Coexistence and nature-inclusive design in Nordic offshore wind farms

Nordic Energy Research

Contents

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Foreword

The energy transition needs to be environmentally and socially viable. While scaling up deployment of renewables, we must minimise climate and nature impacts, or even achieve a net-positive impact via active measures to develop biodiversity. Simultaneously, we must ensure vital societal interests are not displaced. These ambitions are integral to the Nordic vision of becoming the most integrated and sustainable region in the world.

The European Commission's Offshore Renewable Energy Strategy recognises that the North and Baltic Seas will be instrumental in the anticipated twentyfold increase of Europe's offshore wind capacity, to reach climate neutrality by 2050. However, this will create new challenges for ecosystems, commercial activities, and marine spatial planning. Impacts on nature and livelihoods in the region must be carefully managed.

Here, Nordic co-operation can add value. When correctly sited, mature renewable energy technologies, such as offshore wind, can provide clean, affordable energy with the lowest impacts on nature and adjacent activities. By exchanging knowledge across borders and sectors, spatial planners can coordinate at sea basin-scale, to develop new energy infrastructure in balance with other uses of the sea.

Nature is a stakeholder in the energy transition. Though it is yet to be a focus area in our region, regulators may consider a requirement in the licensing process that offshore wind farms provide nature-development solutions, and which actors are positioned to support this. The potential for active biodiversity restoration in energy infrastructure should be investigated in a Nordic context.

The discussions underpinning this publication gathered governments, industries, nature advocates, researchers, and civil society, to drive implementation of best-practice solutions for coexistence and nature inclusive design in Nordic offshore wind farms. I hope the views herein support regulators in issuing licensing and location requirements for new offshore wind farms, to enable a just transition to nature-sensitive energy systems.

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Marte Rusten at DNV was the project manager and had overall responsibility for implementing the study. Solrun Figenschau Skjellum was responsible for NIVAs contributions.

Marton Leander Vølstad at Nordic Energy Research coordinated the project.

Disclaimer

The report primarily summarizes the opinions of the workshop participants. In addition, the reports expresses some opinions of the consultants (clearly labelled), and background has been provided by the consultants. They do not necessarily reflect the views of the Nordic Council of Ministers, Nordic Energy Research, or any entities they represent.

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Executive summary

To fulfil the European Commission's (EU) climate neutrality target and to meet the increased demand for energy caused by the global political climate, a substantial expansion in renewable energy is required. Offshore wind (OW) energy will be an important part of the future energy supply. Recent development has shown that offshore wind energy is both scalable and cost competitive, and the industry is ready to deliver the volumes required. Key challenges to reach the needed expansion lie within potential conflicts for ocean space, permitting processes and nature conservation goals.

Offshore wind farms (OWFs) will require large surface areas of sea, often combined with claims of exclusive access. In addition to surface areas, grid connection, anchoring arrangements etc. will occupy a significant amount of pelagic and seabed space. The planned expansion will entail additional pressures on environmental assets and spatial competition with established marine uses like fisheries, shipping, military activities, aquaculture and tourism. In order to reach energy goals while at the same time accommodating established marine uses and nature, there is a need to find good solutions to coexistence to minimise conflicts and maximise synergies. It will be vital to move away from a sector-by-sector management of marine activities to a more comprehensive and integrated approach to ensure sustainable solutions.

The climate crisis and the nature crisis are two sides of the same coin. As the climate changes, natural habitats change, in turn aggravating climate change and causing biodiversity loss. It is key that the expansion of renewables will be fast while at the same time applying sustainability and mitigation of adverse impacts on nature as guiding principles.

Based on workshops with a wide range of stakeholders from Nordic countries, input on needs, opportunities, incentives and suggested governmental instruments to facilitate successful coexistence and nature-inclusive design (NID) have been collected. The project has been performed in a collaboration between DNV and NIVA. DNV has been responsible for the overall project management, workshop facilitation and the topic of coexistence, stakeholder dialogue, mapping and forecast. NIVA has been in charge of the NID aspect.

Coexistence and stakeholder dialogue

The key takeaway from the discussion on coexistence was that the participants did not question why coexistence is important. The focus was on how to find good solutions for, and optimise benefits from, coexistence. Successful coexistence was considered to be crucial to solving both the energy crisis and the nature crisis, and governments were considered to have the main responsibility in establishing a framework to ensure this. The list of opportunities identified was longer than the list of constraints identified during the workshops. Many of the constraints identified can be converted into opportunities – for example, those relating to knowledge gaps are opportunities to leverage the planned expansion to learn, share and adapt to

acquired knowledge. Stakeholders representing fisheries expressed concerns about conflict for space with offshore wind development and knowledge gaps related to the impact of floating offshore wind structures on fisheries. There were also concerns about the challenges to prioritising environmental assets and to estimating the value of nature versus the value of energy. Marine spatial planning was highlighted as an important tool for both coexistence and stakeholder engagement, with transparency and communication of input data being important for building trust in the process and outcome.

A total of 22 governmental instruments (shown below) to inspire successful coexistence and stakeholder engagement were collected. Such instruments are relevant for the different phases of the site allocation and consenting process in the Nordic countries, including opening new areas for development, prequalification of tenderers and the awarding of tenders and licences. Knowledge, transparency and predictability were cross-cutting themes in the suggested instruments, which included suggestions related to frameworks and approaches to be applied during the entire consenting process, and non-price criteria to be applied during auctions. The suggested instruments have not been qualified or prioritised, and should be investigated further in the context of regulatory regimes in the different Nordic states (Denmark, Finland, Iceland, Norway, Sweden), autonomous entities (Faroe Islands, Greenland) and autonomous region (Åland).

SUGGESTED INSTRUMENTS FOR GOVERNMENTS TO INSPIRE SUCCESSFUL COEXISTENCE IN DIFFERENT PHASES OF THE OW CONSENTING PROCESS.

Governmental instruments for successful coexistence	General	Opening	Prequal	Tender award	Licence award
Apply a defined process to clarify what coexistence topics need handling. Explore the problem and do not focus on the solutions early.	x	x	x	x	x
Follow a clear and defined process to quantify coexistence and deliverables on coexistence, including agreed and communicated goals, basis and processes.	x	x	x	x	x
Apply transparent platforms and roundtables for processes and sharing information to secure transparent processes and trustworthy flow of data/information by using reliable third parties.	x	x	x	x	x
Make environmental monitoring programmes a "backbone" in a long-term strategy for OWFs to allow for knowledge-based adaptive management.	x	x	x	x	x
Stimulate and support strategic research and joint industry programmes and ensure knowledge transfer between programmes and towards society.	x	x	x	x	x
Consider cross-regulatory legislation and facilitate coordination between countries and between national agencies, as is the case with HELCOM or OSPAR.	x	x	x	x	x
Potential opportunities for coexistence should be a part of the process of opening areas and be integrated in Marine Spatial Planning (MSP). MSP should include mapping of stakeholders and need for coexistence in an area.	x	x			
Apply consenting criteria/solutions that enforce coexistence solutions on the developer before they construct.			x	x	x
Set non-price criteria with transparent and robust evaluation criteria to be evaluated (e.g. by expert committee) in the tender process to be fulfilled before award.			x	x	x
Utilise market (and potentially public) dialogue as an instrument to design tender criteria and to facilitate coexistence approaches in the industry at large.			x	x	x
Consider combining requirements for energy production with production of food or other products to ensure collaboration in the design phase.			x	x	x
Apply a permit requirement that operators should accept new stakeholders in the licencing area if public authorities can balance operators' interests against newcomers'.					x

SUGGESTED INSTRUMENTS FOR GOVERNMENTS TO INSPIRE SUCCESSFUL STAKEHOLDER ENGAGEMENT IN DIFFERENT PHASES OF THE CONSENTING PROCESS.

Governmental instruments for successful stakeholder engagement	General	Opening	Prequal	Tender award	Licence award
Ensure efficient communication of scientific advice to governments and facilitate a common understanding of knowledge among stakeholders.	x	x			
Identify and communicate incentives for stakeholders of planned activities.	x	x			
Set the framework for the stakeholder discussion and agree with stakeholders on the framework, including the scope, language and information sets upon which the engagement process can be built.	x	x			
Facilitate a safe and stable meeting space with a capable and neutral facilitator.	x	x			
Ensure transparency around the broader stakeholder engagement scope and communicate timescales for regulatory activities that incorporate stakeholder engagement.	x	x			
Facilitate knowledge transfer from other countries.	x	x			
Start the engagement as early as possible and bring in local stakeholders.	x	x	x	x	x
Stakeholder engagement should be tailored to the process.	x	x	x	x	x
Ensure mandatory early stakeholder engagement as part of the public tender requirements for OWFs.			x	x	x
Include criteria for stakeholder engagement in competition.			x	x	
Require stakeholder engagement plans after the tender award.				x	x

Nature-inclusive design shows promise, but knowledge gaps must be filled

NID measures can be used to restore a degraded habitat, enhance ecological functioning, and promote biological production and diversity in an offshore wind farm (OWF), for cables to land and coastal infrastructures related to offshore wind. NID solutions must be tailored to the OWF technology and the biotope. NID measures are a fairly new mitigation option. While participating energy companies were familiar with the topic of NID, the awareness varied for other types of stakeholders. Stakeholder views also varied. The majority of workshop participants were positive, but pointed to challenges such as lack of knowledge, regulatory barriers and cost concerns. Four types of tender and allocation instruments were suggested, as shown in the table below.

GOVERNMENTAL INSTRUMENTS SUGGESTED BY WORKSHOP PARTICIPANTS TO FOSTER NID IN VARIOUS PHASES OF OWF DEVELOPMENTS.

