North
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A North Sea Perspective on Shipping,
Energy and Environmental Aspects
in Maritime Spatial Planning

NorthSEE Project Interim Findings

Interreg
North Sea Region
European Regional Development Fund
EUROPEAN UNION

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Please cite this document as:

Lukic, I., Schultz-Zehden, A., Plug, D., Ooms, E., Ripken, M., & Scheffler, U. (2020) Project Interim Findings, NorthSEE project, INTERREG North Sea Region Programme, Grant agreement 38-2-2-15.

Graphic design:

Eurydyka Kata | re:design studio

Cover page images:

M. Zonderling, Krists Sidlovskis, Thierry Meier, Joshua Rawson Harris | Unsplash

External Project Coordination Office (2016–2019):

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KEY QUESTIONS

- How are MSP processes organised in each of the NorthSEE partner countries?
- What can NorthSEE MSP authorities learn from each others' processes?
- What planning criteria are used across the North Sea Member States for offshore energy, shipping and environment?
- What are the main challenges with regard to the coherent transnational planning of linear corridors across the region?
- What transnational planning cooperation mechanisms are in place and what are the future priorities for cooperation in the North Sea Region?
- What priorities and next steps do Member States foresee in the near future for more compatible planning in the North Sea Region?

ABBREVIATIONS

AIS	Automatic Identification System
AL	Autonomy Level
BE	Belgium
BSH	German Federal Maritime and Hydrographic Agency
COLREGS	Convention on the International Regulations for Preventing Collisions at Sea
CPMR	Conference of Peripheral Maritime Regions
DE	Germany
DK	Denmark
EEZ	Exclusive Economic Zone
EIA	Environmental Impact Assessment
EU	European Union
GI	Green Infrastructure
GIS	Geographic Information System
GPSR	General Provisions on Ships' Routing
GW	Gigawatt
HELCOM	Baltic Marine Environment Protection Commission – Helsinki Commission
HVAC	High Voltage Alternating Current
HVDC	High Voltage Direct Current
ICES	International Council for the Exploration of the Sea
IMO	International Maritime Organisation
LNG	Liquified Natural Gas
MarES	Marine Ecosystem Services
MARIN	Maritime Research Institute Netherlands
MPA	Marine Protected Area
MSP	Maritime Spatial Planning
MW	Megawatt
NL	The Netherlands
NM	Nautical Mile
NO	Norway
NRA	Navigational Risk Assessment
NSR	North Sea Region
OREI	Offshore Renewable Energy Installations
OSPAR	Oslo and Paris Conventions
OWF	Offshore Wind Farms
PVVA	Particularly Valuable and Vulnerable Area
SCO	Scotland
SDE+	Stimulation of Sustainable Energy Production
SE	Sweden
SEA	Strategic Environmental Assessment
TEU	Twenty-foot Equivalent Unit
TW	Terawatt
TYNDP	Ten-Year Network Development Plan
UK	United Kingdom
UNCLOS	United Nations Convention for the Law of the Sea
VMS	Vessel Monitoring System
VTS	Vessel Traffic Services

PREFACE

Finding the balance between sustainable economic uses, and environmental protection is a key challenge of maritime spatial planning (MSP).

Even though MSP is a national competence, countries need to ensure coherence with their neighbours. This is a requirement of the EU MSP Directive (89/2014), but also plain good planning practice: Linear infrastructure, especially energy and shipping, need to match up and important natural habitats do not stop at the border.

The countries around the North Sea have been pioneering the use of MSP in coastal zones and the EEZ. Most already have national maritime spatial plans in place and some are in their third or fourth planning cycle. Each country has used its own planning methods and processes to develop these plans. Approaches differ based on the history, traditions and geography of each country. It is interesting to note, for example, that MSP tends to be more prescriptive and detailed the smaller a country's maritime space is.

Official consultations within the plan development process, such as those carried out in the framework of Strategic Environmental Assessments (SEA), have so far constituted the main form of transnational cooperation.

With the evolution of the planning systems in North Sea countries, a more comprehensive approach to cooperation that aims to raise understanding of each other's processes, methods and planning systems will further improve coherence.

The INTERREG co-funded NorthSEE project, implemented since 2016, represents the first attempt to organise closer cooperation on MSP in the North Sea Region. So far, an informal network of planners and experts who share ideas and concepts directly with each other has developed within the project.

The main focus of the project – as indicated by its acronym – is on shipping, energy and the environment. Using an integrated approach, we work with research institutes and authorities to foster science-policy exchange.

The MSP Challenge software is a new tool for stakeholder involvement: In four transnational workshops we have been able to interact in new ways, see instant results of decisions and increase understanding of the trade-offs when planning the North Sea.

This report provides an overview of the main interim project results with more details to be found in the referenced main reports. It is designed for planners, sector and regional stakeholders, experts and the members of future cooperation projects. The findings will hopefully inform the discussion on how to continue transnational cooperation in the future.

On behalf of the BSH (German Federal Maritime and Hydrographic Agency), I thank all partners very warmly for the good cooperation, support and partnership.

Let us continue in that spirit in the coming years.

I hope you enjoy reading this report,

KAI TRÜMPLER

Head of division "spatial planning" at the German Federal Maritime and Hydrographic Agency (lead partner of NorthSEE)

THE NORTHSEE PROJECT APPROACH

Over the past 15 years, the North Sea Region (NSR) countries have substantially progressed with MSP, mainly focusing on the national context. These processes continuously lead to the development of new tools and solutions. In fact, most NSR countries have adopted at least one version of a statutory national maritime spatial plan. Belgium, the Netherlands, Norway and Germany are even working on the revision of their national MSP. Others, such as Denmark and Sweden, are in the process of establishing a maritime plan for the first time.

NorthSEE was the first project to foster exchange between these MSP processes; even though other previous and parallel projects have also supported an increase of knowledge. The NorthSEE project builds on this experience and on recommendations from these existing national processes as well as previous project undertakings. The project – led by the German Federal Maritime and Hydrographic Agency – involves MSP authorities as well as selected research institutes from countries around the North Sea. For the full list of project partners, please see the back page of the report.

NorthSEE – A North Sea Perspective on Shipping, Energy and Environmental Aspects in Maritime Spatial Planning (2016–2021)

- Fosters a better understanding of national MSP processes, tools, methods and practices of countries around the NSR,
- Informs on current and future developments and resulting connections between borders and structures,
- Identifies relevant transnational issues in relation to shipping, energy and environmental protection,
- Proposes planning solutions for fixed linear infrastructure (cables and pipelines), wind farms and the designation of shipping lanes,
- Improves and uses the 'MSP Challenge' simulation platform to foster sector and planning experts' input into and understanding of transnational challenges and possible solutions.

Objectives

The NortSEE project aims to achieve:

- Greater coherence in maritime spatial planning (processes) and in matitime spatial plans (capturing synergies and preventing incompatibilities).
- Better conditions for sustainable development of the area in the fields of shipping, energy and evironmental protection.

Activities

Sectoral work packages

Focus on three main transitional issues relevant to MSP:

- Shipping
- Energy
- Environment

Integrated MSP work package

Focus on coordination and coherence among national maritime spatial plans and planning processes.

STEP 1: Analyse status quo

STEP 2: Analyse trends

STEP 3: Develop planning solutions

MSP Challenge

A computer simulation game on MSP is used as a method to learn from each other and gather stakeholder input.

Infoquarium

Online platform for sharing information on MSP in the North Sea Region.

Result: Improved coordination

The 3-step approach will lead to:

- Recommendations for MSP processes
- Suggestions for creating synergies and preventing incompatibilities among national MSP plans

Figure 1 NorthSEE project at a glance (2019)

EXECUTIVE SUMMARY

The North Sea plays an essential role for adjacent coastal and marine regions, especially regarding sustainable development, transport, security, energy transition, employment and innovation. For life in and around the sea basin, it is also the link to the high seas. It is the joint obligation of NSR coastal states to care for the marine environment, and to duly safeguard aspects of safety and efficiency of navigation.

The EU Member States around the NSR have to implement the obligations of the EU Maritime Spatial Planning Directive 2014/89/EU and are required to establish a mechanism for cross-border cooperation with the aim of ensuring coherent maritime spatial plans by 2021, including arrangements for cooperation with third countries. Nevertheless, the EU Directive shall not interfere with Member States' competence to design and determine the format and content of their maritime spatial plans. MSP is a process guided by politics and subject to political dynamics. Thus, the political developments in the NSR countries since the NorthSEE project started in 2016 have had a considerable impact on the NorthSEE project, its work and achievement of key objectives [within and beyond the scope and duration of the project].

Moreover in 2016, when the NorthSEE project started, the NSR countries were at different phases in their MSP processes:

- Belgium, Netherlands, UK (England/Scotland), and Germany (federal) had maritime spatial plans in place; Norway had established integrated marine management plans including spatial management measures; while Sweden and Denmark had established Marine Protected Areas (MPAs) and other spatial measures for human activities at sea (e.g. IMO routing system in the area of Kattegat);
- MSP processes have been ongoing during the project in Belgium, Netherlands, Scotland, England, Germany, Sweden and Norway, whilst Denmark has started its MSP process.

The NorthSEE project aims to support greater coherence between MSP processes and maritime spatial plans across the NSR for three transnational topics: Shipping routes, Energy infrastructure and Environment.

To this end, the NorthSEE project produced the NSR-wide status quo and trend reports on Shipping, Energy and Environment. These reports include an analysis of the differences and similarities among the MSPs and suggestions on how to involve regions and stakeholders in cross-border MSP.

The project welcomed contributions by numerous private, research and political stakeholders during the NorthSEE stakeholder meetings on Environment, Energy and Shipping. It also benefitted from the exchange of outcomes with the NorthSEE sister project BalticLINes (Interreg VB BSR) and used the opportunity to share its results during the Connecting Seas MSP Conference in Hamburg on 13 and 14 February 2019.

This NorthSEE project interim findings report synthesises the main project reports and maps with the aim of informing planners and stakeholders, thereby contributing to increased coherence, and providing the basis for recommendations for transnational dialogue for the coordination of MSP in the NSR beyond the lifetime of the project.

MSP IN THE NORTH SEA

Maritime spatial plans are the result of multi-year processes in each country being based on different kinds of institutional structures, national legislation and data input. To get a better understanding of the transnational coherence among national maritime spatial plans, the project analysed the current status of their shipping, energy and environmental designations. The analysis aimed to identify differences regarding competences, objectives, legal basis, steps used in the planning processes and planning criteria applied for in the designations. Furthermore, project partners assessed the type and intensity of the use of maritime space by different sectors, e.g. current routes used by the shipping sector. This has provided a first overview of possible incoherencies between actual uses and the designations in the plans, as well as incoherencies between the plans. Figure 2 presents the cartographic presentation of cross-border MSP (or the diversity of representations of MSP) in the North Sea (used for indicative purposes only).

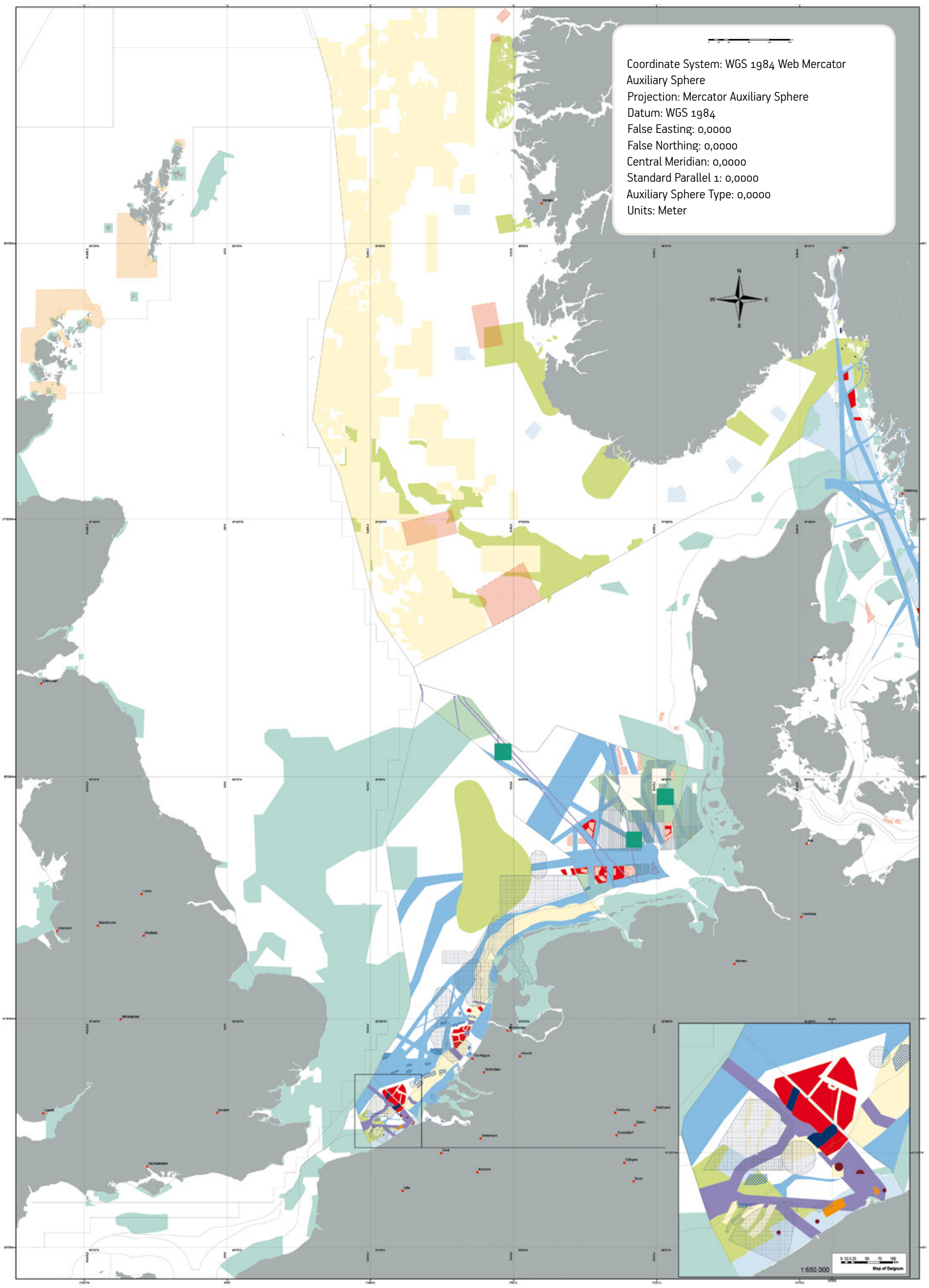


Figure 2 Cartographic presentation of cross-border maritime spatial planning in the North Sea (used for indicative purposes only) (Source: Fraunhofer Center for Maritime Logistics and Services CML, 2019)

Legend

Spatial Designation	Spatial Designation
Shipping Lanes	Shipping Lanes
Anchorage Area	Anchorage Area
Offshore Wind Energy	Offshore Wind Energy
Offshore Hydro Energy	Offshore Hydro Energy
Fishing	Fishing
Aquaculture	Aquaculture
Marine Aggregates	Marine Aggregates
Hydrocarbonates	Hydrocarbonates
Pipelines and Submarine Cables	Pipelines and Submarine Cables
Marine Research Area	Marine Research Area
Nature Conservation Area	Nature Conservation Area
Disposal Areas	Disposal Areas
Military Area	Military Area
Natura 2000	

Information

- Natura 2000
- World Cities > 200.000 Population
- Countries
- Maritime Boundaries

BSH tendered a study to the Fraunhofer Center for Maritime Logistics and Services CML to analyse spatial planning designations. In a first step, the Fraunhofer CML analysed existing regional planning regulations and systems in the North Sea Region. Secondly, a framework to combine and harmonise planning designations and the corresponding map symbology were elaborated. This resulted in an approach for a common map legend. It should be noted that this map does not represent the respective maritime spatial plans in these countries. More details can be found in the report published in June 2019.

A Comparative Analysis of Spatial Planning Designations in North Sea Countries, June 2019.

Understanding the different MSP processes

A comparative analysis of MSP allows for inconsistences to be identified and knowledge transfer between planners, and is the first step to facilitate greater coherence and cooperation in MSP. The so-called "explorative MSP timeline" visualises the time overlap between MSP process steps (table 1). It allows for a look ahead into the timing of MSP activities within the various NSR countries and hence for a better planning of transnational consultations between them.

