounds.

Yet, despite the conceptual promise of these approaches, their practical implementation continues to face considerable challenges. Addressing the lack of legislative synergies across sectors and jurisdictions is perhaps one of the most significant challenges, as comprehensive frameworks to support coexistence, co-location and multi-use across diverse contexts remain scarce. This regulatory gap generates cascading uncertainties

around insurance, liability, safety measures and operational procedures, which may discourage stakeholders from pursuing such solutions. Additionally, the cumulative ecological impacts of co-located activities remain insufficiently studied, leaving planners unable to assess whether proposed synergies could generate unforeseen environmental consequences. In addition, financial barriers complicate implementation.

Successfully moving coexistence approaches from concept to practice depends largely on stakeholder cooperation and meaningful participation in MSP processes. The literature emphasises that successful coexistence requires not only spatial arrangements but also collaborative relationships built on trust, shared knowledge and aligned goals. However, current MSP practice sometimes fails to foster the conditions for such collaboration. Power imbalances between actors, particularly between fisheries and OWE in this study, shape who participates in planning and whose interests are prioritised. Fisheries often face structural disadvantages, including limited resources, time constraints, insufficient understanding of planning processes and historical marginalisation from decision-making. When participation is limited to consultation rather than active involvement, stakeholders may lose trust in MSP processes and, in some cases, withdraw entirely. The challenge of achieving coexistence is further complicated by the political nature of MSP and the fragmented regulatory landscape within which actors operate. MSP processes reflect broader political agendas, with different nations bringing distinct priorities, resources and physical conditions to their waters. The European context, in particular, demonstrates how renewable energy and green transition targets have driven offshore wind development, sometimes at the expense of other sectors. This study therefore recognises the political structures as a patchwork of existing sectoral policies and MSP, creating a complex regulatory landscape that stakeholders have to navigate.

Looking forward, the literature identifies requirements for translating coexistence concepts into practice. Overcoming the lack of legislative synergies necessitates comprehensive policy frameworks that support coexistence, co-location and multi-use across sectors and jurisdictions, establishing clear regulations for insurance, safety and operational procedures. Reducing uncertainty requires moving beyond speculation through more empirical research that documents the effects of cumulative impacts and lower barriers to implementation. Additionally, scholars emphasise that realising coexistence requires fostering genuine cooperation among stakeholders through MSP processes built on trust, shared knowledge bases and joint targets and goals. This is particularly critical for cross-border cooperation in shared sea basins and marine areas, where regulatory fragmentation and divergent priorities currently challenge coordination.

Finally, this review has shown that while the literature provides relatively strong conceptual frameworks for coexistence, multi-use and co-location in marine spaces, practical implementation is still limited by regulatory, social and environmental barriers. These insights will guide the next stages of the project, informing strategies and approaches to support sustainable coexistence in the Nordic seas.

## Future considerations

It became evident from the reviewed literature that a large portion of the published articles focus on conceptual thinking, highlighting the relative novelty of the topic. Consequently, several research gaps were identified regarding the coexistence of different marine activities within MSP processes. We propose that the following gaps be considered for future research:

- Research cumulative effects and impacts of multi-use and co-location, incorporating aggregate analyses of impact across sea basins and larger areas.
- Close the knowledge gap on barriers to coexistence by examining the regulatory, financial and safety constraints identified in this study.
- Assessment social justice considerations in MSP, with a focus on developing an equity-oriented approach.
- Include local and Indigenous knowledge in the co-production of MSP-relevant knowledge systems.

