Blade Extensions for Silent Turbines

Publieke samenvatting / Public summary

Aanleiding

Noise generation is one of the key constraints in widespread adoption of onshore wind energy. On the one hand, compliance with noise regulations constrain a large number of turbines that often run in low-noise mode, leading to loss of annual energy production (AEP). On the other, reduced social acceptance of wind turbines due to anticipated annoyance from noise pollution, hinders the construction of new wind farms. These issues show the need for innovations that reduce the wind turbine overall sound pressure level (OSPL) and mitigate specific (psycho)acoustic effects such as low-frequency noise or annoyance. Having its roots in the Aeroacoustics Research Group of TU Delft, MuTech is developing its permeable blade trailing edge extension technology MuteSkin . It offers a step improvement in performance over current solutions - trailing edge serrations - with a 6 dB reduction in OSPL compared to a clean blade at scaled lab conditions.

Doelstelling

The aim of the project is to reduce aeroacoustic noise emissions generated by operating wind turbines and noise annoyance experienced by people through the use of blade extensions in order to grow the potential for onshore wind energy generation. More specifically, the main objective is to study, develop, and prepare for industrial implementation, the first commercially attractive application of permeable blade extensions for the reduction of noise in onshore wind. This is further specified in three subobjectives: (1) Bring the permeable blade trailing edge extension technology

Projectinformatie / Project information

Projectnummer / Project number
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Subsidiebedrag / Grant amount
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Algemene informatie / General information

Penvoerder / Secretariat
MuTech B.V.

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MuteSkin from TRL4 to TRL8; (2) Develop industry-usable aeroacoustic knowledge and numerical (simulation) tools that include the use of permeable materials to support future technological and operational developments; and (3) Investigate the benefit of MuteSkin (and permeable blade extensions in general) for (secondary) wind turbine acoustic phenomena such as low-frequency noise and amplitude modulation and their effect on people, and explore other physical mitigation strategies.

Korte omschrijving

The project consists of many innovation activities spanning both lab and field, and being of both numerical and experimental nature: (1) Investigation of aerodynamic and acoustic characteristics of flow mechanics related to wind turbine blades and novel noise-reducing devices through scaled and full-scale wind tunnel testing with different diagnostic methods. (2) Field testing of wind turbine noise with novel noise-reducing devices (next generation serrations vs. permeable extensions) using both industry-standard noise measurements and advanced methods such as acoustic beamforming. (3) Long-term measurements of rotor power, blade loading, and durability for validation purposes. (4) Detailed flow physics investigation of permeable blade extensions with large eddy simulations. (5) Extension of lower-fidelity aerodynamic- and acoustics simulation tools to include the use of permeable materials. (6) Simulations of low-frequency noise generation by inflow turbulence and identification of physical mitigation strategies. (7) Study of psychoacoustics effects of wind turbine noise on people in an anechoic listening room.

Resultaat

This project will result in an accelerated adoption of more silent, and therefore more cost-effective and socially accepted onshore wind turbines. It does so in the short term by having MuteSkin ready for market introduction in 2025, further reducing wind turbine noise with 3 dB compared to the status quo and thereby the AEP of currently noise-constrained

turbines with 6%. It also serves the long-term with a better understanding of how to reduce other noise sources and annoyance for the development of future generations of noise-reducing devices. Concretely, this project delivers: (1) Permeable trailing edge blade extension tested and validated on a 3.6MW commercially operating wind turbine. (2) Extended and improved industry-applicable aerodynamic and aero-acoustic simulation tools that include the use of permeable materials to support technological and operational developments. (3) Physical mitigation strategies for secondary (psycho)acoustic effects such as low-frequency noise, amplitude modulation, and perceived annoyance.

De data in deze applicatie is afkomstig van de Rijksdienst voor Ondernemend Nederland (RVO) en wordt in samenwerking met de Topsector Energie ontsloten.
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