Table 1 Current status of MSPs in the NSR (2019)

Country	MSP Authority	MSP existing	MSP Round	Current MSP Activity (December 2019)
Belgium	Belgian Minister of the North Sea	Yes	2nd plan revision, 3rd cycle	Approved, second plan will enter into effect on 20 March 2020
Germany	BSH in EEZ, State Authorities in territorial waters	Yes	1st plan revision, 2nd cycle	Planning phase. Preparation of a baseline report and development of first planning alternatives.
Denmark	Danish Maritime Authority, Ministry of Business and Growth	No	1st cycle, no plan yet	Planning phase. MSP will enter into force March 2021.
Norway	Norwegian Ministry of Environment/ Norwegian Environment Agency	Yes	5th plan revision, 6th cycle	Approval phase.
The Netherlands	Interdepartmental Directors' Consultative Body North Sea led by the Ministry of Infrastructure and Water Management	Yes (since 2009)	3rd plan revision, 4th cycle	Start of revision National Water Plan 2022–2027 announced in November 2019. Planning phase 2020. Consultation on plan and SEA December 2020 – June 2021.
Scotland	Scottish Ministers for the Scottish inshore and offshore regions	Yes	1st plan revision, 2nd cycle	Completed consultation on 1st plan revision. No amendments required.
Sweden	Swedish Agency for Marine and Water Management (SwAM)	No	1st cycle, no plan yet	Approval phase. Preliminary plan and first consultation

The following recommendations with regard to transnational MSP have been suggested by the NorthSEE project:

- **Carry out a detailed comparative analysis of the different MSP approaches and processes between NSR countries to foster understanding and to enhance cross-border cooperation.**
- **Establish an over-arching North Sea MSP body or mechanism that can coordinate efforts and facilitate cooperation between NSR countries after the lifetime of the NorthSEE project.**
- **Create an MSP dictionary that defines general terms to make terminology comparable to facilitate a better understanding of each other's MSP processes.**

MSP Timeline – Comparative analysis (September 2018)

General planning cycles and phases

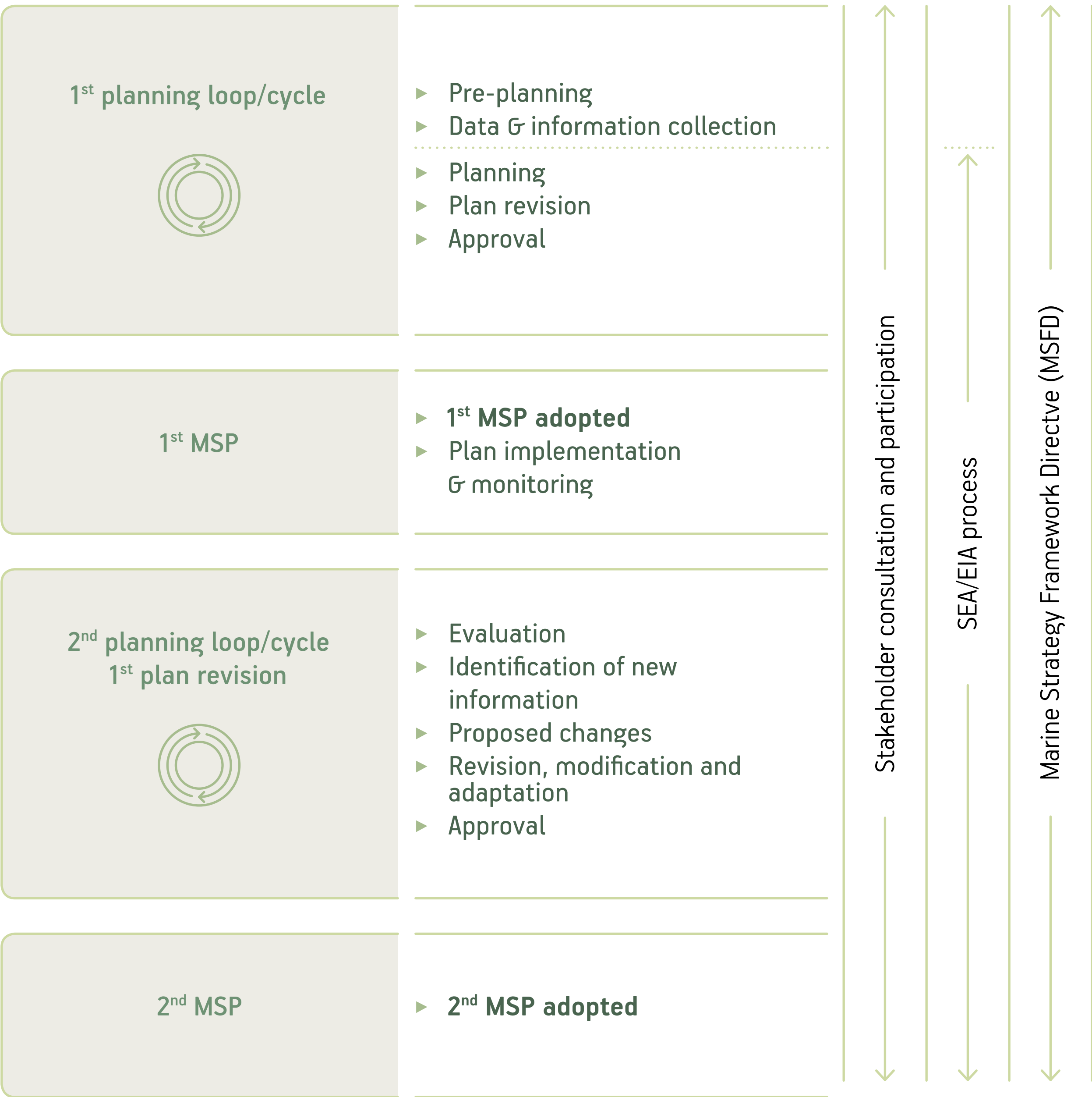


Figure 3 General steps in the MSP processes in the North Sea (2019)

MSP timeline exercise

To gain a better overview of future consultation opportunities, the NorthSEE partners made a joint timeline of their national activities (table 1) and steps in their planning processes until 2020 (figure 3). The timeline was successful as an ad hoc tool to facilitate discussions at meetings. The digital timeline tool was, however, not continuously updated. It was deemed to be a time-consuming exercise. At the same time there are too many differences in the MSP process, which makes it difficult to compare the planning steps. It would be beneficial to discuss these different MSP steps and develop a generic framework, which would fit all NSR countries.

It is important to jointly define general steps in an MSP process, where countries can put their specific MSP activities in a timeline. This process timeline will allow a comparison of where countries are with respect to their MSP preparations or revisions. This supports countries in better coordinating the timing of steps in their processes and harmonising any planned transnational consultations.

Cooperation in projects such as the NorthSEE project provides an opportunity to improve coordination of a number of aspects related to MSP.

MSP Timeline – Comparative analysis (September 2018)

Data needs for MSP

The NorthSEE project has revealed that data and information for MSP on the various sectors and the North Sea countries are not easily accessible, accurate or well integrated, particularly for cross-border and transboundary use. Project partners encountered an unforeseen level of effort needed in terms of data and information sourcing to achieve results.

Thus, the project acknowledges the need to improve data quality, data availability and sharing among the NSR countries, as well as the need to advance the use and effectiveness of data and information in MSP processes. It stresses the need for planners and stakeholders to have up-to-date access to locations and publicly available information on existing wind farm sites, those under development, in planning and indicated as search areas. As a baseline, this information should be available as soon as possible for uptake in MSP processes around the NSR.

The NorthSEE partners are committed to:

- **Closing data and information loops and gaps; in particular to complete an update of the OSPAR database on MPAs, and availability of vessel tracking data (AIS), files and maps;**
- **Sharing and use of all available data by MSP authorities and stakeholders, and the creation of information products that are useful for MSP authorities and in particular assist in transparency and communication with stakeholders;**
- **Accurate and up-to-date available data and information provided by NSR countries, and a cooperation mechanism to share available data on MSP;**
- **Exploring benefits that could be derived from the possibility to source relevant MSP data and information (on shipping, energy and environment) from one database and (further) integration, alignment and interoperability of decision support models for ecosystem-based MSP.**

Comparative analysis of MSP systems

To kick-start the discussion within the project on similarities and differences, a schematic overview of 13 elements was compiled, characterising each national MSP system within the NSR (table 2).

Table 2 Characterisation of national MSP systems within the NSR (2019)

Theme	Main differences / observations
Institutional structure of MSP Authorities	▸ Apart from a national level, DE, SE and NO also have MSP competences on a regional level (Länder, counties). SCO has developed a new entity dealing with MSP issues (Planning partnerships). ▸ MSP process established as new task for an existing ministry (BE) or department (DK, DE). ▸ NL has a long-standing interdepartmental working structure under coordination of (currently) the Ministry of Infrastructure and Water Management. In NL, the national government has exclusive planning competence, but only for waters from 1km off the coast to the end of the EEZ.
Agencies involved in national MSP Authorities	▸ In each of the countries, the MSP process is led by a single public entity, either a ministry or a relevant government agency. The process also involves other relevant public entities, either through more official inter-ministerial working groups, or through a consultation process at various steps of MSP.
Type/Function of the MSP	▸ NO has an integrated management plan covering all international criteria for MSP, while the other MSPs are more normative / policy-oriented. NL for example, combines its Marine Strategy Framework Directive measures, spatial policy and management plan within one single document.
Legal impact of MSP	▸ In some cases, direct legal impact (BE, NL, DE), in other cases rather limited impact when the MSP steers the management of the area (NO) or sets the frame for other institutions (SE, SCO). In SE and NO plans are not legally binding but rather have a guiding character.
Experience in MSP	▸ Some countries have a lot of experience in MSP and are revising or have already revised their first or up to fifth MSP (NL, BE, NO, DE), while others are in the process of developing their first one (DK, SE).
Objectives, goals and drivers of national plans	▸ Integration of new and emerging uses is a common driver for MSP across the countries. Perceived conflicts among uses is a driver in all countries. Marine conservation is also to a certain extent a driver in all countries. Climate Change is included as a driver in BE, NL, DE, SCO.
Uses in plan	▸ Shipping, mineral/aggregates extraction, offshore renewable energy and tourism are the common uses included in all the plans across the region.
Stakeholders	▸ All countries have a consultation process involving stakeholders at different stages of the process. SCO, NL and BE also have continuous stakeholder working groups, some of them focusing on certain topics such as environment, multi-use and blue growth. NO has cooperation across all sectors on an equal basis.
Relation with other processes and plans	▸ Somewhat weak relation between national MSP and integrated coastal zone management in countries with sub-national MSP authorities (DE, SE, NO). ▸ In NL, BE, and SCO Marine Protected Areas (MPAs) are directly incorporated in MSPs. In NO and DE, MPAs are designated under separate processes.
Data and tools for planning	▸ BE and SE used scenario building as part of the MSP process. ▸ SE and SCO used decisions support tools in the plan development process.
Compliance of plans	▸ High compliance level in all countries; only in SCO there is mixed compliance due to the strategic level of the MSP and the use of Marine Partnerships.
Plan evaluation and revision	▸ All countries with an MSP in place actively evaluate it for the next planning cycle. ▸ BE and DE use no indicators for evaluation, NO uses environmental indicators, while the others use a variety of social, economic and environmental indicators.

Schematic exploratory overview of current MSPs (February 2016)

ANALYSING THE STATUS QUO

The NorthSEE project has analysed the existing status with regard to offshore renewable energy, grid and interconnectors, shipping developments and environment across the North Sea countries. The report highlights existing collaborations in the North Sea but also maps the operational, under construction and planned wind farms in the North Sea with the aim of providing a better understanding of current advancements made by countries towards their renewable energy goals and the associated spatial pressures. Partners have also analysed in what way the grid and interconnectors are included in MSP. The report on current shipping developments produced as part of the NorthSEE project, analyses existing collaborations, seasonality of shipping and existing challenges with regard to the further development of the sector.

Energy

Wind energy (both on – and offshore) already meets 10.4% of the EU's power demand and is the most competitive source of new power generation. By the end of 2016, 81 offshore wind farms with a total of 3,589 offshore turbines had been installed and were grid-connected in 10 European countries, leading to a cumulative total of 12,631 MW produced by offshore wind.

The majority of these wind turbines (72%) can be found in the North Sea (figure 5), making the region a frontrunner in this technology. The UK is in the lead (figure 4), with the largest share of cumulative installed offshore wind capacity in Europe (44%). Technology costs seem set to decline further, provided that there continues to be a robust domestic market in the EU.

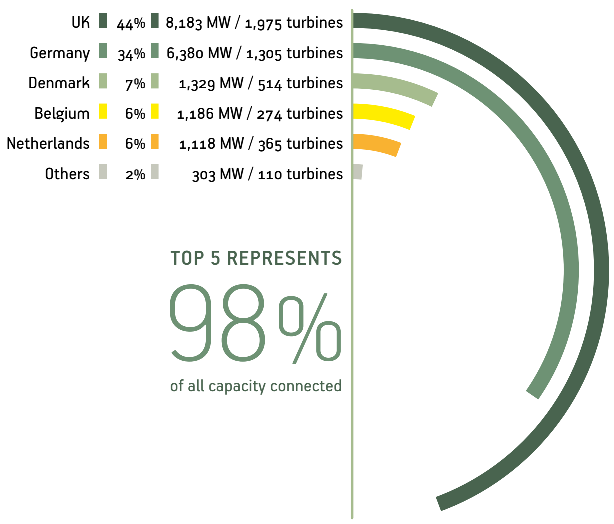


Figure 4 Cumulative installed capacity (MW) and number of turbines of offshore wind by country (Source: Wind Europe, 2018)

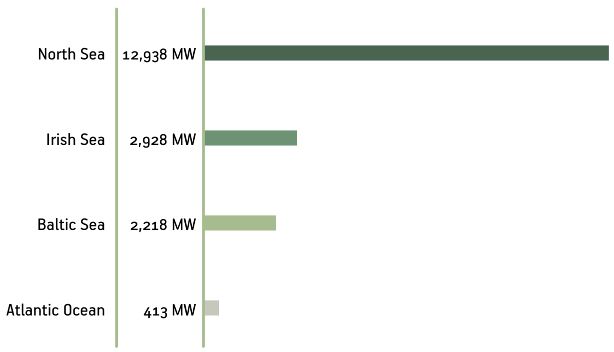


Figure 5 Cumulative installed capacity (MW) by sea basin (Source: Wind Europe, 2018)

With the exception of Norway and Sweden, most NSR countries have planned and designated spatial areas for offshore renewable energy and set goals to meet renewable energy targets (figure 6). No zones have been opened in Norway yet, but areas have been identified.

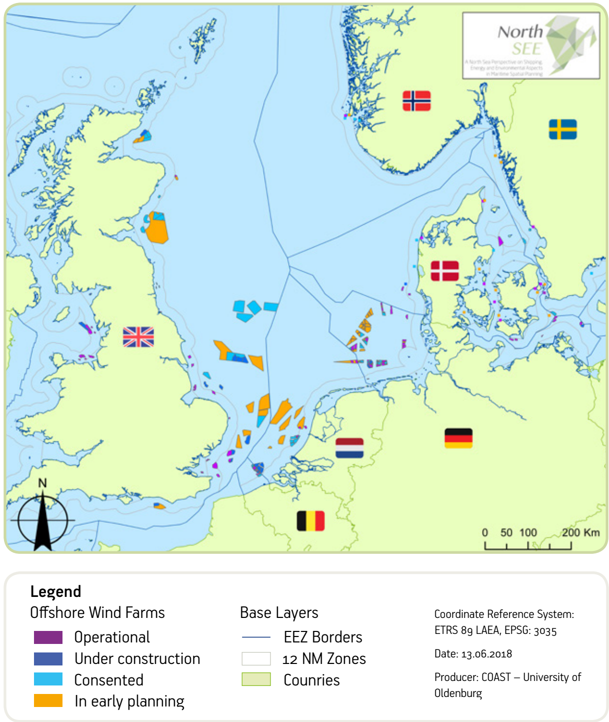


Figure 6 Map showing the operational, under construction and inplanning offshore wind farms in the NSR (2018)

Governance of transnational energy cooperation

While developments in shipping are dominated by the market, the development of renewable energy (including offshore wind) is much more steered by national and regional governments. Their targets and incentives for offshore energy significantly influence the rate of increase in renewable energy production. At the moment, most countries are pursuing renewable energy production policies on a national basis. However, the need for cooperation to improve the effectiveness of policy measures and increase the efficiency of offshore energy production (incl. energy sharing), has been recognised by governments.

Importance of transnational cooperation

Numerous activities have been pursued over the past years to foster regional energy cooperation in the North

Sea. The institutional framework of North Sea energy cooperation in recent years has included regional sea basin mechanisms and organisations, multi – and bilateral energy declarations and agreements, energy trade bodies and stakeholder forums with sea basin interests, as well as European projects looking to promote the sustainable development of offshore energy in the NSR (figure 7). Specifically, the North Sea Energy Political Initiative of the 10 North Sea countries aims to foster cooperation on offshore renewable (wind) energy. In particular, the sub-working group on MSP aims for greater coherence in dealing with cumulative ecological impacts. Cooperation on SEA methodology between the planning authorities is also taking place within the EU-financed SEANSE project[1].

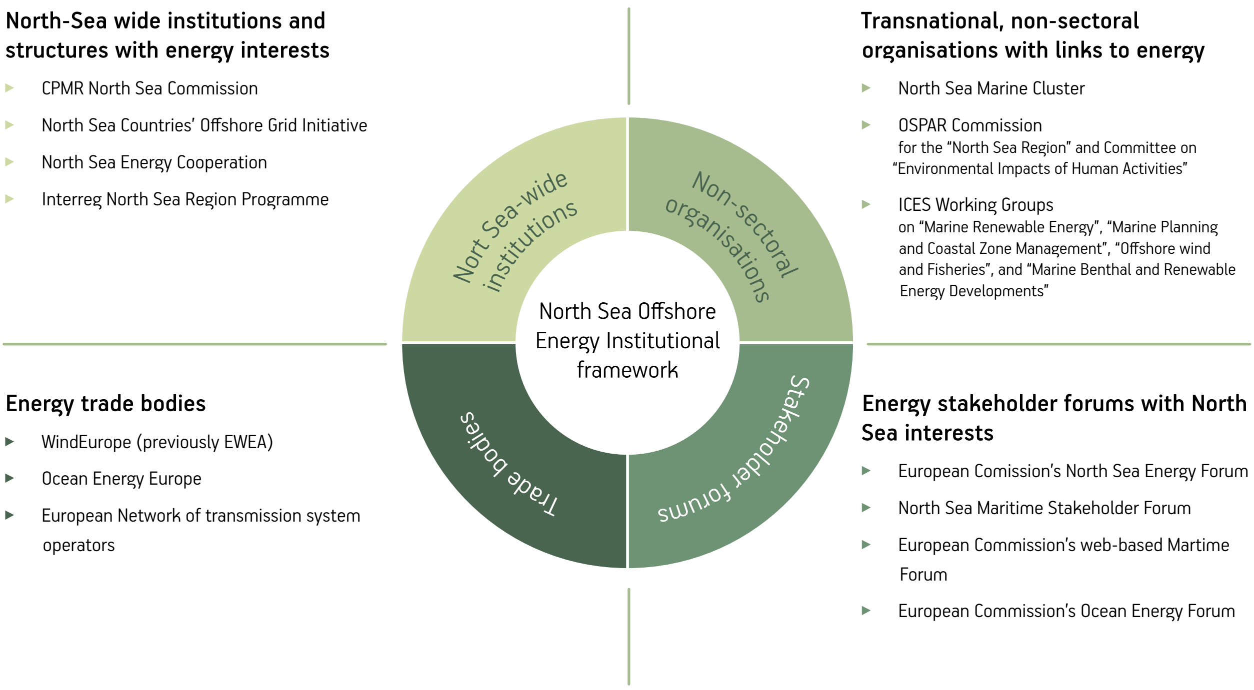


Figure 7 Existing energy cooperation structures in the NSR (2018)

While the NSR has some cooperation initiatives concerning MSP, there are still opportunities for improvement, primarily concerning offshore energy.

