

Optimizing Hybrid Renewable Energy with Tidal and Offshore Wind in the Mersey Estuary

The River Mersey in Liverpool has long been recognized for its considerable tidal range, offering significant potential for energy generation. However, none of the studies explored integrating tidal and offshore wind energy systems within a hybrid configuration. This study addresses this gap by investigating the integration of these two sources by leveraging the proximity of the existing Burbo Bank Offshore Wind Farm (OWF) to a proposed tidal barrage site. An optimization model is developed to determine the most cost-effective configuration of the tidal barrage by maximizing its net present value. The design variables include the barrage location, the number and type of turbines, and the number of sluice gates. The model accounts for the combined energy contributions from the tidal barrage and the OWF, which share a common export cable that constrains the total energy exported to the grid. The study demonstrates the benefits of hybridizing tidal and wind energy sources in the region, highlighting synergies that can enhance energy reliability and efficiently use existing transmission infrastructure.

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