

Site Suitability of Offshore Wind Energy: A Combination of Geographic Referenced Information and Analytic Hierarchy Process

Authors : Ayat-Allah Bouramdane

Abstract : Power generation from offshore wind energy does not emit carbon dioxide or other air pollutants and therefore play a role in reducing greenhouse gas emissions from the energy sector. In addition, these systems are considered more efficient than onshore wind farms, as they generate electricity from the wind blowing across the sea, thanks to the higher wind speed and greater consistency in direction due to the lack of physical interference that the land or human-made objects can present. This means offshore installations require fewer turbines to produce the same amount of energy as onshore wind farms. However, offshore wind farms require more complex infrastructure to support them and, as a result, are more expensive to construct. In addition, higher wind speeds, strong seas, and accessibility issues makes offshore wind farms more challenging to maintain. This study uses a combination of Geographic Referenced Information (GRI) and Analytic Hierarchy Process (AHP) to identify the most suitable sites for offshore wind farm development in Morocco, with a particular focus on the Dakhla city. A range of environmental, socio-economic, and technical criteria are taken into account to solve this complex Multi-Criteria Decision-Making (MCDM) problem. Based on experts' knowledge, a pairwise comparison matrix at each level of the hierarchy is performed, and fourteen sub-criteria belong to the main criteria have been weighted to generate the site suitability of offshore wind plants and obtain an in-depth knowledge on unsuitable areas, and areas with low-, moderate-, high- and very high suitability. We find that wind speed is the most decisive criteria in offshore wind farm development, followed by bathymetry, while proximity to facilities, the sediment thickness, and the remaining parameters show much lower weightings rendering technical parameters most decisive in offshore wind farm development projects. We also discuss the potential of other marine renewable energy potential, in Morocco, such as wave and tidal energy. The proposed approach and analysis can help decision-makers and can be applied to other countries in order to support the site selection process of offshore wind farms.

Keywords : analytic hierarchy process, dakhla, geographic referenced information, morocco, multi-criteria decision-making, offshore wind, site suitability

Conference Title : ICEER 2023 : International Conference on Energy and Environment Research

Conference Location : Paris, France

Conference Dates : February 06-07, 2023