The following topics have been identified to be of particular relevance for further collaboration in the NSR:

- **Harmonised or rather cross-country compatible planning, terminology and technical criteria.** Currently, countries are using different spatial designations, which are not only named and defined in a different way, but also exhibit a low level of transnational compatibility. Moreover, the data used in planning across countries is not harmonised, making it difficult to accurately map and plan activities across borders.
- **Streamlined SEA/EIA processes.** Countries approach the processes of Strategic Environmental Assessment and Environmental Impacts Assessment in different ways. This makes it difficult to plan for transnational developments and conduct relevant assessments in an efficient way.

1 More information about the project available at: www.northseaportal.eu

- **Early and proactive engagement in transnational consultations.** Transnational approaches to MSP can benefit offshore renewables through additional efficiencies in cross-border coordination, reduced planning uncertainty for developers and expanded opportunities for deployment and/ or cost savings from shared infrastructure.
- **General offshore energy linear infrastructure provision (e.g. offshore grid, interconnector cables etc.).** There is a need to identify demand for grid connections, interconnector routes and gates, grid and connection points on land across countries. In line with growth targets for offshore renewable energy, the demand for grid connection is set to increase.

Timeline of Offshore Renewable Energy Development and Maritime Spatial Planning in the North Sea

Interim report: Status quo report on offshore energy planning provisions in the North Sea Region (March 2018)

Grid and interconnectors

Electricity interconnectors (figure 8) are the physical links which allow the transfer of electricity across national borders. This exchange of power helps to ensure safe, secure and affordable energy supplies. In the North Sea, interconnections provide a crucial increase in interconnectivity between the smaller and relatively isolated British and Irish power systems (that already feature high shares of wind generation), the hydro-dominated Scandinavian systems, and the continental European countries going through a rapid conventional-to-renewables shift.

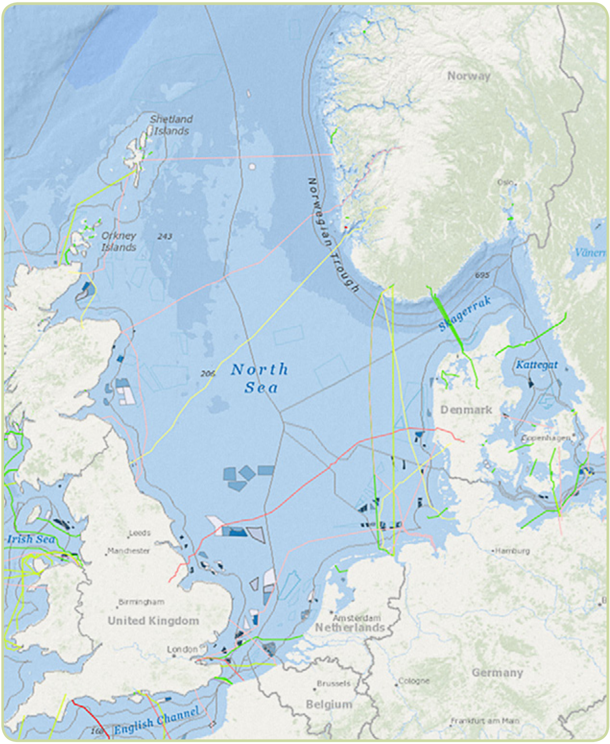


Figure 8 Map of NSR interconnectors overlaying the offshore wind farm dataset. (Source: 4COffshore, 2018)

It is the ambition of the EU to have a fully-integrated internal energy market and for countries to have achieved 10% interconnection by 2020 and 15% interconnection by 2030.

Table 3 Interconnection levels across the NSR countries (Source: European Commission, 2017)

NSR Country	Interconnection levels in 2017
BE	19%
DK	51%
DE	9%
NL	18%
SE	26%
UK	6%

The European Commission report on the state of the Energy Union (23 November 2017) found that Germany and the UK have not yet reached the 10% electricity interconnection target (table 3). It is predicted that the UK will be unable to reach the 10% interconnection target by 2020.

Planning and licensing

Planning for grid infrastructure in the North Sea up to 2016 has been nationally focused with limited transnational coordination (usually done bi-or trilaterally, and only with countries involved in the grid infrastructure development). The North Sea Political Energy Initiative was put in place in 2016 to work towards more transnational and interconnected grid systems.

Cables connected to offshore renewable developments (e.g. wind farms) are normally linked to the national offshore energy planning processes. In the grid planning process, various licences are granted such as a construction licence and a transmission licence. Transmission is usually dealt with by a designated national Transmission System Operator, responsible for providing safe and reliable energy supply.

North Sea countries are not only at different stages of grid planning, but their approach to it and link to MSP also differs. For example, Germany has a more established and focused approach to grid planning, by developing a Site Development Plan, while Scotland's approach to grid planning features only as a chapter in the MSP rather than a dedicated grid plan.

In terms of spatial areas designated for cables, Belgium, Denmark, Netherlands and Scotland have either designated cable corridors and gates or priority areas for cables. Spatial and technical planning criteria for cables include bundling cables by parallel routing, routing via gates, free space on either side of the cable and cable crossing agreements such as in the shortest route and at right angles to the cable.

Interim Report: Status quo report on offshore linear energy infrastructure in the North Sea Region. *Grid cables, electricity interconnectors and pipelines* (May 2019)

Shipping

The North Sea is one of the busiest maritime areas in the world, second only to the South China Sea. All areas of the North Sea are occupied by shipping activities, with the highest concentration along the coastal and central parts which are transited by passenger ships and supply vessels.

Governance and transnational data exchange

Shipping has a strong international character and is thus governed by international shipping conventions, adopted by the International Maritime Organization (and the International Labour Organization). Although a lot of countries around the North Sea have a significant number of ships sailing under their flag, most of the ships sailing North Sea waters are not European flagged. The three biggest flag states (Panama, Liberia and Marshall Islands) hold almost 70% of the entire world fleet. Ship routing establishes an international predetermined path for ships to navigate in order to avoid navigational hazards such as collisions and subsequent damage to ships, crew members, and the marine environment. The International Maritime Organisation (IMO) is the only internationally recognised competent body for establishing such systems, and its responsibilities are enshrined in the SOLAS convention Chapter V. Traffic separation schemes as well as other ships' routing measures have now been established in most of the heavily congested shipping areas around the world, including the North Sea.

Seasonality of shipping

With the introduction of the Vessel Monitoring System (VMS) and Automatic Identification System (AIS) in the last 20 years, it has become possible to track shipping density more precisely. The European Maritime Safety Agency tasked all national governments (figure 10) in the North Sea to collect AIS information from their maritime areas and supplement it with data from other countries through the North Sea Data Exchange Agreement between Belgium, Denmark, Faroe Islands, France, Iceland, Ireland, Netherlands, Norway, Sweden, and the United Kingdom.

From a maritime spatial planning perspective, it is essential to look at seasonal variations in traffic intensity. Regular periods of low shipping traffic intensity may allow for other activities (e.g. sporting activities such as seasonal regattas) to be planned in those areas at least during some parts of the year. According to an analysis of data from 2016, summer months are the busiest in all parts of the North Sea. Particular intensity is seen along the route from the English Channel to the entrance of Skagerak as well as along the south coast of Norway. Port areas and inland waters are particularly busy (red areas, figure 9). The last quarter of the year shows less activity compared to other quarters throughout the entire North Sea area.

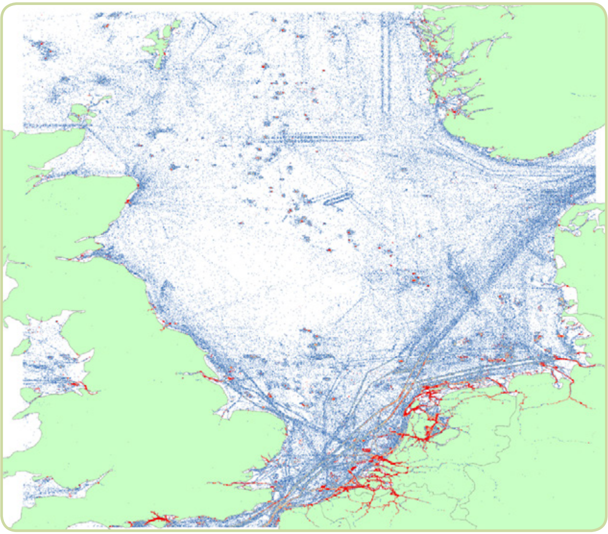


Figure 9 Shipping activity in the summer months (2016)

Country	Responsible Authority for collecting and storing AIS data	Data supplier
BE	Flemish Region VTS service	Network of shore-based AIS stations
DE	The Federal Waterways and Shipping Administration	Network of shore-based AIS stations
DK	Danish Maritime Authority	Network of shore-based AIS stations
NL	Coast Guard (AIS-maritime shipping); Rijkswaterstaat (AIS-inland shipping)	Network of shore-based AIS stations and platforms at sea
NO	Norwegian Coastal Administration	Network of shorebased AIS stations Satellites
SE	Swedish Maritime Administration	Network of shore-based AIS stations
UK	Maritime and Coastguard Agency	Network of shore-based AIS stations Satellites Raw data is processed at Marine Scotland

Figure 10 National authorities in the North Sea countries that are responsible for collecting AIS data and their data suppliers (2018)

Report: Transnational Maritime Spatial Planning in the North Sea: The Shipping Context (March 2018)

Environment

The ecological system in the North Sea presents yet another transnational corridor, strongly connected across borders.

In the North Sea, the regional sea convention OSPAR and its Contracting Parties are establishing a network of Marine Protected Areas (MPAs). The OSPAR map of MPAs, in figure 11 from October 2016, has been used in the NorthSEE project as a (status quo) reference. The NorthSEE study on MPAs aimed to build on the OSPAR network and make suggestions for improvement. The result is shown in figure 12. Contracting parties agreed to continue work on the OSPAR Network of MPAs in the North-East Atlantic in terms of connectivity. Not all MPAs have management plans with measures yet. Those will need to be developed by the respective national or regional authorities or other organisations, such as the EU for fisheries measures.

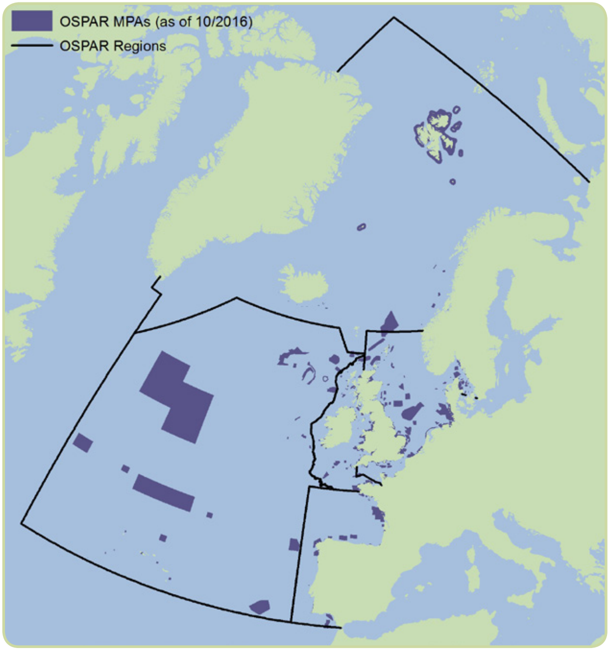


Figure 11 OSPAR MPAs across OSPAR Regions (Source: OSPAR, October 2016)

The North Sea ecosystem is interlinked and does not respect borders. It is important for planners to gain a good understanding of the way in which a marine conservation site affects areas elsewhere, and of the significance different sites might have for the ecosystem as a whole. In October 2019, the Norwegian Institute of Marine Research was subcontracted by the Norwegian Environment Agency to compile a study on *Connectivity among marine protected areas, particularly valuable and vulnerable areas in the greater North Sea and Celtic Seas regions*. This chapter presents some of the insights and findings of this report.

The NorthSEE project has analysed the connectivity of a selected number of MPAs within the already established network (figure 13), ratified by the Oslo-Paris (OSPAR) agreement in the greater North Sea and Celtic Seas regions and the particularly valuable and vulnerable areas (PVVAs) in the Norwegian part of the North Sea (together hereby referred to as 'the network') (table 4). It is important to note that the analysis included only the MPAs under management of the NorthSEE project partner countries, thus excluding MPAs in English and French waters. The analysis was done by applying a state-of-the-art biophysical model of larvae of the lesser sand eel. This animal has an important role in the North Sea food chain, and the larvae are moved by sea currents, making it possible to model their dispersion. To decrease complexity, the study assumes that countries will develop plans or measures for the MPAs, making it possible to analyse the potential effects of one MPA protection regime on the connectivity.

The results of the study show that the MPA network established by OSPAR is highly connected. At the same time there are some areas along the edge of the European continental shelf that did not receive larvae from MPAs. However, it is debatable whether MPAs as management tools would be effective within the open and highly advective environment, as the species spawning there have a high level of mobility.

For the placement of future MPAs, it is advised to create redundant dispersal pathways between the Celtic Seas and greater NSR. This would mainly involve establishing new MPAs along the Irish western coast within the Irish Coastal Current, and along the edges of the Fladen Ground in the path of the Fair Isle Current (see figure 13).

The study confirms that ecologically important areas in one place can be important for the environment in other areas or countries, and that the North Sea is a highly connected ecosystem. This must be taken into account when planning for activities in ecologically important areas.

