# Anemoi Newsletter

**Issue 04**
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## Content



## Anemoi third stakeholder event

The third Anemoi stakeholder event was held on **June 19th in Brussels**. We were pleased to welcome over **20 stakeholders** representing the offshore wind industry, research institutions, and regulatory bodies. The event featured keynotes addressed by:

- **Benjamin Ebbers** (OSPAR Commission) – *Protecting and Conserving the North-East Atlantic*
- **Birit Buhr** (European Energy) – *Environmental Impact from Offshore Wind: Reflections from the Industry*

A draft **policy brief** on the harmonisation of offshore wind farm (OWF) regulations was presented, followed by an interactive **workshop.** In the afternoon**, scientific findings** were shared, followed by a **panel discussion**. The panel focused on the integration of offshore renewable energy within marine spatial planning, environmental monitoring, and stakeholder engagement. Panellists discussed the complex balance between ecological protection and energy infrastructure development. Key themes included the importance of adaptive management, long-term monitoring, and harmonized regional standards.

**Key messages were:**

1. Strengthen collaboration between scientific institutions, industry, and policymakers.
2. Develop standardised approaches for environmental monitoring and data collection.
3. Ensure transparency and promote active stakeholder involvement in planning processes.
4. Support pilot projects that align renewable energy with ecosystem services.
5. Facilitate knowledge exchange through international forums and networks.

Stay tuned for our **next stakeholder meeting** in the first half of **2027** in **Copenhagen**.

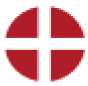
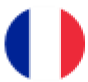
Stay connected with our project, visit our website and LinkedIn page.

## Policy brief and workshop outcomes

As part of Anemoi Work Package 1, regulations governing chemical emissions from OWFs were reviewed across the participating partner countries. The **key findings** and **recommendations** for future policy development were compiled into a **draft policy brief**, which was presented at this year’s stakeholder event in Brussels. The review revealed that existing regulations on chemical emissions are partly **incomplete, fragmented, and inconsistent across countries**. Although all project partner countries require efforts to minimise emissions or anthropogenic impacts in general, specific measures—such as corrosion protection strategies and monitoring protocols—differ significantly between national frameworks (see Table 1). Moreover, there is currently a **lack of transnational guidelines** addressing chemical emissions from OWFs. Regulatory gaps may partly stem from limited knowledge of substances used and their potential environmental impacts.

To improve protection of the marine environment and move toward regulatory harmonisation, the development of more specific, coordinated regulations and best available techniques (BAT) is essential. Both should be regularly updated based on the **latest findings from environmental monitoring**, scientific research, and chemical inventories.

*Table 1: Overview of selected national regulations on chemical emissions of OWFs. Legend: ↓ Reduce, ✓ rules available, ✗ not allowed/recommended, 🐟 biology, 💧 water/hydrodynamics.*

| Country | General | Corrosion protection | Monitoring |
|---|---|---|---|
|  | ✗ Introduction of substances | ✗ Some antifouling paints | 🐟 💧 |
|  | ↓ Chemical emissions | ✗ Antifouling paints<br>✓ ICCP (preferred)<br>✓ Galvanic + coatings<br>✗ Zn anodes<br>↓ 2ry components | 🐟 |
|  | ↓ Negative env. impacts | | 🐟 |
|  | ↓ Negative env. impacts | ✗ Antifouling paints<br>✓ Galvanic<br>✓ ICCP | 🐟 💧 |
|  | ✗ Introduction of substances | ✓ Specific types | 🐟 |
|  | ↓ Negative env. impacts | ✓ Specific types | planned |

The **workshop** revealed broad stakeholder support for the harmonisation of chemical emissions regulations. At the same time, participants emphasised the **importance** of **maintaining flexibility** to accommodate site-specific conditions and **foster innovation**. Stakeholders suggested that **existing regulatory frameworks** from other sectors, such as offshore oil and gas, could provide useful references in developing **guidelines for OWFs**. Additionally, they highlighted the need for **greater transparency** and **access to data** on chemical composition of existing coatings, as well as their **environmental and ecotoxicological impacts**, before implementing new regulations. Based on this valuable feedback, the policy brief will now be revised and finalised. Once completed, it will be published and shared with all stakeholders.

