



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.

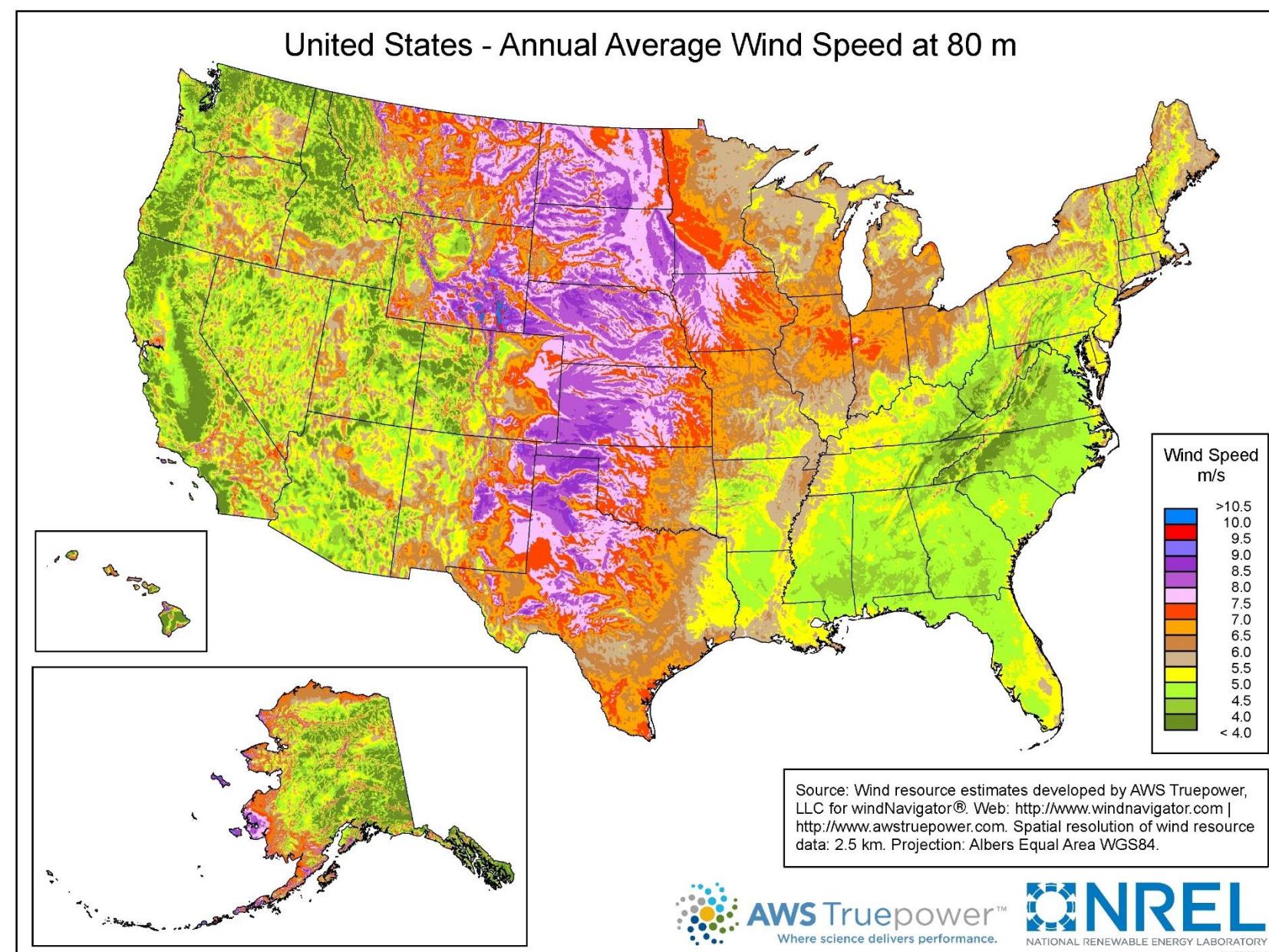


Figure 1. Average wind speeds at 80m in the United States

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

Portable Wind Turbine Design

- Desire quick set up and tear down
- Quick Release system adapted for quick removal of nacelle (turbine head)
- Maximize neck length and minimize leg length to reduce parts
- Clamps allow telescoping leg adjustment
- Wing nuts for blade attachment eliminate tools