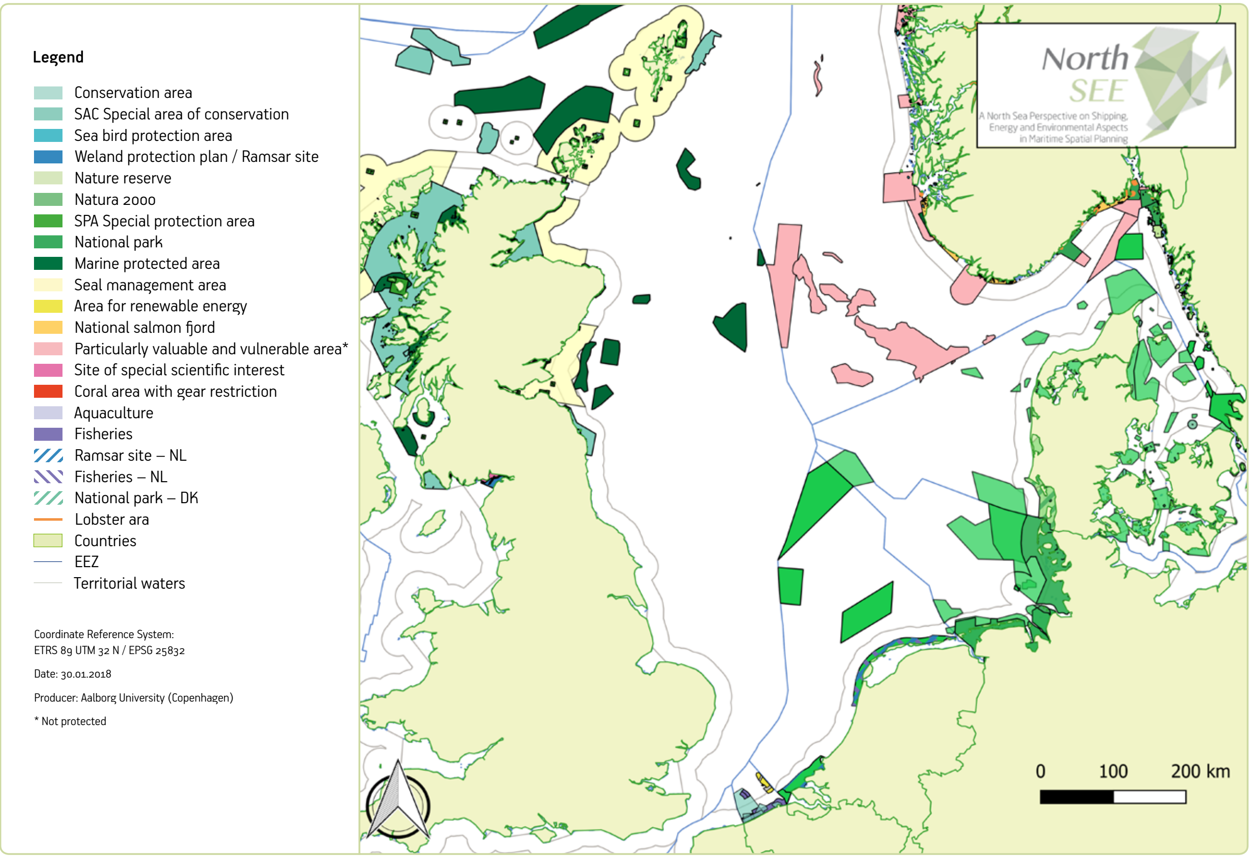
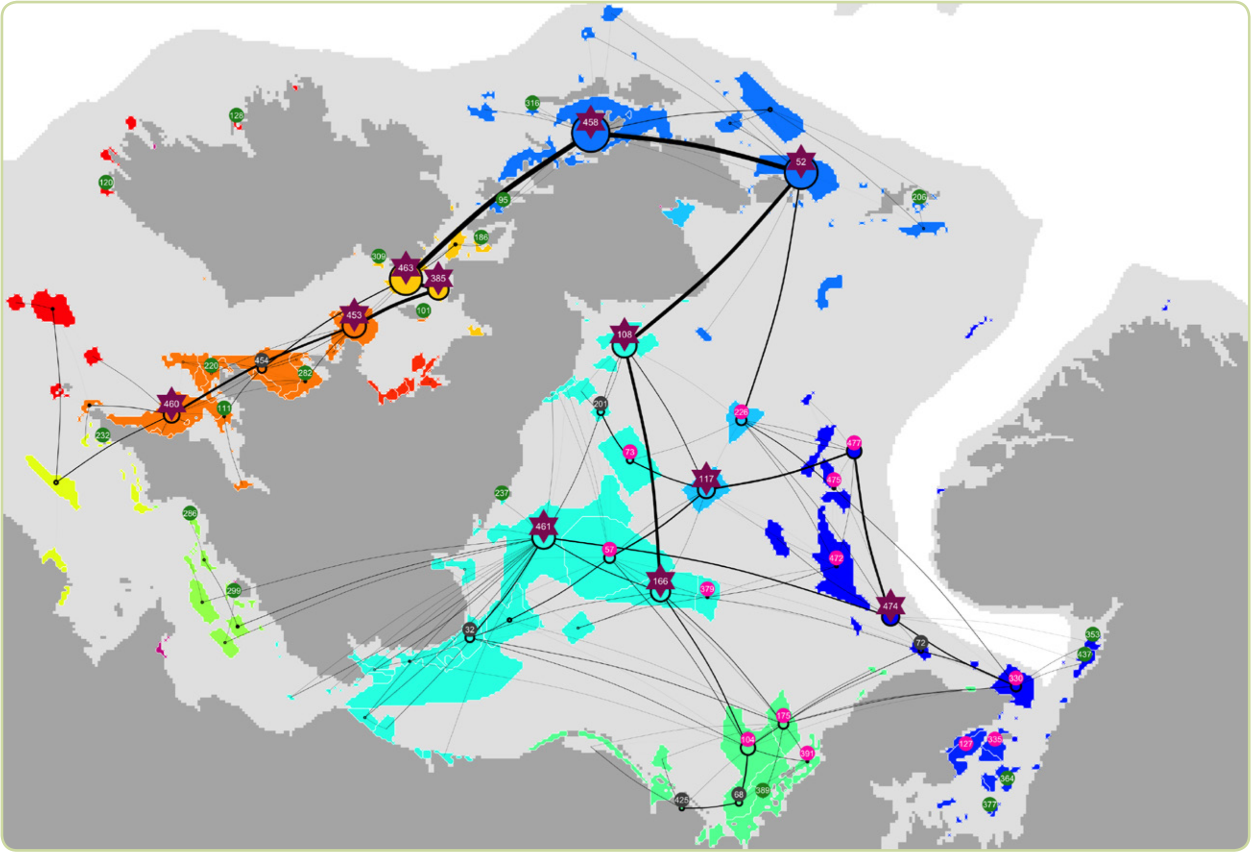


Figure 12 Number and coverage of OSPAR MPAs in Territorial Water, the Exclusive Economic Zone (EEZ) of the North SEE partner countries in 2018 taken from the OSPAR data base (not showing MPAs in English and French waters) (2018)[2]

Table 4 MPAs ratified by the Oslo-Paris (OSPAR) agreement in Territorial Waters and the Exclusive Economic Zone (EEZ) (Source: OSPAR, 2017)

OSPAR	No. of	MPA coverage [km²]				
Contracting Party	OSPAR MPAs	territorial waters	EEZ	beyond EEZ	Total	% of territorial waters+EEZ covered
Belgium	2	749	490	n.a.	1,239	35,7
Denmark	34	6,954	5,536	n.a.	12,49	17,2
Germany	6	8,963	7,911	n.a.	16,875	41,4
Netherlands	5	2,434	5,922	n.a.	8,356	13,2
Norway	15	8,312	2,408	n.a.	85,528	4,1
Sweden	10	1,114	1,364	n.a.	2,478	19,6
United Kingdom	2698	30,607	106,179	17,158	153,944	20,1

2 for an up to date map, please check the OSPAR database via https://odims.ospar.org/ or http://mpa.ospar.org/home_ospar



Legend

- Purple stars: MPAs/PVVAs with highest priority for conservation
- Pink, green, and grey circles are of second priority
- Size of coloured circles (without numbers) reflect how central the MPA/PVVA is for the overall connectivity of the network,
- Thickness of black lines reflects how important a given connection is in exchange of larvae (in a clockwise direction).
- Colour of MPA/PVVAs represents clusters of well-connected MPAs

* Note that the map is rotated ≈45° relative to true north due to the projection of the ocean model.

Figure 13 Connectivity and conservation priorities in the greater North Sea and Celtic Seas regions (Source: The Norwegian Institute of Marine Research, 2019)

Connectivity among marine protected areas, particularly valuable and vulnerable areas in the greater North Sea and Celtic Seas regions (October 2019)

FUTURE TRENDS

The NorthSEE project has identified future trends in energy, shipping and the marine environment. This information enabled project partners to assess the requirements in relation to MSP and gain a better understanding of the possible spatial implications of these trends.

Energy

As part of the European objectives for 2020, the binding targets for renewable energy will have a significant influence on wind energy installations in the next years. NSR countries have adopted different approaches to supporting offshore wind, including differences in support schemes, and spatial designations (figure 14) with varying exclusivity levels for offshore wind installations.

In total, 12 projects (all in the North Sea) reached Final Investment Decision in 2018, 95% of which were concentrated in four countries: UK, Belgium, Denmark and Netherlands.

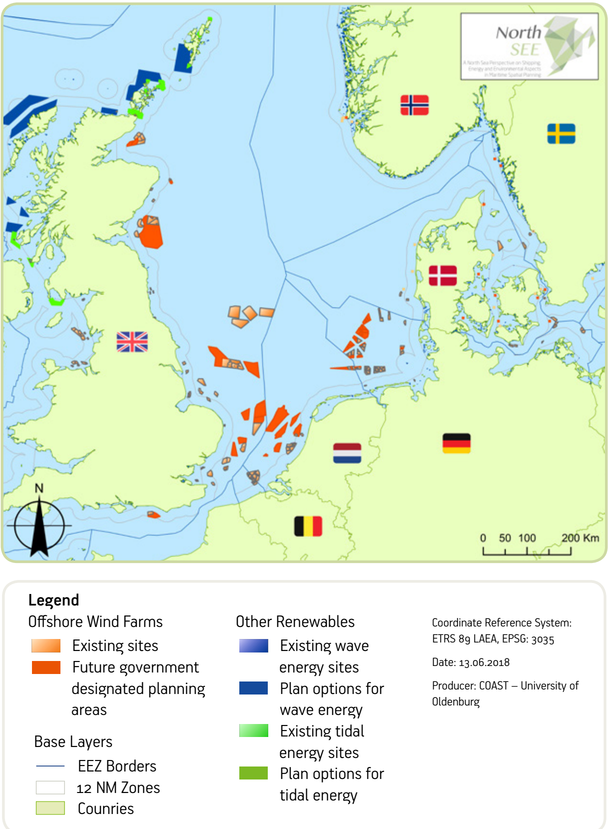


Figure 14 Existing offshore wind farms and future government designated planning areas for offshore wind along with existing and plan options for wave and tidal energy in the NSR (2018)

Table 5 Overview of the short-term wind energy policy landscape (Source: Wind Europe, 2017)[3]

Country	Short-term wind energy policy landscape (up to 2020)
BE	Large scale development offshore. After some changes to the support schemes, the last wind farms under the old legislation are constructed. For future developments, there will be a full switch to tender system for offshore energy.
DE	Full switch to tender system, both for onshore and offshore.
DK	The scheme for onshore wind expired in February 2018 and a one-year stand-still took place before the new scheme was introduced.
NL	Projects still supported by the SDE+ (budget auction) until 2020. Offshore target of 4.5 GW by 2023.
NO	No binding commitments for 2020
SE	Target addition 18 TWh RES electricity by 2030 but exponential trajectory with strong growth only at the end of the period.
UK	End of the Renewable Obligations Certificate system. Offshore wind still supported through auctions.

With regard to policy targets (table 5), the NorthSEE project suggests the following recommendations:

- **Create a concrete national energy policy roadmap to achieving 2050 energy targets.**
- **Energy policy targets should be translated into the same units for all NSR countries. This will allow a comparison between countries.**
- **Support the integration of the European internal energy market.**

According to WindEurope scenarios 2030, assuming that the spacing of wind turbines will remain at 1 km distances in the years to come, space requirements were calculated for incremental offshore wind turbines size scenarios (7 MW to 15 MW).

Timeline of Offshore Renewable Energy Development and Maritime Spatial Planning in the North Sea

3 WindEurope, Wind Energy in Europe: Outlook to 2020., 2017.

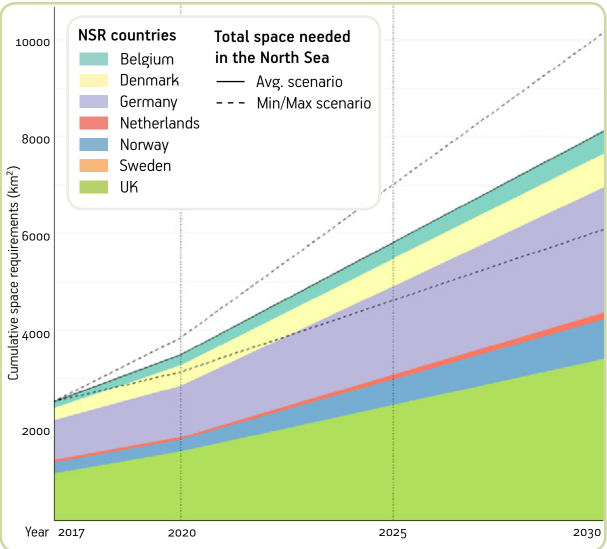


Figure 15 Wind Europe Scenario 2030 showing the cumulative spatial requirements (Source: Wind Europe, 2017)

Besides offshore wind, other forms of renewable ocean energy such as wave and tidal energy are also expected to play an important role post 2020. Industry scenarios (figure 15) indicate that 337 GW of wave and tidal energy capacity could be deployed around the world by 2050. A third of that capacity (100 GW) is expected to be located in Europe alone, and is estimated to produce around 350 TWh of electricity a year. Consequently, the roll-out of wave and tidal energy over the next 35 years could cover up to 10% of the European Union's energy demand.

Technical trends in the energy sector

- **Increased turbine capacity, deployment depth and distance from shore**

There is a trend towards developing OWF in deeper waters, further offshore, as well as developing larger, more powerful turbines. **For MSP this means that zones can also be designated in deeper / further offshore water locations, which will reduce spatial conflict within congested inshore waters and avoid higher densities of marine users.** However, with an average cost of 1 million € per kilometre of cable, often paid by public funding, the discussion needs to include the additional financial burden of establishing OWF further offshore.

- **Increased development area**

The average size of installed wind farms increased 8-fold during the last decade, with an average wind farm size of 379.5 MW. Large offshore wind farms with upwards of 100 wind turbines have been constructed in the North Sea. Whether or not increasing numbers of turbines will become a future trend is not yet clear and largely depends on spatial limitations, competition with other marine users and relative profitability of smaller versus larger turbines. In any case, **planners need to continue to follow market trends to understand the future spatial needs of the offshore wind sector with regards to preferred size and location of development areas.**

- **Floating wind**

Due to the depth profile of the North Sea, the available space able to host fixed foundation offshore wind farms is limited. Floating wind therefore offers a promising alternative as it is mounted on a floating structure that allows the turbine to generate electricity in water depths where bottom-mounted structures are not feasible. This offers the advantage of unlocking deeper water sites and a virtually inexhaustible resource potential, as well as developing larger wind turbines (12–15 MW). **For MSP, the development of floating wind farms means less spatial conflict within inshore waters. Suitable locations should be identified for floating wind across countries in the North Sea.**

> **Good practice example:** Scotland has developed a report detailing their experience in identifying suitable locations for floating wind in Scotland, an example of sharing good practice with other North Sea countries. The report includes an international dimension and explains why floating wind would be an interesting option for the North Sea, and what would be needed for such an approach to be transferable to other nations.

- **Increased development of tidal and wave energy**

Tidal and wave energy can bring the significant benefit, amongst others, of being an alternative solution to traditional grid-connected applications. Alongside utility-scale deployment, ocean energy devices can plug into local and isolated energy markets. The world's first commercial tidal energy farm (86 MW) has been built in Scotland. **For MSP, wave and tidal developments will have to compete**

for inshore areas with offshore wind developments, unless co-located and integrated (i.e. as part of an ocean multi-use system). They will also compete to connect to the grid as there will be limited connection points on land to the national grid and limited capacity as offshore wind will already dominate the connection.

- **Multi-rotor offshore wind turbines**

Multi-rotor wind turbines have several benefits such as increased energy capture, reduced cost of energy through fewer maintenance sites, fewer foundations causing less environmental impacts (such as benthic disturbance and displacement for fish and marine mammal species) and reduced extent of electrical interconnectors per installed megawatt of wind farm capacity. **For MSP, multi-rotor turbines would reduce the footprint and space requirements. However, without proper planning and consultation, they could lead to aerial navigation safety concerns and bird collisions.**

Other relevant trends for offshore energy production

- **Ocean multi-use developments**

Ocean multi-use is the shared use of marine resources in the same marine area or close proximity by two or more users. Examples of multi-use in the North Sea include mussel production in an offshore wind farm in Belgium and the pilot project of nature enhancement (i.e. artificial reef) in the offshore wind farm in the Netherlands. **Multi-use solutions help minimise conflicts and maximise synergies between two (or more) maritime activities. It is important to encourage multi-use in MSP as it can contribute to a more efficient use of marine space.**

- **Offshore energy renewable developments decommissioning**

Most offshore wind farms in the North Sea have a marine licence for 25 years and will afterwards be decommissioned. **A fully-costed decommissioning programme agreed prior to licence award will benefit MSP as it will ensure that offshore wind companies take in to account how to deal with the decommissioned installations when the marine licence expires.**

Grid and interconnectors

Growth of offshore wind energy and increased demand for energy distribution drives the development of an interconnected North Sea offshore grid. This is coupled with the EU's ambition to create a fully-integrated internal energy market where energy flows freely across borders. However, current grid and linear energy infrastructure is nationally focused with only some transnational coordination in the form of integrated connection of a number of offshore wind parks. Figure 16 shows the projects promoted in the region for the Ten-Year Network Development Plan (TYNDP) 2018.

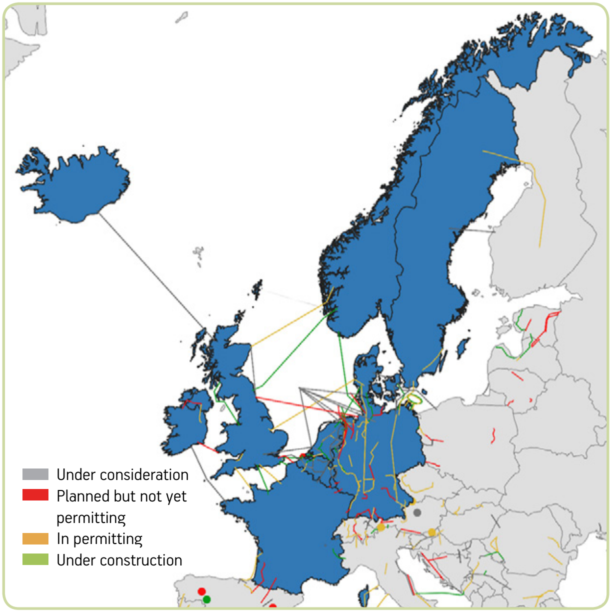


Figure 16 Future interconnectors in the NSR as promoted in the TYNDP 2018 (Source: TYNDP, 2018)

Member states need to reach a level of 10% interconnection by 2020 and 15% by 2030. By developing further interconnection capacity, enabling the integration of renewables and improving transnational cooperation they can meet this target and ensure energy security. In reality, there are difficulties in increasing interconnectivity due to considerable differences in terms of energy mix, size of energy market and geographical location.

With regard to MSP, there is also an increasing need to understand the current and future spatial needs of more submarine cables. The evolution of the energy mix, decentralisation and energy storage will be of particular spatial relevance for the NSR. Innovative techniques are proposed, such as TenneT's North Sea Wind Power Hub, an artificial energy island situated on the Doggerbank, combining wind power, interconnectors and energy storage.

There are several other challenges for MSP. Decommissioned cables left in-situ and not marked properly are a major safety and navigation hazard and thus, MSP issue. Also, further development of oil and gas pipelines will continue in the near future in Scotland, Norway and the Netherlands, but this is expected to stagnate after 2020. The decommissioning of these oil and gas pipelines also creates an opportunity for their re-purposing for carbon capture and storage.

