

Supplementary Information - Part A

Regulation of chemical emissions from offshore wind farms: Comparative analysis and policy recommendations for the North Sea

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A. Material and Methods

The procedure for the comparative analysis of regulations concerning chemical emissions from Offshore wind farms (OWFs) is presented in more detail in the following and summarised visually in the figure below (Fig. SI A1).

Online research was conducted between December 2023 and June 2024 to identify publicly available literature and websites for regulations and guidance concerning chemical emissions from OWFs. Newer developments in regulation, established after summer of 2024, are therefore not considered in this paper. A regional focus was chosen for the overview of regulation based on the partnering countries of the EU Interreg project *Anemol*. Therefore, a selection of North Sea bordering EEA states, namely Belgium, Denmark, France, Germany, the Netherlands, and Norway were included in the analysis. Even though the UK has currently the highest cumulative capacity of offshore wind energy in Europe, it was not considered in this study.

In different search engines (Google, Google Scholar, ScienceDirect), the following English keywords were used in different combinations: 'chemical emissions', 'emissions', 'offshore wind farms', 'legislation', 'regulation', 'rules', 'guidelines', 'Belgium', 'Denmark', 'France', 'Germany', 'Netherlands', 'Norway', 'North Sea'. Both, primary and grey literature in English and national languages was taken into account in the research as these are both important in the topic of environmental impacts of OWFs and could deliver different views and information as shown by Szostek et al. (2024). If documents and websites were in national languages, these were translated to English.

Two researchers screened the results from the online research to check for their relevance. If relevant and if possible, material was downloaded. Only publicly available documents were considered. The list of relevant material included scientific studies, reports, primary legislative documents, implementing decrees as well as guidance documents and informing websites. The material was examined more closely by two researchers, focusing on different countries, to compile information on relevant regulation of chemical emissions. In total, 61 documents and 9 websites were reviewed. In parallel, regulating national authorities for OWFs, research

institutes for the relevant topic in the respective country and stakeholders from the EU Interreg project Anemoi were contacted to ask for further documents and information and to validate online research interpretations.

References containing information on regulatory approaches with respect to specific chemical emissions from OWFs were primarily selected. In addition, references providing more general information, e.g. on the responsible authorities, were considered. We excluded documents on general marine regulations on chemicals from other maritime sectors (e.g. oil and gas, shipping). After screening and sorting, 51 documents, websites and communications with persons from authorities and institutes were further considered. Relevant information from these references were collected in a large overview table. Different categories were introduced to structure the gathered information. These included, on the one hand, more general categories e.g. concerning the authorisation process, and, on the other hand, chemical emission specific categories addressing different potential sources like 'corrosion protection', 'discharge water', 'extinguishing foams', 'fluorinated greenhouse gases', 'waste', 'diesel generators', 'grouting', 'microplastics', 'scour/cable protection', 'system cooling', according to Hengstmann et al. (2025). The overview table can be found in the Supplementary Information Part B.

Based on the overview table, fact sheets were produced to summarize information for each country individually. A shortened version of the table and the fact sheets were then shared with six researchers working on the topic of chemical emissions from OWFs and involved in the *Anemoi* project for evaluation. Following an approach similar to a SWOT (Strengths, Weaknesses, Opportunities, Threats; Stewart et al. 1965) analysis, the strengths and weaknesses of the regulations in the individual countries were analysed, and similarities between them as well as potential gaps were identified. Results of individual evaluations were brought together and discussed in an online meeting with all involved researchers in October 2024. Based on the overall results, the policy brief was drafted.

In a stakeholder meeting of the EU Interreg project Anemoi in June 2025, the first draft of a policy brief was orally presented and a workshop was conducted to receive feedback on the document. Twenty stakeholders from various areas of interest participated in the workshop, including representatives of authorities, environmental protection groups, industry, operators, policy and research. The workshop was based on the World-Café method, a collaborative method allowing a dialogue on specific topics in smaller groups (Brown a. Isaacs, 2005). Feedback gained was integrated in the draft version during a revision process.

