Virtual Design Review 2

Kite Generator

Team 16

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Team Introduction

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Lead ECE

Libni Mariona
Lead CAD

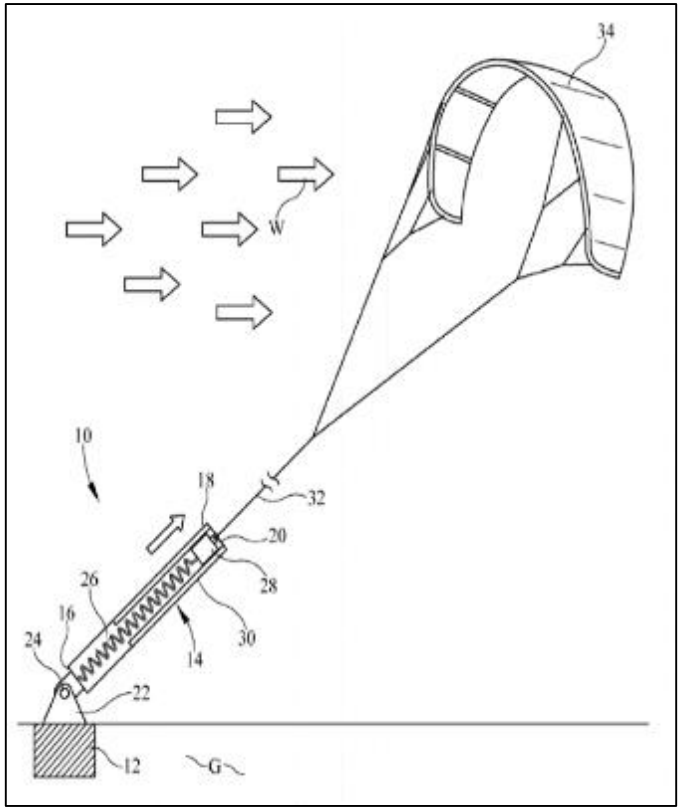
Simone Nazareth
Lead ME

Presenter: Libni Mariona

Project Recap

- Project Summary
  - Provide power to off-grid locations.
  - Harness wind energy with portable system.
  - Ensure ability to perform in varying wind conditions.

- Utilize Jeff Phipps' Patent
  - Convert mechanical energy to usable energy.
  - Oscillating magnet inducing electro-motive force (emf).



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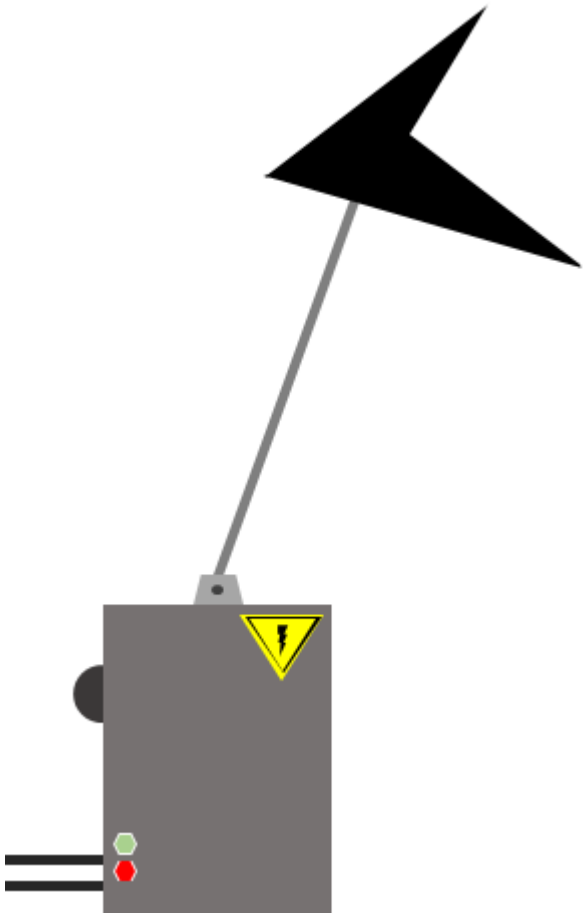
Project Recap

- Project Scope
  - Market for disaster relief and developing countries.
  - Catalog engineer an airfoil.
  - Airfoil sustains flight pattern.
  - Use off the shelf parts and available technology.
  - Ensure safe operation.

- Customer Needs
  - Airfoil takes off and lands on command.
  - Tether load is dispersed evenly along the wing.
  - Generate ≥ 5 kW of power.



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Targets

- Essential design parameters
  - What contributes to power output?
  - Which parameter has the greatest effect?
- Benchmarking
  - Makani
  - Wind turbines
  - Sustainable power generation
- Physical models
  - Background research
  - Moving magnet inside inductor
    - EMF - *V* [Volts]
    - Power - U_b [Watts]
    - Magnetic field - *B* [Telsa]

Notable Equations:

$$I = \frac{BL}{\mu_0 N}$$

$$V = \frac{NBA}{\Delta t}$$

$$U_b = \frac{B^2 AL}{\mu_0 \Delta t}$$

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Notable Targets

- Produce 10 kW of mechanical motion.
- Convert 50% of mechanical motion to electrical power.
- Generate ≥ 5 kW of power.
- Weight ≤ 200 lbm.
  - Each sub-section ≤ 50 lbm.
- Cost ≤ $2,000.
- Power to weight ratio ≥ 25 W/lbm.

