

HARNESSING WIND ENERGY FROM RECYCLED MATERIALS

Presentation 3: Engineering Analysis

Design Team 3:

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CONTENTS

- Brief overview of project
- Final design concepts
- Design components
- Component Analysis
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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 .5 kWh / day
 - Total cost does not exceed \$50
 - Weight does not exceed 45 kg

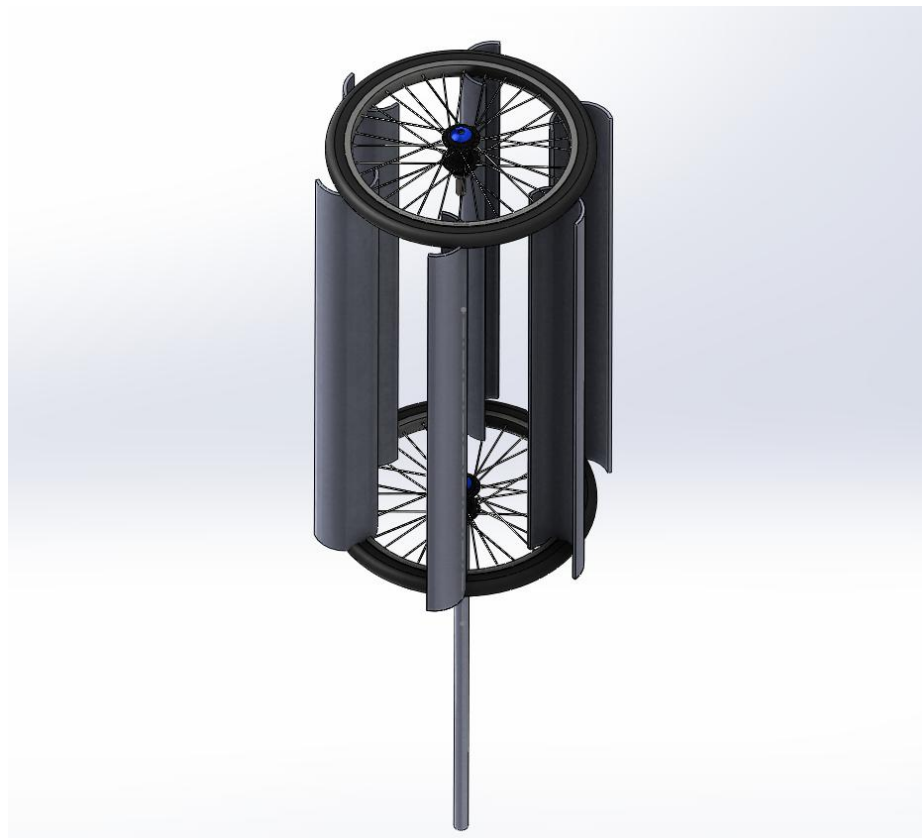
FINAL DESIGN CONCEPT 1

- 55 Gallon Drum



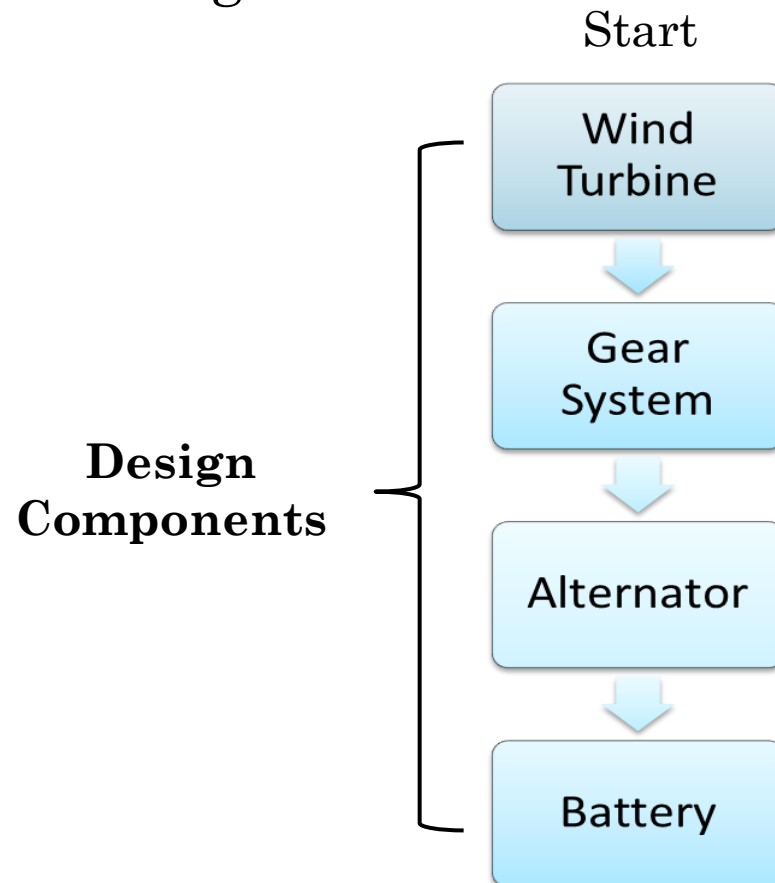
FINAL DESIGN CONCEPT 2

- Bike Wheel Darrieus Turbine



DESIGN COMPONENTS & ENERGY FLOW DIAGRAM

- Energy Flow Diagram:



COMPONENT ANALYSIS

○ Wind Turbine

- Mechanics of Materials
 - Weight, Strength
- Fluid Mechanics
 - Air Density, Wind Speed, Swept Area, Power Output

○ Gear System

- Machine Design
 - Gear Ratio, Strength, RPMS

○ Battery & Alternator

- Electricity & Magnetism
 - Power Output, Component Interfacing

COMPONENT ANALYSIS: ASSUMPTIONS

- Air density
 - Dependent upon atmospheric pressure and temperature
- Average wind speed
 - Dependent upon region
 - Taken from meteorological data
- Material strength
 - Tabulated strengths for available materials

COMPONENT ANALYSIS: EQUATIONS

- Power generated by wind turbine

$$P = \frac{1}{2} C_p \rho v^3 A$$

- Power output from battery

$$P = VI$$

- Gear ratio

$$n_1 = \left| \frac{N_2}{N_1} n_2 \right|$$

- RPM of wind turbine

GENERAL COMPONENT SPECIFICATIONS

- Car battery:

- 12 V
- 40 A
- 1 kWh

- Alternator:

- Produces 13.5 – 14.4 V at 2000 rpm

CURRENT 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					
	10/29	10/31	11/1	11/5	11/7	11/9			
Prelim. Analysis Phase (Gather Information, etc.)	●—→								
Prepare Presentation			●—●						
Perform Analysis				■					
Compose Report					■				

CONCLUSIONS

- Designs:
 - 55 Gallon Oil Drum
 - Bike Wheel Darrieus Turbine
- Components:
 - Wind turbine
 - Gear system
 - Alternator
 - Battery
- Analysis
 - Fluid mechanics
 - Machine design
 - Electricity & magnetism

QUESTIONS?