EVALUATING THE SUITABILITY OF OFFSHORE WIND AREAS FOR SUSTAINABLE ENERGY DEVELOPMENT IN NORWAY: A COMPARATIVE ANALYSIS

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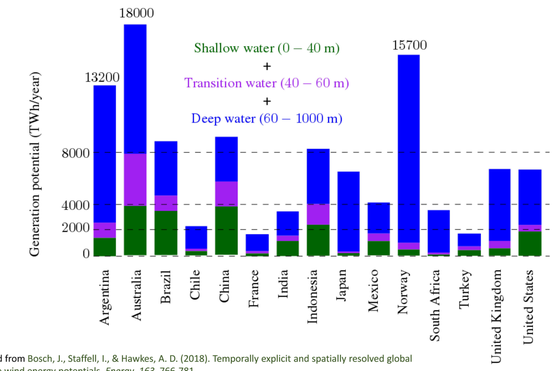
MOTIVATIONS

In 2023, the Norwegian Water Resources and Energy Directorate (NVE) identified 20 promising offshore wind areas to meet Norway's ambitions in offshore wind energy. These areas are characterized by both technical feasibility and relatively low conflicts of interest. More specifically, identified zones serve as a cornerstone in Norway's mission to develop 30 GW of offshore wind capacity by 2040.

Norway possesses significant potential for floating offshore wind capacity in deep waters, surpassing most other countries in this sector (Figure 1). To ensure a fair and sustainable development of offshore wind along Norway's shores, it is crucial to select optimal locations that minimize conflicts among various stakeholders. Additionally, the study explores diverse sustainability factors influencing offshore wind projects, with a specific focus on environmental considerations.



Adapted from Bosch, J., Staffell, I., & Hawkes, A. D. (2018). Temporally explicit and spatially resolved global offshore wind energy potentials. *Energy*, *163*, 766-781.

Figure 1: Offshore wind energy generation potential of key countries based on Bosch et al. [3].

METHODOLOGY

The research aims to better understand the environmental factors affecting the development of offshore wind projects in different locations of the Norwegian Exclusive Economic Zone (EEZ).

The study integrates the baseline scenario developed in Solbrekke and Sorteberg [1] for assessing offshore wind area suitability with the zones proposed by NVE in 2023. QGIS software is employed for the spatial analysis.

The study overlays the 20 areas designated by NVE onto score maps generated in Solbrekke and Sorteberg [1]. These score maps provide a visual representation of the suitability of marine areas for offshore wind development, graded on a colored scale based on different factors including technical, socio-economic, and environmental considerations. The baseline scenario (Figure 2) aims to find a balance between the three dimensions, producing a score map with the least trade-offs among the stakeholders involved.

By comparing NVE criteria with the model's output, the study identifies potential conflicts and areas requiring further examination due to low suitability. The analysis incorporates current spatial datasets and recent literature to offer valuable insights into common environmental challenges within Norway and across Europe.

