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Increasing the efficiency of wind turbines electric generation capactiy with an airfoil spinner

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Given the current rate of climate change, renewable energy is vital to the future of our planet. Wind energy is one of the most promising sources of renewables, but currently falls short in efficiency of electrical output when compared to the Betz limit. I have focused on designing different shapes of hubs, or airfoil spinners, to maximize electrical output for small scale wind turbines, through directing the wind more smoothly across the turbine's nacelle, so the blades have more available wind, and thus more possible kinetic energy. To obtain the most optimal designs, an online modelling software was used to analyze the effect of different shaped spinners on output and wind flow. These were then analyzed based on the Tollmien-Schlichting waves and minimizing the drag coefficient. The Reynolds number was used to calculate the type of wind flow. The best performing spinner shapes were picked for testing, and mounted on a one meter, five bladed turbine. Based on this, the voltage, amperage and wattage were calculated. The first spinner design improved the average output by 6%; the second improved on average by 11%, when compared to the average outputs of the control group with the standard nacelle. Based on this, the Tip Speed Ratio (TSR), Rotations Per Minute (RPMs), power in the wind, and Coefficient of Performance (Cp) were calculated to analyze all aspects of their performance. These findings illustrate the significant effect spinners will have on efficiency for small scale turbines, a rapidly growing wind energy sector.

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