## References

- Aschenbrenner, M., & Winder, G. M. (2019). Planning for a sustainable marine future? Marine spatial planning in the German exclusive economic zone of the North Sea. *Applied Geography*, 110. <https://doi.org/10.1016/j.apgeog.2019.102050>
- Astariz, S., & Iglesias, G. (2017). The collocation feasibility index – A method for selecting sites for co-located wave and wind farms. *Renewable Energy*, 103, 811–824. <https://doi.org/10.1016/j.renene.2016.11.014>
- Bastardie, F., Nielsen, J. R., Eigaard, O. R., Fock, H. O., Jonsson, P., & Bartolino, V. (2015). Competition for marine space: Modelling the Baltic Sea fisheries and effort displacement under spatial restrictions. *ICES Journal of Marine Science*, 72(3), 824–840. <https://doi.org/10.1093/icesjms/fsu215>
- Bergh, Ø., Beck, A. C., Tassetti, A. N., Olsen, E., Thangstad, T. H., Gonzalez-Mirelis, G., Grati, F., Bolognini, L., & Søvik, G. (2023). Analysis of spatial conflicts of large scale salmonid aquaculture with coastal fisheries and other interests in a Norwegian fjord environment, using the novel GIS-tool SEAGRID and stakeholder surveys. *Aquaculture*, 574. <https://doi.org/10.1016/j.aquaculture.2023.739643>
- Bonnevie, I. M., Hansen, H. S., & Schrøder, L. (2019). Assessing use-use interactions at sea: A theoretical framework for spatial decision support tools facilitating co-location in maritime spatial planning. *Marine Policy*, 106. <https://doi.org/10.1016/j.marpol.2019.103533>
- Bonnevie, I. M., Hansen, H. S., & Schrøder, L. (2020). SEANERGY - a spatial tool to facilitate the increase of synergies and to minimise conflicts between human uses at sea. *Environmental Modelling & Software*, 132, 104808. <https://doi.org/10.1016/j.envsoft.2020.104808>
- Bonnevie, I. M., Hansen, H. S., Schrøder, L., Rønneberg, M., Kettunen, P., Koski, C., & Oksanen, J. (2023). Engaging stakeholders in marine spatial planning for collaborative scoring of conflicts and synergies within a spatial tool environment. *Ocean and Coastal Management*, 233. <https://doi.org/10.1016/j.ocecoaman.2022.106449>

- Bonsu, P. O., Letschert, J., Yates, K. L., Svendsen, J. C., Berkenhagen, J., Rozemeijer, M. J. C., Kerkhove, T. R. H., Rehren, J., & Stelzenmüller, V. (2024). Co-location of fisheries and offshore wind farms: Current practices and enabling conditions in the North Sea. *Marine Policy*, 159. <https://doi.org/10.1016/j.marpol.2023.105941>
- Calado, H., Papaioannou, E. A., Caña-Varona, M., Onyango, V., Zaucha, J., Przedzimirska, J., Roberts, T., Sangiuliano, S. J., & Vergílio, M. (2019). Multi-uses in the Eastern Atlantic: Building bridges in maritime space. *Ocean and Coastal Management*, 174, 131–143. <https://doi.org/10.1016/j.ocecoaman.2019.03.004>
- Christie, N., Smyth, K., Barnes, R., & Elliott, M. (2014). Co-location of activities and designations: A means of solving or creating problems in marine spatial planning? *Marine Policy*, 43, 254–261. <https://doi.org/10.1016/j.marpol.2013.06.002>
- Custodio, M., Moolaert, I., Asselman, J., van der Biest, K., van de Pol, L., Drouillon, M., Hernandez Lucas, S., Taelman, S. E., & Everaert, G. (2022). Prioritizing ecosystem services for marine management through stakeholder engagement. *Ocean and Coastal Management*, 225. <https://doi.org/10.1016/j.ocecoaman.2022.106228>
- Depellegrin, D., Hansen, H. S., Schrøder, L., Bergström, L., Romagnoni, G., Steenbeek, J., Gonçalves, M., Carneiro, G., Hammar, L., Pålsson, J., Crona, J. S., Hume, D., Kotta, J., Fetissoy, M., Miloš, A., Kaitaranta, J., & Menegon, S. (2021). Current status, advancements and development needs of geospatial decision support tools for marine spatial planning in European seas. *Ocean & Coastal Management*, 209, 105644. <https://doi.org/10.1016/j.ocecoaman.2021.105644>
- Directive 2014/89/EU. (2014). In Official Journal of the European Union (p. 6). <https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32014L0089>
- Douvere, F., & Ehler, C. N. (2009). New perspectives on sea use management: Initial findings from European experience with marine spatial planning. *Journal of Environmental Management*, 90(1), 77–88. <https://doi.org/10.1016/j.jenvman.2008.07.004>
- Erkkilä-Välimäki, A., Pohja-Mykrä, M., Katila, J., & Pöntynen, R. (2022). Coastal fishery stakeholders' perceptions, motivation, and trust regarding maritime spatial planning and regional development: The case in the Bothnian Sea of the northern Baltic Sea. *Marine Policy*, 144. <https://doi.org/10.1016/j.marpol.2022.105205>
- Flannery, W., Ellis, G., Nursey-Bray, M., Van Tatenhove, J. P. M., Kelly, C., Coffen-Smout, S., Fairgrieve, R., Knol, M., Jentoft, S., Bacon, D., Marie, A., & Hagan, O. (2016). *Planning Theory & Practice*. <https://doi.org/10.1080/14649357.2015.1131482>
- Guerreiro, J. (2021). The Blue Growth Challenge to Maritime Governance. *Frontiers in Marine Science*, 8. <https://doi.org/10.3389/fmars.2021.681546>
- Gusatu, L., Yamu, C., Zuidema, C., & Faaij, A. (2020). A Spatial Analysis of the Potentials for Offshore Wind Farm Locations in the North Sea Region: Challenges and Opportunities. *ISPRS International Journal of Geo-Information*, 9(2), Article 96. <https://doi.org/10.3390/ijgi9020096>
- Janßen, H., Bastardie, F., Eero, M., Hamon, K. G., Hinrichsen, H. H., Marchal, P., Nielsen, J. R., Le Pape, O., Schulze, T., Simons, S., Teal, L. R., & Tidd, A. (2018). Integration of fisheries into marine spatial planning: Quo vadis? *Estuarine, Coastal and Shelf Science*, 201, 105–113. <https://doi.org/10.1016/j.ecss.2017.01.003>