Governmental instruments for fostering NID in OWF developments	Legislation	Prequal	Tender award	Licence
State NID goals in tender – required conservation and restoration objectives should be defined in line with the status and importance of biodiversity in the areas.			x	
Revise supporting regulations				
- Assess positive impacts of NID in Environmental Impact Assessments (EIAs)	x		x	x
- Allow for keeping successful NID solutions after decommissioning	x		x	x
Requirements to foster learning, including				
- Monitoring of NID solutions			x	x
- Knowledge and data sharing			x	x
- Facilitating research on site			x	x
- Overarching licensing programme – across sectors	x		x	x
Non-price criteria – should be considered, but it would be useful to acquire more knowledge regarding the efficacy of NID solutions first.			x	x

Additionally, several "non-tender" instruments were suggested, i.e. research, a Nordic evidence base for NID solutions, awareness raising, a verification concept and compensation for monitoring costs. The need for early stakeholder dialogue was also emphasised and a NID discussion forum suggested. It should be noted that the suggested instruments have not been qualified or prioritised, and that the Nordic EU and non-EU members do not have the same regulatory incentives for nature. All suggestions should be investigated further in a national context.

However, research and awareness-raising activities can and should be implemented without further delay. Several initiatives are calling business to action on biodiversity, for example the recently adopted Global Biodiversity Framework (GBF), which aims to halt and reverse biodiversity loss, and the proposed EU nature restoration law (Nordic EU members only). Several Nordic offshore wind players, such as Equinor, Hafslund, Mainstream Renewable Power (part of Aker Horizon), Vattenfall and Ørsted, already have goals addressing nature-positivity or net biodiversity gain. Internationally, NID solutions are pointed to as a key part of nature-positivity, and building the evidence base for NID should be a research priority. Options for NID research could be industry-funded research, the EU's Horizon Europe programme, a joint action programme under JPI Oceans, or preferably a targeted joint Nordic Action on research. Knowledge needs highlighted in the workshops include solid baselines for the OWF sites and knowledge regarding the impacts of NID solutions. NIVA would also like to stress the need for knowledge to tailor NID solutions to offshore wind in Nordic waters, in particular for floating wind. Impacts of a changing climate, non-commercial species, natural variation and cumulative impacts of OWFs, as well as the positive and negative impacts of NID solutions on fisheries, should also be addressed.

The willingness to facilitate and fund on-site research on NID could be rewarded in the consenting process. Should NID solutions prove to be effective in the long term, non-price criteria requiring NID measures could be introduced. The Nordic countries could then also jointly initiate an OSPAR assessment of whether full removal of offshore structures is the most environmentally friendly decommissioning strategy, keeping in mind the potential disadvantages of partial removal to other stakeholders.

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Chapter 1

Introduction

To fulfil the European Commission's (EU) climate neutrality target and to meet the increased demand for energy, a substantial expansion in renewable energy is required. For offshore wind (OW) the targets are to increase production from today's 190 GW to 510 GW in 2030 and 1300 GW in 2050 (EU, 2022). Development equivalent to 32 GW per year is required to hit the target for 2030. Recent development has shown that OW energy is both scalable and cost competitive, and the industry is ready to deliver the volumes required (WindEurope, 2022a). Key challenges to reach the needed expansion lie within potential conflicts for ocean space between OW and established maritime uses, nature conservation goals and permitting processes.

The ongoing development of offshore wind farms (OWFs) will require large surface areas of sea, often combined with claims of exclusive access. In addition, surface areas, grid connection, anchoring arrangements etc. will occupy a significant amount of pelagic and seabed space. The planned expansion of OW will entail additional pressures on environmental assets and spatial competition with established maritime uses like fisheries, shipping, military activities, aquaculture and tourism. An additional driver for future competition for marine space results from the Post-2020 Global Biodiversity Framework that was adopted at the UN Biodiversity Conference (CBD COP15). The framework includes a commitment for the signatory parties to effectively conserve or manage at least 30 per cent of terrestrial, inland water and coastal and marine areas by 2030.

The competition for space in the North Sea and the Baltic Sea, taking spatial requirements of different sea users and marine protected areas into account towards 2030 and 2050, is shown in Figure 1-1 (DNV, 2023).

In order to reach energy goals while at the same time accommodating established maritime uses and nature, there is a need to find good solutions to coexistence to minimise conflicts and maximise synergies. It will be vital to move away from a sector-by-sector management of marine activities to a more holistic and integrated approach to ensure sustainable solutions (DNV, 2023).

DNV's Energy Transition Outlook (DNV, 2022) identifies the following key permitting barriers for renewable energy projects and power and grid developments: rules are complex, procedures are slow, and there are too many administrative authorities involved (at national, regional and municipal level). These barriers result in projects

being hindered from the start and permitting costs being added to development costs and risk, which deters investors from developing projects. Reaching build-out targets will require reforms to current regulatory frameworks concerning permitting and tender design. The European Council is taking serious action in this matter and in October 2022 called for a fast-tracking of the simplification of permitting procedures in order to accelerate the rollout of renewables and grids, including by means of emergency measures.

Nature is currently under severe pressure from the activities of a growing human population. Awareness of the overall footprint of new activities is a must. According to the Living Planet Report 2022, there has been an average decline of 69 per cent in species populations since 1970 (WWF, 2022). The climate crisis and the nature crisis are two sides of the same coin. As the climate changes, natural habitats change, in turn aggravating climate change and causing biodiversity loss. Nature-based solutions are also key to solving the climate crisis. There is a double interlinked emergency of climate change and the loss of biodiversity. It is key that the expansion of renewables will be fast while at the same time applying sustainability and mitigation of adverse impacts on nature as guiding principles. Investigating how OW development could benefit nature while at the same time contribute to climate goals could be realised by implementing nature-inclusive design (NID). NID refers to options that can be integrated or added to the design of an anthropogenic structure to increase habitat suitability for target species or communities. NID is an area that has received a lot of interest lately but is less studied in the Nordic countries.

In this project we study opportunities related to consenting, stakeholders and the natural environment in a Nordic context for coexistence and NID. The project has been performed in a collaboration between DNV and NIVA. DNV has been responsible for the overall project management, workshop facilitation and the topic of coexistence, stakeholder dialogue, mapping and forecast. NIVA has been in charge of the NID aspect.

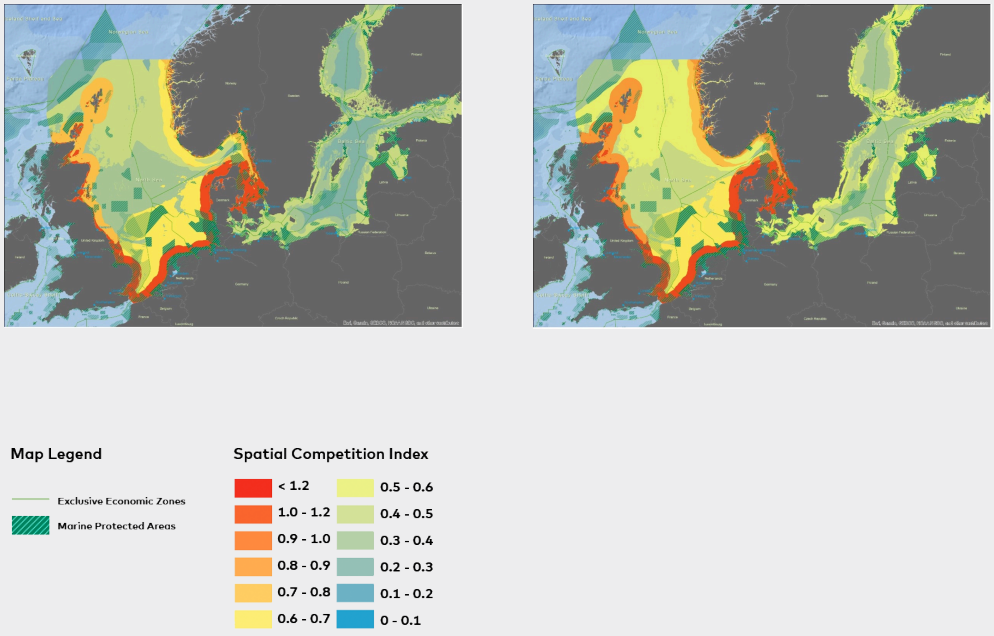

FIGURE 1-1. SPATIAL COMPETITION (GRADIENT FROM RED TO BLUE) IN THE NORTH SEA AND THE BALTIC SEA IN 2030 (left) AND 2050 (right).
The scale is a measure of combined area utilisation from all industries present in relation to available area. Red (as seen in the coastal zone) indicates all available area is used, implying competition for space, and that need for coexistence is prevalent. Marine Protected Areas are shown in shades of green. (DNV, 2023).

1.1 Aim of study

The aim of this study was to collect stakeholder views on how governmental instruments in the consenting process for OW development in the Nordics can be used to facilitate successful coexistence and NID. The study gives a list of suggested allocation and tendering instruments to inspire Nordic governments when deciding on process and criteria for opening areas for development, during prequalification of tenderers and the awarding of tenders and licences.

1.2 Process

The work was undertaken as a combination of literature review and stakeholder workshops. Two half-day workshops were organised: the focus of workshop 1 was on coexistence and NID, and that of workshop 2 was on stakeholder dialogue and on mapping and forecast approaches to accommodate coexistence. The workshops were organised as a combination of lectures from experts and facilitated group discussions. The literature review, workshop summaries and suggested governmental instruments for the consenting process are summarised in this report.

1.3 Contents of the report

The report contains:

- a high-level introduction to the status of and licencing procedures for OWF development in the Nordics
- definitions and key concepts related to coexistence and NID for OWFs
- examples of categories and uses of non-price criteria in OWF licencing processes
- workshop structure and key takeaways from discussions
- suggested governmental instruments to facilitate successful coexistence and NID for future OWF development.

