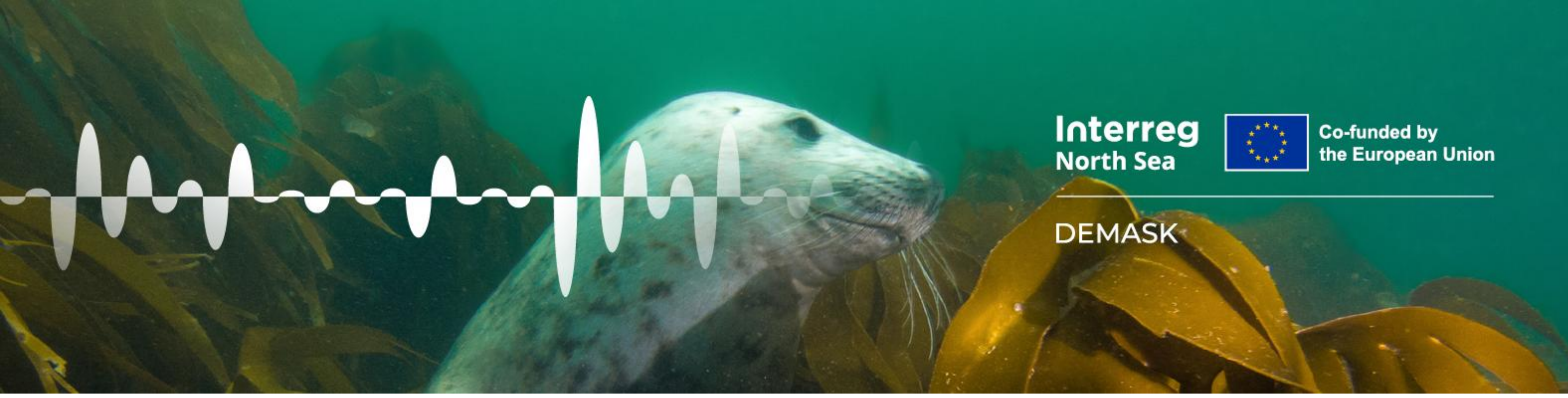


DEMASK Information Brief: Transnational collaboration to reduce noise pollution in the North Sea

Increase of human activities in the North Sea results in the rise of chronic underwater noise – with adverse effects on marine species. In light of these effects, it is urgent time for the North Sea countries and other stakeholders to act on noise pollution by taking effective noise mitigation measures. Several recommendations have been suggested to change the negative trend. These include ship speed limits, quieter technology, and noise protected areas. However, uncertainty about effectiveness of measures and potential trade-offs impede noise management decision taking at international level.

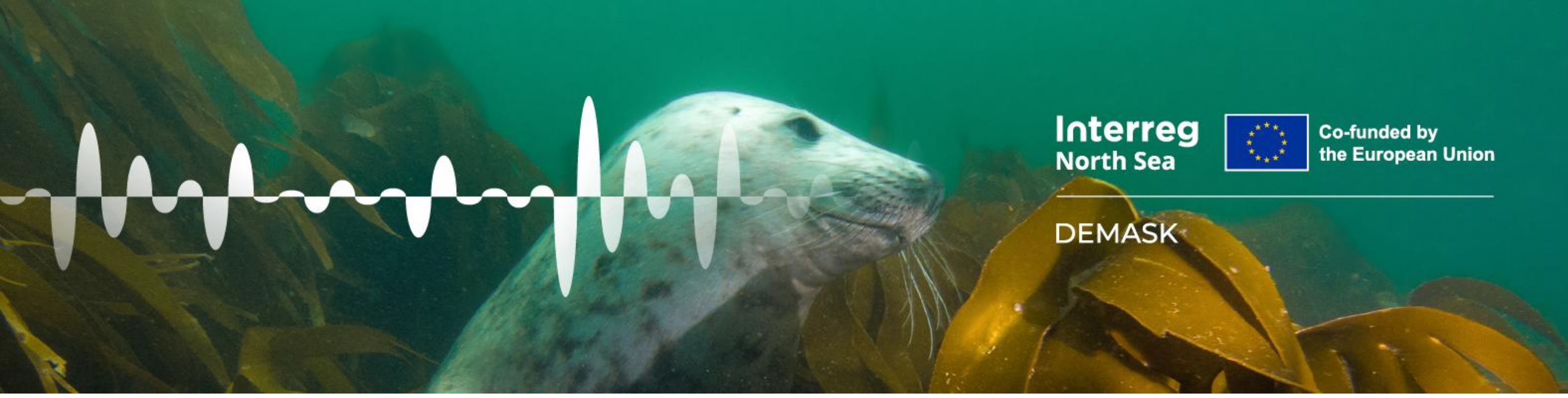
The EU Interreg North Sea project DEMASK will bring together policy makers, administrations, NGOs, and the maritime industry, together responsible for sustainable noise management. DEMASK will provide information on effectiveness of noise-reducing measures and enable stakeholders to make science-based decisions for a well-managed soundscape by developing scenarios for noise management and methods to quantify the effectiveness of those scenarios to mitigate noise pollution and its effects on marine life.

Chapter 1: The challenge: more human activities in a confined area

The North Sea is one of the busiest seas in the world. There is intensive shipping, fishing and offshore wind energy generation. It is also an important habitat for many species which are at risk of being impacted by these activities. Shipping and offshore energy generation may result in high underwater noise levels that negatively affect species. Where clear evidence of harm has been demonstrated, governments have taken management action to prevent negative effects on ecosystems. For instance, the construction of windfarms is only allowed if measures are taken to reduce impulsive noise levels (see textbox 1).

Knowledge on continuous noise in the North Sea has improved significantly during the past decade by cooperation of North Sea countries. Since the EU-Interreg North Sea JOMOPANS project we know that almost everywhere in the North Sea sound levels are increased by human activity, especially shipping. In some places like the Southern North Sea and the Skagerrak this increase is substantial. Man-made noise often exceeds the natural sound by 20 dB or more; in some areas of the Southern North Sea, this level exceedance occurs close to 100% of time due to very intense shipping (figure 1). In air, an increase of 20 dB makes the sound seem about four times as loud to the human ear[1]. This fourfold increase, however, typically has a much more profound effect on marine species (than it does on humans), since many species depend on sound as a primary sense for finding mates, hunting or survival.

[1] See e.g. *The Science of Sound*, 3rd Edition, 2014, Thomas D. Rossing, Richard F. Moore, Paul A. Wheeler.



