Anemoi Newsletter

Issue 03
29th July 2024

Content

Introduction

The Anemoi project aims to study the chemical emissions from offshore wind farms (OWFs) and their impact on the marine ecosystem and aquaculture. The following project hypotheses will be tested within the Anemoi project:

- Offshore wind farms are a source of chemical emissions, including inorganic and organic contaminants as well as anthropogenic particles
- The ecosystem health, nature conservation, and restoration potential are not negatively affected by OWF chemical emissions
- Seafood products cultivated at offshore wind farms are not negatively affected by offshore wind farm chemical emissions compared to aquaculture products cultivated outside offshore wind farms.

The Anemoi project started in February 2023 and is planned to last four years. Currently, it is still in an early phase (Figure 2). Most results will be produced in the upcoming year(s). Nevertheless, a first overview can already be reported for the first three work packages (see the project's timeline).

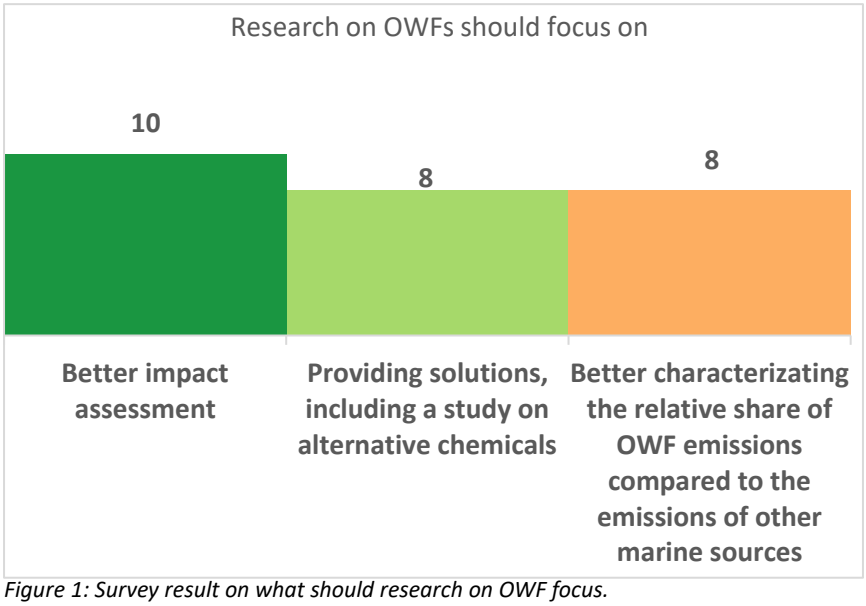


Figure 1: Survey result on what should research on OWF focus.

This newsletter gives an overview of the first preliminary project results, presented during the second online stakeholder event on June 20th, 2024, where we were happy to welcome and engage more than 25 stakeholders. During the event, stakeholders were asked for real-time feedback. A brief overview of the results is also presented in this newsletter.

For example, when asked where the research focus should be, the stakeholders are equally interested in a better impact assessment, solutions to reduce potential leachates, and a better characterization of the

emissions, including a comparison with other marine sources (Figure 1). This is in line with the three objectives of the Anemoi project.

