HARNESSING WIND ENERGY FROM RECYCLED MATERIALS

Presentation 4

Final Design Review and Project Proposal

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Contents

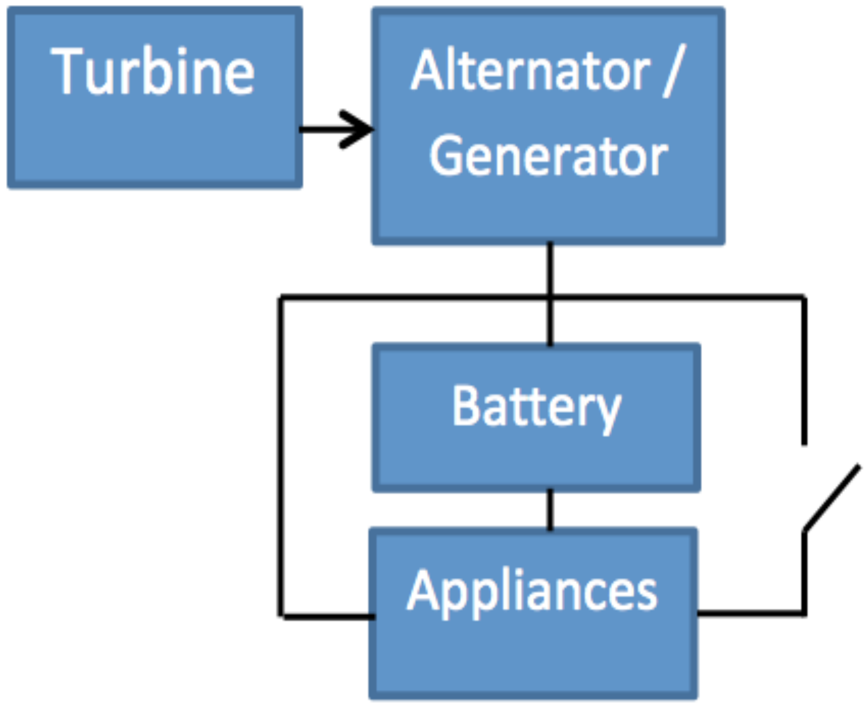
Project Overview

- **Customer Need:**
  - Inhabitants of third world countries have limited access to electricity.
- **Goal:**
  - Design an inexpensive, portable wind turbine system to harness and store wind energy.
- **Requirements/Constraints:**
  - Provide at least 0.5 kWh / day
  - Total cost does not exceed $50
  - Weight does not exceed 45 kg

Criteria

Objective	Quantified Objective	Criteria
Inexpensive	Maximum Cost of $50.00	• Cost
Recyclable	Available from local junkyards/stores	• Recyclability • Material availability
Energy Storage	0.5 kWh per day	• Electrical storage capability
Easily assembled, disassembled, moved		• Physical construction • Materials • Set-up
Able to withstand high wind speeds		• Materials • Design strength

System Components/ Circuit Diagram



Component Overview & Specifications: Battery

- **Overview:**
  - Captures/stores power when appliances are not running.
  - Car/motorcycle battery
    - Easily scrapped for little cost
    - Stores enough energy for project requirements

- **Specifications:**
  - Car battery: 12 V, 80 Ah, 1 kWh
  - Motorcycle battery: 12 V, 6 Ah, 72 Wh

Component Overview & Specifications: Alternator/Generator

Bicycle Dynamo (Bike Light Generator)

- Can produce up to 60 W
- Cost upwards of $200, but older models are less expensive
- Specifications vary widely

Motorcycle Stator

- Lower RPMs required to produce power
- Higher cost than bicycle dynamo, although may be salvaged from old/wrecked motorcycles
- 12 V, 750 RPM, 60-90 Watts