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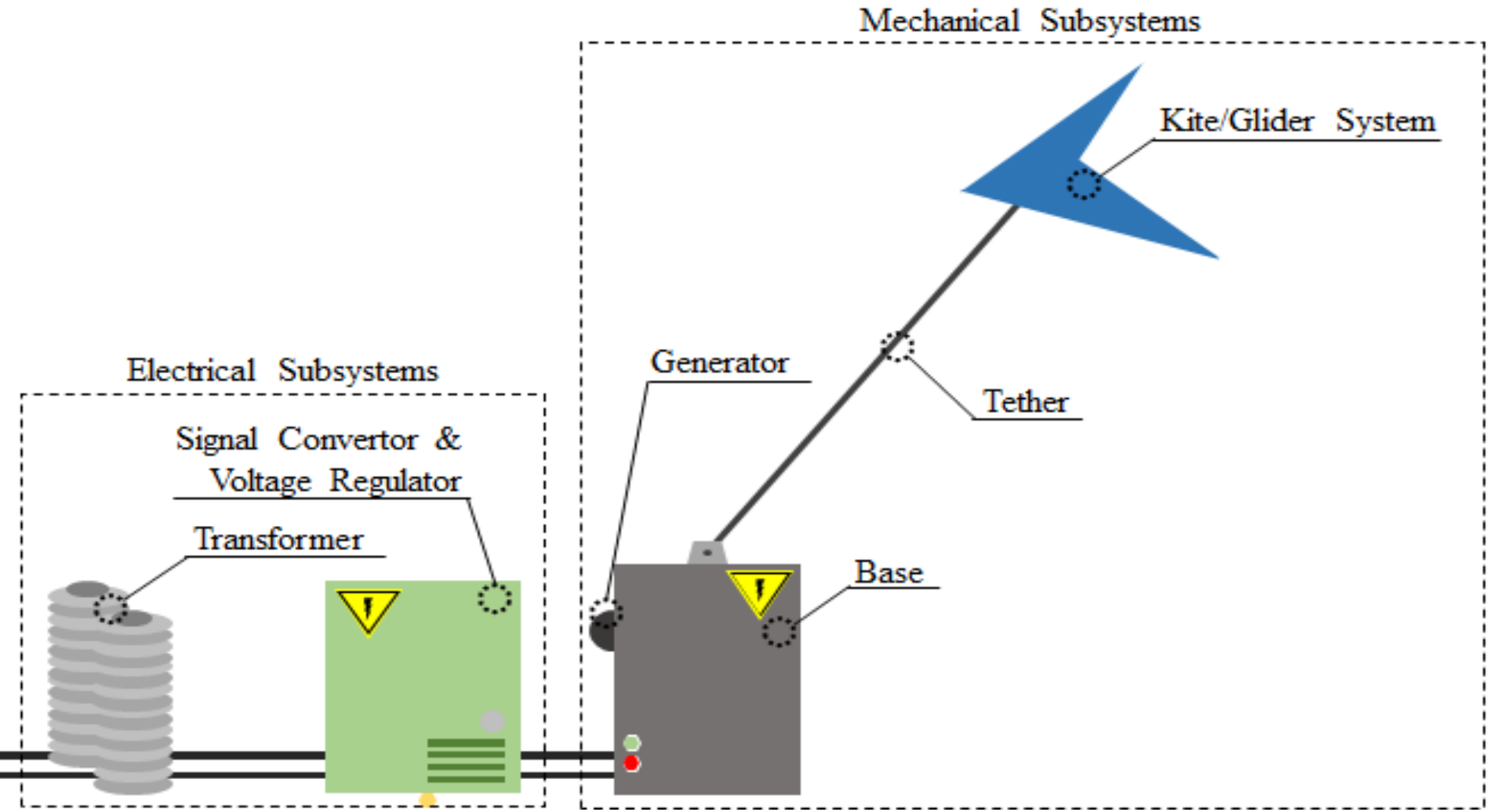
Brian Lyn

