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Wind energy: towards noiseless turbines

Techniques for reducing the noise caused by wind turbines are reviewed in a new study. Noise pollution is one drawback of wind power and restricts where wind farms can be located in relation to people and wildlife. The researchers identify methods that could aid the design of low-noise wind turbines, including modifying the blade's shape and adding rows of brushes to the edge of the blade.

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Wind energy in Europe is a rapidly growing industry; in 2008, nearly 5% of electricity produced in Europe came from wind farms[1]. However, deciding where to place wind turbines is challenged and influenced by the noise pollution caused by blades, generators and other mechanical components of wind turbines. Noise has environmental consequences, as it may disturb birds, bats and other species living close to wind farms, and, although a 2009 paper prepared by health experts for the American and Canadian Wind Energy Associations concluded that wind turbine noise has no proven direct physiological effects on humans[2], it is acknowledged that annoyance and other psychological effects, such as disturbed sleep and stress, are linked to wind turbines. Various EU regulations, including the Birds and Habitats Directives, and the Environmental Impact Assessment Directive, have set rules that should be respected when developing wind energy and establishing wind farms.

The study provides an overview of the different types of noise caused by wind turbines, and potential methods for reducing their levels. Turbines produce both mechanical and aerodynamic noise. Mechanical noise is produced by components such as generators and gearboxes, and the aerodynamic noise, which is more significant, comes from the movement of turbine blades.

Aerodynamic noise can be reduced by changing the pitch angle of blades or how fast they rotate, but these approaches can affect power output. Therefore, approaches to reducing aerodynamic noise without reducing power output are sought after.

One European study analysed by the research, SIlent ROtors by aCoustiC Optimisation (SIROCCO)[3], focused specifically on modifying blades to reduce noise. It found that the sound produced by blades could be reduced by 1-1.5 dB(A) for a 58-metre rotor blade and by 2-3 dB(A) for a 94-metre rotor blade by changing the shape of the blades. However, in the case of the 94-metre blade, it was estimated that power production over a year would fall by 2.8%.

In further experiments, the same researchers added serrations, 'teeth' like shapes, to the 94-metre blades using epoxy resin and fine brushes made from polypropylene fibres to the trailing edge. Both strategies reduced noise by few decibels and up to 10 dB in the case of the brushes. However, at higher frequencies, noise produced by brushes and serrations may actually be greater than that produced by the blades themselves. The researchers therefore suggest retracting them at the frequencies at which they increase noise levels.

The findings of the study may help guide the design of low-noise wind turbines that will have a lower impact on local communities and wildlife. However, other types of disturbance, such as birds colliding with turbines and visual impact, as well as environmental benefits, including reduced fossil fuel use, also need to be considered in the planning of wind energy development and establishment of wind farms.

Source: Jianu, O., Rosen, M. A. & Naterer, G. (2012). Noise Pollution Prevention in Wind Turbines: Status and Recent Advances. *Sustainability*, 4(6), 1104–1117. DOI: 10.3390/su4061104. This study is free to view at: www.mdpi.com/2071-1050/4/6/1104

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1.See: http://ec.europa.eu/environment/nature/natura2000/management/docs/Wind_farms.pdf

2.See: www.awea.org/learnabout/publications/upload/AWEA_and_CanWEA_Sound_White_Paper.pdf

3.See: www.ecn.nl/units/wind/projects/sirocco/

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