Photos: Unsplash.com and Vattenfall

Chapter 2

Offshore wind farms in the Nordics

The status of fixed and floating OWF projects in the Nordics and neighbouring countries is shown in Figure 2 1. Bottom-fixed substructures are currently the most used design, and most of the development has taken place in the southern part of the North Sea, in the Kattegat and in the southern Baltic Sea. Two floating OWFs are online in Norway: Hywind Tampen, which provides electricity for the Snorre and Gullfaks oil and gas fields, and another for research purposes. There is one floating OWF online in Sweden. In the Nordics, Denmark is the country producing the most energy from offshore wind by far (2,308 MW), followed by Sweden (192 MW), Finland (71 MW) and Norway (2 MW) (WindEurope, 2022). By comparison, the UK is producing the most electricity from OWF in Europe, with 12,739 MW and 2,542 turbines connected. OW is currently in the planning phase in Iceland, the Faroe Islands, Greenland and Åland. The 2050 vision for the North Sea is 212 GW and for the Baltic Sea is 83 GW, so there will be considerable expansion compared to current capacities.

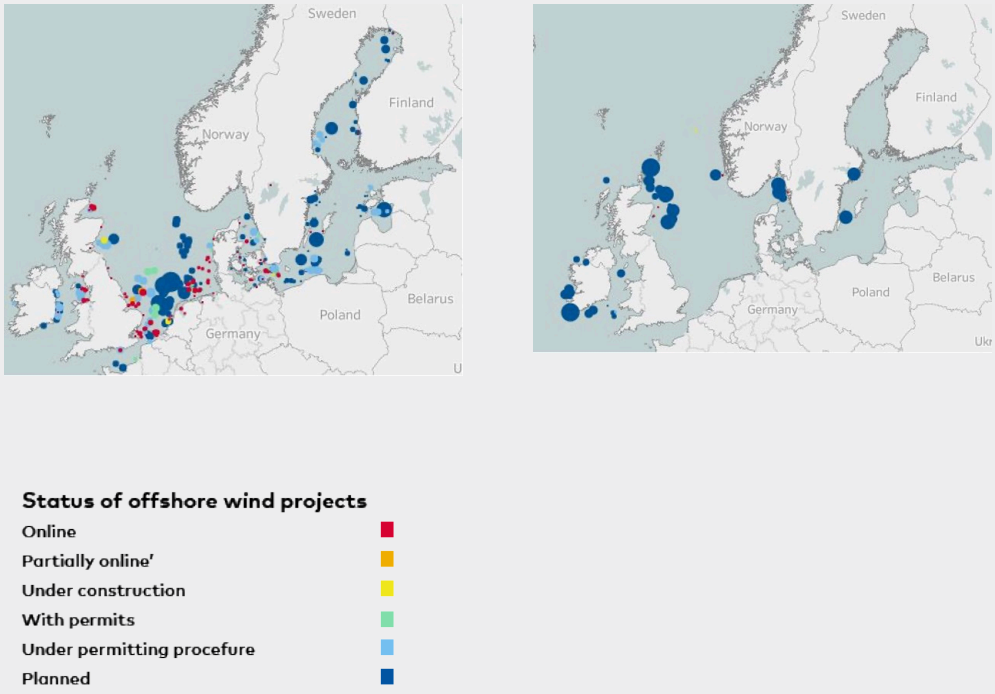

FIGURE 2-1. STATUS OF OWF PROJECTS BASED ON BOTTOM-FIXED (LEFT) AND FLOATING (RIGHT) TECHNOLOGY IN THE NORDICS AND NEIGHBOURING COUNTRIES. (WINDEUROPE, 2022B)

2.1 Consenting processes

There are differences and similarities between the various consenting processes in the Nordic countries for existing or near-future plans for OWF development: they can either follow a government-led process or an open-door process (Sweden and Denmark). Key phases of government-led consenting processes include screening to identify areas to be developed, prequalification of tenderers (based on financial capacity and competence within technological, environmental and safety aspects), followed by tender award/site allocation (often based on an action model), and finally the construction licence award (Figure 2 2). In the open-door process, the operators themselves take the initiative to identify areas and suggest project design. The open-door process is considered to be a higher risk for developers than the government-led process. A high-level description of consenting processes in Nordic countries is provided below.

Denmark has by far the most experience, and the development of OWFs can either be by means of a government call for tender or by an open-door application. The same permits are applicable for both alternatives (Danish Energy Agency, 2022). In the government call for tender procedure, the government covers all aspects involved in the planning and design of a project. Only the construction and operation part of the project is included in the call for tender. All tenders are decided in a political energy agreement (Danish Energy Agency, 2022). For the open-door alternative, the process of establishing an OWF is initiated by a private project

developer. The developer identifies areas and prepares design, applications and studies themselves for the authorities to review. The Danish Energy Agency processes and coordinates the application. The Danish system is so far based on auctions based on price-only criteria and follows a contract for difference (CfD) principle, where the operator sells the electricity at market price and receives a subsidy or must pay the government, according to the difference between the market price and the fixed-bid price.

The licencing procedure in **Norway** is still under development. The current version is described in the Guidelines for Site Allocation, Licensing Procedures, and Applications to Develop Offshore Wind Projects (Norwegian Ministry of Petroleum and Energy (MPE), 2021). The government is leading the process of opening areas for development, and the proposed guidelines for tender awarding (MPE, 2021) propose an auction model as the primary scheme for allocating areas for bottom-fixed OW development. For areas suitable for floating OW development, it is proposed that allocation will be based on a more qualitative competition to favour projects contributing to technology development. A potential allocation will give the winning applicant the right to (exclusively) submit a plan for impact assessment for the area, but does not guarantee a licence to operate. The impact assessment, licence application and development plan will be subject to public consultation. The developer will be expected to have an operational wind farm within three years of approvement of the detailed plan.

Wind power development in **Sweden** is primarily driven by the operators' and developers' investment plans, following an open-door approach, and is regulated by the permitting process and affected by spatial planning. The operators and developers identify locations for wind farm development, based on wind conditions, connection possibilities, the existing grid and the probability of obtaining a permit, based on other interests at the location in question. The developer applies for a permit for the construction and operation of the wind farm and for grid connection. In Swedish maritime territory, offshore wind developers need a permit for activities affecting the environment, as well as for activities at sea in accordance with the Environmental Code, in addition to the relevant municipality's approval. Applications for permits for offshore wind development are normally heard by the Land and Environmental Court. In addition to environmental permits, offshore wind developers also need permits to survey the relevant areas and lay cables in the maritime territorial zone.

In **Finland**, permitting procedures vary by location. In addition, locations in Finnish territorial waters and the economic zone are treated differently when it comes to the permits required. In 2021, the Finnish Ministerial Committee for the Economic Policy approved a proposal for an auction model to be used to lease public water areas managed by Metsähallitus (a state-owned enterprise that manages land and water in Finland). The aim was to accelerate the development of offshore wind projects under market conditions. The first auctions are planned to take place in late 2023 or early 2024.

Metsähallitus will conduct a preliminary survey of the areas and, based on this survey, will select those to be auctioned, taking into account the overall public

interest. Depending on the importance of the project, the Council of State or the Ministerial Committee for the Economic Policy will approve the areas to be leased and the terms and conditions of the auction before it begins. State authorities may also set minimum prices for leasing these areas. The winner of the auction will be responsible for, among other things, applying for the necessary permits. Planning and permitting for offshore wind projects can take five to ten years in Finland.

FIGURE 2-2: KEY PHASES IN THE GOVERNMENT-LED CONSENTING PROCESS IN NORDIC COUNTRIES.

2.2 Governmental instruments

In this study we define governmental instruments as measures and actions taken by governments during all phases of the OWF consenting process. This includes the process or framework applied during opening/screening for new development areas (baseline studies, stakeholder engagement processes etc.), requirements for prequalification of tenderers, action models for the tender award and requirements for construction and operation licences. Non-price criteria are an important instrument to reward solutions for coexistence and nature-inclusive design.

2.2.1 Non-price criteria

Up to now, wind farm auctions have mainly focused on reducing the cost of developers' OWFs, because price (of electricity generated) was the only criterion. However, non-price criteria can be utilised to reward aspects other than price, like protecting biodiversity and ensuring the smooth operation of wider energy systems. The recent EU Guidelines on State Aid for Climate, Environmental Protection and Energy (European Commission, 2022) now allow governments to include up to 30 per cent of non-price criteria in their selection criteria for auctions, and countries are now starting to apply non-price criteria in their auction models.

Permitting processes for OWFs already include a wide range of aspects, including local community engagement, life cycle assessment and decommissioning strategies. Ideally, non-price criteria should not be implemented as a second layer of obligation but rather to inspire innovation and the development of new solutions.

The European wind industry recommends (WindEurope, 2022c) that non-price criteria in wind energy auctions:

- complement, but do not duplicate, existing policy instruments
- are clear, objective, comparable and easy to assess/measure/monitor
- do not create additional administrative or management costs
- build upon the wind industry's strengths and incentivise incremental innovation
- are matched by equal and coordinated policies in adjacent economic sectors and supply chains
- prioritise three categories of criteria:
  - sustainability and biodiversity
  - system integration and innovation
  - European supply chain development and benefits to communities

Table 2-1 shows examples of categories of non-price criteria for licencing that national governments could consider as part of the selection criteria in an auction. The French, Dutch, Scottish, German and Belgian governments are now testing out the use of non-price criteria in their wind farm auctions (WindEurope, 2022c).

TABLE 2-1. EXAMPLES OF CATEGORIES OF NON-PRICE CRITERIA NATIONAL GOVERNMENTS COULD CONSIDER AS PART OF THE SELECTION CRITERIA IN AN OWF AUCTION (WINDEUROPE, 2022C).