Concept Generation Focus

Concept Generation Focus



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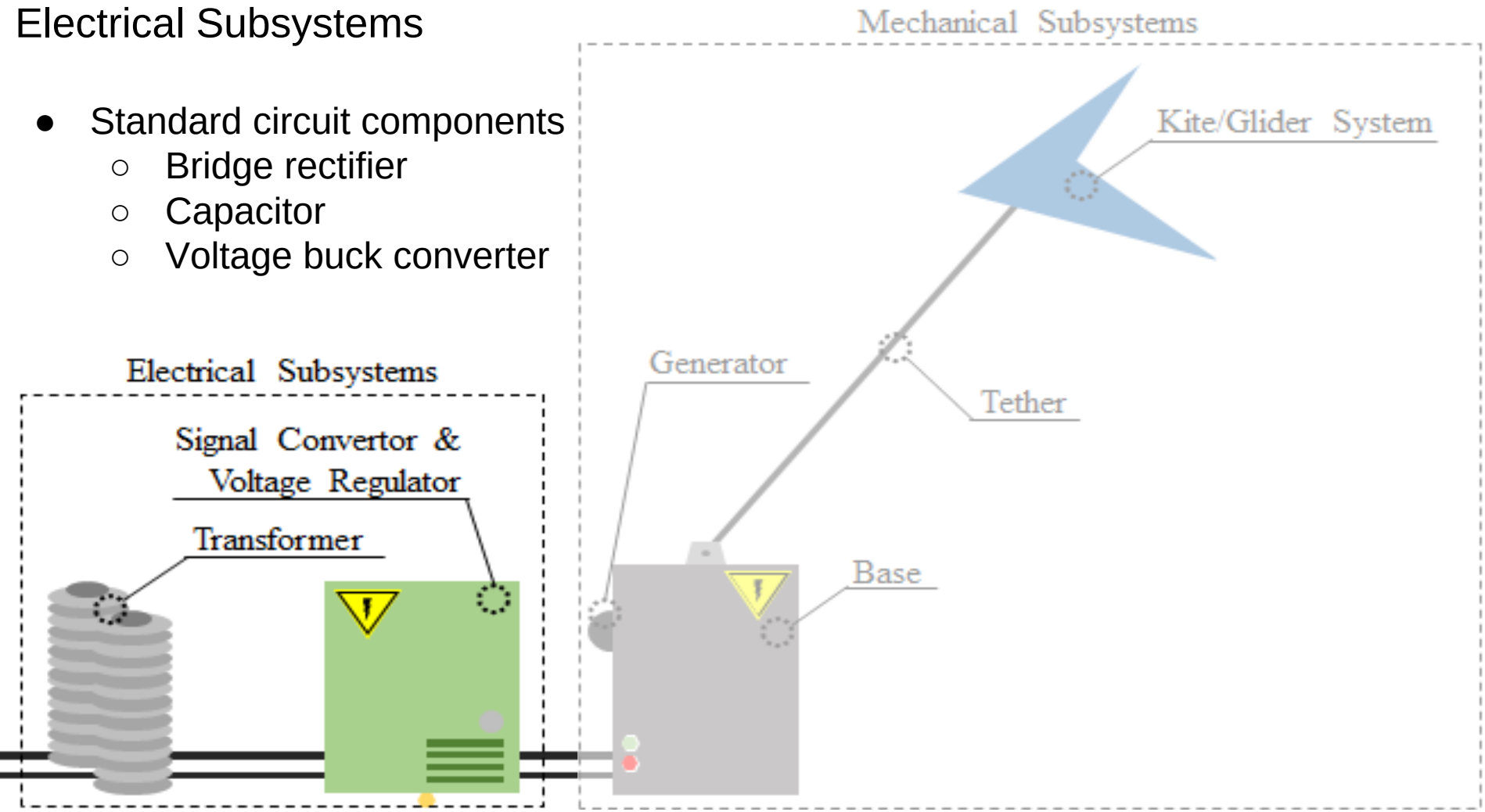
Concept Generation Focus

Electrical Subsystems

- Standard circuit components
  - Bridge rectifier
  - Capacitor
  - Voltage buck converter



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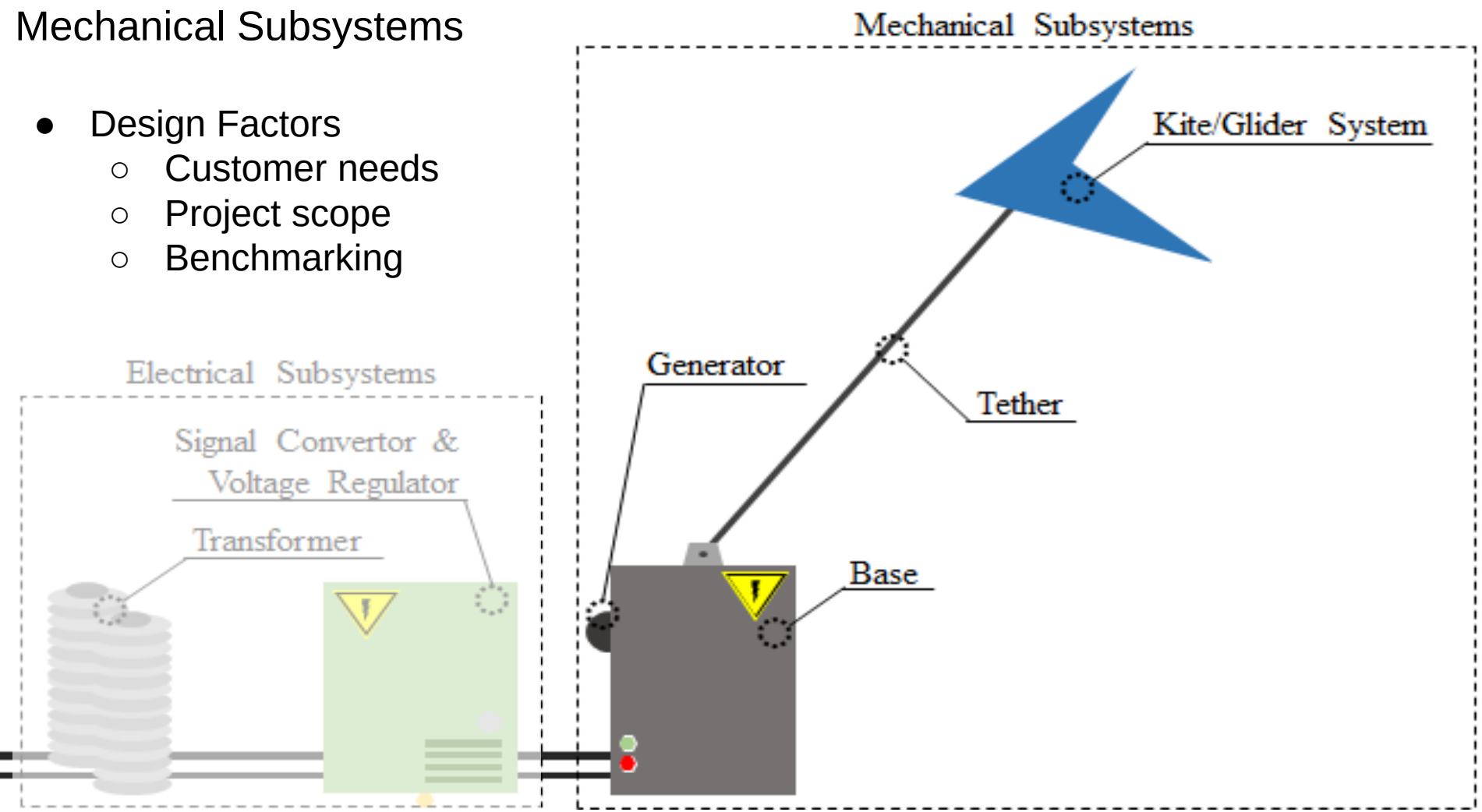
Concept Generation Focus