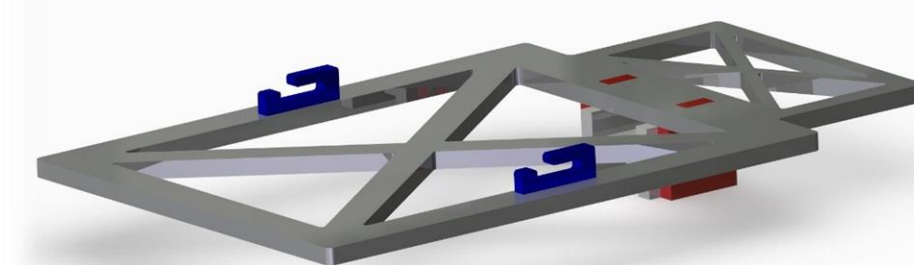


Figure 3. Internal sliding tray for electronics



Figure 4. Clamps for legs



Figure 5. All Terrain Feet

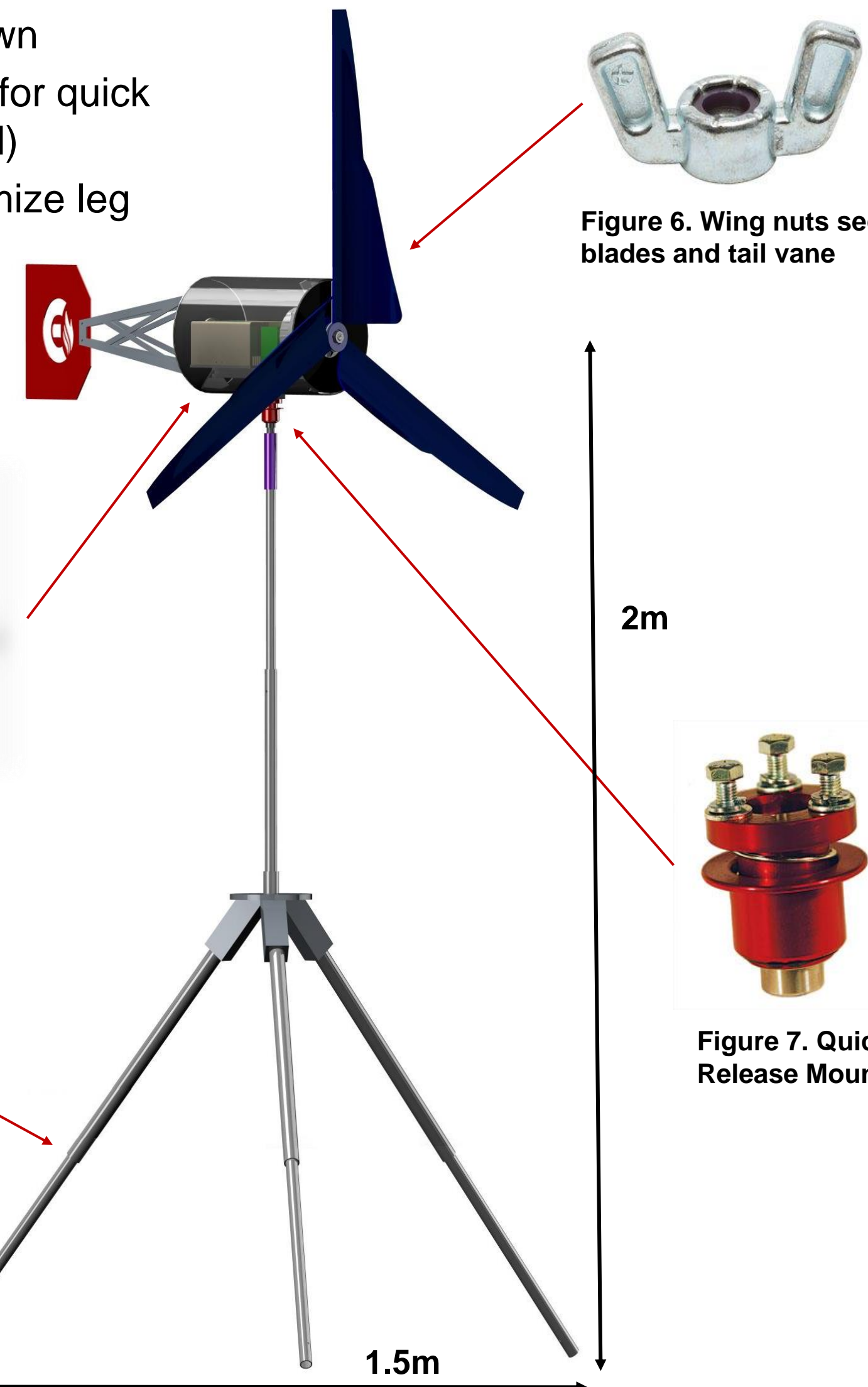


Figure 2. Portable Wind Turbine



Figure 6. Wing nuts secure blades and tail vane



Figure 7. Quick Release Mount

Turbine Base Design

Overtuning Wind Speed Goal: 10m/s (22.4mph)	9.26m/s (20.8mph)	
Max. Slope Adjustment Goal: 15°	17°	
Max. 'Bump' Displacement Goal: 8in	15in	
Maximum Stress	4 m/s Wind Speed	10 m/s Wind Speed
In Legs	6.98 ksi	16.92 ksi
In Neck	1.29 ksi	7.88 ksi