- Jentoft, S., & Knol, M. (2014). Marine spatial planning: risk or opportunity for fisheries in the North Sea? *MAST. Maritime Studies/Maritime Studies*, 12(1). <https://doi.org/10.1186/2212-9790-12-13>
- Kimjeon, J., & Davidsson, P. (2021). External Enablers of Entrepreneurship: A review and Agenda for Accumulation of strategically Actionable knowledge. *Entrepreneurship Theory and Practice*, 46(3), 643–687. <https://doi.org/10.1177/10422587211010673>
- Kirkfeldt, T. S., & Andersen, J. H. (2021). Assessment of collective pressure in marine spatial planning: The current approach of EU Member States. *Ocean and Coastal Management*, 203. <https://doi.org/10.1016/j.ocecoaman.2020.105448>
- Knol-Kauffman, M., Nielsen, K. N., Sander, G., & Arbo, P. (2023). Sustainability conflicts in the blue economy: planning for offshore aquaculture and offshore wind energy development in Norway. *Maritime Studies*, 22(4). <https://doi.org/10.1007/s40152-023-00335-z>
- Kotta, J., Fetissoff, M., Szava-Kovats, R., Aps, R., & Martin, G. (2020). Online tool to integrate evidence-based knowledge into cumulative effects assessments: Linking human pressures to multiple nature assets. *Environmental Advances*, 2. <https://doi.org/10.1016/j.envadv.2020.100026>
- Kusters, J. E. H., van Kann, F. M. G., & Zuidema, C. (2023). Exploring agenda-setting of offshore energy innovations: Niche-regime interactions in Dutch Marine Spatial Planning processes. *Environmental Innovation and Societal Transitions*, 47. <https://doi.org/10.1016/j.eist.2023.100705>
- Kyriazi, Z. (2018). From identification of compatibilities and conflicts to reaching marine spatial allocation agreements. Review of actions required and relevant tools and processes. *Ocean and Coastal Management*, 166, 103–112. <https://doi.org/10.1016/j.ocecoaman.2018.03.018>
- Letschert, J., Stollberg, N., Rambo, H., Kempf, A., Berkenhagen, J., & Stelzenmüller, V. (2021). The uncertain future of the Norway lobster fisheries in the North Sea calls for new management strategies. *ICES Journal of Marine Science*, 78(10), 3639–3649. <https://doi.org/10.1093/icesjms/fsab204>
- Lloret, J., Turiel, A., Solé, J., Berdalet, E., Sabatés, A., Olivares, A., Gili, J. M., Vila-Subirós, J., & Sardá, R. (2022). Unravelling the ecological impacts of large-scale offshore wind farms in the Mediterranean Sea. *Science of the Total Environment*, 824. <https://doi.org/10.1016/j.scitotenv.2022.153803>
- Maldonado, A. D., Galparsoro, I., Mandiola, G., de Santiago, I., Garnier, R., Pouso, S., Borja, Á., Menchaca, I., Marina, D., Zubieta, L., & Bald, J. (2022). A Bayesian Network model to identify suitable areas for offshore wave energy farms, in the framework of ecosystem approach to marine spatial planning. *Science of the Total Environment*, 838. <https://doi.org/10.1016/j.scitotenv.2022.156037>
- Pinarbaşı, K., Galparsoro, I., Depellegrin, D., Bald, J., Pérez-Morán, G., & Borja, Á. (2019). A modelling approach for offshore wind farm feasibility with respect to ecosystem-based marine spatial planning. *Science of the Total Environment*, 667, 306–317. <https://doi.org/10.1016/j.scitotenv.2019.02.268>
- Piwowarczyk, J., Matczak, M., Rakowski, M., & Zaucha, J. (2019). Challenges for integration of the Polish fishing sector into marine spatial planning (MSP): do fishers and planners tell the same story? *Ocean and Coastal Management*, 181. <https://doi.org/10.1016/j.ocecoaman.2019.104917>

