

HARNESSING WIND ENERGY FROM RECYCLED MATERIALS

Presentation 4

Final Design Review and Project Proposal

Team 3

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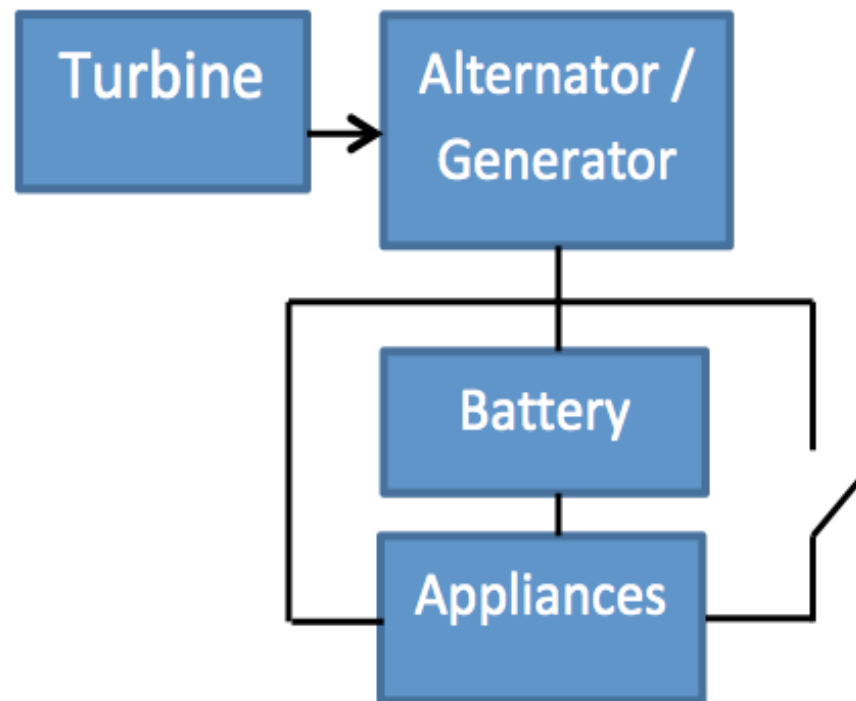
Project Overview

- **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	<ul style="list-style-type: none">• Cost
Recyclable	Available from local junkyards/stores	<ul style="list-style-type: none">• Recyclability• Material availability
Energy Storage	0.5 kWh per day	<ul style="list-style-type: none">• Electrical storage capability
Easily assembled, disassembled, moved		<ul style="list-style-type: none">• Physical construction• Materials• Set-up
Able to withstand high wind speeds		<ul style="list-style-type: none">• 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:

- $P = \frac{1}{2} C_p \rho A V^3 \longrightarrow A = \frac{2P}{C_p \rho V^3}$

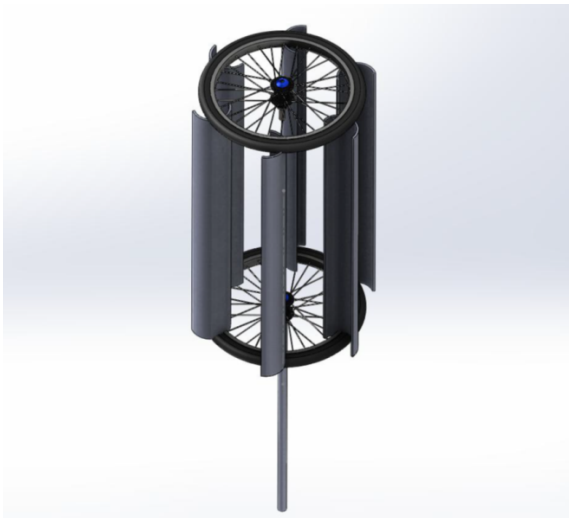
- Assumptions/ Givens:

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



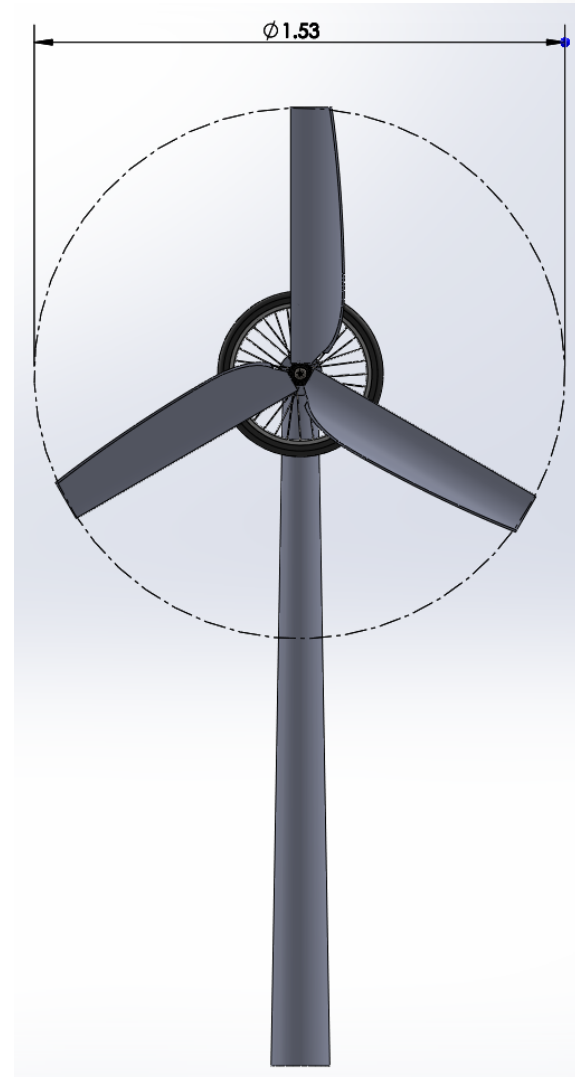
Swept Area Required: 3.33 m^2
($C_p = 0.22$, $P = 55\text{W}$)



Swept Area Required: 1.83 m^2
($C_p = 0.4$, $P = 55\text{W}$)

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

Phase 1: Needs Identification	Week 1			Week 2					
	9/24	9/26	9/28	10/1	10/3	10/5			
Project Assignment	●	●							
Meet With Client			●	●					
Identify Needs / Project Specification & Plan				●	●				
Prepare Presentation				●	●				
Compose Report					●	●			
Phase 2: Concept Generation & Selection	Week 3			Week 4			Week 5		
	10/8	10/10	10/12	10/15	10/17	10/19	10/22	10/24	10/26
Generate Concepts	●	●	●	●	●	●			
Prepare Presentation							●	●	
Compose Report								●	●
Phase 3: Engineering Analysis	Week 6			Week 7			Week 8		
	10/29	10/31	11/1	11/5	11/7	11/9	11/12	11/14	11/16
Prelim. Analysis Phase (Gather Information, etc.)	●	●	●	●					
Prepare Presentation			●	●					
Perform Analysis				●	●	●	●	●	●
Compose Report								●	●
Sponsor Meeting						●	●	●	
Phase 3: Final Design Proposal	Week 9			Week 10					
	11/19	11/21	11/23	11/26	11/28	11/30			
Finalize Design	●	●	●						
Prepare Presentation			●	●					
Thanksgiving Break									
Compose Report				●	●	●			

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>