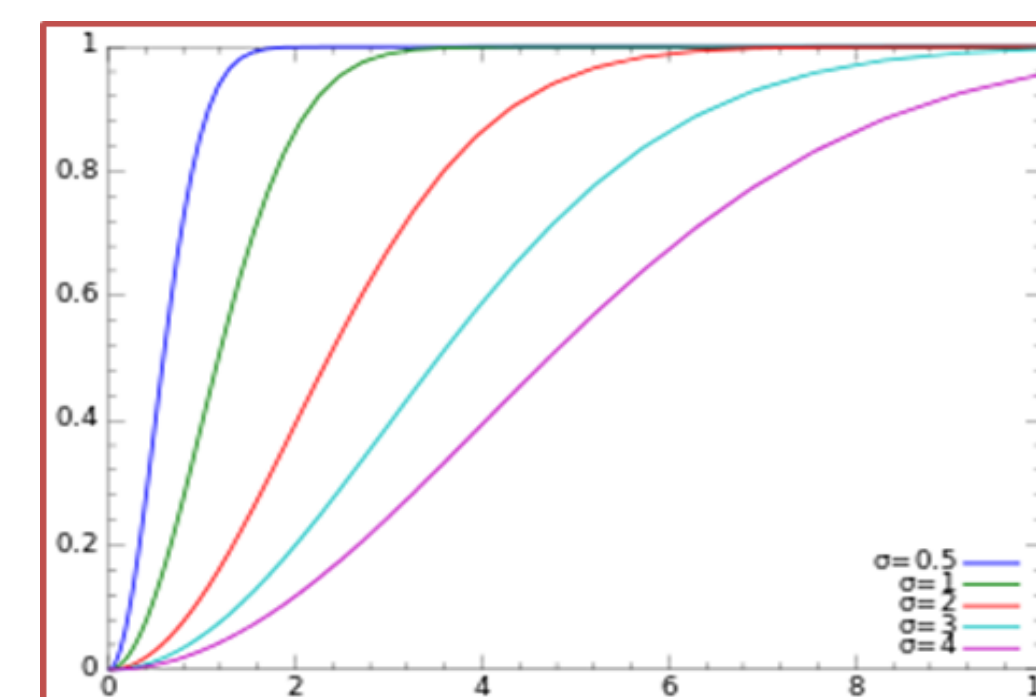


Figure 8. Rayleigh Distribution

Turbine Blade Selection

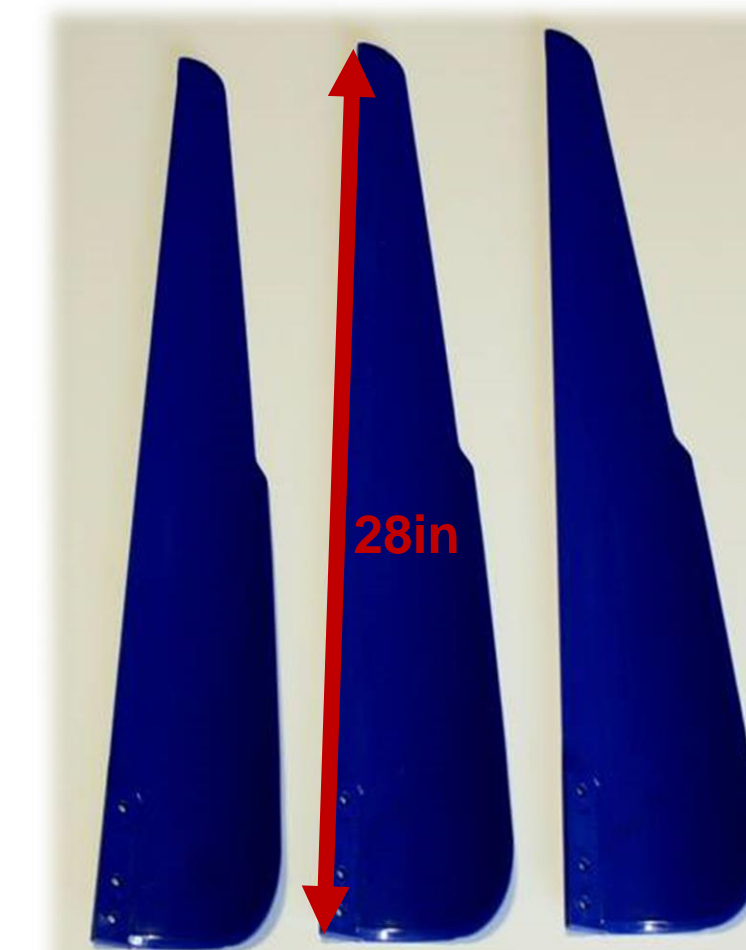


Figure 9. UV-stabilized polycarbonate blades by Windy Nation (approx. 