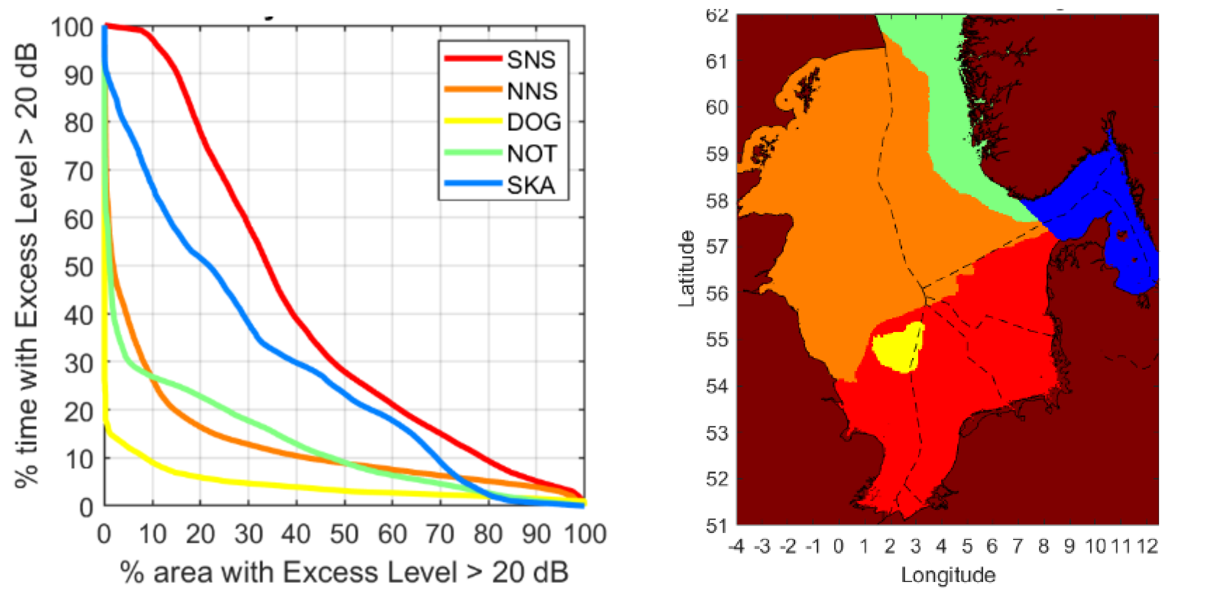


Figure 1. Example calculation of exposure to ship noise for the sub regions of the North Sea, calculated for the 125 Hz third-octave band (SNS-Southern North Sea) (Source: JOMOPANS final project report – Report 7:6)

While noise levels are already high, the North Sea is likely to get busier in the next decades. Commercial shipping, the main source of continuous underwater noise, is expected to rise. Furthermore, a huge extension of wind farms is planned to conform to the EU climate objectives. The North Sea countries have planned new capacity of at least 120 GW by 2030 and 300 GW by 2050 (Ostend Declaration 2024). The North Sea will be re-zoned as the countries have begun to dedicate sea space to multiply their capacity by eight times current levels. The required space for wind farms reduces the space for shipping. It is expected that the main shipping lanes will continue to provide sufficient space, but more vessels will use these lanes. There will also be more vessel movements around the wind farms, for maintenance and supply purposes.

Textbox 1: Knowledge enabled management of impulsive noise

Over the last two decades, there has been an increase of building of offshore wind energy farms. There was concern on the possible effects of piling for the construction of these wind farms, but as measures could be very costly, North Sea governments commissioned research and evaluated potential mitigation measures to minimize impulsive noise. Sensitive animals (harbour porpoises) were monitored and construction noise of windfarms was measured. It became clear that porpoises were affected by piling for turbine installation at large distances (tens of kilometres), when no noise reduction measures were taken. By combining monitoring, measuring and ecosystem modelling, it was shown that unmitigated piling noise would lead to ecosystem effects, and that mitigation measures were essential and available. This knowledge made it possible to develop and implement effective regulation of underwater impulsive noise emissions during construction of windfarms that prevents negative effects on the environment.

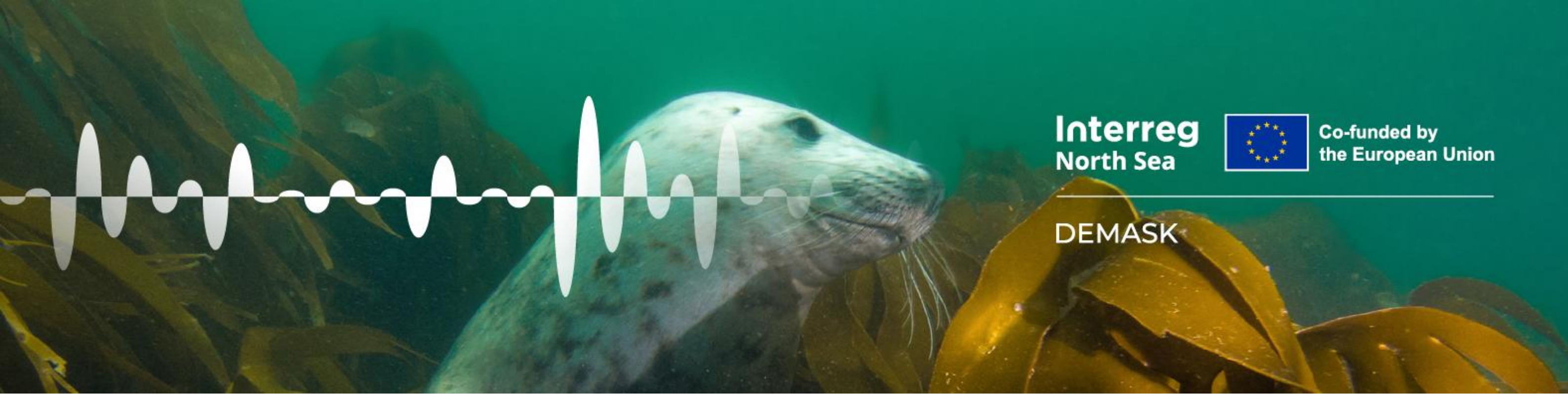
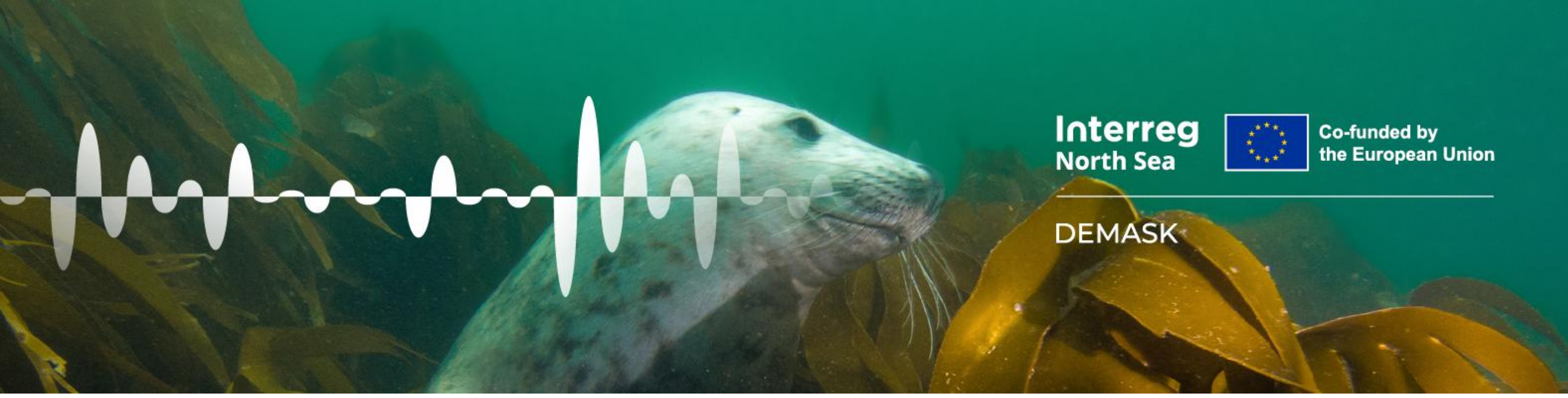



