Wind Energy, vol.22, no.12, pp.1684-1698, December, 2019.

Integrated offshore wind farm design: optimizing micro-siting and cable layout simultaneously

T. Marge; S. Lumbreras Sancho; A. Ramos Galán; B.F. Hobbs

Abstract-

Electrical layout and turbine placement are key design decisions in offshore wind farm projects. Increased turbine spacing minimizes the energy losses caused by wake interactions between turbines but requires costlier cables with higher rates of failure. Simultaneous micro-siting and electrical layout optimization are required to realize all possible savings. The problem is complex, because electrical layout optimization is a combinatorial problem and the computational fluid-dynamics calculations to approximate wake effects are impossible to integrate into classical optimization. This means that state-of-the-art methods do not generally consider simultaneous optimization and resort to approximations instead. We extend an existing model that successfully optimizes cable design to simultaneously consider micro-siting. We use Jensen's equations to approximate the wake effect in an efficient manner, calibrating it with years of mast data. The wake effects are precalculated and introduced into the optimization problem. We solve simultaneously for turbine spacing and cable layout, exploiting the tradeoffs between these wind farm features. We use the Barrow Offshore Wind Farm as a case study to demonstrate realizable savings up to 6 MEUR over the lifetime of the plant, although it is possible that unforeseen design constraints have implications for whether the savings seen in our model are fully realizable in the real world. In addition, the model provides insights on the effects of turbine spacing that can be used to simplify the design process or to support negotiations for surface concession at the earlier stages of a project.

Index Terms- cable layout, economics, offshore wind, turbine micro?siting, wake modeling

Citation:
Marge, T.; Lumbreras, S.; Ramos, A.; Hobbs, B.F. "Integrated offshore wind farm

design: optimizing micro-siting and cable layout simultaneously", Wind Energy, vol.22, no.12, pp.1684-1698, December, 2019.