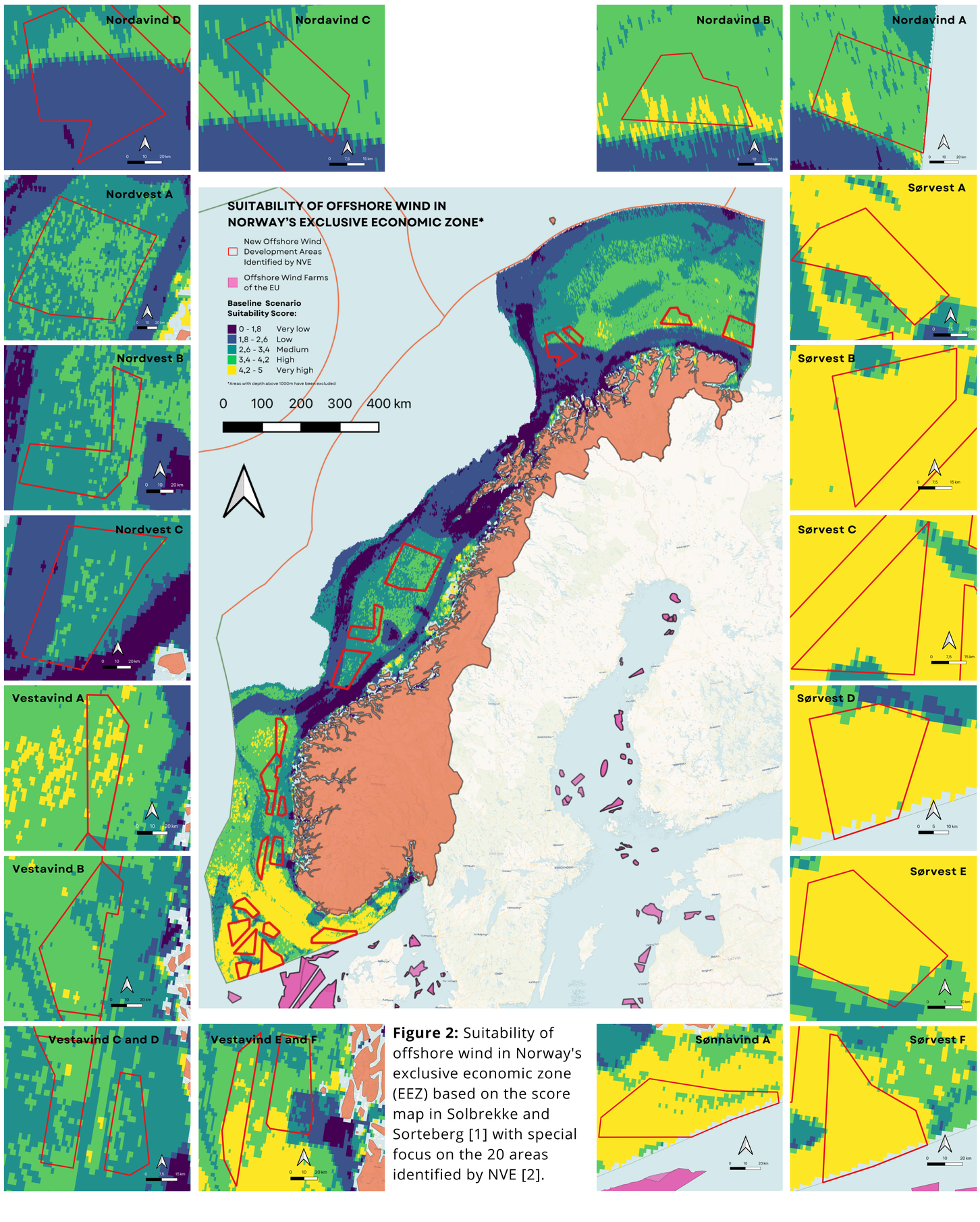


Figure 2: Suitability of offshore wind in Norway's exclusive economic zone (EEZ) based on the score map in Solbrekke and Sorteberg [1] with special focus on the 20 areas identified by NVE [2].

RESULTS

Both the 20 designated NVE areas and the score maps generated by Solbrekke and Sorteberg's model show good alignment. This suggests that the relatively simplified approach in Solbrekke and Sorteberg [1] provides meaningful insights into appropriate site selection for offshore wind projects. However, within certain areas, discrepancies become evident.

For instance, in Nordavind D, a limited suitability is observed due to its overlap with an existing particularly valuable area (PVA). Particularly valuable areas include vulnerable habitats, important spawning and nursery areas for fish, important areas for seabirds, the Egga edge, the polar front, the ice edge and the coastal zone.

Similarly, in Vestavind F, a problematic zone is noticeable, particularly in its southeastern corner, arising from its intrusion into another PVA. That is also the case is for Nordvest C but on a lower extent. This overlap may not be a major issue, and waiting for ideal locations to develop offshore wind is impractical. Yet, this mismatch remains evident and requires careful examination.

It is also notable that the NVE has disregarded certain regions identified as highly suitable in the score map by Solbrekke and Sorteberg, like north-east of Sørvest E or east of Nordavind C. The comparison with suitability maps from other scenarios than the baseline one in Solbrekke and Sorteberg [1] might give more information on whether these areas are indeed associated with low conflicts.

INTERPRETATION

Three areas -Nordavind D, Nordvest C, and Vestavind F- show low to very low suitability in parts of their territories due to overlapping with existing particularly valuable areas (PVAs).

In Nordavind D, this overlap occurs in its southern part with "Tromsøflaket (BH2)". For Vestavind F, it is in its southeastern corner with "Karmoy field (NS4)".

In Nordvest C, the overlap exists only in its southeastern corner with "Mørebankene (NH4)". The west part of the area presenting low suitability is due to a lack of updating of the PVAs map, while the area is actually out of the protected areas. Data on the PVAs of Norway has been updated since the study by Solbrekke and Sorteberg [1].

DISCUSSION & CONCLUSION

The use of score maps in this study has limitations due to dataset constraints and subjective weight assignments to variables. Similar limitations apply to the NVE's approach in designating the 20 areas.

The suitability maps in Solbrekke and Sorteberg [1] align closely with the 20 areas designated by NVE, meaning that their simple multi-criteria decision analysis approach produces meaningful and useful results in offshore wind planning.

Transitioning to sustainable energy requires a balanced, multidisciplinary approach, recognizing the absence of a perfect methodology. We should carefully consider our choices to minimize negative impacts on every stakeholder involved in the planning process. That implies looking at the complexities and trade-offs for sustainable solutions.

ACKNOWLEDGMENT

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