Pulselli, R. M., Struglia, M. V., Maccanti, M., Bruno, M., Patrizi, N., Neri, E., Carillo, A., Napolitano, E., Stefanatos, N., Perakis, C., Damasiotis, M., Di Pietrantonio, F., Magaouda, S., Madalena, V., Stančin, H., Mikulčić, H., Petrou, V., Smagas, K., Valari, E., ... Bastianoni, S. (2022). Integrating Blue Energy in Maritime Spatial Planning of Mediterranean Regions. *Frontiers in Energy Research*, 10. <https://doi.org/10.3389/fenrg.2022.939961>

Quero García, P., García Sanabria, J., & Chica Ruiz, J. A. (2019). The role of maritime spatial planning on the advance of blue energy in the European Union. *Marine Policy*, 99, 123–131. <https://doi.org/10.1016/j.marpol.2018.10.015>

Quero García, P., García Sanabria, J., & Chica Ruiz, J. A. (2021). Marine renewable energy and maritime spatial planning in Spain: Main challenges and recommendations. *Marine Policy*, 127. <https://doi.org/10.1016/j.marpol.2021.104444>

Rempis, N., & Tsilimigkas, G. (2023). Marine spatial planning on Crete Island, Greece: methodological and implementation issues. *Journal of Spatial Science*, 68(2), 205–224. <https://doi.org/10.1080/14498596.2021.1955025>

Salvador, S., & Ribeiro, M. C. (2023). Socio-economic, legal, and political context of offshore renewable energies. *Wiley Interdisciplinary Reviews: Energy and Environment*, 12(2). <https://doi.org/10.1002/wene.462>

Saunders, F., Gilek, M., Ikaunieca, A., Tafon, R. V., Gee, K., & Zaucha, J. (2020). Theorizing social sustainability and justice in marine spatial planning: Democracy, diversity, and equity. *Sustainability* (Switzerland), 12(6). <https://doi.org/10.3390/su12062560>

Schupp, M. F., Bocci, M., Depellegrin, D., Kafas, A., Kyriazi, Z., Lukic, I., Schultz-Zehden, A., Krause, G., Onyango, V., & Buck, B. H. (2019). Toward a common understanding of ocean multi-use. *Frontiers in Marine Science*, 6(APR). <https://doi.org/10.3389/fmars.2019.00165>

Schupp, M. F., Kafas, A., Buck, B. H., Krause, G., Onyango, V., Stelzenmüller, V., Davies, I., & Scott, B. E. (2021). Fishing within offshore wind farms in the North Sea: Stakeholder perspectives for multi-use from Scotland and Germany. *Journal of Environmental Management*, 279. <https://doi.org/10.1016/j.jenvman.2020.111762>

Soma, K., van den Burg, S. W. K., Selnes, T., & van der Heide, C. M. (2019). Assessing social innovation across offshore sectors in the Dutch North Sea. *Ocean and Coastal Management*, 167, 42–51. <https://doi.org/10.1016/j.ocecoaman.2018.10.003>

Spijkerboer, R. C., Zuidema, C., Busscher, T., & Arts, J. (2020). The performance of marine spatial planning in coordinating offshore wind energy with other sea-uses: The case of the Dutch North Sea. *Marine Policy*, 115. <https://doi.org/10.1016/j.marpol.2020.103860>

Steins, N. A., Veraart, J. A., Klostermann, J. E. M., & Poelman, M. (2021). Combining offshore wind farms, nature conservation and seafood: Lessons from a Dutch community of practice. *Marine Policy*, 126. <https://doi.org/10.1016/j.marpol.2020.104371>

Stelzenmüller, V., Gimpel, A., Haslob, H., Letschert, J., Berkenhagen, J., & Brüning, S. (2021). Sustainable co-location solutions for offshore wind farms and fisheries need to account for socio-ecological trade-offs. *Science of the Total Environment*, 776. <https://doi.org/10.1016/j.scitotenv.2021.145918>

Stelzenmüller, V., Letschert, J., Gimpel, A., Kraan, C., Probst, W. N., Degraer, S., & Döring, R. (2022). From plate to plug: The impact of offshore renewables on European fisheries and the role of marine spatial planning. *Renewable and Sustainable Energy Reviews*, 158. <https://doi.org/10.1016/j.rser.2022.112108>

Tafon, R., Glavovic, B., Saunders, F., & Gilek, M. (2022). Oceans of Conflict: Pathways to an Ocean Sustainability PACT. *Planning Practice and Research*, 37(2), 213–230.

