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Framework of Initial Selection of Offshore Energy Island Location for Sustainable Water Desalination

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Abstract. In this paper, a framework for the selection of an energy island location to supply power for water desalination plants with cleaner and more sustainable energy has been developed. The developed framework aims to evaluate the feasibility of creating offshore energy islands and select its location by considering factors such as renewable energy potential, site suitability, marine traffic, future developments, and proximity to desalination facilities. The energy and water data have been collected from available published data on marine traffic, water desalination production and government reports. Solar power data were obtained from the Ministry of Natural Resources via RETScreen, wave data were sourced from Windguru, and wind power data were obtained from both sources. The data were used for the Inverse Distance Weighting (IDW) interpolation and Multi- Criteria Decision Analysis (MCDA) to develop the framework. The developed framework has been utilized to develop an energy Island in the Red Sea to power the water desalination plants along the KSA west shore. The findings demonstrate the significant potential of energy islands to partly mitigate Carbon Dioxide (CO_2) emissions from desalination plants, advancing global efforts toward water sustainability and supporting long-term goals for achieving net-zero emissions. The study also emphasizes the importance of further research into wave energy in the Red Sea, as the lack of real-time data and comprehensive resources limits accurate assessments.

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