PURDUE UNIVERSITY

CAPSTONE/DESIGN EXPERIENCE 2016

Haitian Renewable Energy

Agricultural & Biological ENGINEERING

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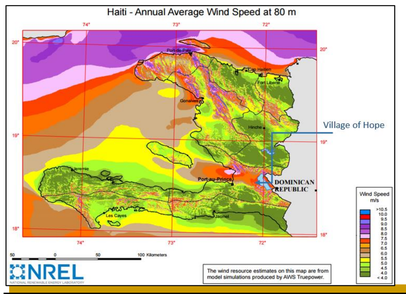
Background & Problem Statement

The Village of Hope is an organization that has provided health care and education facilities for a small compound in Haiti. The compound is currently required to transport fuel over rough terrain to run a diesel generator to provide electrical power for their school, health center, and water pump.

Using assessments by the National Renewable Energy Laboratory, an average 7.5 m/s wind speed was determined for the general area which indicates the potential for wind power. The Village of Hope needs a means of assessing their wind power potential to make a complete decision for their renewable energy system.



Project Goals

1. Select a turbine design that will best suit the needs of the Village of Hope.
2. Design a prototype that can be assembled with locally sourced parts so it can be constructed at the compound for further system expansion.
3. Build a prototype that can be used to educate the people of Haiti as they determine the economic and technical feasibility of on-site wind energy.

Economic, Sustainability, & Societal Impacts

The Village of Hope will be positively impacted by implementing this project. Upon completion they will have a means to learn about wind power and apply this knowledge in growing wind power operations. The negative environmental impacts of the current non-renewable energy source will be reduced as the compound is aided in growing their renewable energy portfolio.

The total material cost of creating the single prototype created by the team is $476. If this design was to be taken into mass production we would see a decrease to approximately $195 per turbine. The scope of the project was for continued production on-site as needed. Economic growth can be observed for the compound if this project further develops in the form of reduction in fuel costs as well as potential job growth since many workers on the compound have welding expertise.

Future Work

Future steps that should be taken include data collection from the constructed turbine. Carrying out the project at the Village of Hope would also require teaching those at the compound about the turbine and its functions.

Alternative Solutions

Evaluation Criteria

- Overall cost
- Foreseen security issues
- Minimum wind speed
- Efficiency
- Installation requirements


Darrieus


Savonius


Standard 3 Blade


Aerocam


Eddy GT


Windspire

Design Evaluation

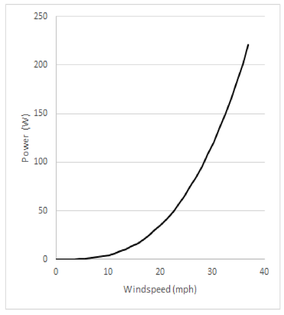
Savonius Rotor

Drag Turbine
- Operates at any wind direction, no need for manual adjustment

Simple Design
- Low cost
- Ease of manufacturing with locally sourced material

Low Profile
- Less attraction to compound
- Reduced theft potential

Expected Power



A small turbine (2'X4') would expect an average 30W power production in 7.5m/s winds.

$$P = \frac{1}{2}\rho A V^3 E K$$

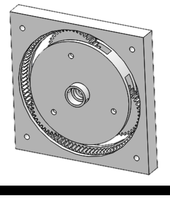
In order to fulfill the needs of the compound the size of turbine or multiset system would be required.

Final Prototype

Aluminum

The material was chosen for optimal turbine weight (3.5 lb) but easily assessed material could be implemented, e.g. PVC pipes (33.4 lb)

V-Belt System
- 1:6 ratio provides an average 1200 rpm input
- Gearbox was initially evaluated but was deemed too expensive



12 V DC Generator
- Permanent magnet
- 50-2200 rpm
- 300 W maximum

Height: 4 ft
Overall diameter: 2 ft
Center shaft diameter: 1.5 in.
Average shaft torque: 16.9 lb-ft

Sponsor:
Village of Hope

Technical Advisor:
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Instructors:
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Dr. Bob Stwalley

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