Figure 2. Use of a bubble screen to reduce effect of piling

Chapter 2: Effective policies are crucial and need international cooperation

The expected increase of human activities will have an impact on the North Sea's ecosystem health. The North Sea countries therefore need to make sure this intensification of activities is well managed in order to minimize this impact. Globally, the urgency to manage oceans and seas in a more sustainable manner has been recognised in the UN Sustainable Development Goals, the UN Decade of Ocean Science for Sustainable Development, and elsewhere. The IMO (International Maritime Organization) is a specialized UN agency for regulating shipping. It sets global standards to ensure safety and security, and to prevent pollution of international shipping. The IMO Sub-Committee on Ship Design and Construction (SDC) has proposed revised guidelines for the reduction of underwater noise from shipping, which were adopted by the Marine Environment Protection Committee (MEPC) in July 2023. The guidelines provide an overview of approaches applicable to designers, shipbuilders and ship operators to reduce underwater radiated noise from ships. They assist relevant stakeholders in establishing mechanisms and programmes for noise reduction. SDC also developed an Action Plan (adopted in October 2024) that intends to increase awareness, uptake and implementation of the revised Guidelines. One of the activities is the establishment of an experience-building phase (EBP) for the development, collection, and distribution of best environmental practice and best available technology in noise reduction.

In Europe, underwater noise and its impact are addressed by the Marine Strategy Framework Directive (MSFD). EU member states have to assess environmental status with regard to noise and take actions to obtain Good Environmental Status (GES) by implementation of measures to



mitigate noise pollution. Other EU regulation like the Marine Spatial Planning Directive (MSPD) supports reaching environmental goals by regulating human activities at sea.
The MSFD requires countries in a (sub)region to cooperate and this is achieved by making use of the existing regional sea conventions, like the OSPAR convention for the North East Atlantic. In line with the need for collective action, OSPAR is developing a Regional Action Plan on underwater noise (see textbox 2). Several concrete actions have been proposed in this plan, some of which will be (partly) taken up by the DEMASK project. Draft action 1 covers shipping noise; the countries will promote and implement the recently revised IMO Guidelines (see below) and contribute to the related Experience Building Phase (EBP). Draft action 2 covers the spatial aspect of underwater noise; the countries will ensure that national marine spatial planning frameworks include management and monitoring measures on underwater noise.

The effects of noise mitigation measures have been evaluated only to a limited extent (and certainly not at larger scale, like the North Sea). Evaluation is hampered by a lack of tools and evidence that support it. The DEMASK project aims to deliver evidence that will help decision makers to base future marine environmental policy on scientific knowledge.

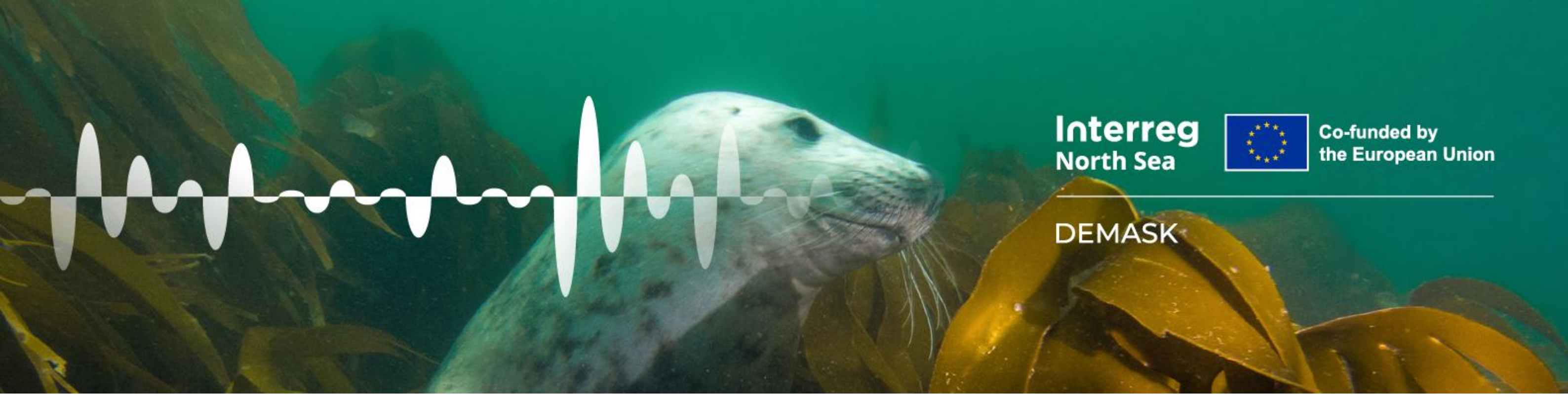
Textbox 2: The OSPAR regional action plan for Underwater Noise (RAP-Noise)

The RAP-Noise will tackle pressures from both impulsive and continuous noise. The action plan is being developed for the period 2025 – 2035. This timespan allows for sufficient time to measure effectiveness of implemented measures and actions. As it is an adaptive plan, further actions can be added during this period. The main objectives of the plan are:

- Developing harmonised targets, standards and approaches towards the reduction of anthropogenic noise;
- Developing sub-regional approaches for noise management in order to reduce both pressure and exposure, taking account of regional specificities [see NEAES Regional approach];
- Sharing best practice (e.g. through workshops etc.);
- Collaborating internationally with other Regional Sea Conventions to develop common approaches, add value to existing processes and not duplicate efforts;
- Collaborating with other International Organisations such as IMO in order to improve protection of the North East Atlantic and promote effective regional implementation of globally agreed measures and guidelines;
- Supporting Contracting Parties in the development, implementation and coordination of their programmes on underwater noise, including those for the implementation of the EU's Marine Strategy Framework Directive (MSFD) and any other EU processes with relevance to underwater noise;
- Improving the knowledge base on underwater noise, through the OSPAR Science Agenda, and the OSPAR Joint Assessment and Monitoring Programme.

Chapter 3: Policy scenarios: shipping, wind farms and recreational vessels

For the identification of effective noise management strategies and the quantification of their effects on noise levels and potential impact on ecosystems, various scenarios are being



developed. These include current and business-as-usual (BAU) scenarios for the years 2030, 2040, and 2050, and scenarios describing the result of different noise mitigation measures.

For that purpose, input from stakeholders on measures and/or developments was collected, discussed, and investigated, and priorities identified. The following noise sources will be addressed:

1. **Commercial shipping** - this is the biggest source of continuous underwater noise. The dominant environmental issue that is currently being addressed at the international level (IMO) is the decarbonization of commercial shipping. Apart from finding alternative, non-fossil fuels, many of the measures that are needed to reduce the carbon footprint focus on improving energy efficiency (EE). Many of these measures (see figure 3) will also affect underwater noise. That effect may be favourable, i.e. measures may both improve energy efficiency and reduce noise at the same time, but some measures may also have an unfavourable effect, i.e. increase noise.