Mechanical Subsystems

- Design Factors
  - Customer needs
  - Project scope
  - Benchmarking



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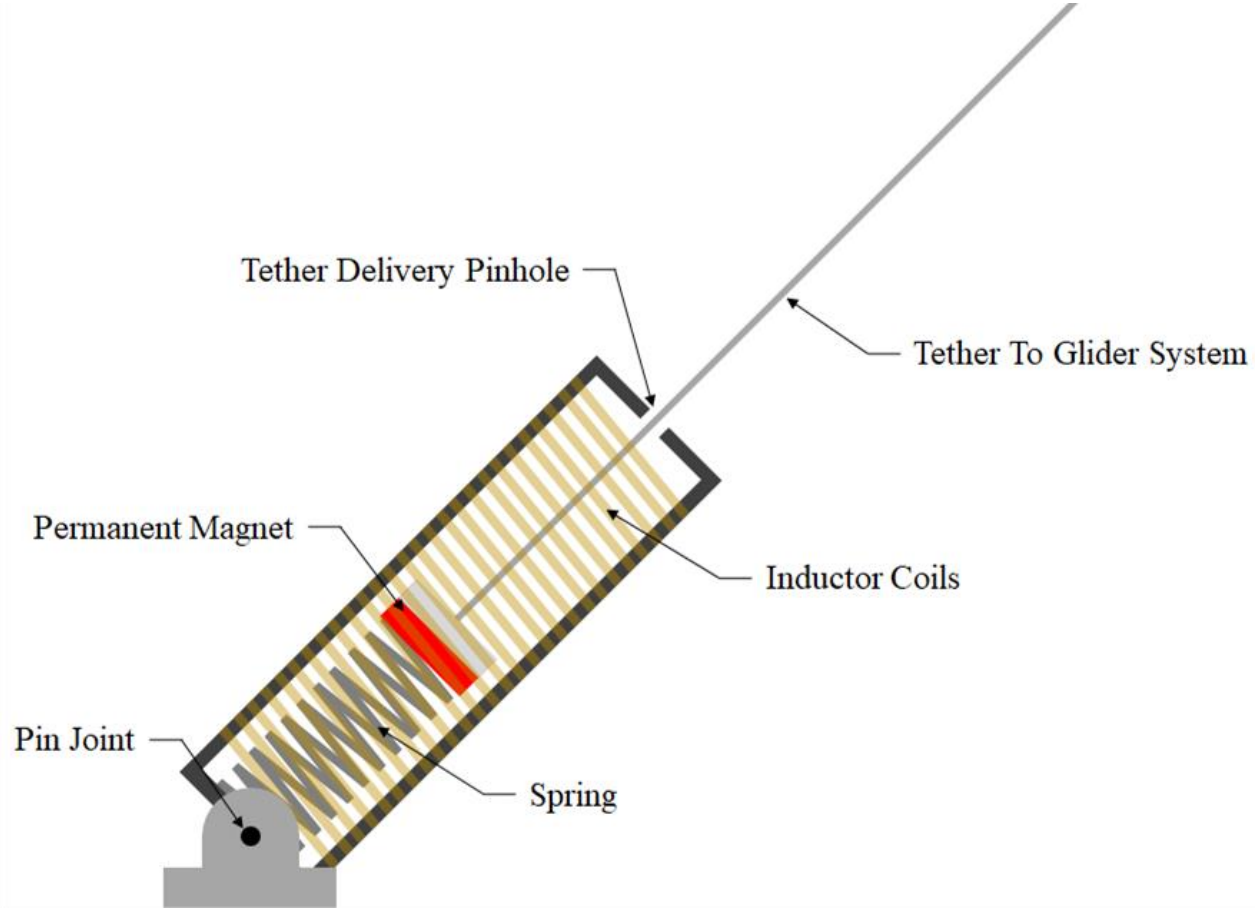
Power Generation: Current Design



