Objective

**Product**: A portable and versatile vertical-axis wind turbine used to power small electronic devices

**Goal**: Scale-down wind technology from industrial to individual applications

Target Market: 19,600 consumers in the MD-DC area

Region data:
- Average wind speed 3mph
- 10% population purchases ‘green’ tech devices

Concept Generation

**Customer Requirements**
- Can be lifted with one hand
- Able to take down and set up
- Now complex to setup or take down
- Generates energy consistently
- Rigid in wind
- Electronic compatibility

**Engineering Characteristics**
- Weight
- Moment of inertia
- Product volume
- Minimum wind speed to power
- Time to assemble
- Battery capacity
- Time until first use
- Material rigidity

**Constraints**
- Min wind speed
- Cost
- Weight

Curve-Blade
- Captures greatest wind potential
- Difficult to manufacture twist
- 51.8%

Straight-Blade
- Simple shape, multiple material choices
- Less momentum generated
- 23.2%

SemiSphere Blade
- Smaller volume, lower weight
- Higher moment of inertia required
- 24.9%

**Prototype and Testing**

**Operation**:
- Low wind speeds cause Savonius blade to rotate
- Product shaft coupled with motor to generate power
- Internal battery powers electronic devices - USB 2.0

**Proof of concept: Low wind speed rotates blades**

**Modeling to vary height and width of blades**

**Final prototype integrated with electronics to verify charge**

**Setup Procedure**:
1. Slide the blade spines down the product shaft
2. Insert catch-pin into bottom spine
3. Extend top spine and insert other pin

**Key Innovation**
- Savonius blades rotate in small wind speeds to make low power

**Sacrifices Made**
- Long charge times
- Large compacted size

**Test Results and Future Work**

**Product Design Process Summary**
1. Identified opportunity for innovation in wind technology
2. Surveyed potential customers to develop CR’s and EC’s
3. Generated concepts and conducted HOQ and AHP to select design
4. Initial prototype to demonstrate proof of concept
5. Final prototype

**Future Work**
- Better gear ratio for improved efficiency
- Develop tracks for removable battery
- Customer feedback
- Lifecycle testing
- Charge indicators on base

**Reflections**
- Largely untapped market for wind energy ideal for product
- Prototyping led to substantial design changes
- Lower power & efficiency than expected

ENME472 - Integrated Product and Process Design and Development

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Mechanical Engineering Design Day
May 7, 2013

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