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Noisy Kites? Exploring Noise Annoyance for Airborne Wind Energy Systems with a Laboratory Listening Experiment

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Placing renewable energy infrastructure close to homes can impact people negatively, leading to low acceptance and hindering the expansion of renewables. The experience with wind turbines has shown that especially noise emissions can burden residents and cause annoyance and stress [1]. It is, therefore, critical to understand how people perceive noise emissions from airborne wind energy (AWE) systems and which factors influence annoyance to be able to mitigate noise impacts of AWE systems if needed. Only one field study has investigated residents' experiences of noise impacts for AWE [2]. The study showed that a small but considerable number of residents (7.5%) are highly annoyed by the noise emissions of a nearby AWE system. While the findings suggest that noise could be an important acceptance factor for AWE, they are limited to one AWE prototype and do not elucidate the relationships between acoustic metrics and reported annoyance. To address this knowledge gap, we conducted an experiment in the Psychoacoustic Listening Laboratory at Delft University of Technology. We recruited 75 participants who listened to 11 randomly ordered sound fragments (25 seconds long each) of four different operational AWE systems (i.e., using both soft-wing and rigid-wing kites). In response to each recording, participants rated their perceived annoyance on the standardized ICBEN scales (International Commission on Biological Effects of Noise) [3]. The resulting data was analyzed to investigate to what extent people experience noise annoyance with AWE sounds, how the prevalence of annoyance differs across various AWE systems, and which personal variables (e.g., noise sensitivity, age) and acoustic metrics (e.g., tonality) predict annoyance. The preliminary findings will be presented. Regarding the implications, we recognize that AWE is a rapidly evolving technology and that many unintended side effects, such as noise emissions, will be automatically eliminated with scaling up and design modifications. However, the present results can still direct efforts to mitigate noise emissions. Moreover, they emphasize that ongoing prototype testing already impacts residents, which, if not accounted for, can negatively affect technology acceptance in the long run.

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