Sustainability and biodiversity

- Reward circularity of current turbine design
- Reward projects with a recycling strategy
- Reward projects with a GHG emissions-reduction plan
- Reward projects with low biodiversity impacts
- Reward projects enhancing coexistence between species and with other economic sectors (e.g. organic agriculture or mussel farms)
- Reward projects built on degraded or agricultural land, man-made forests or non-pristine maritime areas

System integration and innovation

- Reward projects that increase a wind farm's capacity factor, e.g. through co-location with electric storage and/or solar, hydrogen production or demand
- Reward projects that secure cost-efficient integration of wind energy into the energy system through direct and indirect renewables electrification
- Reward projects that deliver ancillary services
- Reward projects that apply and invest in the development of new technology solutions, e.g. testing new (composite) materials or technologies (different floating foundations and moorings)
- Reward projects that enhance cybersecurity

European supply-chain development and benefits to European communities

- Ensure supply-chain development rules are set at European level and used in a coordinated manner
- Reward projects that have a strong community engagement offering
- Reward projects that contribute to a Just Transition, replacing fossil-fuel generation with renewables and re-skilling workers
- Reward projects that foster new business opportunities with other economic or societal actors


Photos: Unsplash.com

Chapter 3

Coexistence

In this study, coexistence refers to coexistence between OW and established maritime uses like fisheries, shipping, military activities, aquaculture and tourism, and coexistence with nature.

3.1 Definition of coexistence

Coexistence with established maritime uses is defined as activities taking place in the same geographical ocean area – ocean multi-use – but with different temporal, provisional and functional integration, as illustrated in Figure 3 1. The provisioning dimension refers to activities supporting the main function of use, like monitoring environmental data or safety installations. The functional dimension refers to a connection between one use function and the other, e.g. multi-purpose platforms designed to accommodate different uses and users. Opportunities and positive synergies increase when the level of integration between actors increases.

Coexistence between an OWF and nature includes aspects other than coexistence with maritime users, and is more about understanding and managing the OWF's impacts on and potential benefits for the natural environment. This understanding requires baseline data on the natural environment, application of the mitigation hierarchy (Bennum et al., 2021) to minimise impacts and optimise benefits, and continuous adaptive environmental monitoring of potential impacts. The planned expansion of OWFs in the Nordic will represent additional pressure on ecosystems that are already under pressure, but also opportunities, as summarised in DNV's recent report "Accommodating Biodiversity in Nordic Offshore Wind Projects" (NER, 2022). Challenges can be turned into opportunities by leveraging possibilities for increased understanding/learning combined with adaptive management as OW development proceeds.

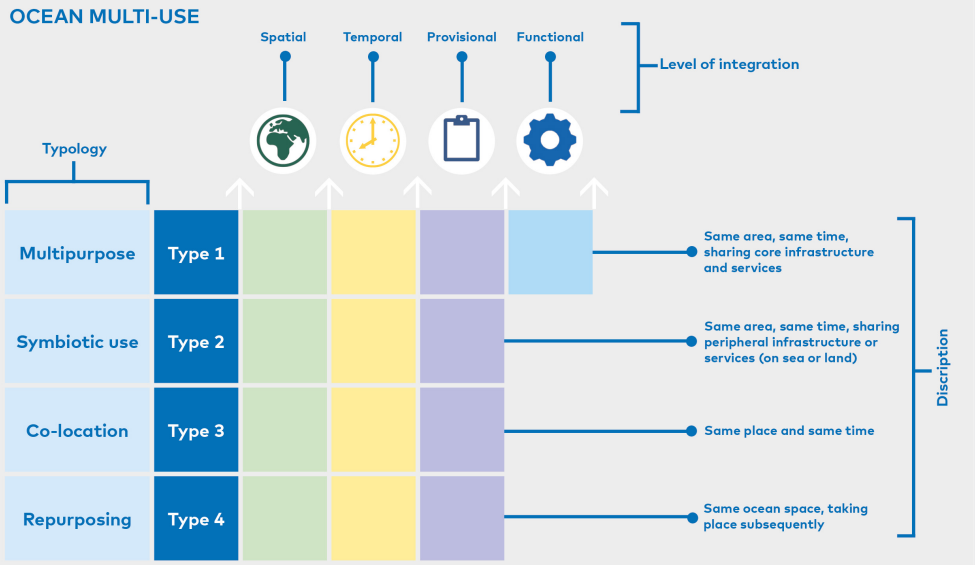

FIGURE 3-1. DIFFERENT TYPES OF OCEAN MULTI-USE INCLUDED IN COEXISTENCE BETWEEN OW AND ESTABLISHED MARITIME USES LIKE FISHERIES, SHIPPING, DEFENCE, AQUACULTURE AND TOURISM, AS DEFINED IN THIS PROJECT. (Illustration modified from Schupp et al., 2019 and DNV, 2023).


Photos: Unsplash.com

Chapter 4

Nature-inclusive design (NID)

Offshore wind farm (OWF) projects can affect biodiversity, for example by introducing physical changes, by producing noise and by creating electromagnetic fields from subsea power cables. Pelagic and benthic nutrient cycles may also be altered due to increased activity from a high accumulation of suspension feeders (Slavik et al., 2019). The intention of NID is to reduce adverse effects on affected areas and ensure that measures to protect nature are included in OWF development plans and projects. NID measures can be used to promote rehabilitation of a degraded habitat, enhance ecological functioning and increase biological production and diversity in an OWF area.

4.1 Definition of nature-inclusive design

NID refers to options that can be integrated into, or added to, the design of an anthropogenic structure with the aim of enhancing ecological functioning (Hermans et al., 2020). In the context of OWFs, NID refers to constructions designed to increase habitat suitability for native species or communities. The positioning of the different infrastructure parts within the designated area of an OWF (so-called micrositing) could also be regarded as a type of NID.

NID options have primarily been tested and developed for bottom-fixed structures (Figure 4-1), while similar options for floating structures remain unexplored. NID options can be classified into three categories, based on the part of the OWF infrastructure they apply to (Hermans et al., 2020):

1. Add-on options refers to structural additions to the design of an offshore substation (or a monopile), thus making NID integral to it (e.g. the Biohut® and cod hotels).

2. Optimised scour protection layer refers to an optimisation of a standard scour protection design for a monopile or a substation (e.g. additional rock layer,

adapted grading armour layer) or placing units on or in the scour protection layer (e.g. habitat pipes, reefball and Eco armour block, etc.).

3. Optimised cable protection layer refers to an optimisation of a standard cable protection design for subsea power cables or cable crossings.

In addition, changing the composition of concrete etc. can foster different growth. Calcium carbonate ($CaCO_3$) or natural shell can be mixed into concrete structures to provide a suitable chemical composition for larval settlement by calcareous organisms such as bivalves. Standalone, artificial reef units of various shapes can also be introduced to the OWF area to add habitat complexity and offer shelter to bottom-associated species.

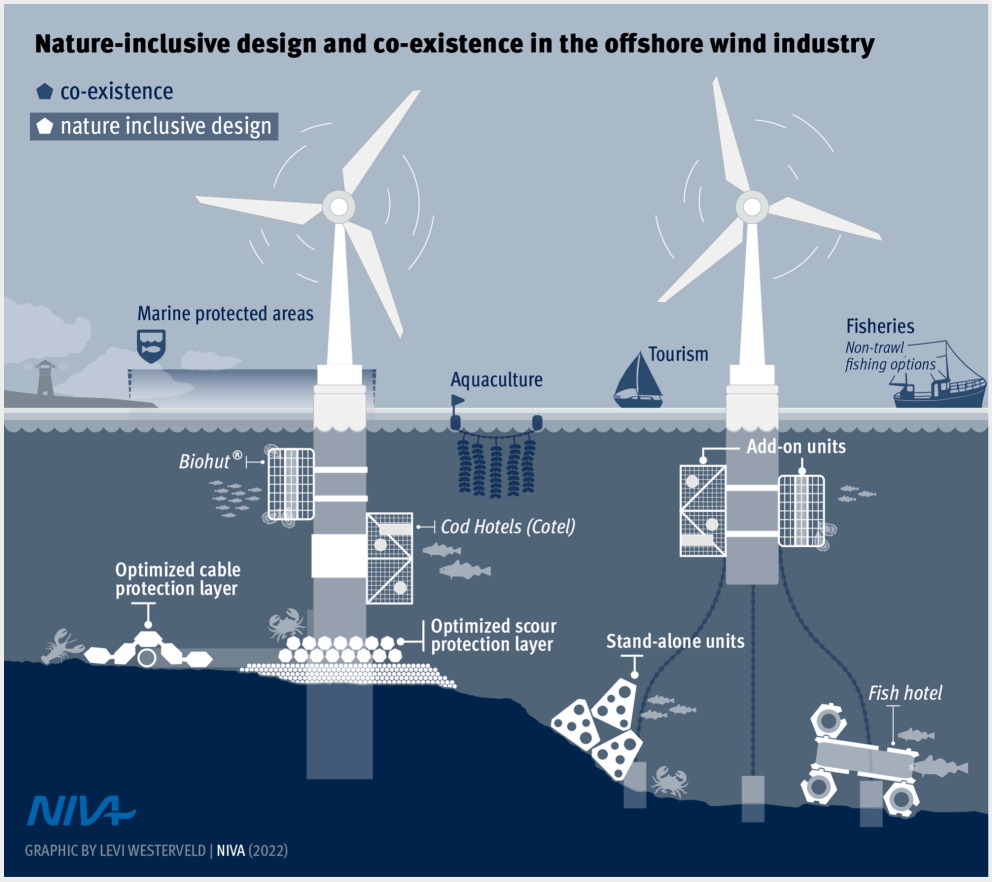

FIGURE 4-1. THE ILLUSTRATION SHOWS DIFFERENT NID OPTIONS AND SOME POTENTIAL TARGET SPECIES ON BOTTOM-FIXED AND FLOATING OFFSHORE WIND TURBINES AND SOLUTIONS FOR COEXISTENCE. (Illustration: Pardo et al., 2023, submitted)

4.2 Ecological opportunities and risks associated with nature-inclusive design

NID measures can be used to restore degraded habitats, enhance ecological functioning and promote biological production and diversity in an OWF area. By locally adapting and integrating NID measures, additional value may be created for targeted species and habitats; these could be key species, endangered species or species of commercial value. It is important to include the end users early on in the project phase to ensure the feasibility of NID options – feasibility that is reflected in both ecological and technical aspects.