Project's timeline

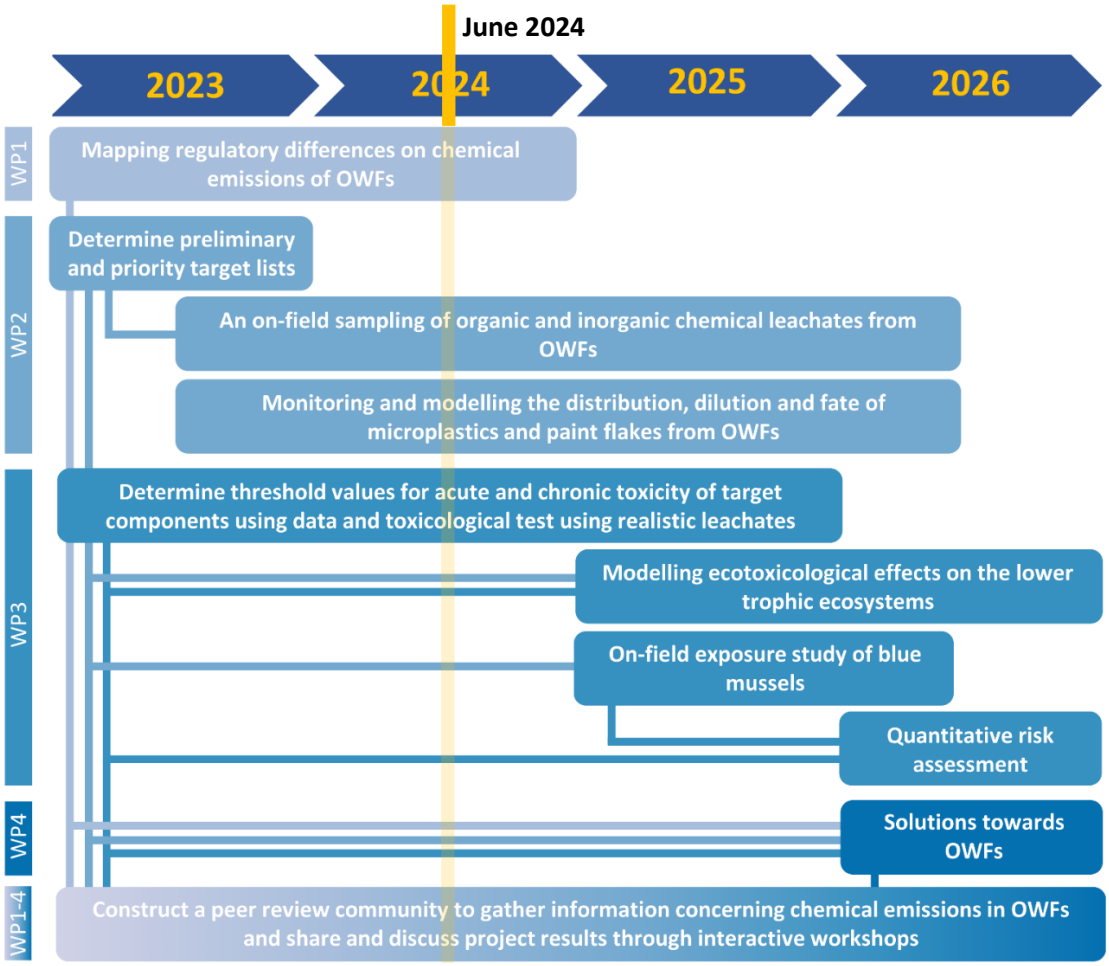


Figure 2: Timeline of the Anemoi project.

Difference in offshore wind farm regulations: need for harmonization

In work package 1, the regulatory differences between North Sea countries on chemical emissions of offshore wind farms are mapped. For each country, documentation from national websites was collected, and relevant authorities and project partners were consulted.

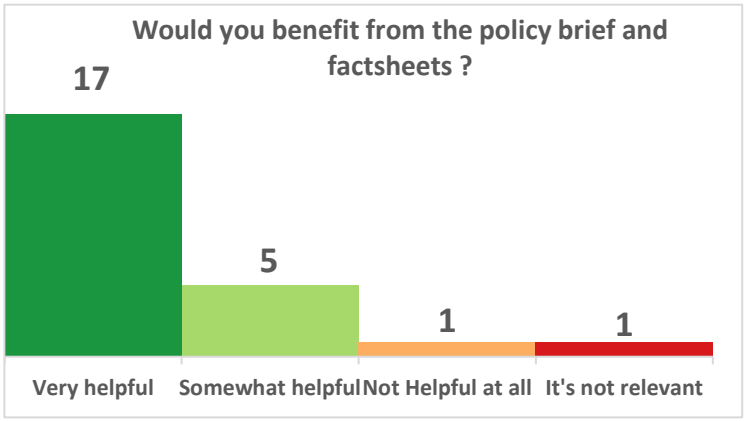
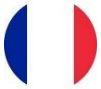


Figure 3: Survey result if the policy brief and fact sheet would benefit the stakeholders.

A **factsheet** was constructed **for each country**, summarizing the findings, to better compare regulations between countries. These will be used to create a **policy brief** addressing similarities and differences, expected to be ready for the following **stakeholder event, which will take place on the 19th of June, 2025, in Brussels**.

We asked the participating stakeholders if the factsheets and policy brief would benefit their company or institute. The majority answered positively (Figure 3). Based on the individual factsheets, few requirements per country are listed in the following table. More information from the fact sheets will be made available in 2025.

