Team 15: Portable Wind Turbine

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Abstract

Currently, there are no highly portable wind turbines available in the consumer market. A portable wind turbine could be used to provide sustainable energy in situations such as disaster relief, research and military applications. Team 15 has been tasked with designing a portable wind turbine, focusing on reducing the number of parts and maximizing the portability and ease of assembly and disassembly of the design.

Background

This project is sponsored by Dr. Sungmoon Jung at the FAMU-FSU College of Engineering, who is also the team's primary advisor. Dr. Jung desires that the team focus on portability over efficiency of power output. He has also tasked Team 15 with determining where the required winds can be found.

Using the Log Wind Profile Ratio, Team 15 determined that wind speeds of at least 7.5 m/s at a height of 80m are required in order to receive the desired wind speed of 4 m/s at the height of 2m.

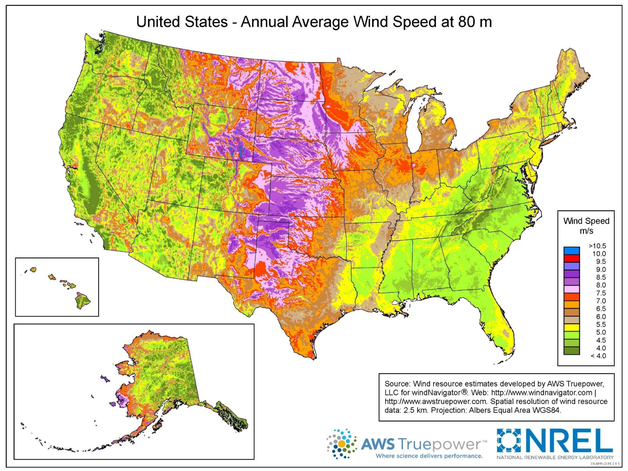

Figure 1. Average wind speeds at 80m in the United States

Objectives and Constraints

- Design a wind turbine that can be easily assembled/disassembled and transported by vehicle (~80lbs)
- Analyze and select off-the-shelf blades and generator
- Complete turbine design must stand approximately 2m high
- Produce enough power to charge small device with 4 m/s wind speeds
- Build and test prototype using $2,000 budget

Nacelle Mounting System Design

- Bolts to nacelle and mates to shaft in base
- Common steering wheel quick release system
- Low number of total parts required
- Easy operation for assembly and tear down
- Inexpensive parts required
- Bearings allow free rotation for changing winds

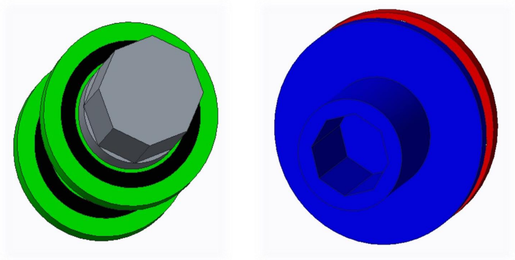

Figure 2. Conceptual views of the quick release and mating shaft

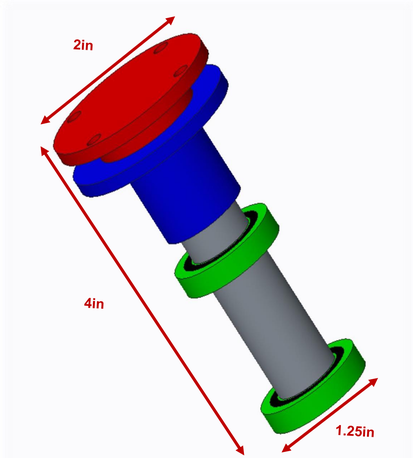

Figure 3. Quick release concept assembly

Turbine Blade Selection

Figure 4. UV-stabilized polycarbonate blades by Windy Nation (approx. 6lbs)

- No increase in power coefficient above 3 blades
- Greater portability than 5 blades
- Polycarbonate more durable than aluminum
- Tip Speed Ratio (TSR) of 4.8: Expect ~250rpm
- Developing mounting system to increase portability

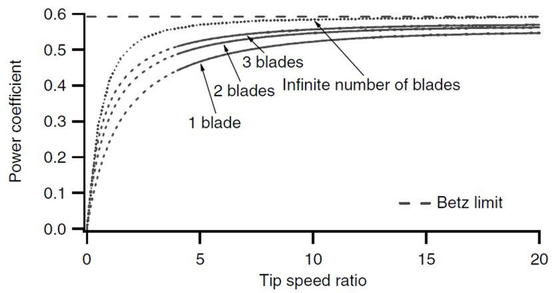

Figure 5. A graph of Power Coefficient (efficiency) of a wind turbine versus Tip Speed Ratio for given blade numbers. The Betz limit is the theoretical maximum efficiency of a wind turbine.

Turbine Body and Base Design

- Desire quick set up and tear down
- Telescoping legs and body for increased portability
- Maximize neck length and minimize leg length to reduce parts
- Pin with retainer for telescoping parts

Figure 6. Pin with retainer

Figure 7. Long neck concept

Electrical Component Selection

- Plan to use DC permanent magnet generator
- Require power output at low RPM in order to avoid adding gear box
- Diode and voltage controller to control flow and prevent over charging

Spring 2016 Plans

- Complete design
- Finalize analysis
- Finalize component selection
- Order components and construct prototype
- Develop testing plan and parameters
- Test and troubleshoot prototype portable wind turbine

Wind Turbine Anatomy

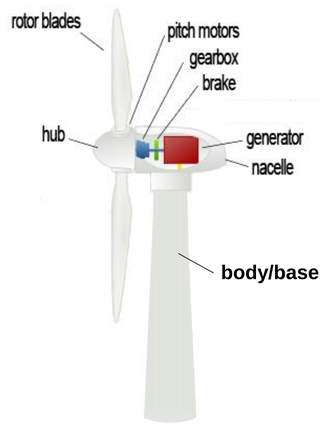

Figure 8. The parts of a wind turbine

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