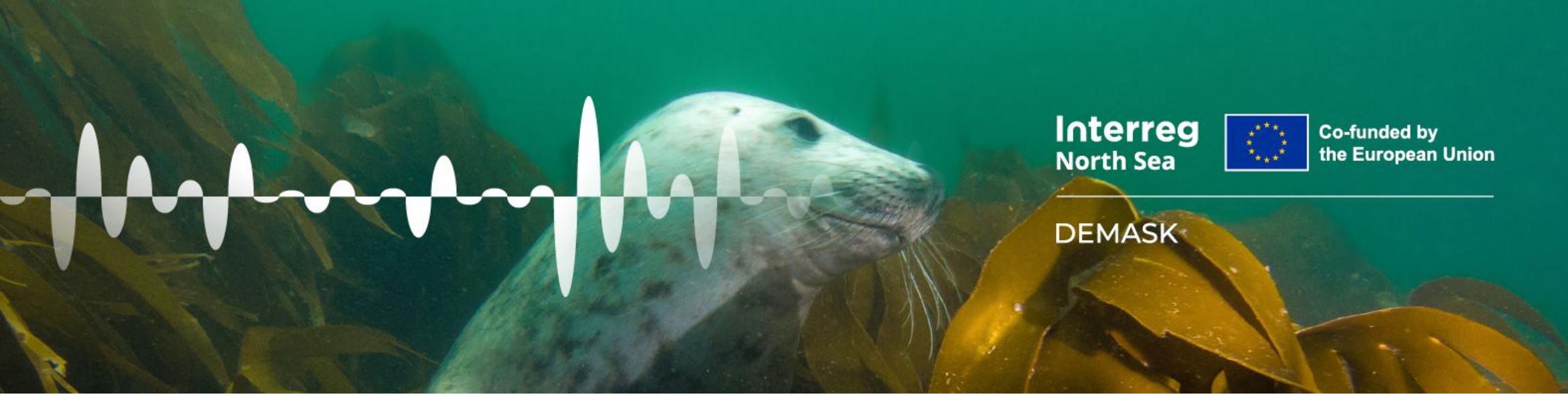
2. **Operational offshore wind farms** - measurements of wind farm noise showed that the turbines itself did not produce much noise and did not significantly change the soundscape . But with current plans, the total number of turbines will increase so much that this needs to be verified again. In addition, these wind farms are accompanied by vessel activities for maintenance, service, and personnel transfer.

3. **Recreational vessels** - compared with the large scale low-frequency noise of commercial shipping, recreational vessel traffic was seen as a smaller scale problem regarding noise emissions. However, there is concern that in some important areas the sounds of smaller vessels, that also include higher frequency sounds, may be relevant. Since these contributions to the soundscape have not been included in existing monitoring, this will be taken up in the project.

For each source, the priorities for scenario development are given below.

1. <u>Commercial shipping</u>

If we start thinking of the combination of measures that reduce underwater radiated noise (URN) from commercial shipping and measures to enhance EE, we see strong interdependencies, leading to co-benefits or trade-offs. These interlinkages between EE and URN have been identified by the international community, and sometimes these can be understood in a



qualitive way to some extent, for example, an improved hull form will reduce drag, reduce propulsion power needed and will therefore be beneficial for both EE and URN. For other measures, there are no co-benefits, sometimes even trade-offs. For decision taking, an improved and quantitative insight in interrelationship is needed, and DEMASK will address co-benefits of EE & noise to help building the information base needed. This will contribute to the Experience Building Phase agreed in IMO and OSPAR's Regional Action Plan on Underwater Noise.

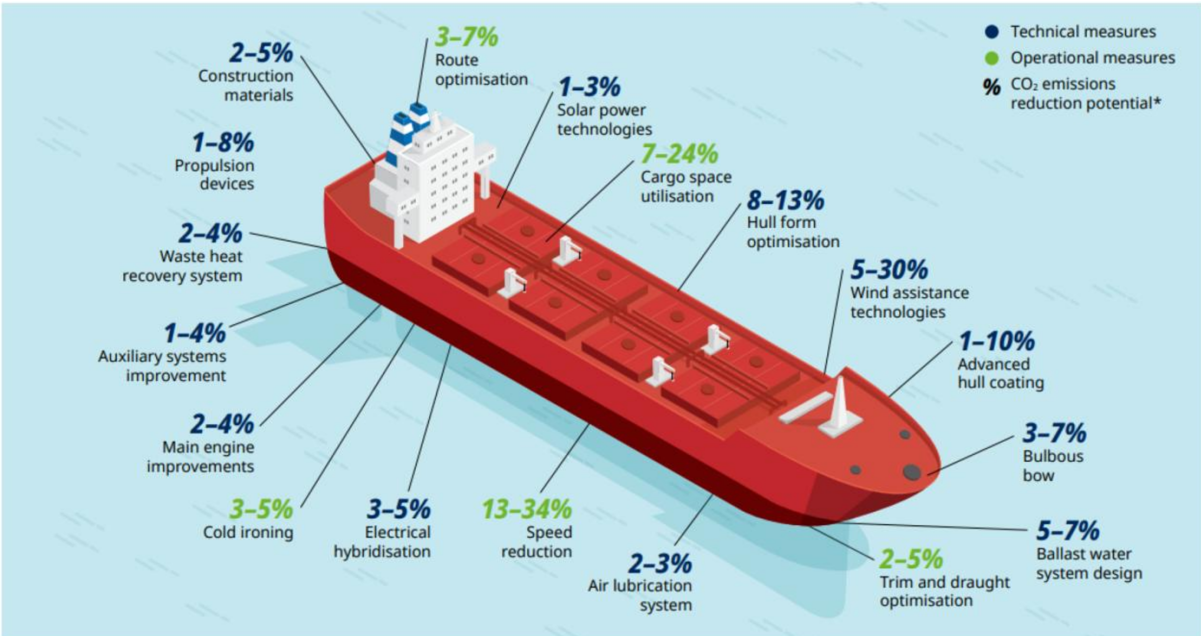
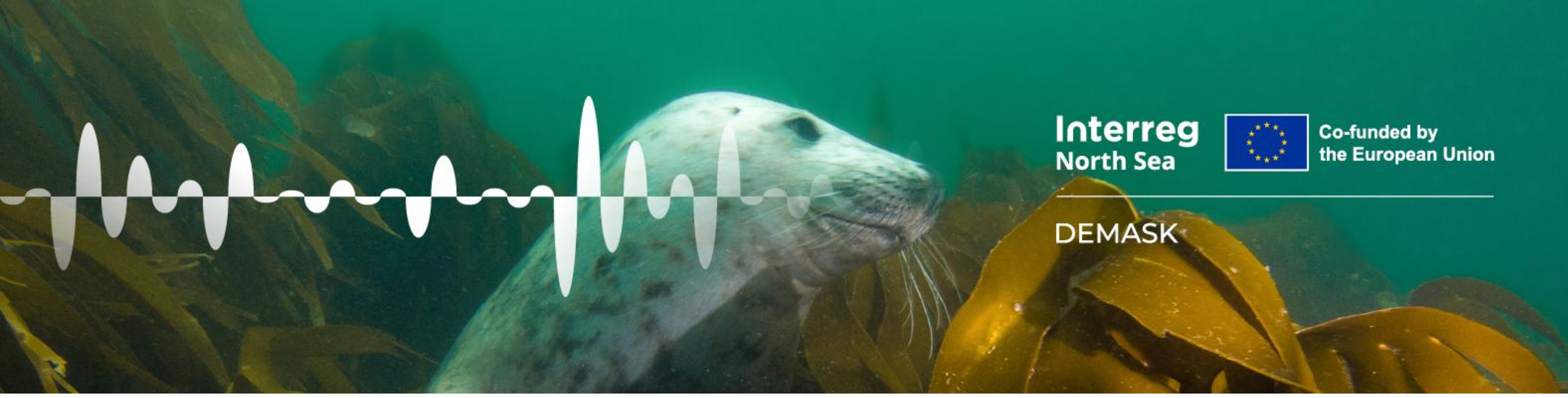