	General requirements	Specific requirements for corrosion protection
	▪ Minimization of emissions ▪ Emission concept and study required	▪ ICCP preferred; Anti-fouling paints are not allowed
	▪ Loss of material must be limited/avoided ▪ Monitoring program to assess effects is mandatory	▪ Some paints not allowed anymore; Only mechanical anti-fouling techniques
	▪ Environmental impact assessment mandatory	▪ None have been found
	▪ Avoid/reduce adverse effects ▪ Impact study and environmental monitoring mandatory	▪ Trend towards ICCP; Anti-fouling paints are not used
	▪ Prohibited to dispose or introduce substances into the sea ▪ Impact assessment mandatory	▪ Coatings that cause little to no release of substances should be used
	▪ Environmental impact assessment is mandatory	▪ Specific type of coatings to minimize particulate emission

Chemical emissions from offshore wind farms to the marine environment

To identify the potential emission, concentration, and distribution of chemical compounds (i.e. organics, metals, and paint flakes), nine scientific activities were defined, contributing to three major axes:

- The construction of a target list
- Field and laboratory work
- Modelling

The construction of a target list

In this activity, we will combine **leaching experiments** and a **literature review** (using peer-reviewed papers, reports, assessments from previous projects, safety data sheets, etc.) to construct a list of chemicals potentially leaching from offshore wind farms.

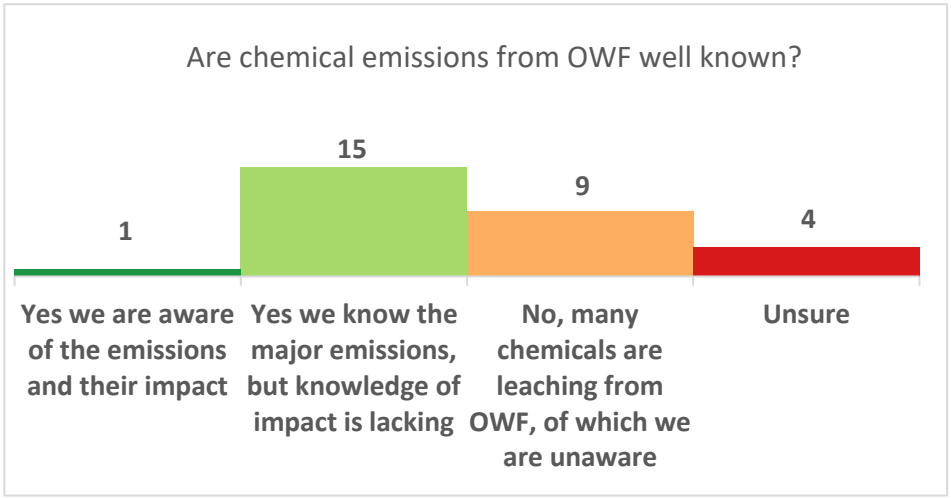


Figure 4: Survey results if chemical emissions from OWFs are well known.

Although a wide range of possible leachates is already known, according to the majority of the stakeholders, there are still gaps (Figure 4). This shows that more knowledge is required on the potential emissions of offshore wind farms and their effects.

For the **leaching experiments** (also briefly described here), stainless steel plates (10 x 20 cm) were coated with Internation or Hempel coatings, two types of paints often used in OWFs in the North Sea. Leachates were extracted from the coupons using seawater at 12°C in closed recipients for seven days under gentle agitation. The experiment was triplicated, including procedure blanks. In total, **204 chemicals** were detected, of which **23 were leachates** from **both** International and Hempel **formulations**. This was combined with a literature search in which 230 compounds were identified, most of which were organic compounds associated with the use of coatings.

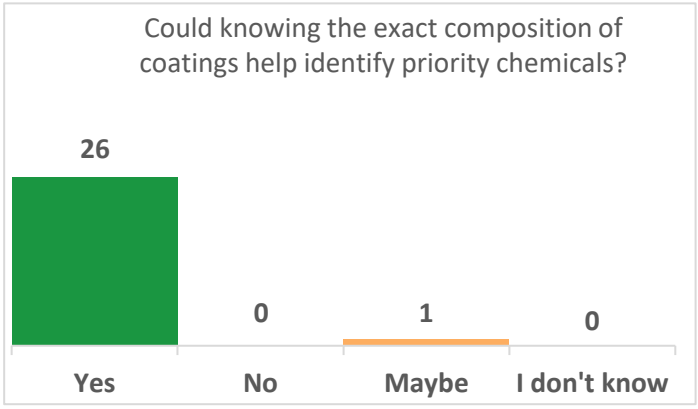


Figure 5: Survey results if the composition of coatings could help to identify priority chemicals.

