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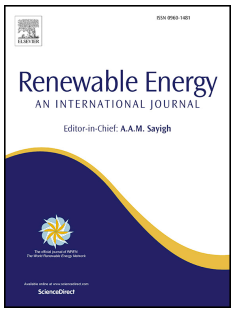

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Trading Off Sound Pressure Level and Average Power Production for Wind Farm Layout Optimization

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Abstract

This research explores the trade-offs between a wind farm's average power production and noise impact on nearby observers. Two specific wind farm designs were studied and optimized using the FLORIS wake model and an acoustic model based on semi-empirical turbine noise calculations. It was found in the two wind farms that the average power production could be increased, up to 8.01% in one and 3.63% in the other, ignoring sound level considerations. Including a noise restriction in the optimization had a minimal impact on the optimal average power production within about a five-decibel range. Past this range, sound limitations decreased the wind farm's power production significantly. By analyzing average power production and sound pressure level together, we can take advantage of the multi-modality of the optimization to find solutions were noise impact can be improved with an insignificant effect on power production.

Keywords: turbine acoustics, wake model, wake propagation, wind farm optimization, wind turbine

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[1]Abbreviations used in this paper:
BPM: Brooks, Pope, and Marcolini (referring to the acoustic model)
FLORIS: FLOw Redirection and Induction in Steady-state
NACA: National Advisory Committee for Aeronautics
NSGA: Non-dominated Sorting Genetic Algorithm
SNOPT: Sparse Nonlinear OPTimizer
SPL: sound pressure level