Figure 3. Example of types of measures under investigation at IMO level (source: UMAS)

After consultation of several stakeholders, especially policy, shipping and offshore wind Focus Groups, a number of priority topics were identified. In WP1 a prioritisation will be made and determined how and to what scale calculations will be made (see chapter 6 for further details on project approach chosen in DEMASK). At this moment, the following issues/measures were identified and currently sorted in a 'scenario stack' (see Annex A):

A. Interactions of URN and Greenhouse gas (GHG)/Energy efficiency (EE)
B. Class notations (URN limits)
C. Silent technology
D. Rerouting – change of main route
E. Rerouting – ship- free marine protected/sensitive areas (MPA)
F. Route optimisation
G. Green corridors
H. Just-in-time arrival
I. Fuel bunkering
J. Slow steaming



2. Operational wind farms

Ship traffic in relation to offshore windfarm maintenance was identified as the most important issue by the stakeholder groups, and in particular:

A. Dynamic positioning of service vessels
B. Slow down or rerouting of service vessels

3. Recreational vessels

DEMASK will develop new approaches to produce noise maps for recreational boats, using satellite images for density maps. In year 2 of the project, when feasibility of the new methods is clear, scenarios will be chosen leading to more comprehensive risk maps. In Policy Brief 2 of 2025 this will be further explained.

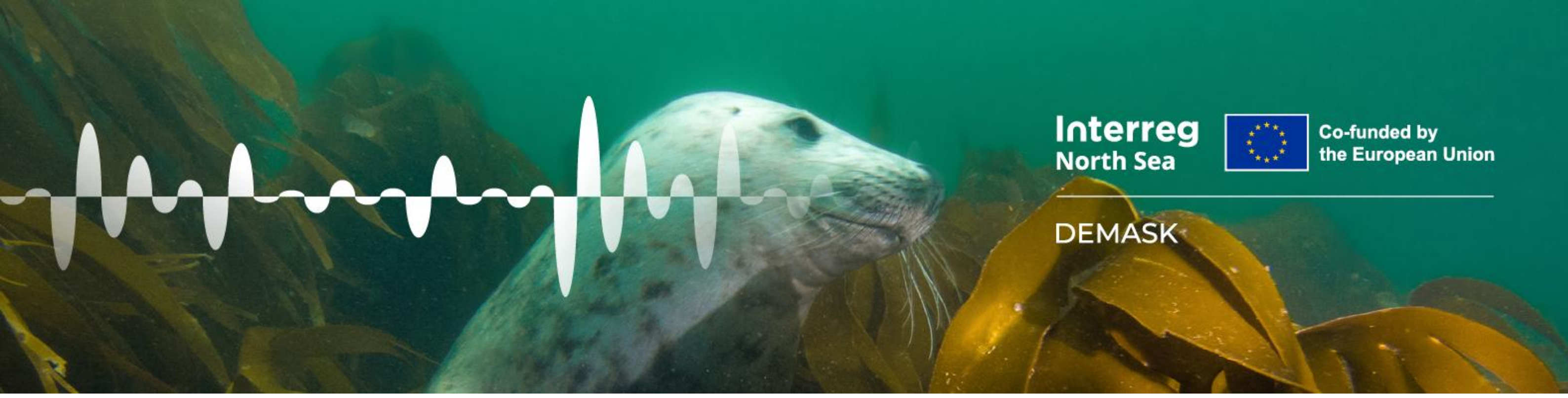
Chapter 4: Policy needs: scenario evaluations and use of metrics

Quantifying the effects of sound is a complex issue. For humans, in air, impact of sound is often expressed (and regulated) using a mixture of different sound levels with a large variety of metrics: average sound pressure level or peak level, instantaneous levels or longer 24 hr or 8 hr exposure, sometimes for specific frequency bands or with correction functions for frequency (weighting).

For underwater noise, the situation is similar. We can use different metrics to say something about the effects of noise. The choice of metric is dependent on the type of noise:

- For impulsive noise, we often use some kind of measure that gives us information about the levels that are reached during peak periods. For example, for regulation of offshore wind farm construction noise, often a limit value is imposed on the maximum sound caused by piling and measures able to achieve that are applied (e.g. alternative piling techniques or bubble screens). The limit value can be based on knowledge of effect levels for certain animals, e.g. hearing damage or behavioural effects of marine mammals.
- For continuous noise, the focus topic of DEMASK, it is probably more useful to use a parameter which describes changes in the sound scape over longer periods, e.g. an hour, a day, a month or even longer. Sometimes we talk about the 'average', but we should realize that there are different ways to calculate the average. And because the noise sources (ships) are moving all the time, we should also say something about noise levels over larger areas, either by averaging sound over larger areas or by making use of sound maps.

The common understanding is that anthropogenic noise has caused a rise of sound levels at global scale (whatever metric we use), that rising noise levels are not good news for the environment and that reduction of global (or at least regional) underwater shipping noise is needed in order to reverse the trend of the past 60 to 80 years. DEMASK will leave the assessment whether GES is reached to the responsible EU member states, but we can determine whether trends in underwater noise levels are positive or negative, and we can



determine whether measures make a difference to sound levels and will contribute to reaching GES.

In the DEMASK project, a number of metrics will be used tailored for the respective evaluation. The choice depends on information available, numerical techniques available, practical choices (often related to project resources), and the needs of the end users.

Textbox 3: Example of metric use

If we need to know whether the total amount of underwater noise produced by specific human activities (e.g. shipping; or specific sectors of the shipping industry) is going up or down (trends), we do not need detailed presentation of the information available. Information on total noise or average levels may be valuable; for instance, to give an indication whether there are co-benefits of greenhouse gas reduction measures. In figure 6 we see results of the NAVISON project, in this case calculations of autonomous trends (without noise regulation) in shipping noise in the North Sea area and the possible effect of measures. The metric used is average acoustic energy density, clarifying what could happen with the total amount of noise energy. We realize that this metric is different from metrics commonly used in noise maps, e.g. sound pressure levels or excess levels, expressed in decibels. Environmental NGOs earlier proposed reduction objectives defined as ‘3dB per decade’ but there is no specification what exactly should be reduced (e.g. ‘average sound pressure levels’). We realize that this different and sometimes unspecified use of metrics can be confusing and hinder policy development, if there is no common view what metrics can and should be used to define policy objectives. Therefore, DEMASK (and future policy briefs) will address this topic.

