

What is a realistic annual energy yield from very large wind farm clusters and energy islands?

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Ambitious targets were declared in Europe for offshore wind in 2022. In Europe, two agreements in particular stand out: the Esbjerg Declaration and the Marienborg Declaration. These outline wind capacity installation commitments of at least 65 GW by 2030 and 150 GW by 2050 in the North Sea (BE,NL,DE,DK) and at least 19.6 GW by 2030 in the Baltic Sea (SE, FI, EE, LV, LT, PL, DE, DK).

This presentation puts into context these targets by considering existing studies that have looked at wind resources in these waters. How does this installed capacity target (in GW) translate into an annual energy yield expectation (in TWh)?

While previous large scale resource studies have considered geospatial constraints and plausible technologies, they have been less detailed about the influence of very large wind farms and wind farm clusters on the atmospheric flow (ENSPRESO, JRC, 2019). Some country specific studies have considered the influence of wind farm clusters on the atmospheric flow and wind resources (Making the Most of Offshore Wind, Agora, 2020) but have not aggregated this approach over waters belonging to several countries.

Latest research results using a diverse range of modelling approaches builds consensus on the findings of Volker et al (2017) that wind farm efficiencies may drop below 70% for very large wind farms (>10E4 km^{**2}) even with relatively low installed capacity densities. This underlines the need to communicate this effect and plan an appropriate build out of wind farms to mitigate losses, use the sea area effectively and fairly, with respect to national borders.

This presentation will introduce the science around wind farms' impacts on the atmospheric flow. It will also describe a number of different approaches that researchers are developing and deploying to carry out resource assessment for wind farm clusters on scales that the aforementioned declarations demand. The findings will also be relevant for offshore plans outside Europe.