When deployed, OWF structures, as well as any associated NID structures, act as artificial reefs and provide hard substrate for colonisation in areas often dominated by soft sea floor. Artificial reefs thus provide available surfaces where algae and invertebrates such as barnacles, corals and bivalves attach. Hence, it is reasonable to consider changes in the existing habitat and its associated macrofauna to be a typical feature associated with the installation of OWFs (Degraer et al., 2020), regardless of NID. Any introduced structures offer an empty niche for settlement and can become "stepping stones" for the spread of non-indigenous species. The ecological structure and functioning of the habitat may also change if firm structures are introduced on pristine soft-bottom areas. Hence, if NID structures do not function as intended, there is a risk that they, along with the OWF structures, will represent additional polluting elements in the ocean area.

On the other hand, the OWF structures may offer habitat for locally rare species, and species of conservation or commercial interest, enhanced by expedient use of NID. It is important to understand the role of these structures in maintaining local populations of such species. In that respect, aspects regarding the termination of OWFs and the implication for such species should be considered (see Fowler et al., 2020).

4.3 Current use of nature-inclusive design in OWFs

Use of NID in offshore wind farms is a fairly new measure, and therefore experience and scientific literature on this theme are limited, especially in connection with floating wind farms. Most of the limited literature on NID and OWFs pertains to bottom-fixed offshore wind turbines in the southern North Sea, in particular in the Dutch sector. Long-term monitoring data on the ecological effects from NID measures are still lacking (Pardo et al., 2023, submitted).

In terms of governmental instruments, the Dutch authorities have been pioneers in stimulating enhancement of ecological functioning during the development of offshore wind projects through nature regulations in wind farm site decisions and related permitting. The site decisions for the Borssele and Hollandse Kust (zuid) wind farm zones included the following regulation for nature-inclusive building: "The permit holder must make demonstrable efforts to design and build the wind farm in such a way that it actively enhances the sea's ecosystem, helping to foster conservation efforts and goals relating to sustainable use of species and habitats

that occur naturally in the Netherlands." In the wind farm site decisions for Hollandse Kust (noord) V, new and more specific requirements were introduced (material type, cavity size, surface area etc.). Rules may change for future wind farm decisions. It is also important to note that the permit holder is responsible for making a NID plan (Hermans et al., 2020).

On behalf of the Dutch authorities, Hermans et al. (2020) developed a catalogue of NID options that can be applied in the Dutch OWFs. The NID options in the catalogue are ready to use, with clear design guidelines and associated risks and costs. The catalogue was created to support the Dutch government in elaborating on nature regulations in future wind farm site decisions or related instruments, but also to support asset owners, wind developers and end users in implementing NID as a new standard in the offshore wind development industry, thus making it relevant for wind farm developers outside the Netherlands. US authorities have a similar catalogue targeted towards sea areas around the USA (INSPIRE Environmental and The Nature Conservancy, 2021).

In the Netherlands, such organisations as De Rijke Noordzee (The Rich North Sea) also work to establish nature development as a permanent element in the construction of every wind farm. One important goal is to restore flat oyster reefs that once were extensive along the Dutch coastline. The Rich North Sea Program has produced several reports on nature reinforcement in offshore wind farms and also developed a knowledge base for enhancing biodiversity in wind farms, accessible at derijkenoordzee.nl/kennisbank. The Danish company Ørsted, a global market leader in offshore wind energy, is a partner to this programme.

Ørsted was also awarded contracts for the Borssele 1 and 2 OWFs and worked with Wageningen Marine Research to introduce formations of concrete pipes to the sea floor, creating cavities for fish to hide and forage (orsted.com). Another major Nordic player in offshore wind, the Swedish company Vattenfall, won the contract for the Hollandse Kust Zuid wind farm. Their nature-inclusive design plans include adding large rocks to the regular scour protection to increase habitat complexity and further increase the ecological benefits for Atlantic cod and other species. Vattenfall is also working together with the Technical University of Denmark – DTU to integrate biodiversity components into life cycle assessment methodology to assess decommissioning strategies most beneficial for biodiversity. Vattenfall's Wind Reef project started in 2021 and will continue until 2025 (group.vattenfall.com).

4.4 Possibilities for nature-inclusive design in OWFs in Nordic waters

The suitability for NID applications will vary biogeographically, and water depth and the type of turbines used in an area will be of particular importance for case-specific NID options. Unlike bottom-fixed structures, floating turbines typically neither have a large horizontal scour protection platform on the seafloor nor an intertidal habitat. They may have some scour protection for anchors in high-current waters. So far, most bottom-fixed OWFs have been monopile structures deployed close to shore (< 20 km) in shallow waters (< 30 m depth). At greater depths, other technologies must be used as the current type of monopile is not suitable. This means that it will be relevant to accommodate other species through NID, and NID solutions must be adapted to both new technology and different biotopes.

Furthermore, the results derived from NID will vary depending on the initial state and resilience of the OWF area, with increased potential and chance for nature-positive effects in areas already altered or affected by human impact (i.e. areas where the seabed is physically disturbed from bottom trawling or petroleum activities). It is therefore important that NID options and target organisms are selected based on site-specific ecological knowledge, and that the spatial and temporal distribution of sensitive species is carefully assessed. For example, Nordic Seas areas have strong gradients in salinity and species diversity.


Photos: Unsplash.com

Chapter 5

Workshop summaries

Two half-day workshops were organised with a wide range of stakeholders involved in, or impacted by, OW development in the Nordics. Significant efforts were made to achieve broad participation, both from all Nordic territories, as well as from all relevant stakeholder groups, to ensure relevance and eligibility for findings. Invitations were sent to all major Nordic stakeholder groups, and key Nordic energy companies and NGO groups were represented at the workshops. In our opinion, attendance reflected the current status of OWFs in the Nordic countries, with a particularly high focus in Norway due to the upcoming prequalification of tenderers and OWF auctions later this year. Attendance lists were communicated to and approved by Nordic Energy Research prior to each workshop. The collected input is considered relevant for the Nordic Seas.

The first workshop had around 70 participants and the second around 50, representing energy companies, trade organisations, governmental organisations, financial institutions, technology providers, the research field and non-governmental organisations (NGOs). Most participants were from Nordic countries, as shown in Table 5-1.

TABLE 5-1. OVERVIEW OF ORGANISATIONS REPRESENTED AT THE WORKSHOPS.

NO = Norway, SE = Sweden, DK = Denmark, B = Baltic, BE = Belgium, NL= The Netherlands, UK = The United Kingdom.

Stakeholder groups	Organisations
Energy companies	Aker Offshore Wind (NO), Statkraft (NO), Vattenfall (SE), Ørsted (DK), Vårgrønn (NO), RWE (DK), Equinor (NO), Technip FMC/Magnora (NO), Seagust (NO)
Aquaculture	Utror (NO)
Trade organisations	Offshore Norway (NO), Norwegian Offshore Wind (NO), Havfram (NO), Danmarks fiskeforening (DK), Fiskarlaget (NO)
Governmental organisations	VASAB (B), Statnett (NO), Norwegian Environment Agency (NO), Danish Energy Agency (DK)
Financial institutions	DNB (NO), KLP (NO)
Technology providers	Bladt Industries (DK), Aibel (NO), Kongsberg Maritime (NO), De Rijke Noordzee (NL), Spoor (NO), Nature Metrics (UK), Wee (NO)
Research	University of Bergen (Faculty of Law) (NO), University of Århus (DK), Royal Belgium Institute of Natural Sciences (BE), Institute of Marine Research (NO), The Netherlands Enterprise Agency (NL), Akvaplan-NIVA (NO), Aqua DTU (DK), IVL – Swedish Environmental Research Institute (SE), Biodiv-Wind SAS (UK)
NGOs	WWF (NO, DK), Bellona (NO), Tenketanken hav (DK), Green Power Denmark (DK)

The workshops were organised as a combination of presentations from subject-matter experts and facilitated group discussions. Significant efforts were made to find relevant and inspiring experts to introduce the topics. External subject-matter experts who contributed presentations included

- Steven Degraer (Royal Belgium Institute of Natural Sciences, Workshop 1)
- Paulina Ramirez-Monsalve (NIVA Denmark, Workshop 2)
- Jan Peter Oelen (Netherlands Enterprise Agency, Workshop 2).

Internal experts from the project team who contributed presentations included

- Camilla With Fagerli (NIVA, Workshop 1)
- Øivin Aarnes (DNV, Workshop 2)
- Anna Ervik (DNV, Workshop 2)
- Solrun Figenschau Skjellum (NIVA, Workshops 1 and 2)
- Marte Rusten (DNV, Workshops 1 and 2).

Participants were divided into groups of six to ten for discussions. The groups had an assigned facilitator from the participant group and a record-keeper from the project team. In Workshop 1, the NID groups were primarily facilitated by the NIVA group.

Different aspects of coexistence and NID were covered, the overall aim being to

collect stakeholders' views on governmental instruments to inspire successful coexistence and nature-inclusive design. The first workshop focused on identifying stakeholder needs to achieve successful coexistence and NID, whereas the second focused on stakeholder engagement including processes and dialogue, together with mapping and forecasting tools for marine spatial competition. An overview of the questions discussed is provided in Figure 5-1.