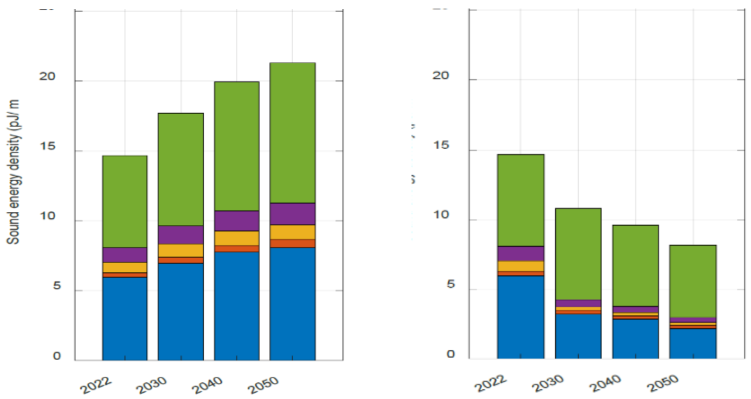
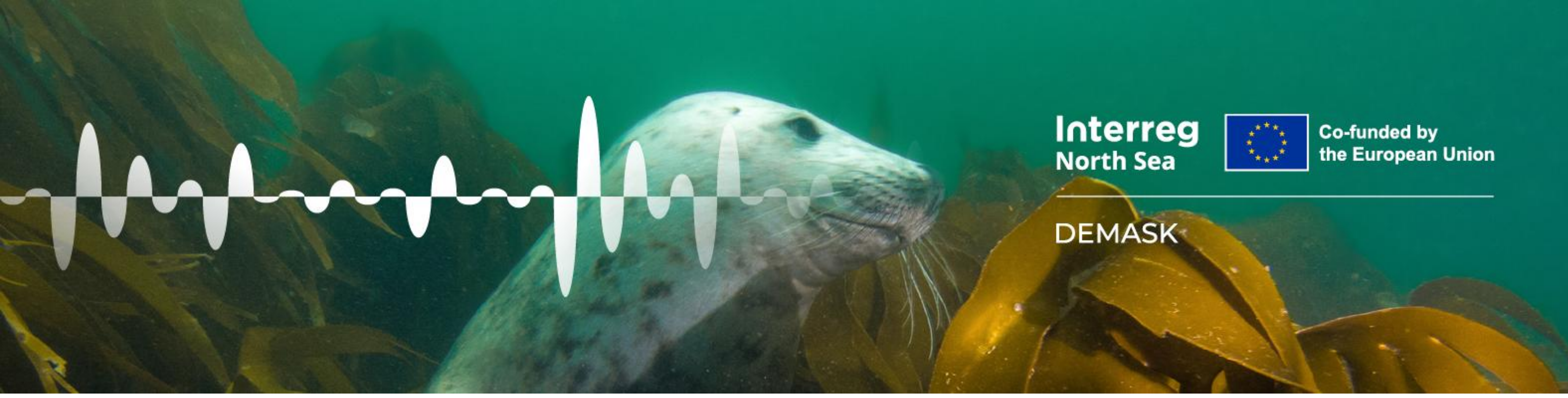


Figure 4. Autonomous trends in shipping noise in the North Sea, expressed as acoustic energy density (left) and potential effect of some specific measures to reduce underwater radiated noise (right). Source: NAVISON project. (blue: cargo ships, red: container ships, orange: passenger ships, purple roll-on roll-off ships, green: tankers and gas carriers

Future policy briefs will provide an overview of metrics that are used in DEMASK assessments and metrics currently used in (international) science and policy development, and how these relate. We will provide policy makers with the information needed about metrics. When decisions on policy targets come into view (e.g. the above mentioned 3dB reduction) and need



to be discussed, there is a need to have common understanding, and the policy briefs will provide relevant guidance to achieve common understanding.

Chapter 5: Approach(es) to analyse the scenarios

The DEMASK project uses a strategic approach to address the different noise reduction measures identified in the scenario stack, whilst making best use of its resources. The main objective of DEMASK is to determine the effectiveness of different noise mitigation strategies, preferably done in a quantitative way, and this can be assessed at different spatial scales (figure 6): A. Numerical large scale; B. Numerical small scale; C. Parametric approach; D. Qualitative analyses. Where making large scale (North Sea) calculations for measures is not practicable, alternative approaches are given below. These approaches will be used in an “analysis train”: we will study the effects of measures, based on results from approaches B and C.

A. Numerical large scale- North Sea scale

To obtain insight in large scale effects and to be able to execute other calculations (e.g. impact calculations in WP 3 - Marine Life) for selected measures, some calculations will be done at North Sea scale. WP 3 follows the recommendations of the Technical Group on Underwater Noise (TG Noise), where a framework was provided to assess effects and determine thresholds. In accordance with the TG Noise framework, indicator species need to be defined for each Marine Reporting Unit (e.g. North Sea), followed by definition of the level of adverse biological effects (LOBE) and the time periods for assessment. As a first step to define indicator species, a vulnerability scoring system will be developed by DEMASK. The choices for indicator species and LOBE (to be made in DEMASK) can affect the conclusions and therefore need to be aligned with policy targets and definition of good environmental status. The experts in WP3 will therefore ensure these steps in the assessment process are well harmonized with policy makers. This will help policy makers in applying the TG Noise framework for the North Sea.

B. Numerical small scale- shipping lane scenario

A generic shipping lane scenario (uniform environment) is developed to study the effects of various parameters and mitigation strategies on the underwater sound. This is based on an actual shipping lane in the North Sea, using archival AIS data to obtain a realistic and representative picture. This shipping lane scenario will provide generic insight in efficacy of measures. Based on the results of this scenario it can be decided to do calculations at larger scale (North Sea).

C. Parametric approach:

The parametric approach is a fast approach to derive the effect of different measures for single ships. It uses a “linear” model with basic parameters, like: ship source level, speed, position and water depth. The analysis is done by varying the basic parameters over time. These variations will (preferably) be framed by a real example, e.g. the Hamburg – Rotterdam Routing. The parametric approach can assist in defining the numerical scenarios (approaches A and B above) and simultaneously provide insights in its own right (at a lower level of detail).

D. Qualitative analyses

Where a (complete) quantitative evaluation by the DEMASK project is not needed or not achievable, we will still aim to provide relevant advice for policy makers. We can derive the results for some scenarios from quantitative analyses and/or from other projects, like the NAVISON project. Even when we do not have complete numerical data, DEMASK will aim to clarify the policy implications of the scenarios.