6lbs)

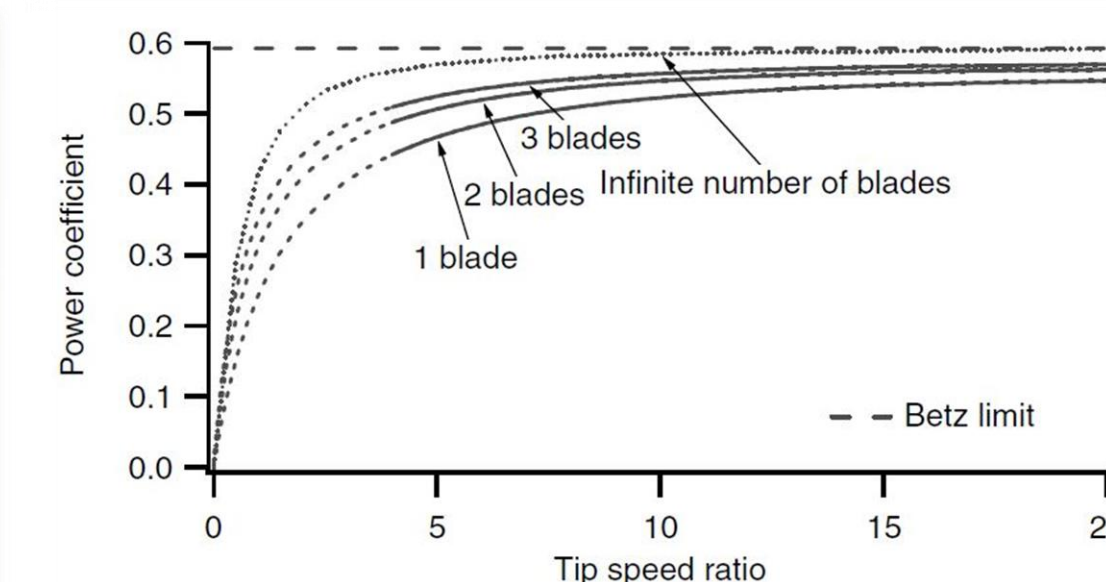


Figure 10. Graph of Power Coefficient (efficiency) of a wind turbine versus Tip Speed Ratio for given blade numbers.