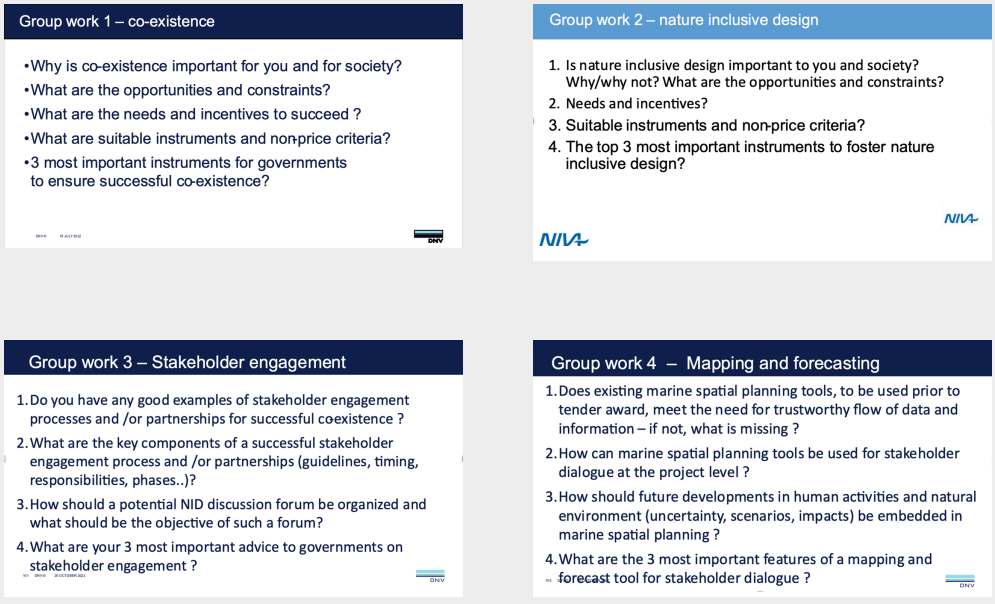

FIGURE 5-1. QUESTIONS FOR GROUP DISCUSSIONS.

5.1 Summary of discussion on coexistence and stakeholder engagement

In order to capture views from different stakeholders' perspectives, group work 1 was performed in groups with participants representing similar stakeholder interests (to the degree possible). Participants expressed general views on coexistence, as well as opportunities, needs and constraints for successful coexistence within innovation, data and knowledge, finance, stakeholder engagement, climate and regulations. Discussions are summarised below and in Table 5-2.

General perspectives on coexistence

Energy company representatives considered planning for and implementing good solutions for coexistence as part of their licence to operate. They also expressed that governments should take responsibility for setting a framework for coexistence. They

considered that successful coexistence would be crucial to solving both the climate crisis and the nature crisis, and that it would help in avoiding delays in the concession process.

Stakeholders from the finance sector expressed that they had a higher focus on nature enhancement than on coexistence. Spatial efficiency resulting from coexistence was considered beneficial as it could be a way to combine investments and also serve as a platform for negotiation and compensation.

From a fisheries perspective, coexistence was considered challenging because of a potential conflict for space as OWF developers often seek shallow waters, which are the same areas often used for fishing. In reality (from the perspective of the Norwegian fishermen), it is currently not possible to fish in areas that are used for OW, but efforts should be made to identify solutions/technology to accommodate this. They also expressed that there is a lack of data on distribution and impact of OWFs on pelagic species, that there is confusion around area requirements for planned OWFs, that wind farms must not be placed in spawning grounds and that there is a lack of knowledge about coexistence between fisheries and floating OWFs.

From a nature (environmental) stakeholder perspective, concerns were expressed that most of the planned development will happen in coastal, nature-rich areas. Coastal ecosystems are under pressure, and it is not known how much additional pressure these ecosystems can sustain, at a local and regional level, taking cumulative impacts into account. It was emphasised that society needs more renewable energy without affecting nature.

Output from discussions during group work 1 is summarised in Table 5-2, systemised according to the topics of innovation, data & knowledge, finance, stakeholder engagement and climate. Suggested governmental instruments are listed in Chapter 6.

TABLE 5-2. KEY TAKEAWAYS FROM GROUP WORK 1 ON COEXISTENCE (OPPORTUNITIES, NEEDS AND CONSTRAINTS), SYSTEMISED BY THE TOPICS OF INNOVATION, DATA & KNOWLEDGE, FINANCE, CLIMATE AND LEGISLATION.

INNOVATION

Opportunities

- Opportunity in itself to identify new opportunities for coexistence and related benefits
- Opportunity to establish great industry development, circular economy and energy transition
- Opportunity to drive technology development
- Opportunity to make coexistence not be a risk
- Opportunity to develop operational factors that do not hinder coexistence with fisheries
- Opportunity to develop technology for fishing methods compatible with OWFs
- Opportunity to develop new value chains

Need

- To develop technology for environmental monitoring, including unmanned sensors that are cost-efficient and have a smaller environmental footprint

DATA & KNOWLEDGE

Opportunities

- Opportunity to obtain data on the environment (leverage the number of installations in the water)
- Opportunity to coordinate data collection
- Opportunity to learn along the way and allow for an iterative process

Constraints

- Challenging to prioritise environmental factors
- Knowledge gaps and lack of understanding nature at a high, general and system level
- Lack of understanding between stakeholders (fisheries and renewables sector)
- Lack of clear framing of the problems coexistence should solve
- Lack of clear, understandable communication of knowledge
- Not clear how to measure the value of nature vs energy
- Established perception that wind farm areas must be no-go zones because of safety issues
- Too little resources and mandate for environmental authorities (in Norway)

Needs

- Environmental baseline before start
- Criteria to be used in consenting process should be based on robust data
- Clear definitions of objectives for coexistence
- Marine spatial plan
- Site-specific knowledge about resources (nature mapping and seabed) opportunities for coexistence and stakeholders

- A better understanding of risk related to coexistence
- Better sharing of data, possibly linked to the national environmental monitoring programmes
- Better utilisation of funding of research
- Structured, standardised way of collecting data at sea basin levels (protocols and best practice for data collection before, during and after). Can be area-specific

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FINANCE

Opportunities

- Key to profitability
- Successful coexistense is key to profitability
- Could allow larger investments, as there is a possibility to monetise in several sectors at the same time
- Identify and focus on value creation at the interfaces between actors
- Benefits from investments in nature restoration
- Identify financial solutions to compensate impact (shipping)

STAKEHOLDERS (INCLUDING NATURE)

Opportunities

- Increase trust
- Opportunity to learn more about stakeholders' needs and concerns
- No-go fishing areas may be positive for ecosystem and provide increased fishing outside the wind farm
- Opportunities for nature enhancement

CLIMATE

Opportunity

- Opportunities for reducing climate footprint by coordinating logistics

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REGULATIONS

Opportunities

- To use tendering as a main instrument to obtain coexistence
- Licences could include obligation to allow for new sea users
- Include standards and guidelines on monitoring and research and nature-inclusive design, quantitative guiding in regulations
- The same call can include a requirement to produce both energy and food from the ocean
- Move away from price criteria, as they can hinder development of solutions and innovation

- Regulatory requirements may "force" sectors to interact
- OWF owners need to be incentivised to give other users access to space
- Coordinate regulations in different sectors

Needs

- In Denmark there could be a better system to reward positive impacts of the activities – this is better captured in Norway through the ESIA (Environmental and Social Impact Assessment)
- Predictable (good) concession processes that balance cost and responsibility
- Coordination of legislations is essential
- Governmental instruments should be specific, quantifiable and verifiable (need to be verified after a certain number of years to verify that the criteria work as they should)
- Sustainability should be first priority for non-price criteria (including local content and coexistence)
- Pre-qualification process/criteria should be general (basic requirements to qualify)
- An expert committee for setting/evaluating the criteria
- Site-specific considerations: should differentiate with some areas, with tenders focusing on innovation
- Dynamic assignment of areas

5.2 Summary of discussion on stakeholder dialogue and partnerships

In order to capture agreement/disagreement between stakeholders, group work 3 was performed in mixed groups. Participants highlighted good examples of stakeholder engagement and expressed general views on stakeholder engagement related to knowledge, process and predictability. The discussions are summarised below and in Table 5 3.

Many examples were brought up from both government-led and project-specific stakeholder engagement processes. The North Sea Agreement from the Netherlands was highlighted as an example of a successful government-led approach in several of the groups. The North Sea Agreement was presented to the Dutch House of Representatives in June 2020 (Physical Living Environment Consultative Body, The Netherlands, 2020). The agreement resulted from the North Sea Consultation and included agreements between central government and stakeholder parties about choices and policy in the North Sea to 2030 and beyond. It was initiated to achieve a balance between nature, energy production and food resources in one of the busiest seas in the world. An important outcome is that there is now an agreement that offers a negotiated future strategy. There is a common understanding and expectation that protection of nature and production of sustainable energy is increasing in the North Sea, and that there will be more money made available for research and for making the fishing fleet more sustainable. The consultations started in 2019 and included port organisations and NGOs. In 2021, it expanded to include a wider range of stakeholder groups and fisheries.

It was also mentioned that government-led stakeholder dialogue early in the opening/screening process can be efficient, especially as it may include information not available to the general public, for instance related to planned military activity. The open-door process in Sweden has been shown to be especially slow due to the lengthy process of understanding military area usage and demand by individual developers.

The offshore wind forum in Norway, where stakeholder groups are invited by the government to discuss opportunities and challenges around OWFs, was mentioned as being a good start for defining a framework for sustainable coexistence in Norway.

