A Preliminary Techno-Economic Evaluation of AWE for Offshore Applications in Italy

Alessandro Croce, Francesca Neri, Umberto Nobile
Department of Aerospace Science and Technology, Politecnico di Milano

Alessandro Croce

Professor
Politecnico di Milano
Department of Aerospace Science and Technology
POLI-Wind Laboratory

Via La Masa 34
20156 Milano
Italy

alessandro.croce@polimi.it
www.aero.polimi.it/en

MERIDIONAL

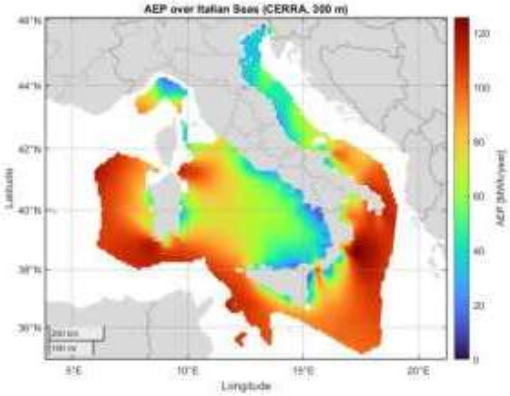
POLITECNICO MILANO 1863

This work presents a preliminary techno-economic evaluation of offshore airborne wind energy (OAWE) applications in the Italian maritime domain. The analysis combines an offshore wind resource assessment with an economic evaluation based on the Levelized Cost of Energy (LCoE). Wind conditions at altitudes relevant to AWE systems are analysed using two atmospheric reanalysis datasets, ERA5 and CERRA, which are compared in terms of wind speed distributions and resulting Annual Energy Production (AEP). A reference ground-generation AWE system (SkySails PN-14) is adopted to estimate site-specific energy yields and to map the large-scale offshore energy potential across Italian seas, after excluding environmentally and legally constrained areas.

The comparison between ERA5 and CERRA at 100 m shows strong temporal coherence offshore, with correlation coefficients around 0.98 and only small deviations in monthly mean values. Differences increase in coastal areas, where CERRA resolves local gradients induced by land–sea interactions, while ERA5 exhibits a smoother spatial and temporal evolution. Results show that, when extrapolated over the entire Italian offshore domain, the theoretical energy potential ranges between about 340 and 450 TWh/y The techno-economic analysis is based on an offshore-adapted cost framework, building on the model developed in [1] and extended with a cost model for floating platforms derived for conventional floating offshore systems [2]. This analysis highlights the dominant role of offshore infrastructure and operation and maintenance over the plant lifetime in the total expenditure, accounting for more than half of the capital cost.

Despite the reduced structural mass of airborne systems, offshore deployment requires floating platforms, mooring systems, and marine operations of a magnitude comparable to those of conventional floating wind.

Despite several limitations of this preliminary analysis, the work provides a foundation for future assessments of offshore AWE and opening new avenues of investigation.



AEP density map based on the CERRA dataset at 300 m altitude [3].

References:

[1] Joshi, R et Al: A reference economic model for airborne wind energy systems Airborne Wind Energy Conference (AWEC 2021)

[2] Croce, A., and Galliani, M.: Holistic Design of a 2-Bladed Spar-Buoy Floating Offshore Wind Turbine, TORQUE 2026, 2026

[3] Neri, F.,and Nobile, U.: A Preliminary Techno-Economic Evaluation of Airborne Wind Energy for Offshore Applications in Italy, 2025

This research has been supported by the MERIDIONAL project, which receives funding from the European Union's Horizon 2020 program (grant agreement no. 101084216).