- Minimal increase in power coefficient above 3 blades
- Tip Speed Ratio of 4.8 leads to expectation of ~250rpm

Electrical Component Selection

- Wind Blue Power DC-540 Alternator (DC or AC output)
- Windy Nation TrakMax Charge Controller
- Battery Tender 12V Lithium Iron Phosphate battery

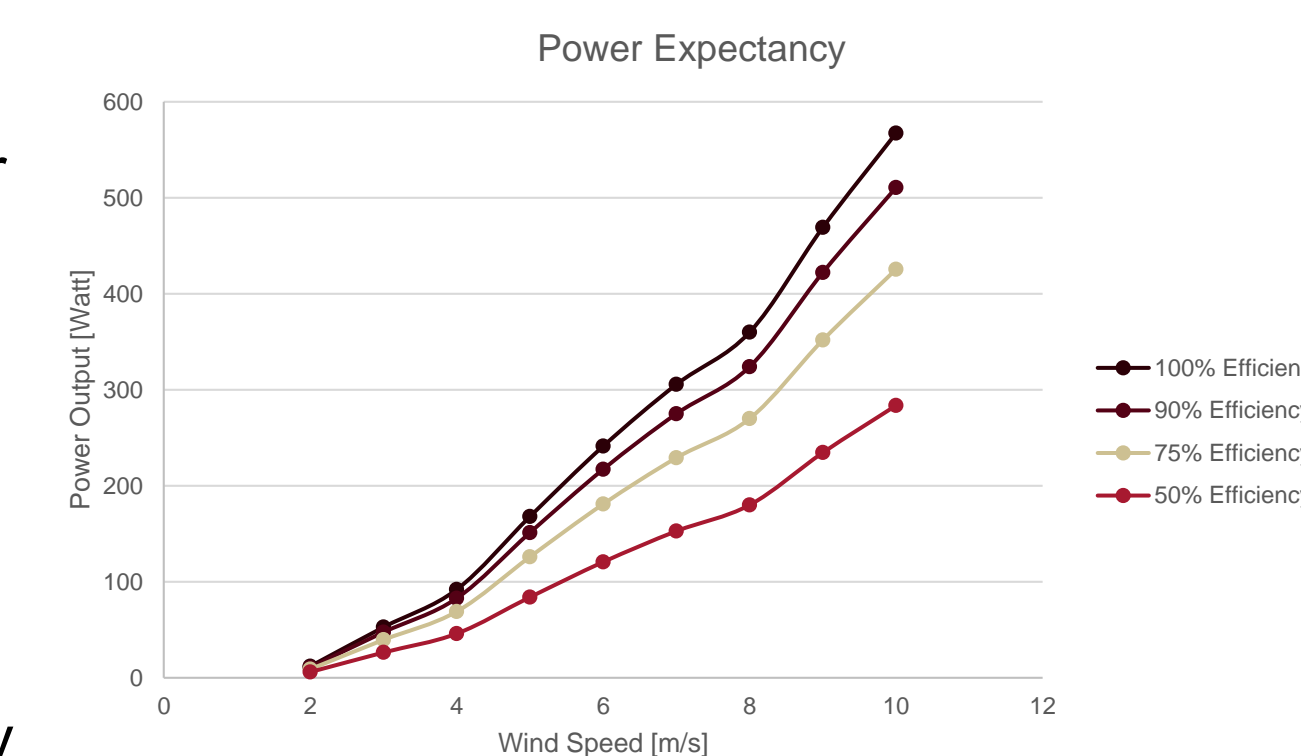


Figure 11. Power expected from the Portable Wind Turbine

Protective Traveling Casing

- Custom fit foam inserts for turbine
- Hard, durable outer plastic
- Water/dust/shock proof
- Multiple handles for easy lifting
- Wheels for easy transportation



Figure 12. Locking case with foam padding