CALIFORNIA SCIENCE & ENGINEERING FAIR
2018 PROJECT SUMMARY

Name(s)

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Project Number

J0219

Project Title

Stack-A-Wind: Developing Small Vertical Axis Wind Turbines (VAWT) for Various Wind Speeds

Abstract

Objectives/Goals

The goal is to develop a vertical-axis wind turbine that will work for regions below 30m or the turbulent area in suburbs/residential areas.

Methods/Materials

The design criteria and constraints were based on Mr. Nader Shareghi, Director of Public Work Department at Mountain House Community Services District, and US Department of Energy "Small Wind Guidebook for Small HAWT." Development of VAWT was completed in 4 stages that includes different aspect ratios of height and width, different numbers of blades, different blade profile designs and stackable positions. The best VAWT from each stage became the control for the next stage. Prototypes for each stage were built from thin aluminum foil sheets with wood dowels/skewers, then attached to a hub and DC motor. Box fan with 3 different wind speeds, measured with an anemometer, was set up 12in. away from VAWT. The outcome of all stages was power generated, measured using a multimeter and how the VAWT responded in various wind speeds (stalling or not).

Results

The data showed as the VAWT evolved from stage 1-4, the power generated improved significantly and there was less stalling. The average power increases as the wind speed increases. The blade surface area increases as the aspect ratio increases. However, higher aspect ratio doesn't increase the average power generated. The average power produced on all wind speeds increases with the number of blades, at a slower rate. Additional surface area in blade profile may add more weight that affects the power generated because it requires higher wind force to push the blade.

Conclusions/Discussion

Stackable VAWT improved the power generated by creating differences of high forces on concave side & low forces on convex side of the blade. In VAWT, aerodynamic shapes (curved) for blade designs didn't help in generating more power. The aspect ratio of height and width and number of blades affect more than the surface area and/or blade design profile in generating more power. Weight of the blade is also important because it affects the power generated negatively. The Stack-a-Wind design saves space and produces more power in the same footprint. This may be a viable alternative for suburbs or residential areas because it works in curved winds below 30m. A proposed solution for stackable VAWT installed either in a backyard of a residence or in a common area. Safety parameters must be established.

Summary Statement

Developing small vertical-axis wind turbines that can harness a clean, renewable wind energy in region below 30m or turbulent area (various wind speeds).

Help Received

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