Examples of successful stakeholder dialogue at the project level included Equinor's process featuring discussions with the UK Ministry of Defence as part of project developments in south-east England. Early in the project phase there was a major issue due to interference with radar signals. The military is a complex stakeholder with a high threshold for satisfying requirements. Discussions took several years but a good solution was identified. It was also mentioned that offshore wind farms have been positive for some fisheries south of England, and for lobster fisheries in particular. The collaboration between Ørsted and local lobster fisheries was mentioned as an example of a fruitful partnership. The activities by the aquaculture companies Lovundlaks and Utror on the small island of Lovund were mentioned as examples of how new industry could be beneficial for the local community by creating new jobs and investment possibilities.

The takeaways from the group discussions on stakeholder engagement can roughly be classified in three main topics: knowledge, process and predictability. Output from the discussion is summarised in Table 5-3.

TABLE 5-3. KEY TAKEAWAYS FROM GROUP WORK 3 ON STAKEHOLDER DIALOGUE AND PARTNERSHIPS, SYSTEMISED BY THE TOPICS OF KNOWLEDGE, PROCESS AND PREDICTABILITY.

Knowledge

- Availability: Information and data are a required basis for stakeholder engagement and to identify workable and practical solutions.
- Quality and competence: In addition to availability, data must be of the required quality and resolution, and be combined with competence to evaluate the data in a local context. There is also a need to understand/accept that not everything is known.
- Communication: Honest, transparent and understandable communication of data is fundamental for successful stakeholder engagement.
- Experience transfer: Leverage experience and best practice from other countries.

Process

- General: The stakeholder process should have a clear mandate and include social scientists. The process can be proactive or reactive. An ideal process will be proactive, solving issues at an early stage. Stakeholders should agree on a common goal, otherwise it will not work.
- Responsibility: Stakeholder processes should primarily be managed by the governments during the opening processes and governemnts should set the framework for project-based stakeholder engagement.
- Participation: All affected parties should be listened to. Everyone who wants to join the process should be invited, and in turn they should ask their network to join. Same-level participation is important and the process should be balanced with the need for efficiency.
- Timeline: Early contact/engagement is important. Stakeholder engagement should from the outset be based on a plan that defines all stakeholders and key stakeholders, communication channels (including feedback loops) and knowledge sharing.
- Trust: Trust in the process should be built from the local level to the municipality level, to the county level, to the national level. Trust is linked to transparency. The process should be facilitated by an independent party (chairperson) with knowledge about the process.

Predictability

- Predictability is difficult but key.
- It is impportnat to obtain predictable timelines of activities and early engagement with a clear goal (cf. community of practice approach in the Netherlands).
- Rules and regulations must be clear.
- Regulatory bodies should communicate with each other and have an understanding of each other's points.
- Stakeholder engagement should be long-term and continuous.

5.3 Summary of discussion on mapping and forecast

The topic of group work 4 was tools and approaches for mapping and forecast of cumulative pressure as a basis for creating a common understanding of current knowledge and future cumulative pressure in the ocean space. The discussions were performed in mixed groups. General considerations from discussions include that map solutions should go beyond just mapping, be a tool for planning activities and serve as a basis for communication with stakeholders. The discussions focused on features/contents, quality/trust, user-friendliness and communication, and are summarised according to these topics in Table 5-4.

TABLE 5-4. KEY TAKEAWAYS FROM GROUP WORK 4 ON MAPPING AND FORECAST, SYSTEMISED BY THE TOPICS OF FEATURES/ CONTENTS, QUALITY/TRUST AND USER-FRIENDLINESS/COMMUNICATION.

FEATURES/CONTENTS **Solutions should:** • be adaptive and easily take in new information on developments (e.g. new wind farm designs, tidal, wave, floating solar) • represent dynamics of nature, ecosystems etc., including baseline indicators • communicate potential gains for new infrastructure at a local level • be based on a common understanding of definitions • display residual risks associated with development of a particular area • propose a list of stakeholders, include stakeholder-relevant information, and be based on multiple stakeholders' input to mitigate the risk of blind spots • be open-source • include cross-border data that provides a full picture in all impacted areas • include forecasting that highlights the differences among alternative scenarios for different development objectives (energy, food, conservation)
QUALITY/TRUST IN DATA **Solution/approach should:** • be based on controlled and updated input data (important to build trust) • include degree of accuracy/reliability of the data • include information about when updates are available for the data upon which the forecast is based • be based on an agreed set of input data that are analysed by experts
USER-FRIENDLINESS AND COMMUNICATION **Solution/approach should:** • be easy to use and easy to communicate • be accessible for the wider public • not create barriers by using difficult language – the person in the street should be able to understand the "message"

5.4 Summary of discussion on nature-inclusive design

Nature-inclusive design was discussed in mixed groups, as NID solutions must be technically feasible and support coexistence. "Mixed groups" means that the various groups of stakeholders were represented in all groups to the greatest extent possible.

Key takeaways from discussions on NID solutions

While participating energy companies were familiar with the topic of nature-inclusive design (NID), the awareness varied for other types of stakeholders. Some participants had little knowledge about NID, which mirrors the fact that nature-inclusive design is a new mitigation option that only started appearing in both scientific and non-scientific literature a few years ago. The highlights from the NID discussion are as shown in Figure 5-2.

FIGURE 5-2. KEY TAKEAWAYS FOR DISCUSSION ON NATURE-INCLUSIVE DESIGN.

Many think NIDs are a necessity, but some think money is better spent elsewhere
Consensus on minimizing damage to ecosystems
Insufficient koowledge - need to monitor, learn and research
Regulatory barriers (i.a. decomissioning requirements) and cost concerns
Want even playing field, but also rewards for NIDs
Need early stakeholder dialouge and some suggest a discussion forum

The questions asked about NID were identical to the questions regarding coexistence, with the exception that the question regarding the importance of NID was an open question, not assuming a positive opinion. This was done to test whether there is caution or scepticism linked to nature-inclusive design. This was confirmed. There appeared to be consensus regarding the importance of minimising negative impacts on ecosystems, but not consensus on whether NID solutions are a required tool to ensure biodiversity. The majority were positive to NID, but some argued that there are other, more efficient, ways of conserving and restoring biodiversity. However, a key cause of the caution/scepticism towards NID appeared to be the lack of documented long-term impact of NID measures. All groups

emphasised knowledge gaps and in particular limited knowledge on the impact of NID solutions. The need for monitoring, learning and research was underlined by many of the groups.

Some of the groups pointed to regulatory barriers to NID measures, in particular decommissioning requirements. Denmark, Finland, Iceland, Norway and Sweden are all contracting parties to the OSPAR Convention, which aims to protect the marine environment of the north-east Atlantic, including the Greater North Sea (ospar.org). The OSPAR framework's default is that all offshore installations should be fully removed at end-of-life. If "significant" reasons exist, the coastal state can issue a permit to leave parts of the infrastructure at sea, typically extremely heavy steel installations and some types of concrete installations (Trubbach, 2020). Several of the groups were concerned that removing the OWF structures and associated NID solutions could potentially outweigh any long-term ecological benefits of NID.

The Rig-to-Reef project in the USA has been testing out leaving artificial reefs behind. Upon decommissioning of oil and gas platforms in the Gulf of Mexico and California, developers apply to leave a portion of each structure in place to continue functioning as an artificial reef. Part of the costs saved by not removing the entire structure are put toward management of the artificial reef. Monitoring studies that have been sponsored by the federal government include addressing habitat value, fish recruitment and attraction, and impacts to species upon platform removal (Nature Conservancy and Inspire Environmental, 2021). Some results from the USA point in a positive direction. However, there is little information from OSPAR waters. Monitoring and research in OSPAR waters is required for OSPAR to consider revisions of the decommissioning regime. It should also be noted that partial removal is not without risk or disadvantages, and can for example pose a coexistence problem for fisheries.

In addition, Environmental Impact Assessments for offshore wind typically focus on reducing negative impacts, not on positive impacts, which some of the stakeholders find may impede the development of NID solutions. Cost concerns, in particular for additional monitoring, were also highlighted as a barrier.

Interestingly, there was support for both "a level playing field for NID" (e.g. cost sharing) and rewards for applying NID. The importance of early stakeholder dialogue and the involvement of researchers were underlined, and several groups suggested a NID discussion forum for sharing knowledge.

The compiled list of top 3 instruments is presented in Appendix A. See also Table 6-3 for instruments.

Details on opportunities, constraints, needs and incentives

Details regarding the groups' answers on opportunities, constraints, needs and incentives are shown in Table 5-5.

TABLE 5-5. LIST OF INPUT FOR OPPORTUNITIES, CONSTRAINTS, NEEDS AND INCENTIVES RELATED TO NID SOLUTIONS.

Opportunities

- Licence to operate
- Claim of nature-positivity (when possible to document)
- Attract investors/capital
- Possible to increase knowledge as many ongoing projects

Needs

- Insufficient knowledge – intended impact not guaranteed
- Technical constraints – must be understood by regulators
- Cannot yet document nature-positivity
- Regulatory barriers, e.g. decommissioning and Environmental Impact Assessments (EIAs)
- Increased costs
- Risks associated with NID

Needs and incentives

- Need to increase knowledge and learn
- Need to use funding and financial resources more strategically (to learn)
- Need to tackle monitoring costs for NID (share or compensate)
- Need early dialogue/discussion forum
- Even playing field vs reward innovation


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Chapter 6

Suggested governmental instruments

The governmental instruments suggested by stakeholders to ensure successful coexistence, stakeholder engagement and NID are presented below.

6.1 Coexistence and stakeholder engagement

Suggested governmental instruments to ensure successful coexistence and stakeholder engagement are presented in Table 6-1. Many of the instruments are of a general nature and are applicable throughout the consenting process focusing on frameworks, process and cross-border collaboration, data collection and research. Non-price criteria are suggested as a tool to facilitate both coexistence and stakeholder engagement. The suggested tender and allocation instruments have not been qualified or prioritised. All the suggestions should be investigated further in the context of the different Nordic states, autonomous territories and regions.