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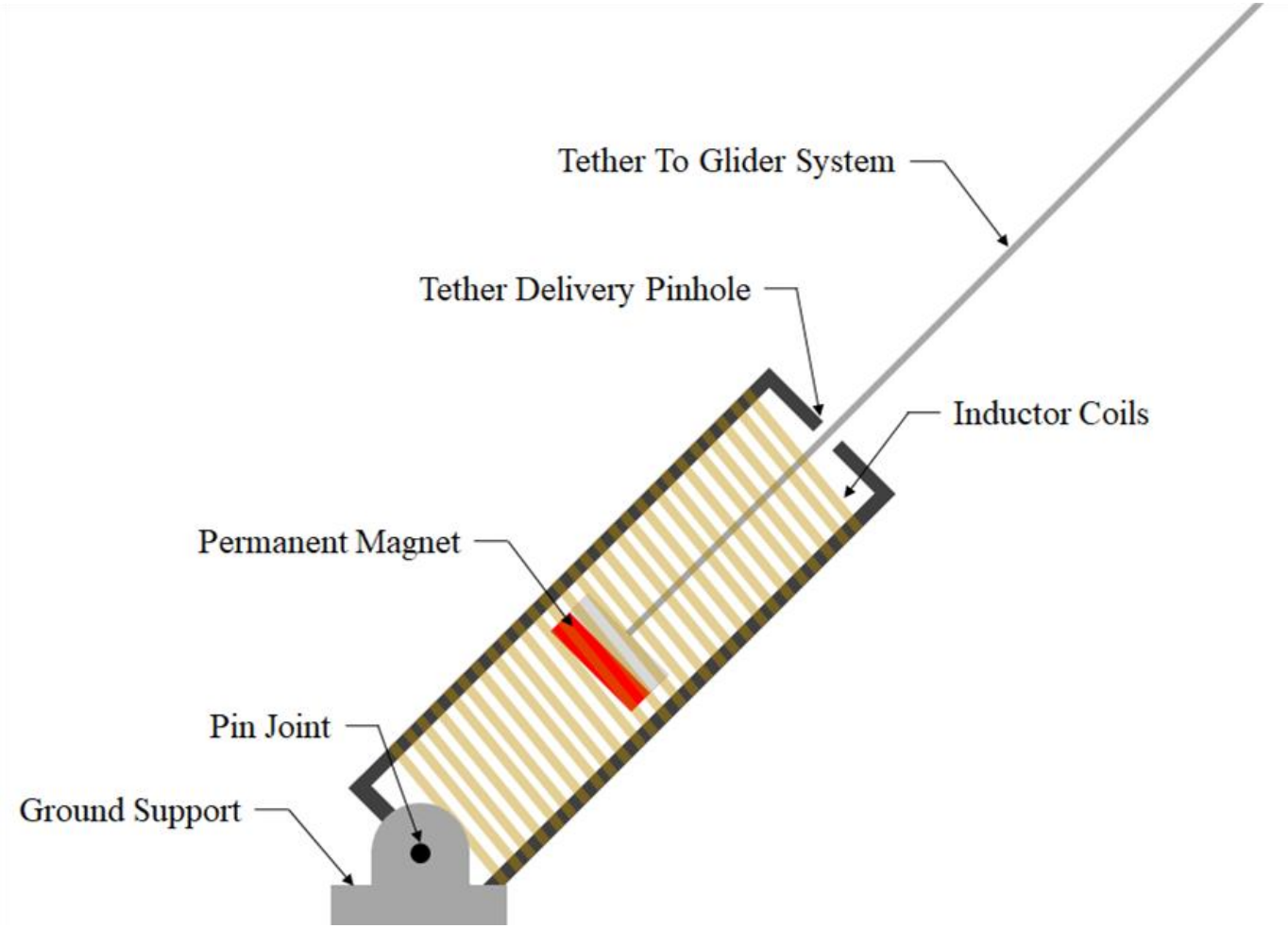
Power Generation: Concept 1



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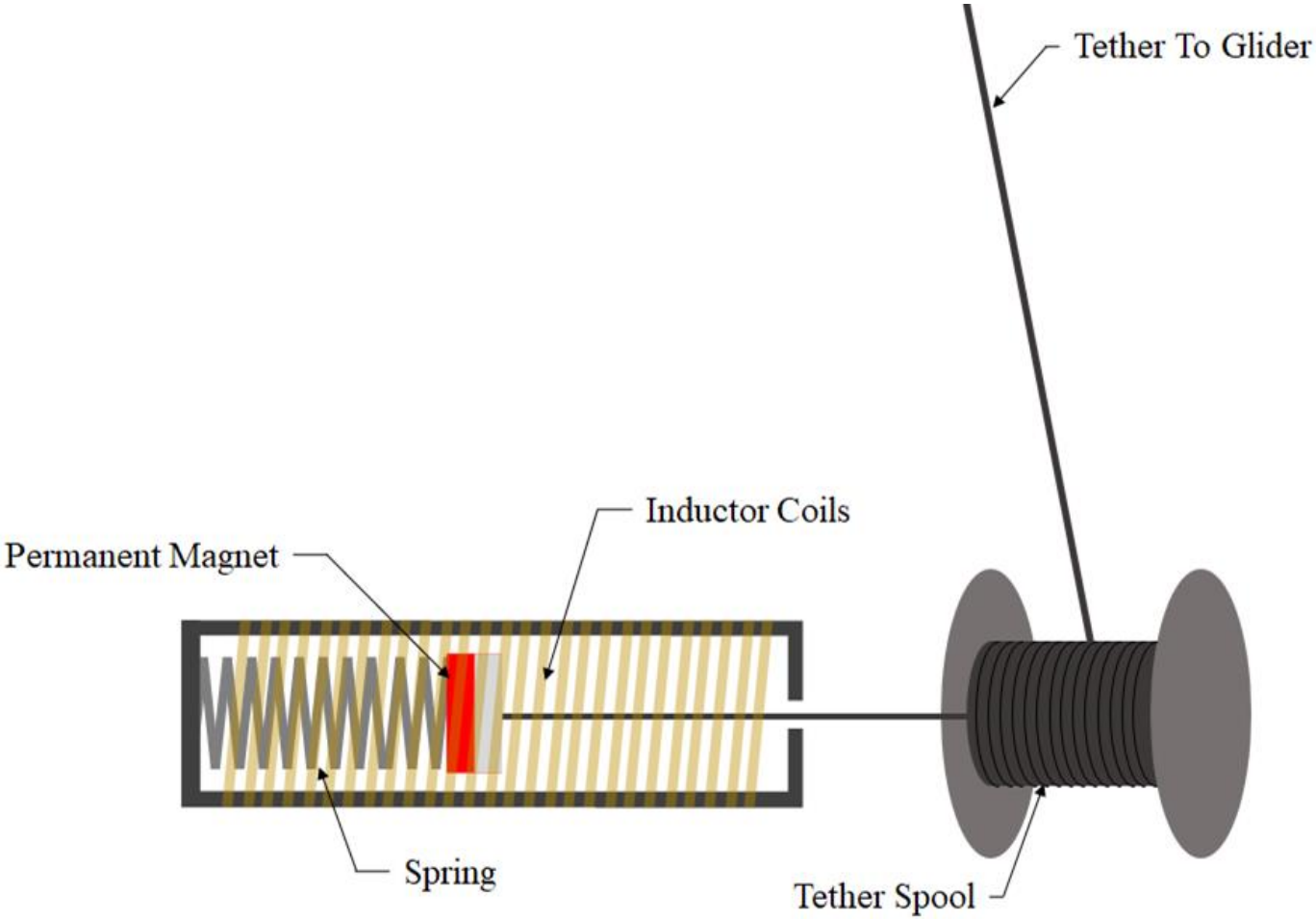
Power Generation: Concept 2