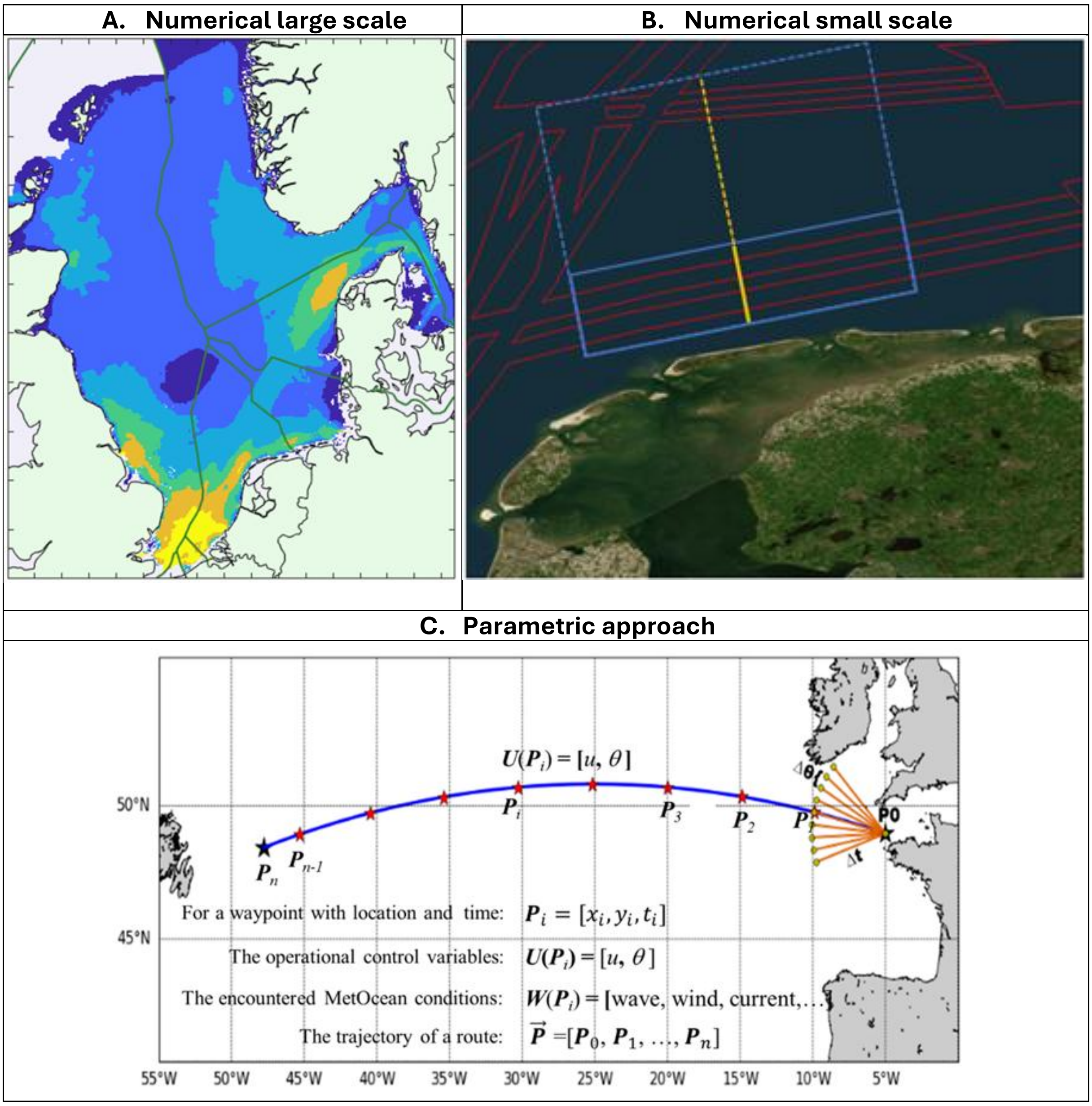


Figure 5. Approaches for the quantitative analysis. A: Map produced by the JOMOPANS project showing annual median excess level for 2020. In DEMASK scenario calculations can be done at

the same scale for selected sources. B. Map showing the contours of the shipping lanes north of the Dutch Wadden island Terschelling. The solid blue rectangle indicates the area over which AIS messages are included in the modelling. Calculations of noise level will be provided over the yellow line. C. Map showing a linear model with parameters.

Chapter 6: Strengthening transnational and transdisciplinary cooperation

The DEMASK project strengthens transnational and transdisciplinary cooperation by bringing together and involving relevant stakeholders from the North Sea and international shipping. Different stakeholder groups have their own role in the project (figure 6):

- Circle 1: The Stakeholder Advisory Board (SAB) is advising the project implementation by defining and prioritising the relevant needs;
- Circle 2: Representatives from various sectors are directly collaborating;
- Circle 3: Organisations and individuals that need to be informed and kept updated.

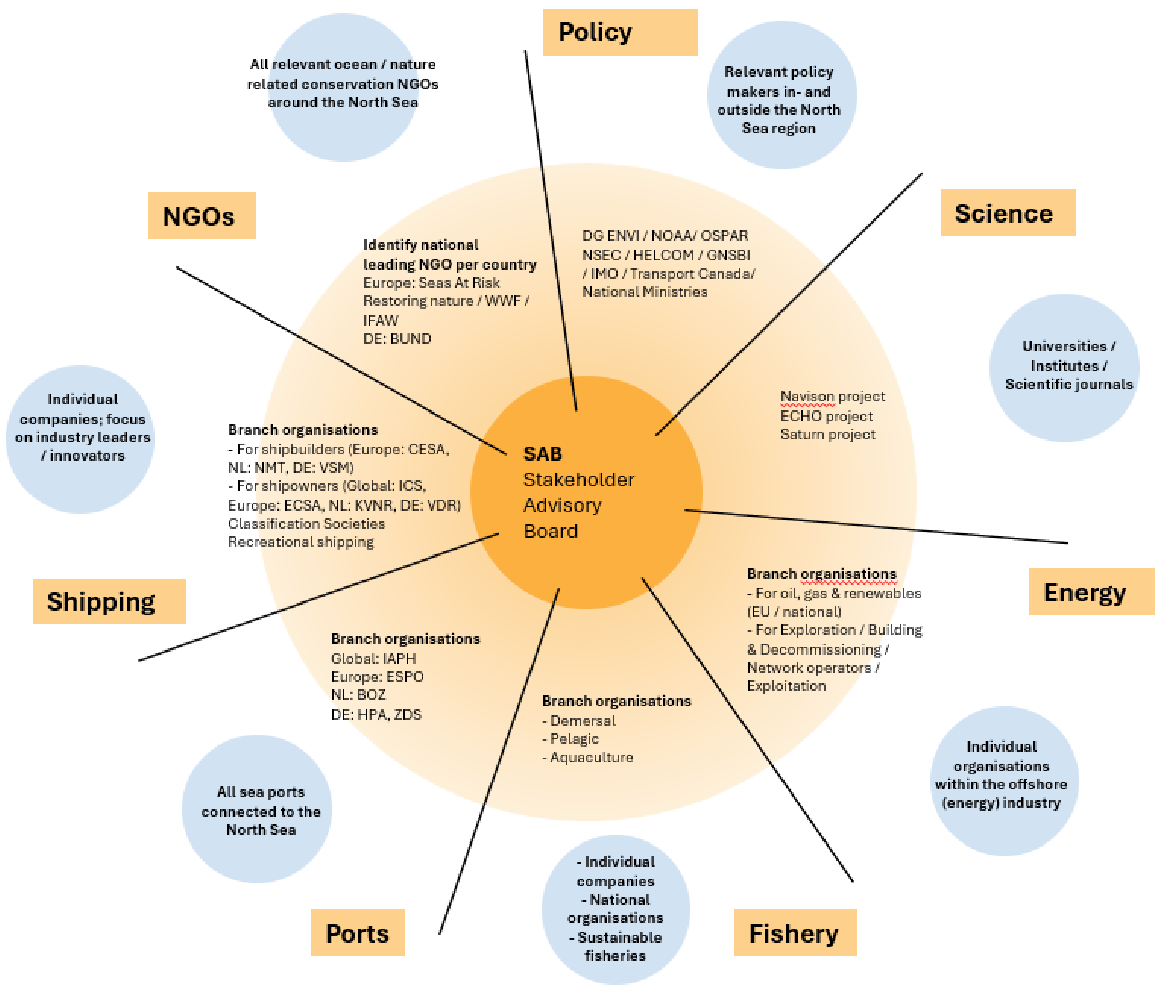
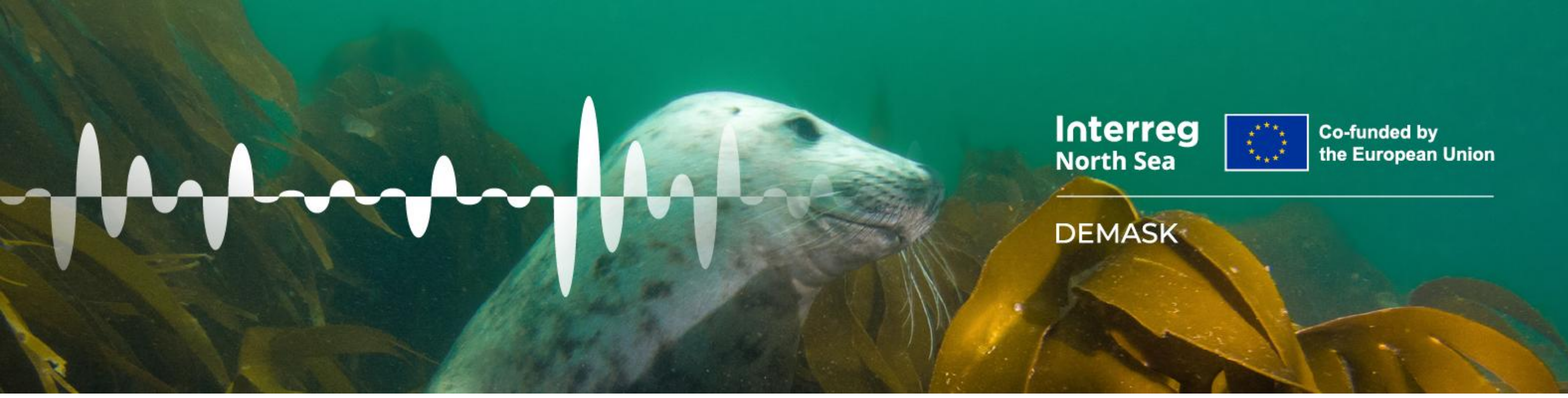