The conducted leaching experiments are important as the composition of coatings used in the marine environment is not fully known. Some of the identified leachates were not found in the literature. Most stakeholders agree that knowing the composition of these paints is essential to identifying priority chemicals (Figure 5).

The leachate experiments and literature search indicate that chemicals are leaching from OWF. These emissions should also be monitored over time. Most stakeholders agree that monitoring should become routine; however, this should be limited to the compounds for which a risk assessment has revealed a potential risk (Figure 6). To do this, the list of potential chemicals based on leachate experiments and literature produced in Anemoi is reduced (Figure 7). In total, 50 components are prioritized by considering the following criteria:

- Continuous released
- Potential hazardous effect on the environment

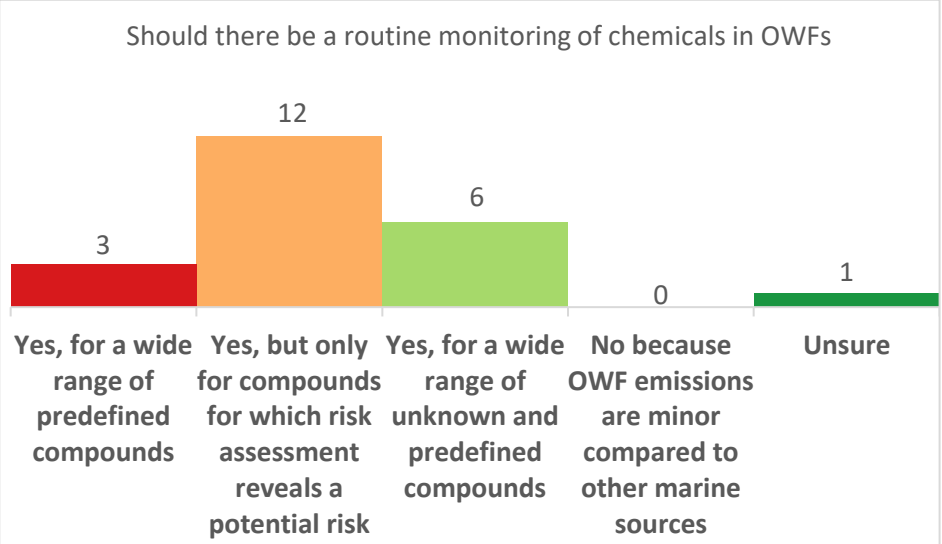


Figure 6: Survey results if monitoring of chemicals should became routine in OWFs.

By considering chemical risk assessment, a second prioritization will be performed to reduce these 50 compounds to 20 priority chemicals. An overview of the prioritization scheme is given below (Figure 7).

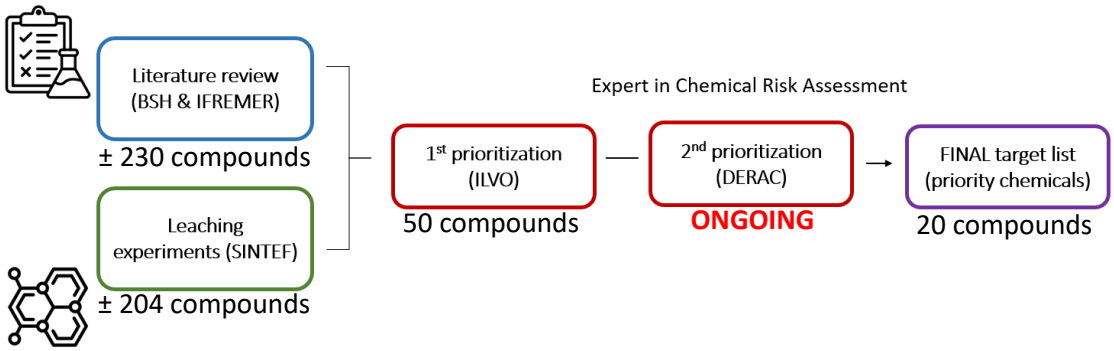


Figure 7: Overview of the prioritization scheme for the chemical risk assessment.