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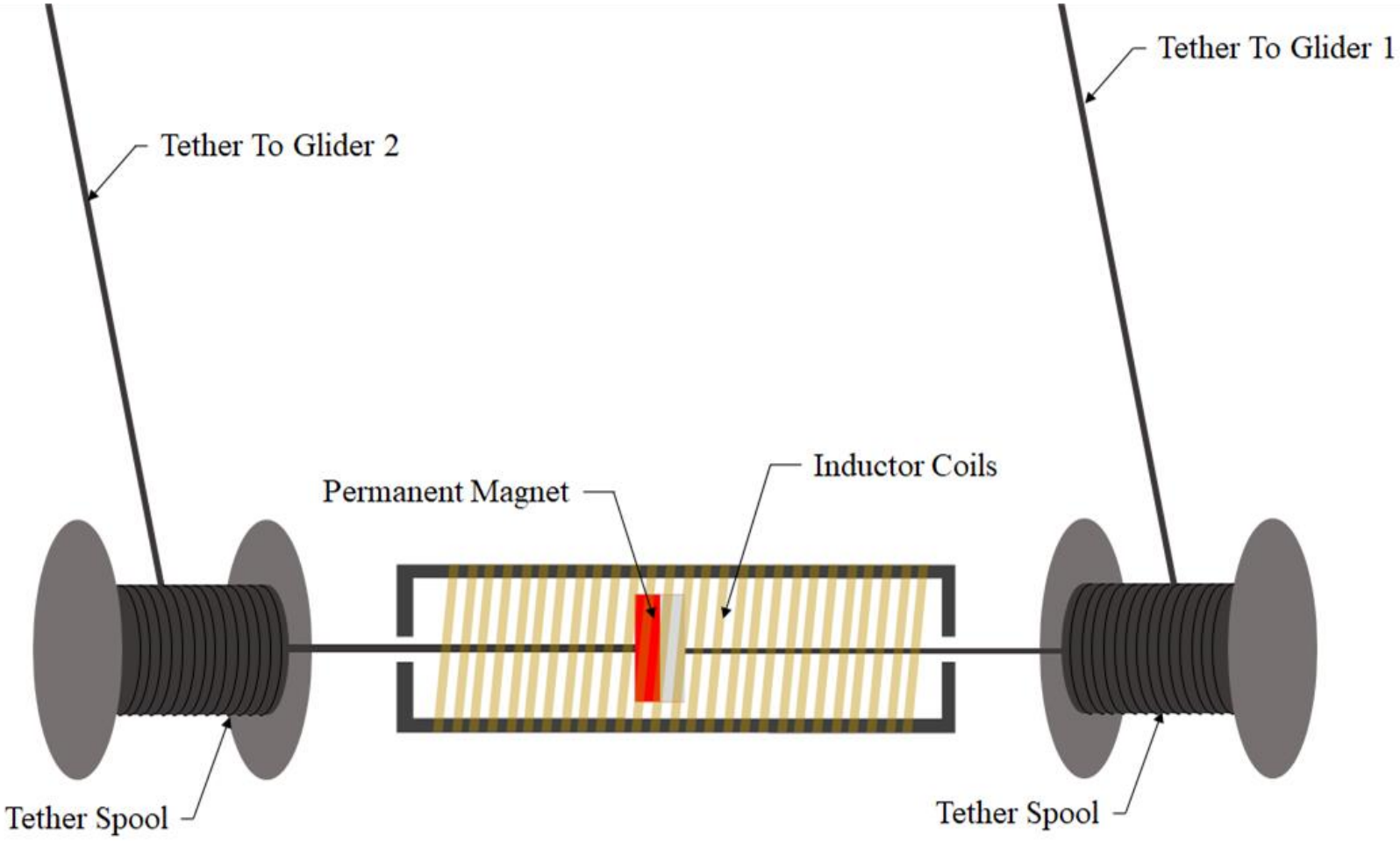
Power Generation: Concept 3