Engineering Analysis

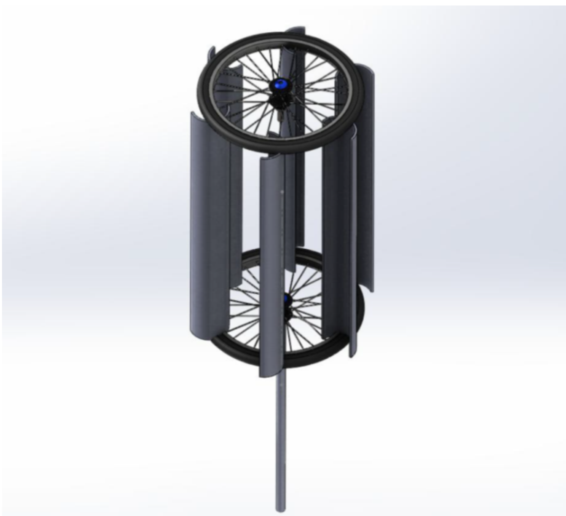
- Power from a wind turbine:
  - $P = \frac{1}{2} C_p \rho A V^3 \longrightarrow A = \frac{2P}{C_p \rho V^3}$
- Assumptions/ Givens:

Symbol	Variable	Quantity
A	Swept area of turbine blades	m^2
C_p	Coefficient of performance	0.4 (horizontal) 0.22 (vertical)
ρ	Density of air	$1.2 \ \frac{kg}{m^3}$
V	Average wind speed	$5 \ \frac{m}{s}$
P	Power produced (CFL + Fan)	55 Watts* (for 5 hours each day)

*Replaced 60W incandescent bulb with 15W CFL bulb

Analysis Results

- Vertical vs. Horizontal Turbines



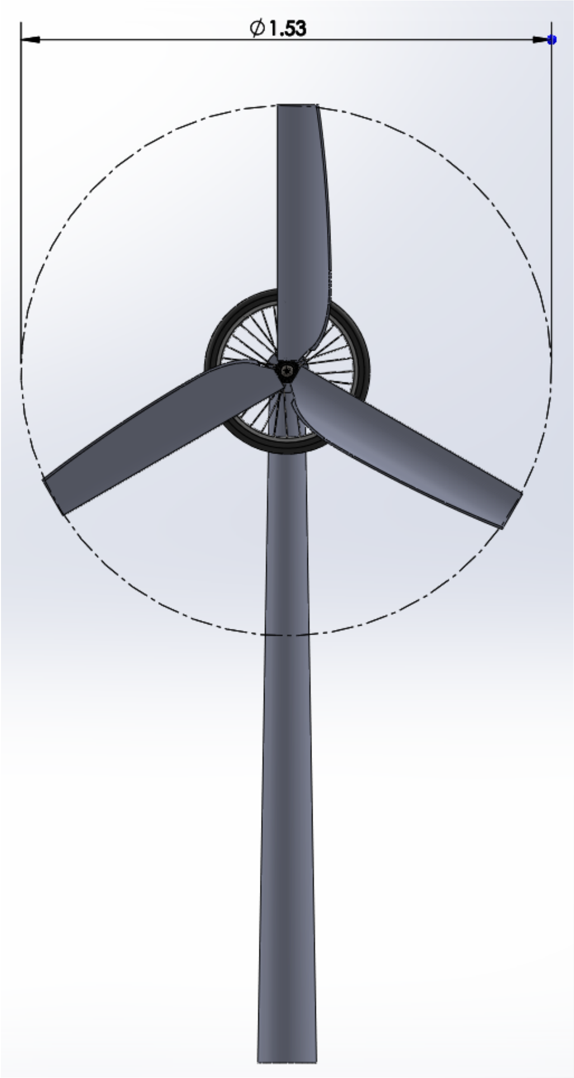
Swept Area Required: 3.33 m^2
(Cp = 0.22, P = 55W)

Swept Area Required: 1.83 m^2
(Cp = 0.4, P = 55W)