Field and laboratory work

In the spring of 2023 and 2024, sediment and water samples were collected in the Belgian and German parts of the North Sea. Our website provides a complete overview of the sampling devices and how water and sediment samples were taken. In the project, we proposed different methods to detect various chemicals. Although most methods are still in development, we hope to present you the first results soon. An overview of the laboratory work is given in Figure 8.

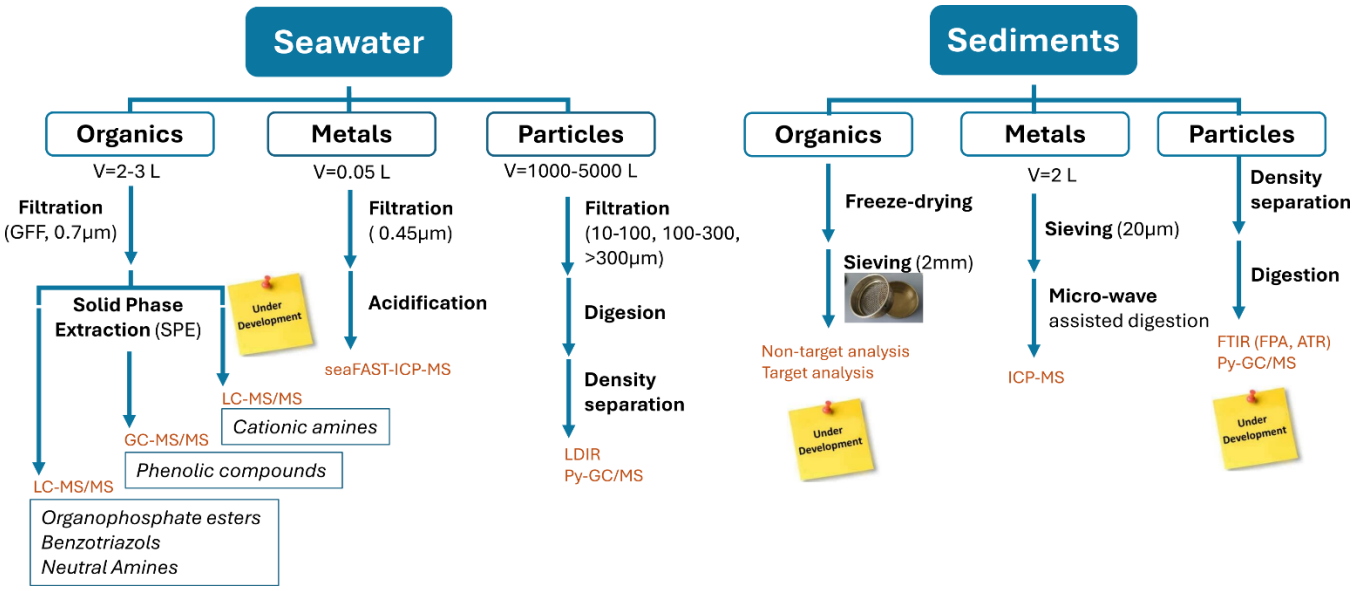


Figure 8: Overview of the methodologies applied to analyse organics, metals, and particles.

The primary concern of stakeholders was to ascertain if the measured concentrations were related to the offshore wind farms and not from other nearby activities like shipping. In the Anemoi project, we are aware of the many activities taking place in the North Sea. Therefore, samples were taken in the proximity of OWFs, at nearby locations following a distance gradient, and at different reference locations, including offshore and nearshore locations. The effect of shipping was also considered. Various parameters such as grain size, total organic carbon, salinity, and pH are measured, allowing us to compare different locations. Most stakeholders believe we can detect (partly) the emissions from offshore wind farms with our current strategy (Figure 9).

