

Wind Energy Efficiency Mechanism

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The world today revolves around energy, whether it is the engine of a car powered by fossil fuels or a medical facility whose nuclear reactor energy saves lives. As humanity becomes more dependent on energy in all forms, the necessity for more efficient, clean energy production becomes apparent. Renewable energy such as that from wind turbines becomes a new focus. This clean, unlimited energy is not constant, with varying conditions resulting in output efficiencies as low as 10-20%. Higher wind speeds may theoretically produce more power, but realistically the turbine itself will shut down completely if the wind speed exceeds a certain point. In other situations, lower wind speeds may not create enough force to move the turbine at all. If the windmill can adapt to the changing wind, it can maintain a much higher efficiency by reducing or increasing the amount of drag on the blades as winds pick up or slow down. This will allow the turbine to operate at a larger number of wind speeds, thus enabling it to operate more efficiently under varying conditions. The ultimate goal of this project was to design a mechanism with which a windmill can adapt to its environment and increase its efficiency by changing the pitch angle dependent on wind speed. Using a scale model windmill, varying wind speeds, and several different blade configurations, it was determined that a 3-blade was the most efficient. The results show that varying conditions provide varying efficiencies. They also prove that efficiencies in wind energy can be increased developing mechanisms for adaptation, which was the ultimate goal of this research. The windmill blades were built to uniformly rotate on an separate axis, decreasing the blade angle as the wind speed increases and return to their maximum blade angle when wind speed decreases, to maintain enough adapt to higher wind conditions, allowing a turbine to continue operating in high winds.