In terms of main findings, the role of MSP in grid development involves identifying areas of least constraint to locate cable corridors that match up offshore energy resources to suitable grid connection points on land, whilst carefully routing around environmentally sensitive areas. MSP will become more important as coastal space in the (southern) North Sea becomes more congested, priority planning and spatial designations (e.g. cable corridors) will be required. There is currently no over-arching regulatory regime facilitating the association of offshore grid with offshore renewable projects across the NSR countries.

To date, most wind parks in the North Sea have been connected to shore by an individual electricity cable, a so-called 'radial' connection. However, a meshed, hub / interconnector or integrated approach may be the way toward achieving transnational coordination of a North Sea offshore grid. The NSR needs more landfall points in the northern North Sea in order to meet future needs and more interconnectors are required in the UK and Germany to help them achieve their 2020 and 2030 interconnection targets. However, despite higher interconnection demand in the future, there might be less requirements for landfall points if a meshed or more integrated grid solution is implemented.

Recommendations on possible future actions are as follows:

- **Energy and grid**

It is recommended to establish a dedicated transnational regulatory framework for offshore grid. It is also important to identify current and future areas of large energy generation offshore and energy demand onshore and to match them up and designate a well-defined and centralised responsibility for developing the post 2020 offshore grid.

- **NSR countries**

It is recommended to prioritise the development of interconnections with those neighbours that are below any of the thresholds (e.g. UK and Germany) in a spirit of solidarity and cooperation.

- **MSP**

NSR countries would benefit from developing a Spatial Offshore Grid Plan which takes into account energy and climate change targets, current and future energy industry trends, spatial planning principles and criteria and integrates cable corridors and gates. Also identifying viable new areas for landfall points, connecting MSP to terrestrial planning, considering optimal expansion of offshore grid from a transnational perspective and considering grid connectivity when planning areas for wave and tidal energy developments.

- **Future energy industry trends**

It is crucial to encourage and support transnational grid configurations, decommission old and unused cables and invest in Carbon Capture and Storage opportunities in decommissioned pipelines.

Interim *Status quo* report on offshore linear energy infrastructure in the North Sea Region (May 2019)

Shipping

The shipping industry is highly market driven. Consumer behaviour (such as preferences for foreign versus regional / local products, as well as timely versus cheaper transport) have an effect on the development of the shipping industry.

It can be expected that the growth of the shipping industry, and most significantly an increase of the total global fleet, will be limited in the coming decades. Thus, the total number of ships is likely to stay the same, with the exception of the tanker fleet which is currently experiencing growth. The continuous demolishing of old ships and their replacement by modern ships has a positive effect, as these are more environmentally friendly.

The number of ships sailing the North Sea will depend on the development of the EU market. If the demand for foreign goods is low, the number of ships will also be low. To lower the costs of transportation, shipping companies increasingly use one larger vessel to go to major ports instead of having several smaller vessels going to different ports. The dispersion of the goods is then done with smaller short sea ships.

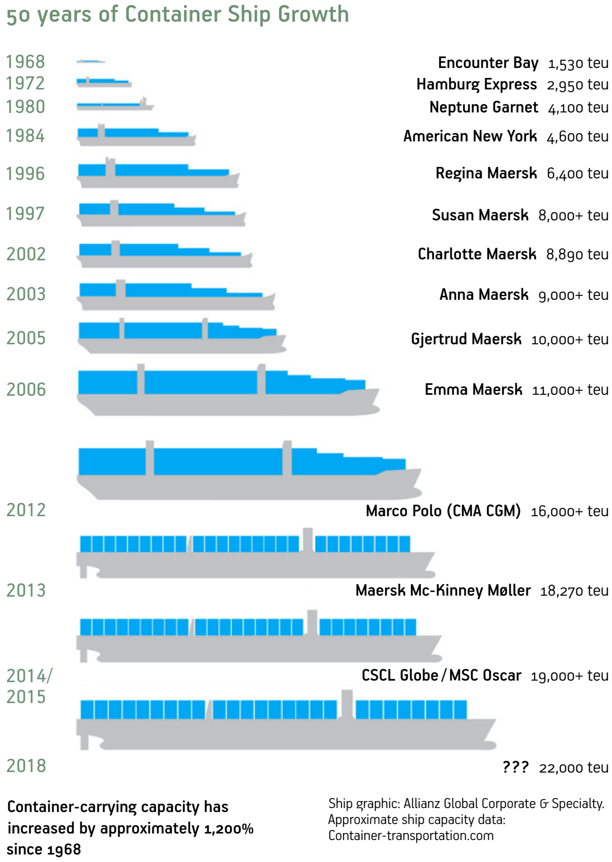


Figure 17 Increase in cumulative carrying capacity of ships (Source: Allianz Global Corporate & Specialty, 2018)

Key trends and spatial implications

- **Ship sizes**

The bigger and better-trend is largely a result of containerisation and automation which enables the faster loading and unloading of vessels. Every year new plans are created to outsize the currently available megaships (figure 17). However, whereas the sky at sea might have no limit, ports cannot accommodate ships of any size.

Thus, very big ships find it more and more difficult to enter ports, due to limited manoeuvrability or draught. This limits the number of ports that very big ships can use. Possible implications are the adjustment of existing ports for bigger ships; the development of new, large deep-water ports and offshore ports.

- **Short Sea Shipping**

Trends in port accessibility for large container vessels show a possible growth for short sea shipping. Large container vessels will make berth in major hubs like Rotterdam, where smaller and more efficient vessels will transport cargo to other ports. Short sea shipping made up close to 59% of the total maritime transport in the EU, but varies considerably among countries.

The increase of ship sizes on the short sea shipping lanes is likely to have an impact on MSP. It might be important to keep routes open. The larger vessels will focus on main hubs. It is important for them to keep the accessibility and opportunities to make berth at these larger ports.

- **Ship design and marine technology**

Shipping companies are once again reinvesting in specialised ship types. This trend is mostly visible in the heavy lifting industry, transportation of chemicals, extremely specialised ships that are able to transport parts of offshore wind turbines, or ships transporting crew members and maintenance personnel in and out of windfarms.

The problem with these vessels for MSP related issues is the fact that they do not follow the standard traffic lanes, used by commercial cargo ships. These specialised ships will go where they are needed and

in so doing, will have to cross standard traffic lanes, raising safety concerns. It is therefore important, while creating new shipping traffic lanes, to foresee safe crossings for these specialised vessels.

- **Green innovative sector – LNG**

Considerable resources and efforts are spent on innovative, green vessels and techniques. Innovations that reduce the environmental footprint of ships range from improvements of engines over better propeller range and high-tech coatings via friction-reducing air cushions and even skysails that reduce carbon and sulphur emissions. Considering fuel, LNG can play a big role replacing current diesel engines. The greatest limitation for the global adoption of LNG is the lack of infrastructure and bunkering facilities, which is currently solved by using dual engines.

The increase of LNG-fuelled vessels will not have a strong impact on the traffic lanes. These ships will continue to use the traditional routes. The only potential impact of this new trend is the need for LNG bunker facilities. Ports which offer LNG facilities may become more attractive. Areas with no LNG ports need to foresee enough space for bunkering at sea. If possible, bunkering can also be done by smaller LNG bunker vessels that will probably use the same routes as the short sea shipping vessels to go between ports.

- **Digitalisation – autonomous shipping**

The technologies to design unmanned vessels (even large cargo vessels) already exist. However, the ambiguity of legal status, economic feasibility, interaction with manned vessels, and cyber-attacks are all factors that have slowed down the process of developing operational unmanned vessels. But industry is working together with international organisations to overcome all difficulties and within a few years, the first larger unmanned cargo vessels will set sail. According to the ship autonomy level classifications by Lloyd's Register, ships with a minimum crew will come first. These ships are already being built. Within 5 to 10 years, vessels with no crew may be expected to be deployed. However, they will still be completely controlled onshore. The fully autonomous vehicle with artificial intelligence may seem like a distant prospect, but will become possible in future. Ports that are willing to adapt to this new trend, with adequate services, will have the benefit of operationalising these vessels first. The six levels of automatisation are presented in the green text box.

The effect of unmanned ships on MSP can be enormous. Specially dedicated routes (used solely by autonomous ships), special anchorage areas and adapted aids to navigation can all have an impact on MSP. It is however very difficult to take this trend into account already while planning, because most maritime spatial plans have a planning horizon of only a couple of years. Taking into account the uncertain development of unmanned vessels sailing around on a commercial level requires a long-term planning perspective.

Lloyd's Register has proposed six autonomy levels (ALs) for shipping, depending on the technology, systems, and operating procedures involved. These levels should provide clarity to shipping stakeholders about the specific requirements of different automation strategies.

Ship autonomy level (AL) classifications:

AL1 and AL2: For ships classified under this, all actions on-board would be taken by a human operator but there would be decision support from shore. This is already in place with some leading ship owners at some vessels of larger shipping companies. K-Line has developed an integrated vessel operation and performance management system that includes analysis and real-time remote monitoring and decision support.

AL3 and A4: Humans are present, but only in supervisory roles which go beyond autopilot operations.

AL5 and AL6: Ships are fully autonomous, with decisions carried out without human supervision. These types of ship are being examined by Advanced Autonomous Waterborne Applications, which includes DNV GL, Rolls – Royce, Inmarsat, Napa and Deltamarin. The Advanced Autonomous Waterborne Applications project also has the support of operators such as Finferries and ESL Shipping. So, it is likely that by 2020 there will be an autonomous ferry prototype operating between islands in Europe. Whether there will be unmanned cargo ships, tankers or other ship types remains to be seen.

(Source: Lloyd's Register, 2017)

Infographics: 4 Shipping Industry Trends (in cooperation with BalticLINes) (January 2018)

Environment

Research in the NorthSEE project has i.a. analysed innovative approaches to green infrastructure (GI), ecosystem services assessment and decision support tools. This chapter presents these three aspects and their relevance for transnational MSP in future.

Green infrastructure

"Strategically planned network of natural and semi-natural areas with other environmental features designed and managed to deliver a wide range of ecosystem services. It incorporates green spaces (or blue if aquatic ecosystems are concerned) and other physical features in terrestrial (including coastal) and marine areas"[4].

Identification and development of the GI focuses on two central criteria:

1. Identify areas of high ecological value. This could be in terms of biodiversity, rarity and importance for threatened species or habitats and their function in producing ecosystem services.
2. Define the degree of connectivity between those areas; Connectivity is about establishing ecological corridors where individuals and species can move between areas of high ecological value.

Incorporating the GI concept in MSP provides one way of strengthening the ecosystem-based approach in national and regional planning processes.

Few countries around the North Sea have started to work and develop a national approach to GI. Some are however interested in fostering a continued discussion on this topic with more countries bordering the North Sea. The following questions have been found to be of relevance for further collaboration across the North Sea:

- **What ecosystem services in the North Sea do we, at this point, identify as those we need to strengthen to achieve a productive ocean?**
- **What data are we missing to take the next step towards increasing both the national and cooperative approaches to marine GI?**
- **What bottle-necks / coordination issues need to be dealt with to strengthen cooperation for marine GI in the North Sea?**

Ecosystem Services

Drawing on a literature-based review, 23 marine ecosystem services provided by the North Sea region were defined and linked to seven offshore energy fields (table 6). The interactions were divided into four categories: dependence, impact, bidirectional, or no interaction.

Results suggested that oil and gas, as well as algae biomass, are the fields with the highest degree of impact on marine ecosystem services, while waves and salinity gradients exhibit the least. Some marine ecosystem services (conditions for infrastructure, regulation of water flows, and cognitive development) are relevant for all fields. Recreation and tourism, aesthetic and cultural perceptions and traditions, cognitive development, and sea scape are affected by all fields. The results of this research provide an improved basis for an ecosystem approach in transnational MSP.

4 https://ec.europa.eu/environment/nature/ecosystems/benefits/index_en.htm

Table 6 The interactions between the energy fields (columns) and the respective marine ecosystem services (MarES) (rows) (2018). Interactions are divided into four categories which are indicated by the colouring of each table element:

	MarES / Energy field	Oil and natural gas	Wind	Tides and currents	Waves	Salinity gradient	Algas biomass	Geothermal energy
1	Food supply							
2	Water supply							
3	Genetic resources							
4	Medicinal resources							
5	Raw materials							
6	Fossil hydrocarbon resources							
7	Renewable energy							
8	Storage							
9	Conditions for infrastructure							
10	Transportation							
11	Weather regulation							
12	Air purification							
13	Climate regulation							
14	Water purification							
15	Nutrient Cycling							
16	Coastal protection							
17	Regulation of water flows							
18	Biological self-control							
19	Lifecycle maintenance							
20	Recreation and tourism							
21	Aesthetic and cultural perceptions and traditions							
22	Cognitive development							
23	Sea scape							

dependence – means that an energy field needs the respective MarES to function;

bidirectional interaction – relates to both a dependence and an impact;

impact – indicates a direct, immediate positive or negative influence of the energy field on the MarES that alters its quality or quantity;

no interaction – refers to neither.

Scientific Article: Vogel, C., Ripken, M., Klenke, T. (2018). Linking Marine Ecosystem Services to the North Sea's Energy Fields in Transnational Marine Spatial Planning

Decision support tools

One of the key attributes of MSP is the compilation and analysis of a vast array of geospatial information about marine ecosystems and their use in a way that enables transparent and well-grounded decisions concerning the allocation of space. Comparison of the five selected decision support tools developed and used by the partners of the NorthSEE and BalticLINEs projects was presented at the Connecting Seas Conference in February 2019 (table 7).

So far, only Tools4MSP and Symphony have been applied in statutory MSP processes. Tools4MSP has supported the development of the pilot MSP for Region Emilia-Romagna in Italy. Symphony has been used extensively in the design and assessment of the Swedish national MSP, where it supported the designation of areas with particular consideration to high nature values, and was the main source for the estimation of the environmental impacts in the strategic environmental assessments of the plan proposals.

The Baltic Sea Impact Index, although not developed to support any particular MSP process, is likely to have influenced MSP and other marine management processes in Baltic Sea countries, as part of the wider efforts to characterise the status of the Baltic Sea environment.

As MSP spreads to new countries and regions, it is likely that decision-support tools will continue to develop. Geospatial tools for estimating the impacts of plans will depend on increasing volumes of data and benefit from greater computing power. Most tools still face considerable limitations related primarily to data coverage and quality, and the myriad assumptions relative to the functioning of ecosystems and how these react to anthropogenic pressures. With a growing international MSP community, it is beneficial to promote exchanges between the developers and users of these and other tools, in order to address limitations and develop improved tools that mirror the ecosystem in the best possible manner.

The basis for MSP is knowledge about the areas to be planned. Therefore, collecting and mapping information about ecological, environmental and oceanographical conditions, and collecting and mapping information about human activities are the first steps in MSP. With spatial knowledge as the basis, one can start identifying conflicts and compatibilities using different tools.

Table 7 Comparison of main functionalities of the five decision-support tools of the five selected tools (2019)

	Cumulative environmental impact assessment	Maritime use conflict analysis	Marine ecosystem service assessment	Scenario building and assessment	Climate change impact analysis	Representation of planning decisions
Tools4MSP	×	×	×			
Symphony	×			×	×	
MYTILUS	×	(×)		×		
BS Impact Index	×					
MSP Challenge	×	(×)		×		×

STAKEHOLDER INVOLVEMENT

The NorthSEE project has involved stakeholders in order to gather insights on future sector developments, receive feedback on project outputs and to ensure stakeholders' active participation in the MSP Challenge. Stakeholders came from a private (industry associations, major shipping or energy companies, NGOs, etc.), research (universities, institutes and specialised consultancies), or political (public sectoral agencies, regional representatives, etc.) background.

The project communication strategy provided concrete communication targets and ways of approaching and working with stakeholders. Different tools and methods were used and developed within the NorthSEE project (e.g. surveys, mapping, Living Q method, MSP Challenge board and simulation game). The four stakeholder meetings with the MSP Challenge Simulation Platform formed the key element of this strategy. In parallel, project partners developed the "Infoquarium" to improve the speed and adequacy of information availability for maritime spatial planners in the North Sea Region.

MSP Challenge

The MSP Challenge uses game technology and role-play to support communication and learning for maritime spatial planning. Since 2011, a role-playing game, a board game and an interactive simulation platform have been developed. NorthSEE enabled the development and application of an improved edition of the interactive simulation platform. This edition was applied in four workshops held in the NSR, involving experts and regional representatives.

Documents and scientific articles:

Building, balancing, fitting and calibrating a simplified Ecopath with Ecosim North Sea model for the MSP Challenge Platform Edition game (2019)

The 'Living Q' – An interactive method for actor engagement in transnational Marine Spatial Planning (2018)

Stakeholder Engagement in Marine Spatial Planning: Design, Experiences and Evaluation of the MSP Challenge Board Game) (2018)

Communicating Maritime Spatial Planning: The MSP Challenge approach (2019)

An offshore energy simulation through flow networks: CEL within the MSP Challenge 2050 simulation game platform (2018)

A shipping simulation through pathfinding: SEL within the MSP Challenge simulation platform (2019)

Outputs MSPsystems (overview and comparison) (2018)

MSP Challenge board game

Key characteristics

- Played on a 2.8 × 1.6 meter board, printed with a map of the fictional 'RICA Sea'.
- 12–30 players assigned to stakeholder or planner roles for the countries Island, Bayland or Peninsuland.
- Key game objective: 'Jointly develop the RICA Sea so that at the end of the game, you and others feel comfortable with the state of the RICA Sea and how you developed it'.
- Players collaboratively discuss and decide on where to place many coloured tiles and threads representing diverse aspects of the marine environment and human activities.
- Typically played over a period of 1.5–2 hours, which includes debriefing.

Benefits

- Literally puts players of all languages around the table to experience MSP.
- Triggers players to quickly share information, evidence and stories from their own experiences, and discuss planning options.
- Lets players jointly develop an ecosystem-based MSP, while dealing with the language and communication challenges that MSP poses.