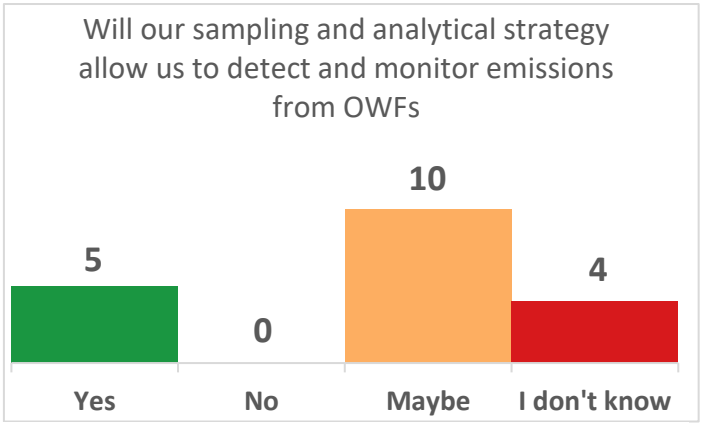


Figure 9: Survey result if the stakeholders believe our sampling strategy would be able to analyse chemical emissions from OWFs.

Modelling

The Anemoi project has initiated a new experiment on the settling behavior of flat-coating particles. In this experiment, particles' movement is recorded, which will be fed to a model to understand the transport of paint particles in OWFs.

Potential effects from offshore wind farm leachates

This work package investigates the potential effects of offshore wind farm leachates. The same coupons as in the leaching experiments are used. Mussels were grown on and beside the coupon. The induced stress was measured by monitoring the valve opening and heartbeat (Figure 10).

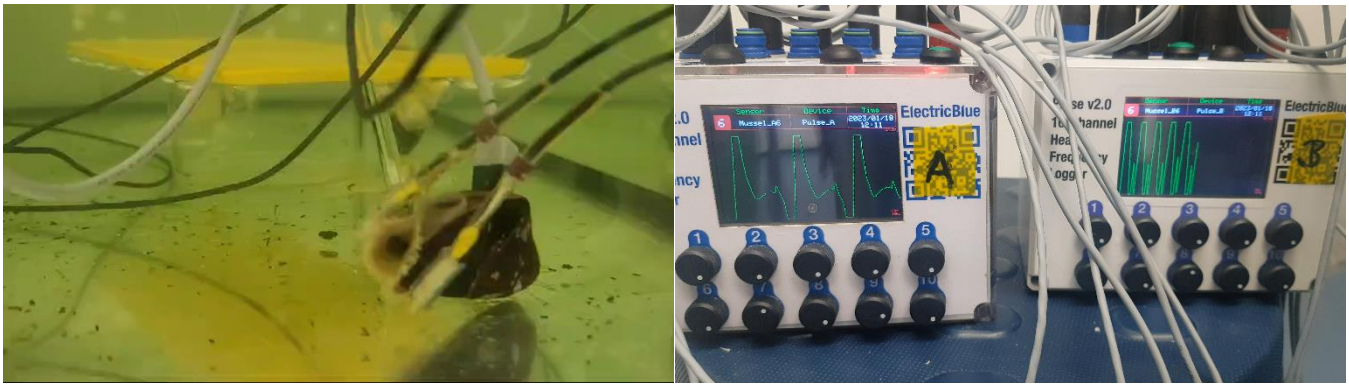


Figure 10: Experimental set-up to measure the heart rate and valve opening in mussels. The photograph on the left shows the sensors attached in vivo to the blue mussel.

Two important conclusions were observed during this experiment:

- Exposed mussels spend more time being less wide-open
- Exposed mussels spend more time with an active heart rate

Despite the abovementioned conclusions, no growth consequences were observed after a two-week exposure to OWF leachates. More ecotoxicological experiments are planned for the upcoming years, and we look forward to sharing these results with you.

Partners and Additional co-Financiers

ILVO Flanders research institute for agriculture, fisheries and food | NIOZ | SINTEF | Technische Universität Braunschweig | University of Antwerp | BSH Bundesamt für Seeschifffahrt und Hydrographie | VLAIO | ILVO – POM - UA | POM West-Vlaanderen | natural sciences .be | Ifremer | hereon | DTU | west-vlaanderen de gedreven provincie | ILVO – POM - RBINS

Contact information

The Anemoi project consortium welcomes questions and remarks. You can contact the consortium by mail or by filling out the Q&A form.

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Visit our website and follow us on LinkedIn for the latest news about the Anemoi projects. Also, have a look at our conference contributions and publications. An overview is given here and will be updated over time.

https://www.interregnorthsea.eu/anemoi

Anemoi Interreg

The **third stakeholder meeting** will be held in **Brussels** on June 19th, **2025**. We hope to welcome you in large numbers.