## Prioritisation of chemicals emitted from OWFs

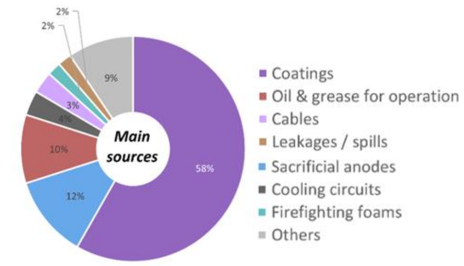



*Figure 1: Overview of the different sources of chemicals potentially emitted from OWFs.*

A major outcome has been the recent peer-reviewed publication identifying more than 200 chemicals potentially emitted from OWFs, confirming OWFs as emerging sources of chemical contaminants (Figure 1 and 3). This was a collaborative work of ANEMOI and experts from two ICES groups, the Marine Chemistry Working Group (MCWG) and the Working Group of Offshore Renewable Energies (WGORE) (Hengstmann, Corella-Zapata et al., 2025).

The potential risk of chemical emissions from OWFs to the marine ecosystem and human health will be assessed for a selection of priority compounds using a **two-tier prioritisation approach** (Figure 2). The prioritisation process began with our compiled literature list and a non-targeted leaching experiment on commonly used OWF coatings.

In Tier 1, **44 compounds** were selected based on several criteria: presence in both literature and leaching tests, known use in OWF coatings, inclusion in multiple regulatory or priority lists, and other relevance indicators. Additionally, **six metals** commonly present in sacrificial anodes were included due to their potential environmental relevance.

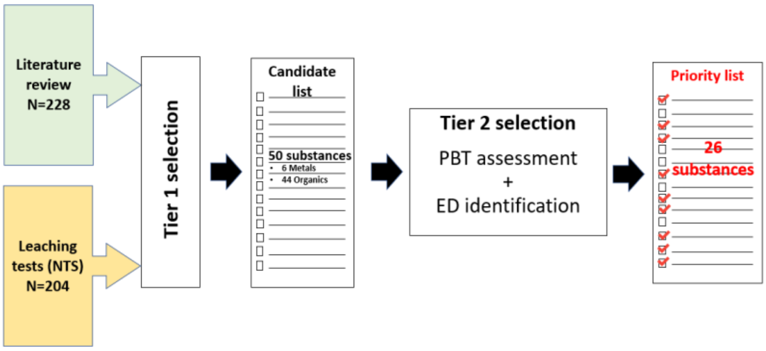



*Figure 2: Overview of the two-tier prioritisation approach.*

In Tier 2, this list was refined to **26 compounds** by prioritising substances identified as endocrine disruptors (EDs) and evaluating their persistence (**P**), bioaccumulation potential (**B**), and toxicity (**T**)—commonly known as PBT criteria. This tiered approach helps to focus further research and monitoring efforts on substances of highest concern.

## Preliminary findings on contaminants in OWF areas

As part of the field and experimental work, more than 200 samples (seawater and sediments) were collected from OWF areas and reference sites in the Belgian and German parts of the North Sea. These samples have been analysed for metal concentrations and a selection of priority organic contaminants.

Methods for particle analysis have been adapted and optimised to account for the differing properties of paint particles compared to **microplastics**. Analyses of environmental samples started, but results are only expected in the **coming months**. Preliminary results of inorganic contaminants (metals) suggest **potentially elevated concentrations** of **certain metals** in sediments near OWFs.