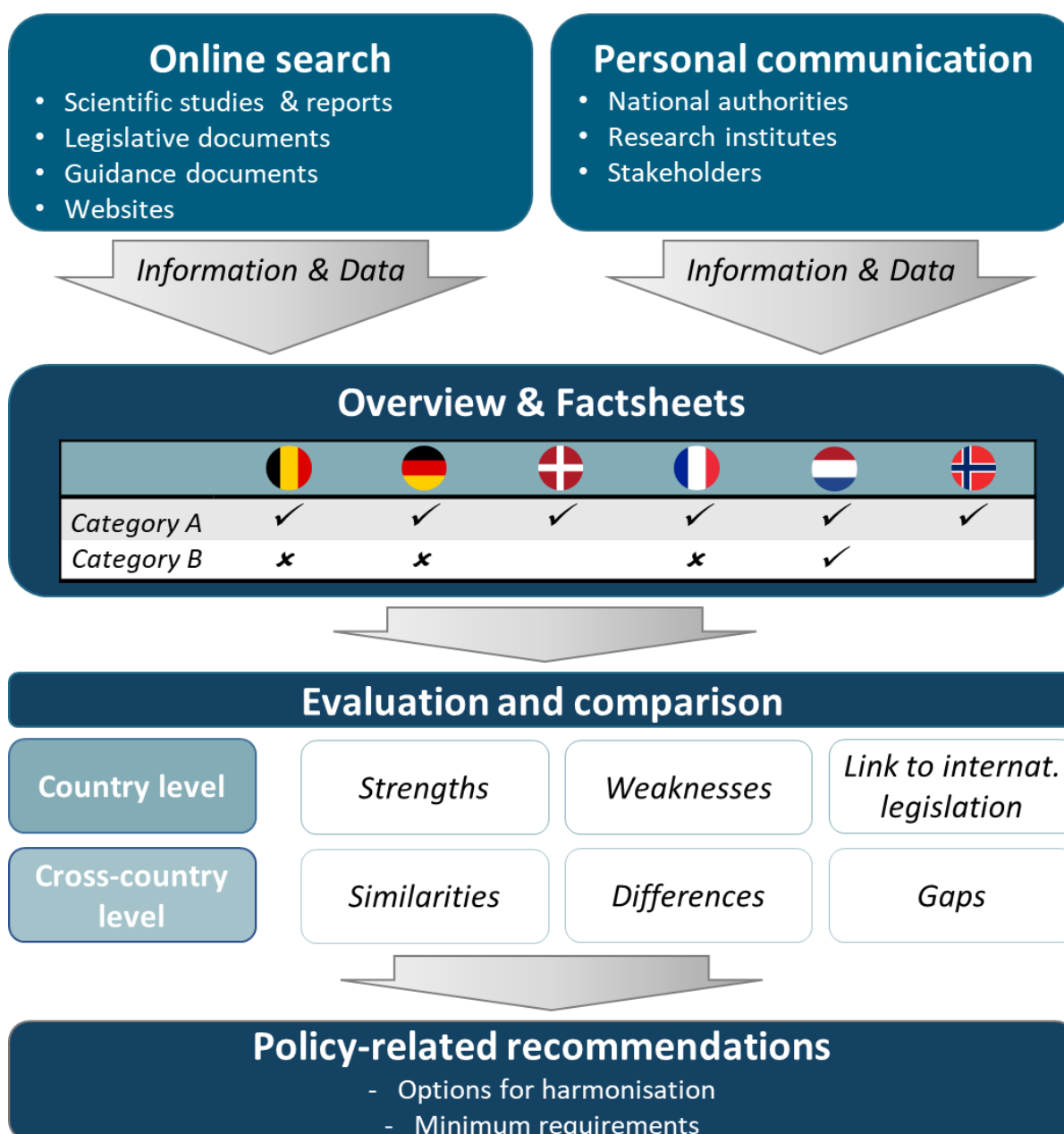


Figure SI A1: Procedure for the comparative analysis of regulations concerning chemical emissions from OWFs.

References

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