Applications

- Used in Scotland to encourage stakeholder involvement in the implementation of the Scottish National Marine Plan (2015).
- Used to kickstart the MSP revision process in Belgium in a meeting with 125 stakeholders in Bruges (February 2017).
- Used at the Connecting Seas conference in Hamburg (February 2019).
- Copies produced for NorthSEE partner BSH, WMU, COAST and other partners, adapted to their national language for future stakeholder processes.

MSP Challenge Simulation Platform

Key characteristics

- Played in teams on computers, all connected to the same digital representation of a real sea basin.
- Integrates real geographical data (both marine and human activities) sourced from a great many proprietary institutions and data portals (e.g. EMODnet)
- Interacts with science-based simulation models for shipping, energy and ecosystem (Ecopath with Ecosim)
- Enables players to collaboratively draw up, implement and evaluate spatial plans for human activities and marine protection.
- Typically played over a period of 1–1.5 days, which includes debriefing.

Benefits

- Enables multiplayer game sessions for experts and non-experts.
- Enables sea basin scenario exploration, co-design, validation or policy-oriented learning.
- Represents a significant step towards becoming a next generation marine planning support system.

Applications

- Clyde marine region edition with bespoke shipping and Ecopath-with-Ecosim ecosystem simulations developed for the Scottish Government (SIMCelt project).
- North Sea edition with bespoke shipping, energy and Ecopath-with-Ecosim ecosystem simulations developed in the NorthSEE project.
- Baltic Sea edition with bespoke shipping, energy and Ecopath-with-Ecosim ecosystem simulations developed in the BalticLINes project.
- Applied in NorthSEE in four workshops with almost 100 participants, in particular for energy and shipping experts as well as regional representatives and NGOs.

MSP Challenge sessions

Environment – Texel (NL) – April 2018

Ecosystem-based maritime spatial planning requires an understanding of current mechanisms, methods, ambitions and measures to deal with the marine environment. During this one-day workshop, environmental experts and other stakeholders discussed about a range of transnational MSP topics, such as:

- Achieving a coherent network of Marine Protected Areas,
- Environmental modelling for MSP and estimating (cumulative) pressures,
- Carrying out Strategic Environmental Assessments,
- Consultation processes and stakeholder involvement,
- Dealing with blind spots, emerging topics and new evidence.

A total of 40 participants from different North Sea countries joined this workshop. As the focus of this session was on environment, many of the external stakeholders had an environment background or worked for an NGO. In addition, the North Sea Commission regional committee on MSP took part in this workshop.

Energy – Aberdeen (SCOT) – October 2018

The two-day workshop facilitated the discussion with energy and regional experts on the future of offshore energy in the North Sea from an MSP perspective. The focus was on validating the results from the energy status quo report published by the energy work package on future energy industry trends, spatial requirements, incompatibilities and spatial solutions.

On the first day, the participants played the board game version introducing them to the concept of MSP. Each player was assigned a role and responsibility and the overall game challenge was to implement 50 offshore wind farm 'tiles', whilst taking into account other marine users.

On the second day the digital version was played by the same group, focusing on the same topic in the actual North Sea. The decisions for offshore wind farms designations were fed into the background models, thereby showing the environmental impact, and the impact on shipping efficiency of the player's planning decisions.

Figure 18 Interactions during the MSP Challenge sessions in the North-SEE project (2019)

Shipping – Malmö (SE) – November 2018

The status quo and future trends analysis on shipping led to some interesting findings on the different approaches of countries in dealing with shipping lanes, shipping measures, and safety zones between offshore wind farms and shipping measures. These findings provided the grounds for discussion on the role of MSP in facilitating sustainable growth of the shipping sector.

During the interactive workshop with shipping-related stakeholders, the participants were divided into countries and were tasked with offshore renewable energy targets they had to reach. In addition, each country had to keep an eye on one key performance indicator of its ports: the shipping route efficiency percentage.

Some countries decided to designate more shipping routes in their EEZ to improve efficiency. This reinforced the key message at the end of the session that it is important to develop coherent shipping routing measures that connect seamlessly across EEZ borders.

MSP Cooperation – Hamburg (DE) – February 2019

A joint NorthSEE and BalticLINEs workshop using the MSP Challenge computer version allowed planners and experts to explore and discuss different planning options relevant in the transnational context and to exchange on the upcoming cross-border consultation opportunities in Members States currently in the process of reviewing or developing their plan.

Involving Regions in MSP processes

The term 'region' means different things to different stakeholders. It can be a technical description of a formal EU sea basin, a geographic grouping of authorities within a hierarchical terrestrial planning regime or a statutory definition of an area for which a formal marine plan shall be prepared as part of an overall national framework.

Organisational and institutional structures already exist to facilitate 'regional' relationships between EU Member States and third countries: some even exist to cater for the particular issues affecting the NSR.

As marine planning processes mature, existing mechanisms may also need to evolve to ensure that they continue to play a relevant part. The emergence of specific entities, such as the Marine Resources Group within the North Sea Commission, offers an opportunity for transnational consideration of specific issues and useful knowledge exchange in a fast-evolving policy environment. In particular, at a time of political uncertainty in relation to the UK's departure from the European Union, such mechanisms offer a way of retaining links with neighbours around a sea basin whose ecosystems do not recognise artificial human-scale political constructs.

The nature of 'regions' is varied but national plans are diminished if they do not reflect what is happening at the sub-national level.

Representation of regional interests – through existing mechanisms or new opportunities – is essential to secure a comprehensive understanding of what MSP can deliver for ecosystems that do not acknowledge artificial human-scale administrative boundaries and transnational sectoral interests.

There is a myriad of different issues that are of environmental, social, cultural, economic or other importance to sub-national areas. These have as much right to be reflected in marine planning as the supra-national, supra-sectoral interests that so drive the global economy.

Stronger links need to be made between national and regional MSP to determine the need for the involvement of regional and local government in MSP and the range of their maritime issues.

Some confusion currently exists surrounding local authorities and their role within MSP. To help avoid this confusion, relevant local authority contacts and MSP issues should be mapped around the North Sea.

There is a need for effective participation in MSP across all relevant governance levels and thus, for better understanding of where regions and their issues or interests fit into a national or transnational/ cross-border picture. This may also ensure a more integrated approach to marine and coastal management, as neither exists in isolation of the other and both are connected to their hinterland.

Good practice example: In England, the Local Government Association's Coastal Special Interest Group was formed to promote the role of local government in coastal issues and it achieves recognition of the English coast in policy and decision-making from local authorities to national government and beyond.

Document: The Role of Regions in Maritime Spatial Planning within the North Sea area

Connecting Seas Conference

The MSP conference 'Connecting Seas', which took place on 13–14 February 2019 in Hamburg, Germany, was a joint event of the two "sister projects" NorthSEE and BalticLINes. For the first time, the conference brought together more than 200 MSP stakeholders from both North and Baltic Sea representing different ministries and authorities, the shipping, energy and environment sector, transnational organisations and initiatives, NGOs as well as research institutes.

9 interactive workshops showcased the various results and findings (figure 18, 19 and 20) from NorthSEE and BalticLINes relating to:

- Energy sector planning issues, criteria, tools
- Shipping sector planning issues, criteria, tools
- Environmental impact
- Stakeholder involvement
- Other sea uses in MSP
- Data in MSPs
- Synergies and conflicts in MSP
- Future trends and scenarios
- Multi-level governance

The various high-level speakers and panel discussions highlighted the need to establish continuous cooperation among the MSP authorities and planners across the North Sea. The North Sea Political Energy Initiative could serve as a model for the Baltic Sea on how to improve the cooperation with the energy sector, which may be necessary in order to turn ambitious renewable energy targets and plans into a reality.

It was stressed that such cooperation has to be stimulated and endorsed at the highest political level. To this end, planners have to clearly present the specific issues at stake, which can and need to be solved through transnational cooperation.

Connecting Seas

NorthSEE – Baltic LINes MSP conference

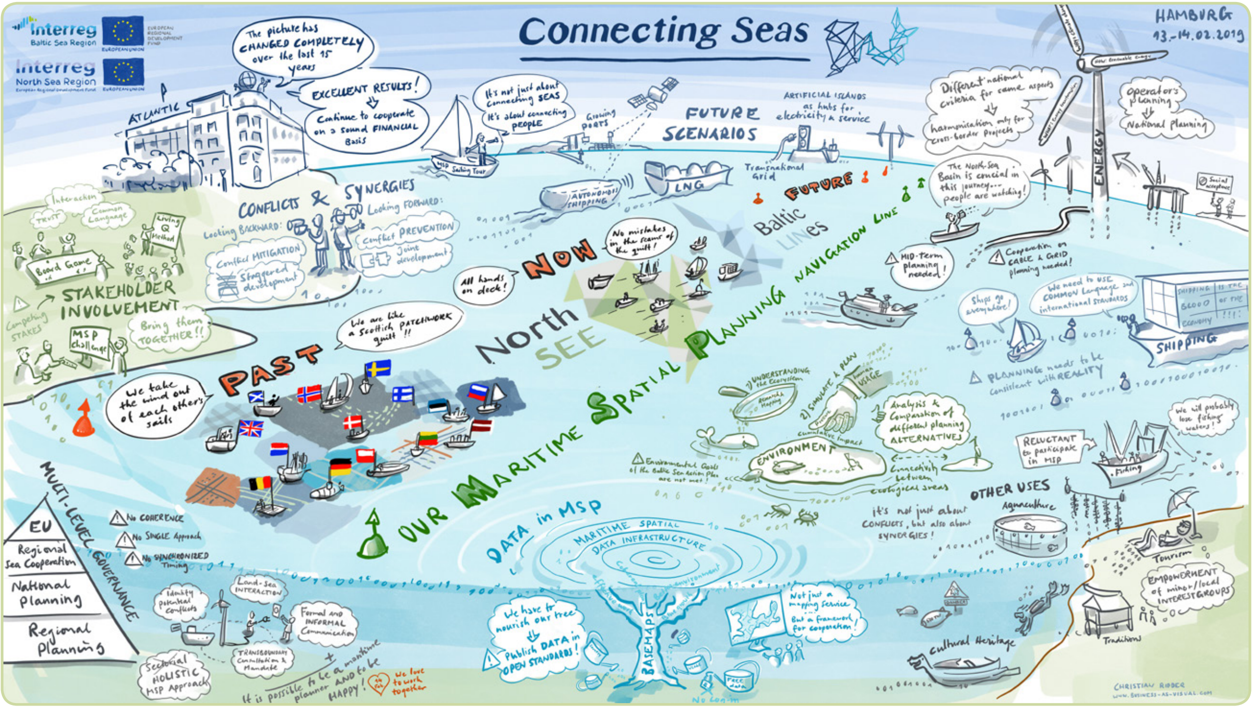


Figure 19 Most important findings from the Connecting Seas MSP conference. Visual summary developed by Christian Ridder business-as-visual.com (2019)

Figure 20 Panel discussion at the Connecting Seas conference in Hamburg (February 2019)

FROM PLANNING ISSUES TO PLANNING SOLUTIONS

Improving co-existence of shipping and offshore wind

There is consensus among stakeholders acknowledging that OREIs (Offshore Renewable Energy Installations) can pose risks to maritime operations in terms of reduced navigational safety. The presence of an OWF, for instance, means that there are more obstacles in the water which ships have to avoid. Offshore wind farms may also restrict the navigable space available to ships, leading to increased traffic density, and an increased risk of collision, as well as interfere with ships' on-board navigation, reducing the navigational safety.

In order to ensure that the mutual risks between OREIs and maritime activities are as low as possible, planners use 'Safety Distances', 'Safety Zones' or 'Safe Passing Distances'. Although there is no universally accepted definition of these distances, the IMO encourages the use of the risk-based Formal Safety Assessment framework. The harmonised legal approach for the establishment of Safety Distances still allows for countries to apply their own technical, implementation and enforcement standards. **Transboundary risk-based approaches could provide solutions, using similar technical approaches (formula-based vs. qualitative) and the same kind of enforcement regimes.**

Planning solution: harmonisation of navigational risk assessment

Risk-based approaches focusing on the spatial conflict between OREIs and maritime activities already exist in the form of navigational risk assessments (NRAs). An NRA is a process which is conducted by OREI developers to get approval for their projects, showing that their projects do not pose an unacceptably high risk to maritime activities. **While approval authorities tend to be more familiar with NRAs than planners, they could also be adopted to be a part of the planning process, as is already the case for example in Netherlands and Belgium.**

In order to make the planning processes more efficient and transparent, different countries' NRA processes should be included into planning and further harmonised. In particular, the calculation-methods, factors, and data sources used for probability and consequence calculations should be similar, especially across countries in close proximity to each other.

Harmonisation does not mean that all countries or all OWFs should have the same acceptability criteria. It simply means having the same steps when doing things such as calculating probabilities or consequences of navigational accidents. Promoting harmonisation can also indirectly lead to greater transparency of models and input-data. In the end, harmonised NRA processes reduce the administrative load on OREI developers, and will improve both the planning and licensing of OREIs. Figure 21 shows the Spatial Planners' Guide to Distances between Shipping & Offshore Renewable Energy Installations, which was developed as part of the NorthSEE project.

Report: Improving the co-existence of Offshore Energy Installations & Shipping (June 2018)

Infographic: The Spatial Planners Guide to Distances between Shipping & Offshore Renewable Energy Installations (November 2017)

The Spatial Planners' Guide to Distances between Shipping & Offshore Renewable Energy Installations

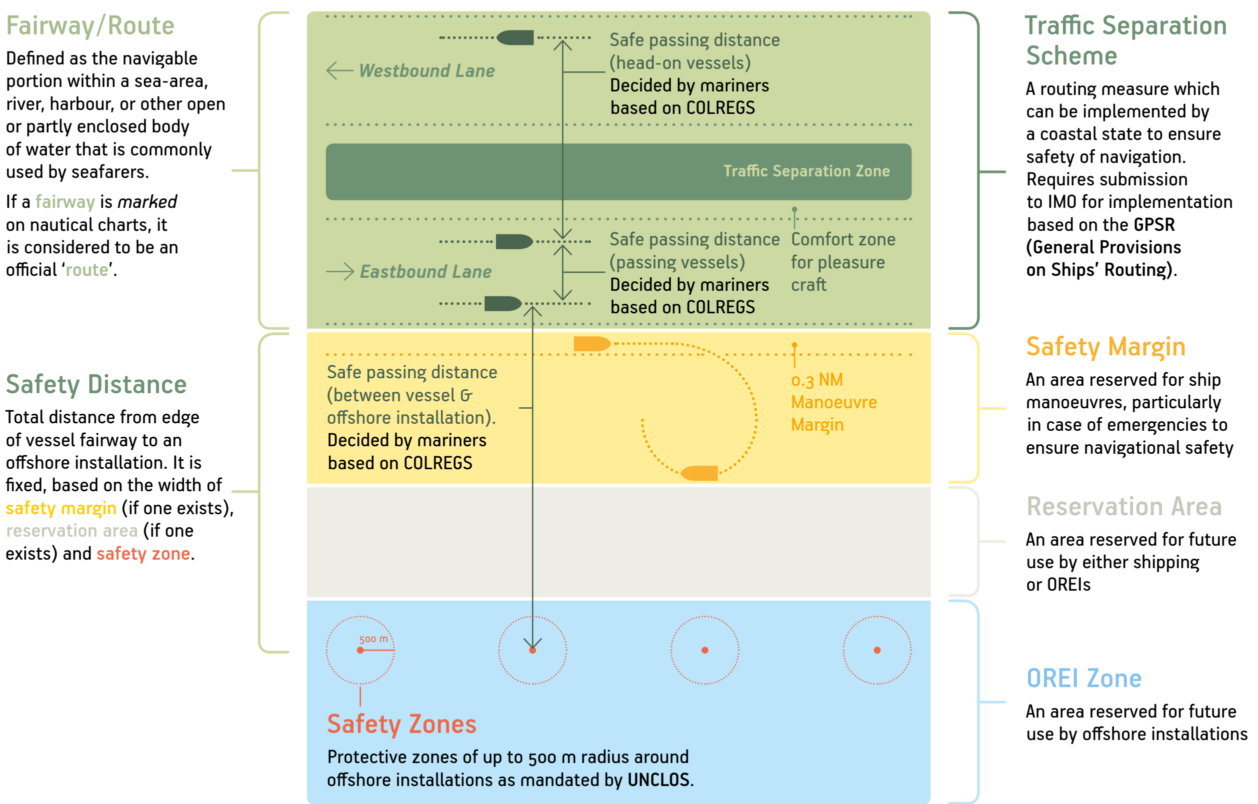


Figure 21 The Spatial Planners' Guide to Distances between Shipping & Offshore Renewable Energy Installations (2018)

TECHNICAL AND SPATIAL PLANNING CRITERIA

Planning criteria are the factors that are taken into account for the identification, assessment and ultimate spatial designation and regulation of areas for specific spatial uses and activities. These include the selection of suitable areas for offshore wind farms, cable corridors and important corridors for shipping ("site/ corridor selection criteria").

Planning criteria and their (different) applications in different countries are highly relevant in the search for both the cause of planning mismatches and their resolution. In view of their importance, the NorthSEE project partners decided to collect those planning criteria for shipping, energy, grid and environmental protection sites that are most frequently used by countries (table 8). Explaining the rationales behind the planning criteria fostered the discussion on their actual meaning and impact as well as the possible need for harmonisation.