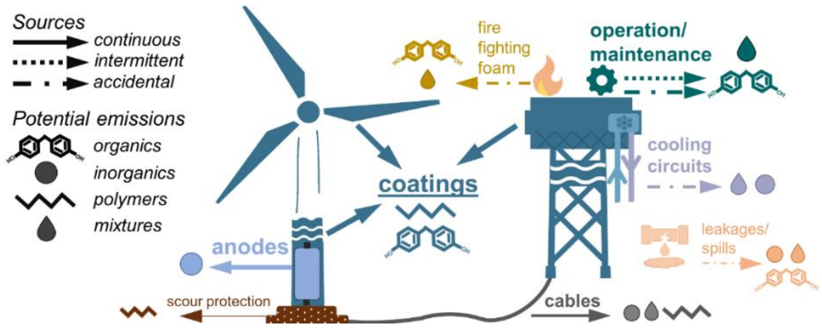



*Figure 3: Potential sources of chemical emissions from OWFs (Hengstmann, Zapata Corella et al., 2025)*

Initial target analyses of **organic contaminants** in **seawater** have **not** indicated any **distinct OWF-related sources** when compared to reference sites. However, further insights are expected from ongoing target analyses of sediment samples. In parallel, **non-target analyses** of sediments have **revealed** the **presence** of **specific chemicals** occurring at higher intensities in **OWF areas**. This approach shows promise for identifying and tracking potential sources of contamination related to OWF operations.

# Impact of chemical leachates on aquaculture products

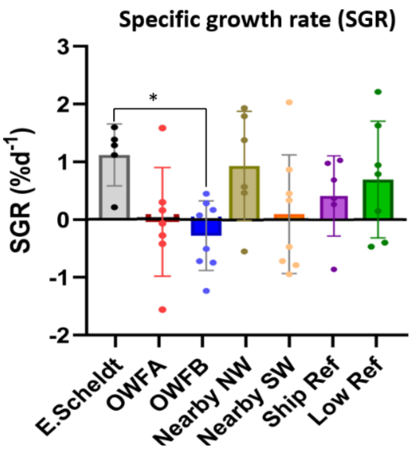



*Figure 4: The SGR of polychates*

The **potential biological effects** of **paint leachates** from OWF coatings were assessed using the **blue mussel** (*Mytilus edulis*), with growth performance measured via the Scope for Growth method. Mussels were exposed to different OWF coating materials, and their energy balance was evaluated. No significant differences were observed between mussels directly exposed to coatings, in proximity to the coatings, or not exposed to coatings at all, suggesting **no measurable effect** from the tested coatings under the given conditions. In a separate test, **polychaete worms** were exposed to **sediments** collected from **OWF areas** and reference sites. A potential **adverse effect** on specific growth rate (SGR) was observed in organisms exposed to OWF sediments (Figure 4).

# Optimising corrosion protection systems in OWFs

To evaluate the **long-term performance** and environmental footprint of galvanic **anode cathodic protection** (GACP) systems used in offshore wind turbine foundations, a **numerical model** was developed to simulate corrosion protection (CP) over a 25-year design life. The model incorporated key influencing factors such as oxygen limitation, coating degradation, and surface resistance to enhance predictive accuracy, and was validated using available field data.

Model simulations estimated that a **single wind turbine monopile** could release approximately **1 tonne** of **aluminium** and **56 kg** of **zinc** into the marine environment over its operational lifetime. When extrapolated to a wind farm consisting of 56 turbines, this corresponds to roughly 60 tonnes of aluminium and 3 tonnes of zinc. Although the simulated seawater concentrations for both metals **remained below established ecotoxicological thresholds**, they were significantly **elevated** compared to **natural background levels**.

To validate these predictions and assess potential biological effects, an experimental CP–mussel setup has been designed. This controlled laboratory system simulates marine conditions to monitor metal release and its impact on marine organisms.

These findings highlight the importance of site-specific monitoring and continuous optimisation of cathodic protection systems—not only to ensure structural integrity, but also to minimise environmental impact and support sustainable offshore wind development.

# Publications: Read our latest publications

- Czerner et al. (2025) discus the transport processes of particles in OWF areas.
  - Read more about it here: https://doi.org/10.1016/j.marpolbul.2025.117728
- In collaboration with ICES MCWG and WGORE, we published a peer reviewed publication identifying more than 200 chemicals potentially emitted from OWFs (Hengstmann, Corella-Zapata et al., 2025).
  - Read the paper here: https://doi.org/10.1016/j.marpolbul.2025.117915
  - Access the entire data set here: https://doi.org/10.5281/zenodo.14865443

# Partners and Additional co-Funders

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