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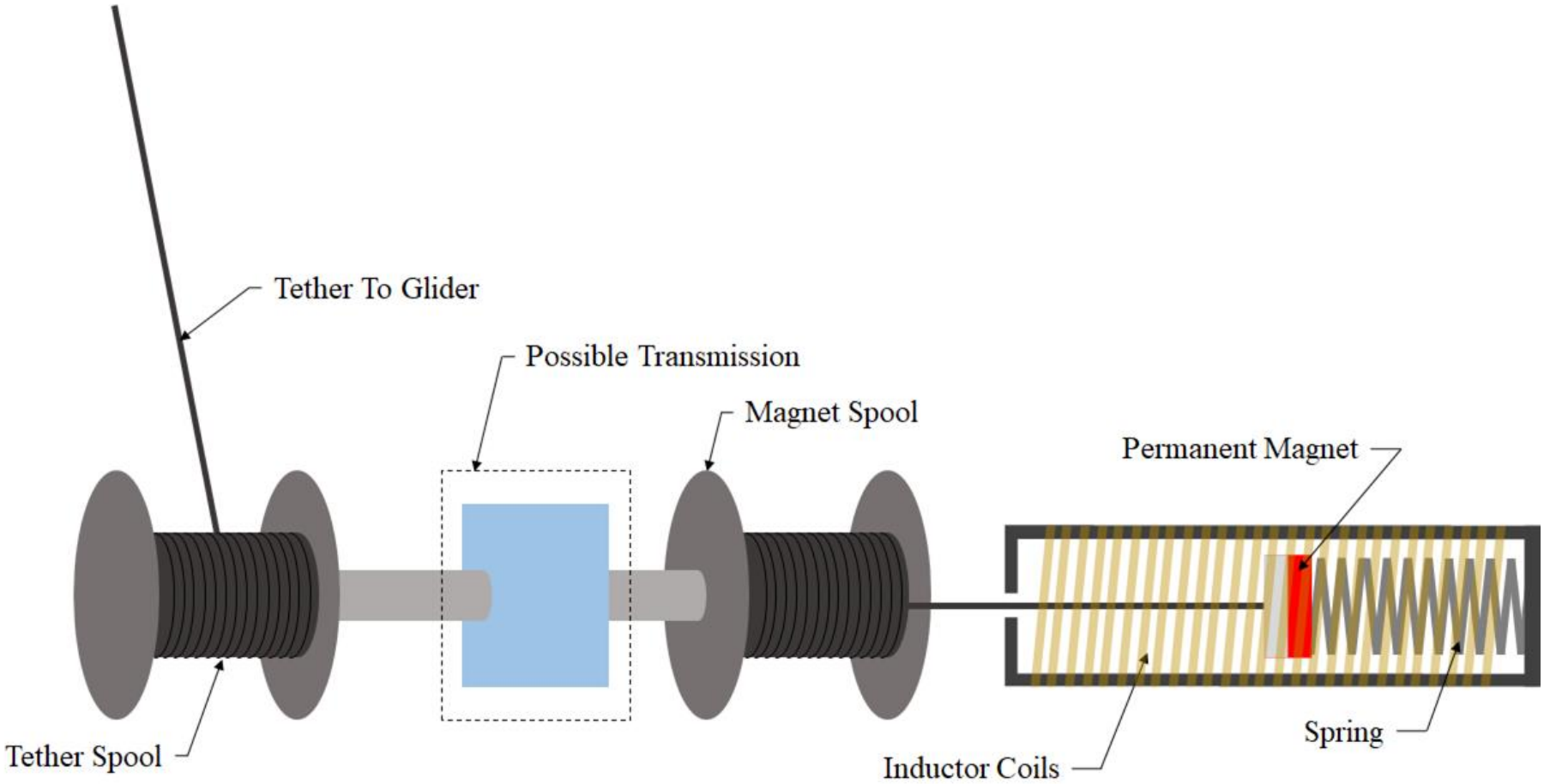
Power Generation: Concept 4