<https://doi.org/10.1080/02697459.2021.1918880>

Tafon, R., Saunders, F., Pikner, T., & Gilek, M. (2023). Multispecies blue justice and energy transition conflict: examining challenges and possibilities for synergy between low-carbon energy and justice for humans and nonhuman nature. *Maritime Studies*, 22(4).

<https://doi.org/10.1007/s40152-023-00336-y>

Tafon, R. V. (2019). Small-scale fishers as allies or opponents? Unlocking looming tensions and potential exclusions in Poland's marine spatial planning. *Journal of Environmental Policy and Planning*, 21(6), 637–648.

<https://doi.org/10.1080/1523908X.2019.1661235>

Tercan, E., Tapkın, S., Latinopoulos, D., Dereli, M. A., Tsiropoulos, A., & Ak, M. F. (2020). A GIS-based multi-criteria model for offshore wind energy power plants site selection in both sides of the Aegean Sea. *Environmental Monitoring and Assessment*, 192(10).

<https://doi.org/10.1007/s10661-020-08603-9>

Tranfield, D., Denyer, D., & Smart, P. (2003). Towards a methodology for developing Evidence-Informed management knowledge by means of systematic review. *British Journal of Management*, 14(3), 207–222.

<https://doi.org/10.1111/1467-8551.00375>

van den Burg, S. W. K., Aguilar-Manjarrez, J., Jenness, J., & Torrie, M. (2019). Assessment of the geographical potential for co-use of marine space, based on operational boundaries for Blue Growth sectors. *Marine Policy*, 100, 43–57.

<https://doi.org/10.1016/j.marpol.2018.10.050>

van den Burg, S. W. K., Skirtun, M., van der Valk, O., Cervi, W. R., Selnes, T., Neumann, T., Steinmann, J., Arora, G., & Roebeling, P. (2023). Monitoring and evaluation of maritime spatial planning – A review of accumulated practices and guidance for future action. *Marine Policy*, 150.

<https://doi.org/10.1016/j.marpol.2023.105529>

Weiss, C. V. C., Ondiviela, B., Guinda, X., del Jesus, F., González, J., Guanche, R., & Juanes, J. A. (2018). Co-location opportunities for renewable energies and aquaculture facilities in the Canary Archipelago. *Ocean and Coastal Management*, 166, 62–71.

<https://doi.org/10.1016/j.ocecoaman.2018.05.006>

Zanuttigh, B., Angelelli, E., Kortenhuis, A., Koca, K., Krontira, Y., & Koundouri, P. (2016). A methodology for multi-criteria design of multi-use offshore platforms for marine renewable energy harvesting. *Renewable Energy*, 85, 1271–1289.

<https://doi.org/10.1016/j.renene.2015.07.080>

# About this publication

## Green Energy Meets Blue Food - Sustainable Coexistence in Nordic Seas

*Kerstin Bly Joyce, Myriam Chilvers, Rebecca Eriksson*

Nordregio report 2025:14

ISBN: 978-91-8001-181-5 (digital)

ISBN: 978-91-8001-182-2 (PDF)

ISSN: 1403-2503

DOI: <http://doi.org/10.6027/R2025:14.1403-2503>

© Nordregio 2025

Layout: Kotryna Juskaite, Marija Zelenkauske / Nordregio

Cover photo: Per Pixel Petersson / imagebanksweden

## Nordregio

**Nordregio** is a leading Nordic and European research centre for regional development and planning, established by the Nordic Council of Ministers in 1997. We conduct solution-oriented and applied research, addressing current issues from both a research perspective and the viewpoint of policymakers and practitioners. Operating at the international, national, regional and local levels, Nordregio's research covers a wide geographic scope, emphasising the Nordic and Baltic Sea Regions, Europe and the Arctic.

### **Nordregio**

Hölmamiralens Väg 10

Skeppsholmen

Stockholm, Sweden

[www.nordregio.org](http://www.nordregio.org)