Document: Planning Criteria overview tables (General MSP, Energy, Grid&Interconnectors, Shipping and Environment) (Update: April 2019)

A comparative analysis of spatial planning designations in the North Sea countries (June 2019)

Table 8 Four examples of planning criteria from the overview tables (2019)

	Shipping MSP's role in providing space for ship traffic	Offshore Wind MSP's role in locating OWE	Grid MSP's role in locating grid connections, platforms and interconnector routes	Environment Consideration of MPAs and other ecologically valuable areas in planning process
BE	Priority area for shipping, no incompatible activities in these areas are allowed.	MSP is used to designate spatial areas for renewable energy and for offshore wind.	Cable corridors are identified in the MSP. Cables (energy and telecom) and pipelines are to be located within these corridors (alternative routes can be allowed).	MPAs are part of the existing plan (Special Area for Conservation, Special Protection Area).
DK	Priority areas for shipping shall safeguard space for ship traffic, no incompatible activities (e.g. artificial installations) are allowed.	Until now, sectoral decision-making and planning by the Danish Energy Agency. MSP's role is to coordinate use of the sea areas for different uses.	MSP will plan for cable corridors to offshore wind farms, and for international transmission pipelines like Baltic Pipe and Nord Stream 2.	No current MSP plan.
DE	Priority areas for shipping shall safeguard space for ship traffic, no incompatible activities (e.g. artificial installations) are allowed.	Designation of priority areas is indicative. OWF can be built outside the designated areas.	Definition of subsea cable routes or corridors and transboundary gates for the grid connection of offshore windfarms and interconnectors within the EEZ in the MSP.	The needs of the marine environment are protected by provisions for marine environmental protection included in the regulations applying to the individual uses (e.g. exclusion of offshore wind farms in Natura2000 areas) and by dedicated regulations for the protection of the marine environment.
NL	Routing measures and other measures apply for the purposes of regulating maritime traffic. These include: traffic separation scheme, precautionary areas, clearways and anchorages.	MSP is used to designate wind energy areas and all the conditions required to build wind farms (location, permit and grid connection etc.).	Priority and preferred routes for cables around sand extraction reserve areas which are determined in the Integrated Maritime Spatial Policy map and North Sea Policy Document 2016-2021.	Designated Natura 2000 areas are part of the current MSP plan.
NO	In the ocean areas there is enough space. Traffic separation scheme for large vessels transporting dangerous goods like oil and gas. Within the coastal zone, designated shipping routes are divided between primary and secondary fairway.	No zones have been opened for OWE yet but 15 possible or suitable areas have been identified by SEA.	No MSP exists so planning for grid connections and cable routes is yet to be considered.	Identifying the environmental value of Norwegian sea areas, and designating particularly valuable and vulnerable areas are part of existing MSP plan. MPA regulations must be respected.
SCO	Navigational safety is paramount to vessel movement and must be safeguarded. Displacement of shipping should be avoided where possible. Mitigate against potential increased journey lengths (and associated fuel costs, emissions and impact on journey frequency) and potential impacts on other users and ecologically sensitive areas.	MSP particularly focuses on the development of the marine renewable energy sector. MSP is used to identify spatial 'Plan Options' for offshore wind, tidal and wave energy.	The planning of cables is considered within Scotland's National Marine Plan (NMP) and planning advice and guidance is captured within the plan's policies and objectives. There are indicative export cable routes for offshore wind, wave and tidal energy developments identified in Scotland's National Marine Plan.	31 Nature conservation MPAs (17 territorial, 13 EEZ) and 8 historic MPAs are part of the National Marine Plan.
SE	Priority areas for shipping shall safeguard space for ship traffic, conflicting or disturbing activities are restricted.	National interest areas from energy authority taken into MSP plan, but MSP also suggests new areas. OWE can be built outside the designated areas.	No MSP exists so planning for grid connections and cable routes is yet to be considered.	Natura 2000, (planned) MPAs and areas of national interest for nature values in MSP plan.

Energy

With regard to spatial designations, most countries have designated OWF areas. The NSR countries differ with regard to duration & process of OWF licensing. They also have different legislation, planning and maturity levels with regard to energy. The zoning schemes also refer to different levels of exclusivity with regard to fishing, MPAs, and shipping activities. For example, Germany specifies priority areas where only offshore wind energy may be developed, while Denmark and Sweden take a more flexible approach. Technical layers per country also differ and planning criteria themselves are different in origin, nature & weighting.

Document: Annex 2: National marine planning and licensing frameworks in North Sea countries and links to offshore renewable developments

Designations in MSP

BE
MSP is used to designate spatial areas for renewable energy and for offshore wind. The maritime spatial plan shows the area for energy i.e. the authorities define the area, but the operators develop the specific windfarm layout.

DK
Until now DK has relied on sectoral decision-making and planning, by the Danish Energy Agency. The future MSP's role is to coordinate use of the sea areas for different uses like offshore energy extraction, shipping, fishing, aquaculture, seabed mining and environmental protection.

DE
The maritime spatial plan shows the designation of priority areas, which is indicative. OWF can be and are also licensed and built outside the priority areas.

NL
MSP is used to designate wind energy areas and all the conditions required to build wind farms (location, permit and grid connection etc.). Wind farms are not permitted to be built outside these designated areas.

NO
There are no zones opened for OWE yet but 15 possible or suitable areas have been identified by SEA. There is no OWF in NO, thus there is no existing practice on licensing for commercial OWE projects.

SCO
MSP particularly focuses on the development of the marine renewable energy sector. MSP is used to identify spatial 'Plan Options' for offshore wind, tidal and wave energy.

Seabed lease and marine licensing applications are expected to be located within the Plan Options and developments will not occupy the whole area. Applications within Plan Options are subject to the licensing process. Scotland's National Marine Plan provides the framework for the licensing and consents process.

The NorthSEE project makes the following recommendations with regard to MSP and energy:

- **Designate spatial areas for offshore renewable energy to safeguard space for future wind parks in suitable locations. This also supports possible cross-border developments of energy production and transmission.**
- **Determine spatial implications of future energy industry trends, including growth of offshore wind production, technical developments of wind turbines, distance to shore, multi-use renewable energy developments, developments in ocean energy, oil and gas and offshore wind farm decommissioning.**
- **Develop harmonised planning and technical design criteria for offshore wind farms across all North Sea countries. This will support the harmonisation of planning approaches, especially for future cross-border developments of energy production and transmission.**
- **Identify planning areas and issues for linear infrastructure and develop planning criteria and proposals for interconnector routes and gates to be integrated in national MSPs.**
- **Develop suggestions for streamlining SEA / EIA processes across the NSR.**

Document: A comparative analysis of spatial planning designations in the North Sea countries (June 2019)

Grid and interconnectors

Technical criteria are rules which apply to the construction or placement of cables (usually industry standards or determined by marine license conditions). Examples are the use of high voltage direct current (HVDC) and high voltage alternating current (HVAC) technology for different connections, cable protection measures and specific depths for cable burial. Spatial planning criteria on the other hand are principles applied to spatial position of cables. There is a difference between the criteria being government-led (e.g. in Germany) or industry-led (e.g. in Scotland). Industry led, the planning principles are more likely to be classed as 'rules of thumb' and adherence to the principles is dependent on risk.

Spatial planning criteria are restrictions, guidelines or specifications for interconnectors and cables in general. One of the main advantages of spatial planning criteria is to avoid conflict with other marine users, protected or commercially important areas. In order to avoid and reduce possible conflicts, Germany and Netherlands encourage bundling of cables where possible and in Belgium, pipelines are also clustered into corridors.

Role of MSP

MSP can help by identifying areas of least constraint to locate cable corridors that match up offshore energy resource to suitable grid connection points on land, whilst carefully routing around sensitive areas. Thereby it contributes to the ambition to develop a North Sea offshore grid which interconnects all NSR countries, facilitates the flow of energy across borders and thus would help to meet EU targets for an integrated internal energy market.

In developing this North Sea-wide grid, the following two approaches could be applied:

1. The 'hub/ interconnector approach' includes both radial offshore wind park connections and a more coordinated form of offshore wind connections, in the form of a hub. It calls for an expansion of the offshore cross-border electricity transmission infrastructure in the form of interconnectors.
2. The 'integrated approach', also known as 'meshed grid' could connect cables, hubs, interconnectors and offshore wind parks all together in one major energy system.

Interim Report: Status quo report on offshore linear energy infrastructure in the North Sea Region. *Grid cables, electricity interconnectors and pipelines* (May 2019)

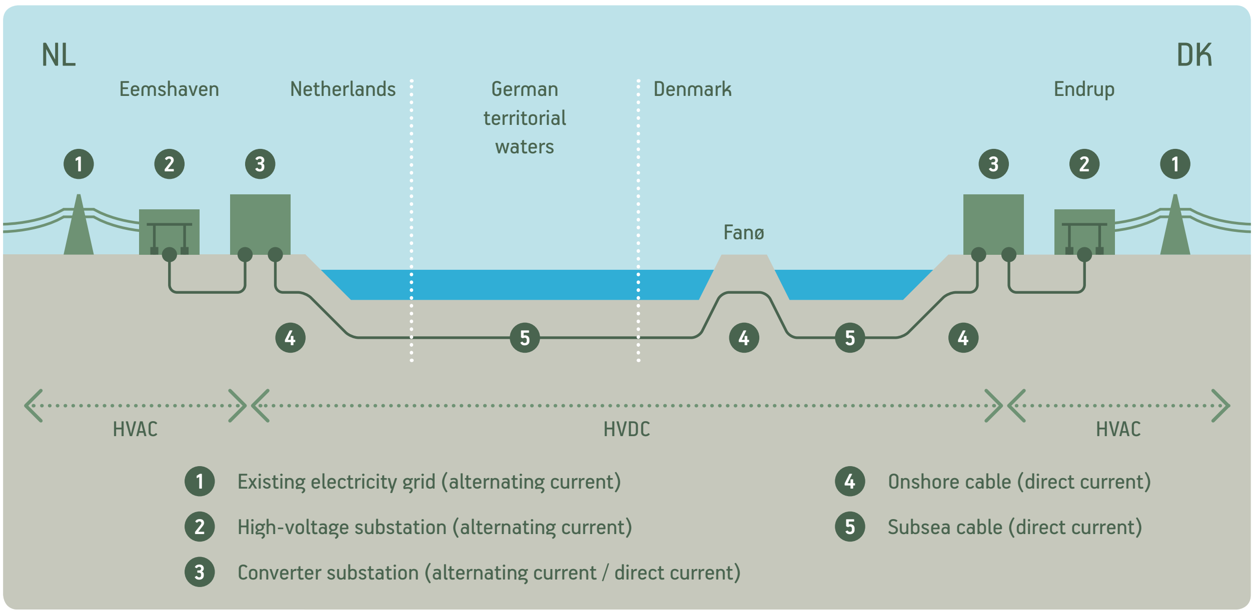


Figure 22 Cross-section of the COBRAcable system (Source: TenneT-Energinet, 2018)

Case study: Cobra Cable

The COBRA cable (figure 22) is a 700 MW capacity interconnector between the Netherlands and Denmark, passing through the German EEZ, thereby requiring national and local consents and permissions. Besides different procedures, licences and national environmental impact assessments, marine sectors in all countries will also have the opportunity to raise their concerns about the planned routing and how it might affect them.

Shipping

Ships' routing establishes an international predetermined path for ships to navigate in order to avoid navigational hazards such as collisions and subsequent damages to ships, crew members, and the marine environment. The IMO is the only internationally recognised competent body for establishing these systems. In their national MSP plans, countries have designated certain areas as priority areas for shipping. In general, shipping is prioritised in maritime spatial plans before other types of activities. However, other activities may take place as long as they do not interfere with shipping. Countries surrounding the North Sea have applied different criteria for designating priority areas for shipping and other maritime traffic regulations (figure 23).

The following are examples of IMO routing measures :

- **Traffic separation schemes:** Two traffic-lanes (or clearways) indicate the general direction of the ships in that zone; ships navigating within the area all sail in the same direction or they cross the lane at an angle as close to 90 degrees as possible.
- **Two-way routes:** A two-way track for guidance of ships through hazardous areas.
- **Recommended tracks:** A route of undefined width, for the convenience of ships in transit, which is often marked by centreline buoys.
- **Deep water routes:** Routes within defined limits which have been accurately surveyed for clearance of sea bottom and submerged articles.
- **Precautionary areas:** An area within defined limits where ships must navigate with particular caution and within which the direction of flow of traffic may be recommended.
- **Areas to be avoided:** An area of defined limits within which either navigation is particularly hazardous or it is exceptionally important to avoid casualties. The defined area should be avoided either by all ships or by certain classes of ships.

Document: Report: Transnational Maritime Spatial Planning in the North Sea: The Shipping Context (March 2018)

Shipping designations in MSPs

Countries surrounding the North Sea have applied different criteria for designating national priority areas for shipping:

BE

- **Priority areas for shipping:** This implies that activities that have the potential to interfere with shipping cannot occur in these areas, but this does not mean that these areas are exclusive to shipping.

DE

- **Priority areas for shipping:** Shipping granted priority over all other spatially significant uses.
- **Reservation areas for shipping:** Shipping is given special consideration.

DK

- **Priority areas for shipping:** These are areas where shipping has the priority, nevertheless, other uses are not prevented from using the space.

NL

- **Precautionary areas:** Areas where vessels must take extra care, as multiple traffic separation schemes converge here.
- **Particularly Sensitive Sea Area:** Wadden Sea has the status of the Particularly Sensitive Sea Area, which is the reason for setting the mandatory route for tankers in the area. The mandatory deep-water route

is located further out from the coast, ensuring that any oil discharged as a result of an accident can be combated before it reaches the protected area.

- **Clearways:** Shipping zones between traffic separation schemes in which mining installations may not be built. Vessels are not obliged to use these areas. Recognising that these areas must remain free of obstacles, a clearway holds the status of recognised sea lane essential for navigation as referred to in the United Nations Convention on the Law of the Sea.
- **Anchorages:** 'Parking spaces' for ships.

NO

- **Traffic separation schemes:** A routing measure aimed at the separation of opposing streams of traffic by appropriate means and by the establishment of traffic lanes. Two traffic-lanes (or clearways) indicate the general direction of the ships in that zone; ships navigating within the area all sail in the same direction or they cross the lane at an angle as close to 90 degrees as possible.
- **Recommended routes:** A route of undefined width, for the convenience of ships.
- **Primary fairways:** Typically, these are the waterways used for traffic along the coast, and traffic to and from ports of national or regional importance that bind landward and seaward traffic together.
- **Secondary fairways:** Used, for example, by traffic to and from industrial sites, priority to other spatial uses.
- **Digital Route Service:** A service for vessels arriving and leaving Norwegian ports was launched in Oslofjorden in 2018, with reference routes available from the Swedish border to Tønsberg. The service was extended to the southeast and parts of the southwest coast on 3 June 2019, and will be available along the entire Norwegian coast in 2020.

SE

- **Priority areas for shipping:** They do not prevent other activities from using the space, but indicate that in case of several competing interests in the same area, shipping should be given priority.

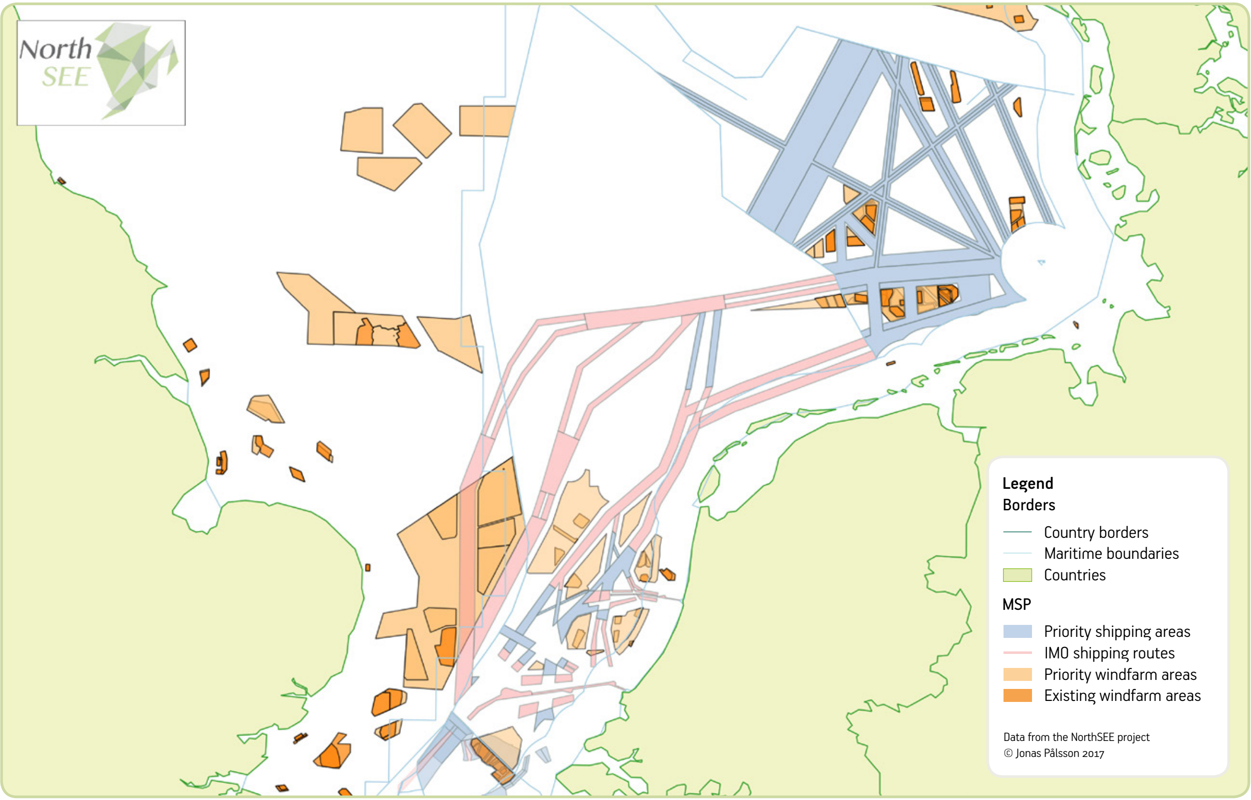


Figure 23 Map showing the priority shipping routes and IMO shipping routes (2017). Figures 23 and 24 may not represent the most accurate actual situation in the respective countries.