Final Design

- Swept area required to produce 55 Watts: 1.833 m^2

- Minimum diameter required : 1.53 m

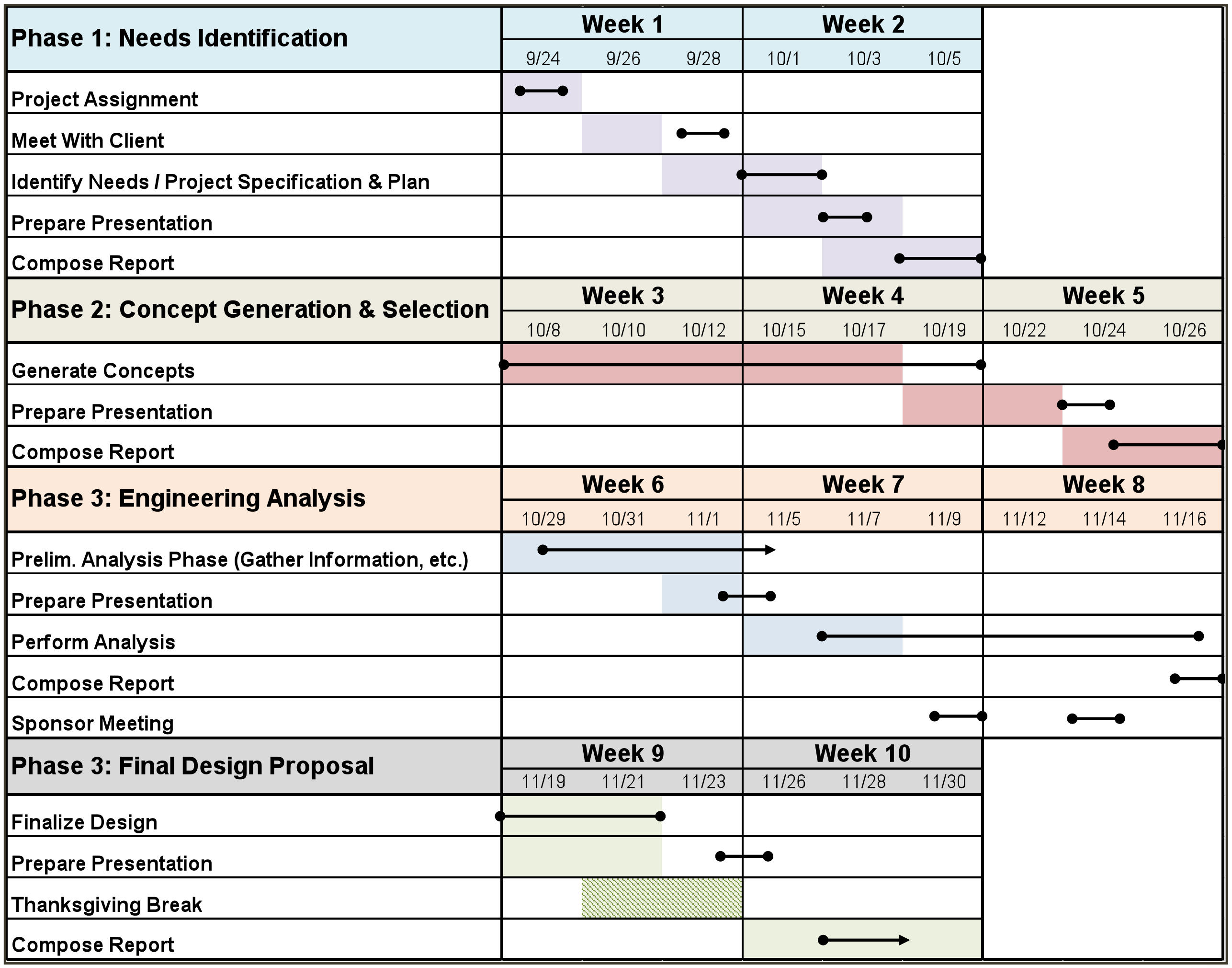


Bill of Materials

Material	Cost
Battery (recycled)	$20.00
Generator/Alternator (recycled – new)	$20.00 - $200.00
Bicycle rim	Scrapped
PVC or Fabric	$10.00
Wood for frame	Scrapped
Shaft	Scrapped
Screws, fastenings, etc.	$5.00

TOTAL COST: $55.00 - $235

Current Project Timeline



Summary

- Project Overview
- System Components and Specifications
- Engineering Analysis Approach & Results
- Final Design

Questions?

- References:
  - Professor Srinivas Kosaraju – Northern Arizona University
  - Professor David Willy – Northern Arizona University
  - J. Twidell and T. Weir – *Renewable Energy Resources*, 2nd Ed., 2006.
  - http://greenterrafirma.com/index.htm