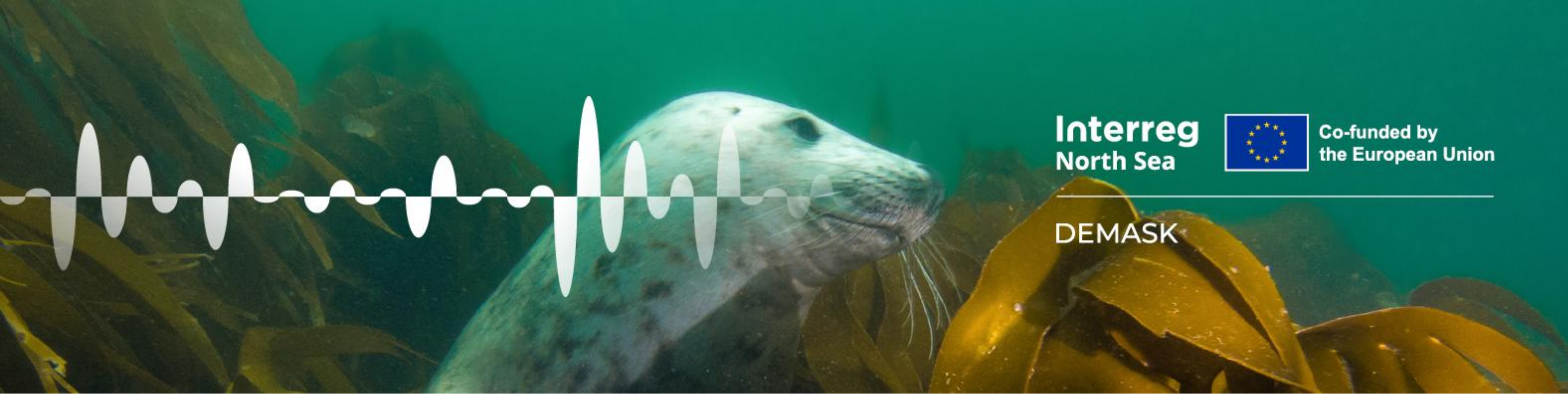
Figure 6. Stakeholder map of the DEMASK project



During the project, there is interaction with these stakeholder groups in different ways. The SAB will provide advice and guidance twice per year. Focus group meetings have been conducted in the first year with representatives from: i) Policy, ii) Shipping, Ports and Fisheries, and iii) Offshore renewables. General communication channels have been established to allow organisations and individuals to view generally shared information. This includes information on the DEMASK website, on LinkedIn and in the DEMASK newsletters.

Those looking to collaborate with DEMASK can become involved in several ways:

- Visit our website [link]
- Subscribe to our newsletter [link]
- Make contact to our lead beneficiary organisation [link]



Annex A: Scenario stack

Scenario name	Scenario description
Interactions URN-GHG/EE	Mandatory requirements for energy efficiency and greenhouse gases are already set today, see MARPOL Annex VI, e.g., energy efficiency design index (EEDI, since 2013), energy design index for existing vessel and carbon intensity indicator (EEXI and CII, since 2023). Subject of this scenario is to outline the co-benefits and trade-offs of these requirements with underwater radiated noise.
Class notations (URN limit)	In future, mandatory requirements for URN may be introduced. After a transitional period, all ships will fulfil URN requirements and contribute to an overall URN reduction in the seas. Subject of this scenario is the assessment of the URN levels in the North Sea if all ships (or a certain percentage of ships) feature an URN below some predefined requirements based on silent-class notations.
Silent technology	A result of the NAVISON project is, that some types of ships contribute more to URN than others. The current scenario focuses on a more detailed analysis on mitigation of certain ships (dealing with the loudest ships) and specific measures. It should especially help to make decisions on the management level.
Rerouting	The scenario focuses on major route-changes (e.g. opening of North Passage)
Rerouting – ship-free MPA	On a small-scale, rerouting is already applied. E.g. service vessels for offshore wind farms (OWF) close to shore consider rerouting to be more efficient and flexible on working hours. The rerouting due to an existing MPA or a generic zone with a variable size is analysed. One aim is to assess the effect on URN if exclusion-areas are established.
Route optimalisation	Currently, routing concepts by shipping companies are only based on energy efficiency, weather, etc. criteria. Further developments foresee as an additional parameter underwater noise radiation, e.g., avoiding protected areas, or URN targets in specified areas. A parametric study shall provide the necessary understanding assisting these developments.
Green corridors	To reach the EE/GHG goals with alternative fuels, use of electric propulsion or wind assisted drives, the implementation of green corridors is in planning. E.g., an electric ship with battery may need intermediate stops for charging causing rerouting, increase of distance, etc. Green corridors are planned to provide the necessary infrastructure for alternative fuels efficiently.
Just-in-time	Especially in container shipping, on-time arrival at the port of arrival is crucial. Thus, to comply with this deadline, ships are often going faster in the first part of the journey to create a time buffer anticipating possible difficulties (e.g. bad weather conditions). From the point of view of energy efficiency, a constant speed would be preferable. The scenario shall help to quantify the URN impact of such an optimization
Fuel bunkering	Ships follow their usual route and bunker conventional and/or alternative fuels in predefined locations
Slow steaming	Slow steaming is currently referred to as an effective operational approach to reduce URN. The scenario shall point out the effect of the slow steaming.
Dynamic positioning by service vessels	The maintenance of OWP induces substantial ship traffic. Most of the used ships are operating in DP mode over a considerable part of time. The scenario analyses the URN contribution and opportunities using alternative operation approaches or e.g., mooring solutions.
Slow down or rerouting by service vessels	The wind farm [example windfarm name] has been built within [example area] and is fully operational, service vessels accessing the windfarm are required to reduce speed due to the nearby MPA.
Recreational vessels	The URN created by recreational boats in the coastal regions of Sweden is to be assessed.