Incoherencies between shipping routes and designations

In developing a map showing maritime traffic, IMO routing measures and other designated priority areas for shipping, some inconsistencies became evident between the existing ship traffic in the AIS data and the spatial designations in the MSP plans (figure 24).

Incoherence 1 (Red circle)
The red circle highlights an area where intense shipping takes place at the same time as the area being designated as prioritised for wind farms. It should be emphasised, however, that Denmark has at the time of writing this report (2019) no MSP plan in place and the areas marked for offshore wind farms are hence not part of an MSP plan. Yet, it is still noteworthy that the circled area is subject to interest for both shipping and exploitation through offshore wind farms.

Incoherence 2 (Blue circle)
The blue circle highlights a possible discrepancy between the position of the designated shipping route (blue route) and the ship traffic (blue dots), that was identified within the NorthSEE project. As a result, the project took the initiative to bring together the shipping experts from Belgium, the Netherlands, Germany and Denmark. They started to discuss how existing and new shipping routes could be optimised or designed and internationally adopted according to the existing traffic patterns.

Apart from shipping intensity, which is mainly market-driven, MSP also needs to consider trends in ship design. Deployment of larger vessels will require port expansion, which will have a direct impact on the surroundings in several ways e.g. spatial, environmental and safety-related.

It is important to predict and consider in MSP the movement intensity of vessels used for development, operation and maintenance of future offshore wind farms.

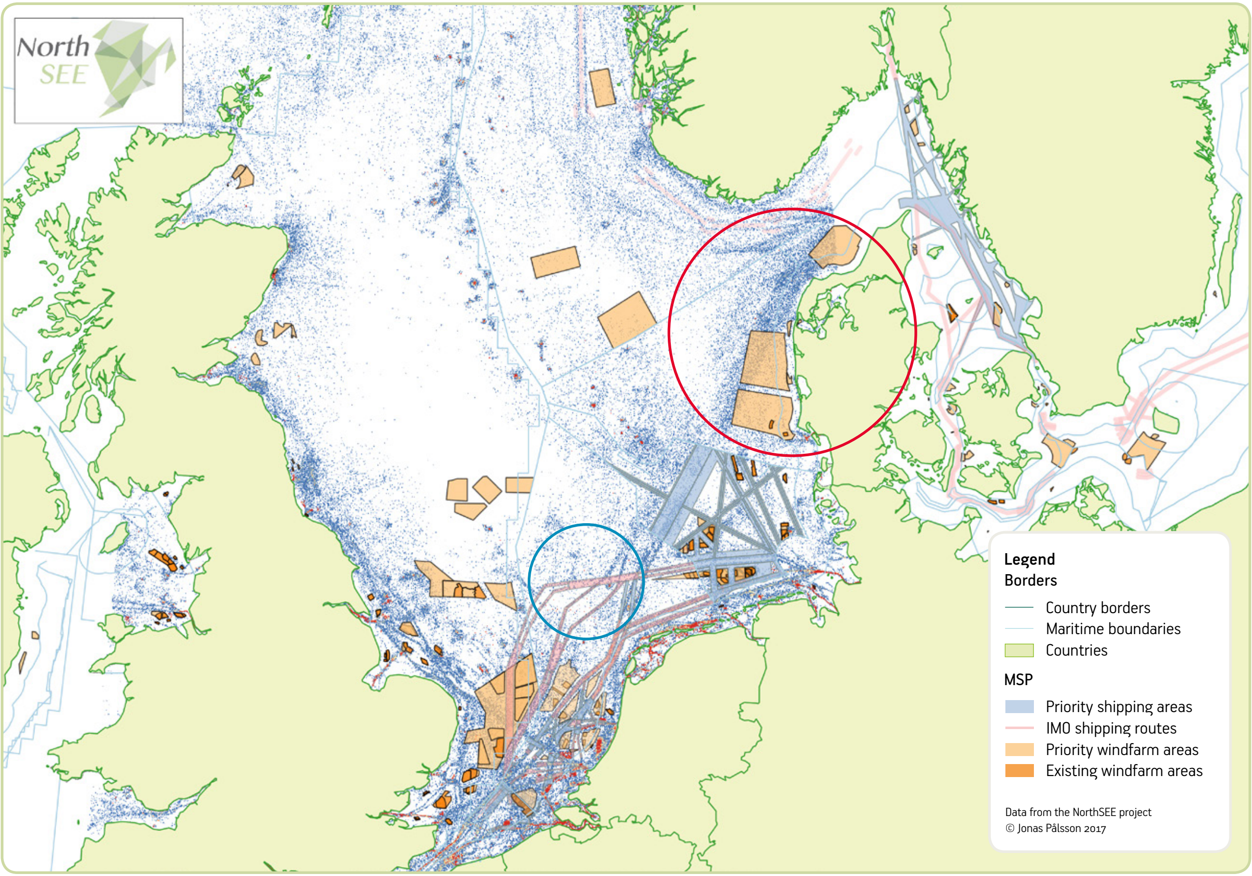


Figure 24 Map showing (possible) incoherence between the actual shipping routes and designations in national spatial plans (2017)

Environment

There are two generic ways in which MSP delivers on environmental protection goals:

1) **Acknowledging and incorporating existing environmental protection areas in the spatial plan.** These include not only area-based protected areas such as MPAs and "particularly valuable and vulnerable areas". It also refers to spatial measures targeting specific sectors – such as "areas to be avoided" or MARPOL "special areas" for shipping, or spatial-temporal closures for fisheries.

   In most planning systems, MSP may not alter the boundaries or the regulations of existing environmental protection areas. Such changes can usually only be made through other administrative or legislative processes. However, even in these cases, MSP can affect existing protection areas, for example by generating new information on the natural values or human uses of a given area, or by rearranging human activities in and around protected areas.

2) **Proposing specific spatial or regulatory measures affecting one or more human activities.** The ability to do this varies greatly between planning systems – whereas in some planning systems' maritime spatial plans may introduce new measures affecting specific activities, in others they can only propose measures that cannot be achieved through any other regulatory instrument. In yet other systems, maritime spatial plans do not have the power to propose any regulatory measures at all.

Within NorthSEE, partners considered both aspects: analysing the way countries are dealing with MPAs within MSP (table 9) as well as showcasing whether and how the various MSP processes and resulting plans can propose measures to achieve environmental protection goals.

There is a need to shift to more flexible approaches, where conservation and use are seen in context and the full range of measures is applied in a continuum from strictly protected to human-made ecosystems. A good supplement for the protection approach is to identify areas that are particularly important for ecosystem structure, functioning and biological productivity, so that this information can be taken in to consideration when planning for other sectors.

In order to sustainably accommodate a wide range of uses in a limited space, countries are already turning to more flexible, seasonal, area-specific environmental management measures (e.g. seasonal closures, reduced boat speed) and with increasing spatial demands, these solutions may be even more widely used in the future.

Good practice example: The Norwegian management plans identify particularly valuable and vulnerable areas (PVVA), using modified Ecologically or Biologically Significant Marine Areas criteria. These areas are often important for ecosystem function and productivity in larger ocean areas, which means that they are important for areas beyond their own limits. Some examples: important spawning grounds for fish, breeding sites for seabirds and marine mammals, and coral reef areas. Such areas do not necessarily need to be strictly protected, but they may have a management regime that requires that the identified values are not reduced.

Table 9 Consideration of MPAs in maritime spatial plans (2018)

Country	Consideration of MPAs in planning process:
BE	Most of the MPAs are part of the existing and the newly adopted plan (Special Area for Conservation, Special Protection Area).
DE	The needs of the marine environment are protected by provisions for marine environmental protection included in the regulations applying to the individual uses and by dedicated regulations for the protection of the marine environment.
DK	Designated Natura 2000 areas (DK does not have an MSP yet – it will be part of the MSP plan to come).
NL	Designated Natura 2000 are part of the current MSP plan, more will be added in the 2022–2027 MSP and for areas outside 12NM (e.g. Doggerbank) we await approval for fisheries management/ measures from the European Commission.
NO	Defining environmentally valuable sea areas is part of the existing management plan for the ocean areas. MPAs are designated under a separate process, and the regulations for these must be followed up in the MSP.
SE	Natura 2000, (planned) MPAs and areas of national interest for nature values are in MSP plan.
SCO	31 Nature conservation MPAs (17 territorial, 13 EEZ) and 8 historic MPAs are part of the National Marine Plan.

CONCLUSIONS AND WAY FORWARD

Conclusions

MSP in the EU is a competence of Member States. However, international organisations such as OSPAR[5], IMO, European Union and European Commission play an important role in various aspects of ecosystem-based management and use of space in the North Sea.

The North Sea countries co-operate in OSPAR to guide the transboundary implementation of the EU Marine Strategy Framework Directive objectives (including MPAs). This cooperation is a crucial instrument to achieve the targets set under the Convention of Biological Diversity. All states in the Greater North Sea area have established a national legal base for MSP (in line with UNCLOS). However, with regard to MSP, OSPAR's mandate is limited to the environmental aspects. EU obligations on Natura2000 and renewable energy targets are defined individually for each country. MSP cannot guarantee cross-border plans for these.

At the same time, the NorthSEE project has shown that **the current use and spatial management in the North Sea marine region display a high level of cross-border (and transboundary) coherence for shipping, energy and environmental protection.** Nevertheless, especially for these sea-basin-wide issues, a consistent transnational approach [be it formal, institutionalised, informal, for specific time frames/ topics] may lead to even greater coordination, alignment and complementarity between plans. **Continuous bilateral, trilateral and multilateral arrangements in management of cross-border and transboundary nature in the North Sea may contribute to more coherent cross border MSP.**

The NorthSEE project has identified pertinent issues still necessitating better cooperation such as:

- **Safety of navigation,** IMO route measures, including the progressive work on safety distances between shipping lanes and offshore wind farms by NorthSEE[6]. There is the need to address the spatial, environmental, safety and economic aspects of increased maritime traffic supporting the growing energy production at sea and the predicted increase in short sea shipping[7]. Moreover, countries can benefit from aligning the terminology used for shipping route designations within MSPs in order to improve international communication and transparency.
- **Environmental protection,** and in particular achieving a clean, healthy, biodiverse and productive state of the marine environment (good environmental status) and the consideration of cumulative impacts of existing and future activities (in a changing environment).
- The signatory parties to OSPAR have designed a coherent network of Marine Protected Areas. Nevertheless, there is the need for further work in OSPAR to evaluate and strengthen this coherence for the Greater North Sea basin in terms of Aichi Target 11 to be achieved by 2020 (in terms of connectivity, representation, resilience and effective management), as it was highlighted in the NorthSEE study[8] on connectivity between marine protected areas. Namely, many of the MPAs have no measures and management plans, while OSPAR does not collect spatial data (unlike HELCOM). This makes it difficult to take these MPAs sufficiently into account in the MSP processes.

The project highlights and encourages the continuation of work in existing cooperation initiatives:

- **The North Sea Energy Political Initiative** of the 10 North Sea countries to cooperate on offshore renewable (wind) energy[9]; in particular on MSP and creating greater coherence in dealing with cumulative ecological impacts in the sub-working group.
- Improve the spatial data infrastructure between the North Sea countries. This is done by moving from isolated GIS-solutions to a common concept for sharing and re-using data and services, which will benefit all planning processes.
- **The studies and cooperation on SEA methodology in the EU-financed SEANSE project**[10];
- **Further cooperation on energy transition challenges under political guidance** and promote good cooperation on cross-border infrastructures (i.e. interconnectors).

5 Oslo-Paris Agreement: the regional sea basin convention for the North-East Atlantic region www.ospars.org

6 https://northsearegion.eu/media/5056/northsee_safetydistances_and_finalposter5.pdf

7 https://northsearegion.eu/media/4836/northsee_finalshippingreport.pdf

8 https://northsearegion.eu/northsee/news/environmental-connectivity-study-published/ initiated and financed through NorthSEE and carried out by the Norwegian Institute for Marine Research.

9 http://www.benelux.int/files/9014/6519/7677/Political_Declaration_on_Energy_Cooperation_between_the_North_Seas_Countries.pdf

10 www.northseaportal.eu

- **The timeline exercise undertaken in the NorthSEE** project could serve as a useful tool for aligning the MSP processes and ensuring more transparency across countries.

Addressing the trends

The findings of the Energetic Odyssey[11] show the potential of achieving up to one third of the North Sea countries' renewable energy needs by implementing offshore wind in the North Sea. To reach the goals of the Paris Agreement, **more innovative methods for energy production at sea are needed, reducing related stress on the marine environment and seeking spatial synergies**. Suggestions such as those contained in **the policy statements of Belgium and Netherlands on their ambition for the co-use of offshore wind farms may be a good way forward**.

The CO_2 emission reduction targets set by the North Sea countries for 2021/2023, 2030 and 2050, and the consequent implementation of these **emission reduction targets are likely to have impacts on MSP processes, on the adjustments/ reviews of plans and Strategic Environmental Assessment and Environmental Impact Assessment studies and procedures** [and the workload this implies for management authorities across the sea basin]. In this regard the NorthSEE report on Energy[12] is especially useful – in particular, its recommendations for MSP.

The **MSPChallenge NorthSEE simulation platform**[13] has proven to be supportive in the stakeholder workshops organised, contributing to collaborative working, better communication and understanding of spatial and environmental challenges in the North Sea amongst academics/ students, policy officers and stakeholders. **Substantial economic and societal benefits could be gained from further innovations in MSP support systems based on "digitally interactive technology"** (such as Big Data handling techniques, geo data sourced with satellites, simulation and game technology, virtual reality / augmented reality, and artificial intelligence). The MSPChallenge simulation software and Infoquarium efforts provide inspiration and a prototype for furthering the creation of a joint tool assisting in MSP.

Way forward

Taking into consideration existing results of the project and identified trends and cooperation needs in the region, the NorthSEE project partners have put together the following suggestions for next steps that may contribute to upscaling the project's results and its wider impact:

- **Creation of an international working / contact group for continued information exchange on MSP around the North Sea basin** consisting of relevant MSP officials from competent authorities;
- **Preparation of a possible draft Memorandum of Understanding for MSP cooperation under the EU MSP Directive** between the competent authorities in the Greater North Sea, with a view to external dimensions, the foreseen increase of future use of the marine region, and the related need for sustained co-operation;
- **Making use of a scientific support group on MSP** around the North Sea consisting of relevant knowledge institutes;
- **An uptake of NorthSEE results in studies and analysis undertaken as part of ongoing national MSP processes,** in particular on the combined safety and (cumulative) environmental consequences of increased traffic supporting the offshore (wind) energy production for the 2021–2030 energy scenarios;
- **Further studies focusing on knowledge transfer** from one country to another e.g. from Germany to Scotland focusing on offshore grid planning, to test the German approach and trial it in the Scottish context;
- **Collaboration and building of stronger mechanisms for involving and tracking involvement of regions in MSP;**
- **Formulation of a possible future role for the MSPChallenge concept as a platform.** Connect the simulation model of the MSPChallenge with a view to cross-over learning between geo-data, marine environment data management and alignment with e.g. EMODnet, OSPAR, national and sectoral data centres/ providers, including the hydrographic offices;

11 https://iabr.nl/en/projectatelier/atelier2050
12 https://northsearegion.eu/media/4930/northsee-offshore-energy-status-quo-main-report-final-version-120418.pdf
13 http://www.mspchallenge.info/northsea-and-balticlines-copenhagen-14-jun-16.html

- **Closing of data and information gaps.** In particular the complete update of the OSPAR database on MPAs, and availability of vessel tracking data (AIS) files and maps;
- **Active sharing and use of all available data by MSP authorities and stakeholders,** such as data and information on migratory species in the North Sea and, in particular, assistance in transparency and communication with stakeholders (incl. mechanisms for ensuring accurate and up-to-date available data and information provided by North Sea countries, and a cooperation mechanism to share available data on MSP);
- **Support to projects and studies on exploring benefits that could be derived from a possibility to source relevant MSP data and information** (on shipping, energy and environment) from one database and (further) integration, alignment and interoperability of decision support models for ecosystem-based MSP.

Next steps in the project

- It should be noted that, by the time of writing these NorthSEE interim findings, a first meeting has been held (not directly linked to the NorthSEE project) in January 2020 bringing together a wider range of representatives from MSP authorities around the North Sea countries.
- Numerous NorthSEE partners have also joined forces – including the universities and research institutes as well as the Danish Maritime Authority – to continue the NorthSEE collaboration for another 20 months. The activities foreseen within this project continuation are designed to provide support to MSP authorities as described above: responding to their immediate needs in view of strengthening their collaboration.

What is in this report?

- Key findings of our reports and studies
- Links to the respective main reports
- Explanations of our workshops
- Clear infographics and relevant maps

Who is this report for?

- Current and future maritime spatial planners
- Students or professionals new to the field
- Shipping, energy and environmental protection stakeholders and experts dealing with MSP

Project information:

Funding programme: INTERREG VB: North Sea Region Programme 2014–2020

Project Name: NorthSEE: A North Sea Perspective on Shipping, Energy and Environment Aspects in MSP

Project Agreement number: 38-2-2-15

Project implementation period: January 2016 and September 2021

Lead Partner: German Federal Maritime and Hydrographic Agency (BSH)

External Project Coordination Office: s.Pro – sustainable projects GmbH, Germany

Publication date: December 2019

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