WIND TURBINE BLADES: MODIFICATIONS TO REDUCE AERODYNAMIC NOISE

WIND TURBINE NOISE: A NEED FOR REGULATION TO KEEP OUR COUNTRY SAFE

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SOCIOTECHNICAL SYNTHESIS

As the United States plans to implement a significant amount of wind energy systems in the near future, the federal government and engineers must collaborate to protect citizens from turbine noise damage via policy and design solutions. The technical report focuses on implementing turbine blade modifications that reduce the overall decibel output of wind farms without drastically impeding on the system's overall electricity generation. Advocation for a federal policy enforcing a firm, quantitative limit on turbine noise exposure at property lines motivates the STS research paper. Evidence displaying the short- and long-term health consequences associated with turbine noise exposure combined with examples of current policy that adequately protect citizens forms the aforementioned argument. The technical report and research paper work in parallel to contrive solutions through both engineering and legislation that limit the generation and exposure of amplitude modulation for U.S. citizens.

The examination of turbine blade modifications that, if implemented, reduce overall noise production results in less stress/loss of sleep for citizens, effectively reducing the health consequences associated with turbine noise consumption. The group examined three different adapted blade designs that generate vortices and soften the trailing edge flow to reduce the overall decibel output of the energy system. Four turbines were constructed, one using a traditional design and three using the group's selected designs, and tested behind a wind tunnel to see how the systems performed in a simulated operational environment.

Results from the experiment remained consistent to the hypothesis, with the standard base blade producing the most noise, followed by the folded tip blade, serrated blade, and lastly the protruding node blade. The blade modifications not only limited total decibel production, but made the system more efficient as well, with the base blade turbine producing the least amount

of electricity. The efficiency results in particular come with significant implications, as energy companies may be more likely to implement blade modifications as they primarily design turbines for maximum power generation. The tested modifications serve as a win-win to both regular citizens and turbine manufacturers, since they pave the way for a safer and more efficient future in the realm of wind turbines.

Describing the necessity of a federal noise mandate curbing the total amplitude modulation exposure at property lines using a Social Construction of Technology framework served as the primary research task of the STS report. Using recommendations from acoustical consulting firms and current governing research backed policy, the thesis calls for a national ordinance limiting turbine noise at property line to 35 dBA during the day and no more than 5 dBA above the ambient background noise during nighttime hours. In conjunction with using statistical evidence to implement a numerical maximum exposure limit, the paper argues the significance of the policy by examining adverse health consequences associated with over exposure to turbine noise.

Survey and medical data found that populations living in close proximity to wind farms experience a significantly lower quality of life and possess a much higher risk of experiencing myocardial infarction due to stress and sleep loss, illustrating the importance of proper noise regulation. Examination of lackluster and ineffective noise ordinances in the United States shows that states/localities cannot be trusted to protect citizens from the aforementioned dangers. The federal government must step in and look to implement professional recommendations that contain scientific basis before turbines cause a decrease in our citizens' wellbeing and overall levels of health.

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