TABLE 6-1. SUGGESTED INSTRUMENTS FOR GOVERNMENTS TO ENSURE SUCCESSFUL COEXISTENCE IN DIFFERENT PHASES OF THE CONSENTING PROCESS.

Governmental instruments for successful coexistence	General	Opening	Prequal	Tender award	Licence award
Apply a defined process to clarify what coexistence topics need handling. Explore the problem and do not focus on the solutions early.	x	x	x	x	x
Follow a clear and defined process to quantify coexistence and deliverables on coexistence, including agreed and communicated goals, basis and processes.	x	x	x	x	x
Apply transparent platforms and roundtables for processes and sharing information to secure transparent processes and trustworthy flow of data/information by using reliable third parties.	x	x	x	x	x
Make environmental monitoring programmes a "backbone" in a long-term strategy for OWFs to allow for knowledge-based adaptive management.	x	x	x	x	x
Stimulate and support strategic research and joint industry programmes and ensure knowledge transfer between programmes and towards society.	x	x	x	x	x
Consider cross-regulatory legislation and facilitate coordination between countries and between national agencies, as is the case with HELCOM or OSPAR.	x	x	x	x	x
Potential opportunities for coexistence should be a part of the process of opening areas and be integrated in Marine Spatial Planning (MSP). MSP should include mapping of stakeholders and need for coexistence in an area.	x	x			
Apply consenting criteria/solutions that enforce coexistence solutions on the developer before they construct.			x	x	x
Set non-price criteria with transparent and robust evaluation criteria to be evaluated (e.g. by expert committee) in the tender process to be fulfilled before award.			x	x	x
Utilise market (and potentially public) dialogue as an instrument to design tender criteria and to facilitate coexistence approaches in the industry at large.			x	x	x
Consider combining requirements for energy production with production of food or other products to ensure collaboration in the design phase.			x	x	x
Apply a permit requirement that operators should accept new stakeholders in the licencing area if public authorities can balance operators' interests against newcomers'.					x

TABLE 6-2. SUGGESTED INSTRUMENTS FOR GOVERNMENTS TO ENSURE SUCCESSFUL STAKEHOLDER ENGAGEMENT IN DIFFERENT PHASES OF THE CONSENTING PROCESS.

Governmental instruments for successful engagement	General	Opening	Prequal	Tender award	Licence award
Ensure efficient communication of scientific advice to governments and facilitate a common understanding of knowledge among stakeholders.	x	x			
Identify and communicate incentives for stakeholders of planned activities.	x	x			
Set the framework for the stakeholder discussion and agree with stakeholders on the framework, including the scope, language and information sets upon which the engagement process can be built.	x	x			
Facilitate a safe and stable meeting space with a capable and neutral facilitator.	x	x			
Ensure transparency around the broader stakeholder engagement scope and communicate timescales for regulatory activities that incorporate stakeholder engagement.	x	x			
Facilitate knowledge transfer from other countries.	x	x			
Start the engagement as early as possible and bring in local stakeholders.	x	x	x	x	x
Stakeholder engagement should be tailored to the process.	x	x	x	x	x
Ensure mandatory early stakeholder engagement as part of the public tender requirements for OWFs.			x	x	x
Include criteria for stakeholder engagement in competition.			x	x	
Require stakeholder engagement plans after the tender award.				x	x

6.2 Nature-inclusive design

Suggested instruments for governments to ensure successful NID are presented below.

TABLE 6-3. SUGGESTED GOVERNMENT INSTRUMENTS FOR FOSTERING NID IN DIFFERENT PHASES OF OFFSHORE WIND DEVELOPMENTS.

Governmental instruments for fostering NID in OWF developments	Legislation	Prequal	Tender award	Licence
State NID goals in tender Required conservation and restoration objectives should be defined in line with the status and importance of biodiversity in the areas.			x	
Revise supporting regulations				
- Assess positive impacts of NID in Environmental Impact Assessments (EIAs)	x		x	x
- Allow for keeping successful NID solutions after decommissioning	x		x	x
Requirements to foster learning, including				
- Monitoring of NID solutions			x	x
- Knowledge and data sharing			x	x
- Facilitating research on site			x	x
- Overarching licensing programme – across sectors	x		x	x
Non-price criteria Should be considered, but it would be useful to acquire more knowledge regarding the efficacy of NID solutions first.			x	x

No groups specifically discussed prequalification requirements for NID. However, a general prequalification requirement for nature (see coexistence) will foster NID, as NID solutions are essentially a tool for enabling coexistence.

Other governmental instruments

Some of the suggested policy instruments did not relate to tender and allocation. Given that NID solutions are new, awareness raising, communication and a common terminology ensuring understanding across stakeholders were mentioned. Compensation for monitoring costs and/or cost-sharing schemes for NID pioneers were suggested. The majority of other instruments did however address the need to increase knowledge and build trust through research calls, including calls for learning

and evaluations, joint EU and/or Nordic funding, joint industry projects, a common evidence base for the Nordics, as well as early stakeholder dialogue including researchers and an NID discussion forum to share knowledge. In addition, a third-party verification concept was suggested.

NIVA recommends tailoring NID solutions to OWFs in Nordic waters and testing long-term impact

In December 2022, the Post-2020 Global Biodiversity Framework (GBF) was approved at the 15th Conference of the parties to the Convention on Biological Diversity (CBD). The GBF aims to halt and reverse biodiversity loss, ensure sustainable management of biodiversity and protect indigenous rights by 2050. By 2030, the world should effectively conserve or manage at least 30 per cent of terrestrial, inland water, and of coastal and marine areas, and ensure that at least 30 per cent of areas of degraded terrestrial, inland water, and coastal and marine ecosystems are under effective restoration. The framework also points to the private sector's responsibility in achieving these goals. For example, it states that actions should be taken to ensure that large and transnational companies and financial institutions regularly monitor, assess, and transparently disclose their risks, dependencies and impacts on biodiversity. This is relevant for several of the Nordic offshore wind players. Similarly, the task force for nature-related financial disclosures encourages the private sector to raise ambitions for biodiversity actions (not yet finalised), and the EU is working actively on new instruments that are relevant to the private sector, such as the EU taxonomy (in force) and a suggested nature restoration law for land and ocean.

Globally, several companies are already responding to this development through objectives related to nature-positivity. In the Nordics, some examples of offshore wind players with ambitions related to nature-positivity or net biodiversity gain include Ørsted (Denmark), Equinor, Hafslund and Mainstream Renewable Power, part of Aker Horizon (Norway) and Vattenfall (Sweden). In a literature review NIVA has performed for Equinor, we found that "nature-positivity" lacks a clear definition and a methodology for documenting positivity, but nature-inclusive design is discussed as a key tool for nature-positivity (Pardo et al., 2023, submitted). We therefore believe it is important that NID solutions be tested in and tailored to OWFs in Nordic waters. Should NID solutions prove to be effective in the long term, the Nordic countries could jointly initiate an OSPAR assessment of whether full removal of offshore structures is the most environmentally friendly decommissioning strategy, keeping in mind the potential disadvantages of partial removal to other stakeholders. It should be noted that OSPAR also includes a definition stating that "An artificial reef is a submerged structure placed on the seabed deliberately, to mimic some characteristics of a natural reef" (OSPAR, 2013). This excludes wind turbine structures per se, but includes NID solutions.

Also, the biodiversity impacts of OWFs are not confined to wind farms. The use of NID should also be considered elsewhere, e.g. for cables to land and coastal infrastructure, such as sites for manufacturing and storing turbine components and industrial harbours.

Nature-positivity should be interpreted as net biodiversity gain, at least at project level. Such an approach could also include coastal and marine restoration projects in areas not impacted by OWFs. In the Kattegat, Ørsted has worked with WWF Denmark to install "biohuts" and custom, 3D-printed concrete reefs to help improve the local stock of cod, which thereby help to maintain the marine ecosystem balance by preying on other species, such as green crabs (orsted.com). Similarly, in Norway, Equinor has worked with NIVA and the Institute of Marine Research to install artificial reefs to restore kelp forests and associated species in urchin deserts off the Northern-Norwegian coast.

NIVA recommends further investigation of instruments in a national context

The suggested tender and allocation instruments have not been qualified or prioritised. All the suggestions should be investigated further in a national context. Three of the Nordic countries (Denmark, Finland and Sweden) and one of the autonomous regions (Åland) are members of the EU (Åland has some exemptions). Iceland and Norway are EEA members, but nature management is not part of the EEA agreement. The Faroe Islands and Greenland are neither EU nor EEA members. While several EU instruments entail legal incentives for the countries to explore and adopt NID in their OWFs, for example the Habitats and Birds Directives, the Marine Strategy Framework Directive and the proposed Nature Restoration Law (see 5.5), other incentives need to be explored to stimulate the use of nature-inclusive constructions by all Nordic non-EU members. Similarly, the non-EU members may have other relevant legislation. Given the varying governance and legal landscapes, different needs for incentives and tools may exist.

Knowledge gaps and other actions that should be taken immediately

Notwithstanding the need for legal contextualisation, research and awareness-raising activities can and should be implemented throughout the Nordic area without further delay. Options for research could be industry-funded research, the EU's Horizon Europe programme, a joint action programme under JPI Oceans, or preferably a targeted joint Nordic research collaboration programme. In the workshops, the need to fill knowledge gaps was a recurring topic. The knowledge needs that were specified by several groups were linked to solid baselines for the OWF sites and knowledge regarding long-term impacts of NID solutions. NIVA would also like to highlight the need for knowledge about suitable NID measures for the Nordic waters, in particular for floating wind. The impacts of a changing climate, non-commercial species, natural variation, and the cumulative impacts of OWFs, as well as the positive and negative impacts of NID solutions on fisheries, should also be addressed.

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