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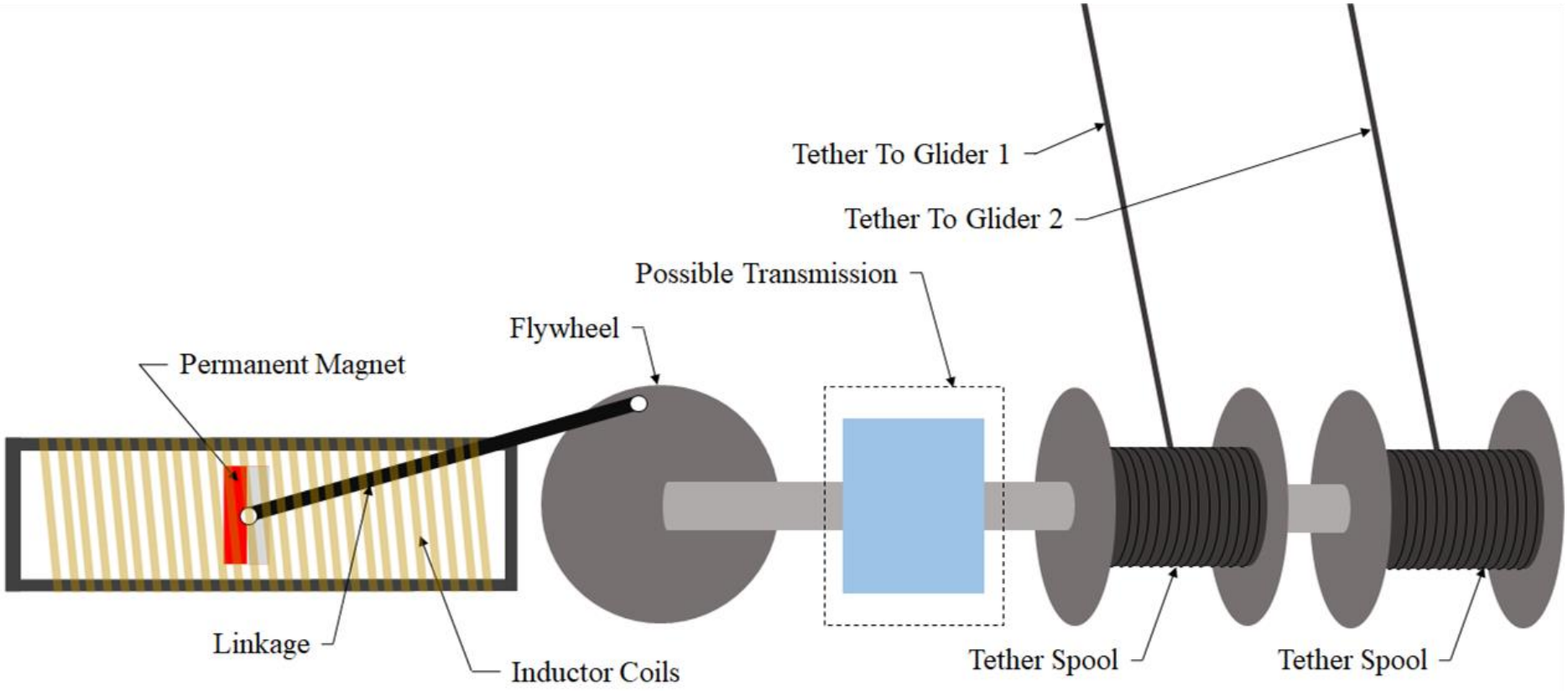
Power Generation: Concept 5



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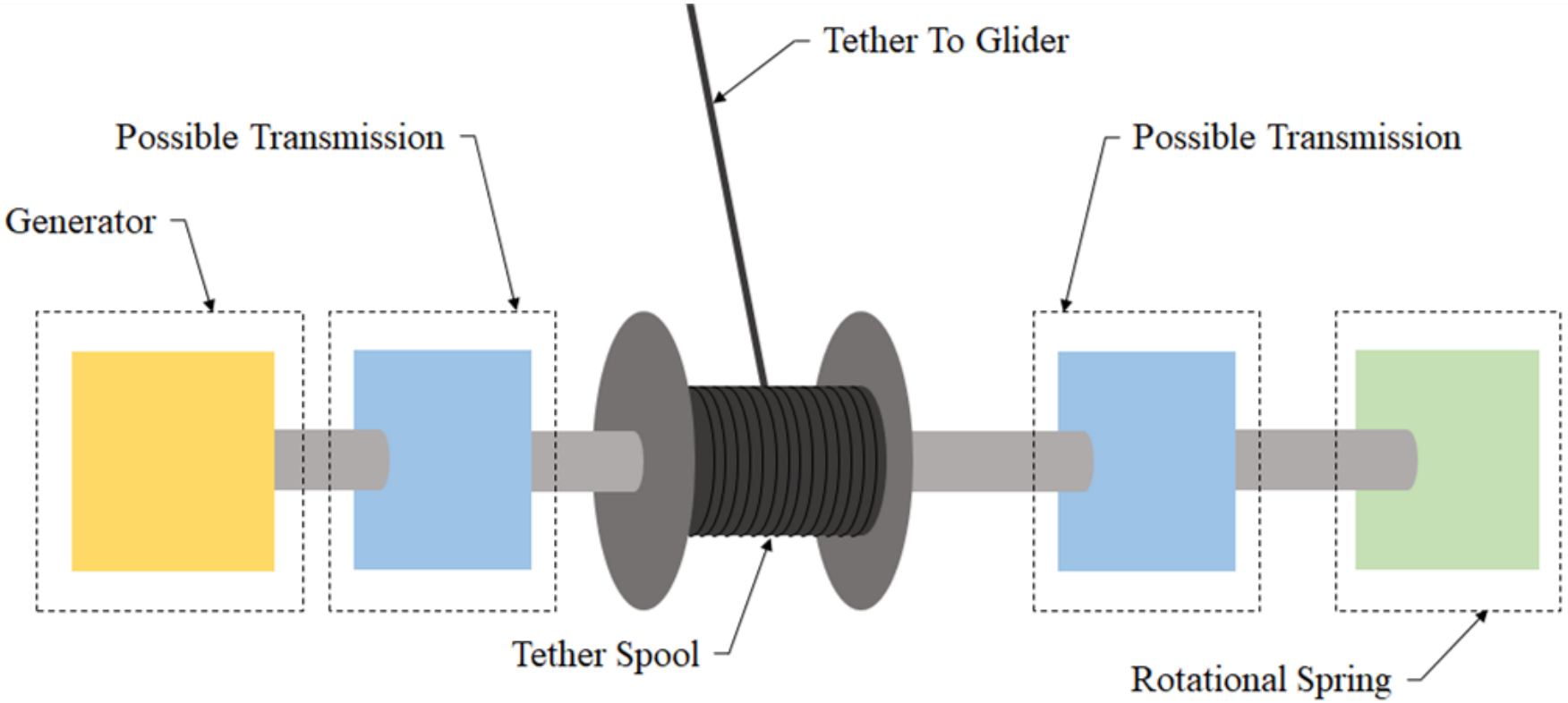
Power Generation: Concept 6



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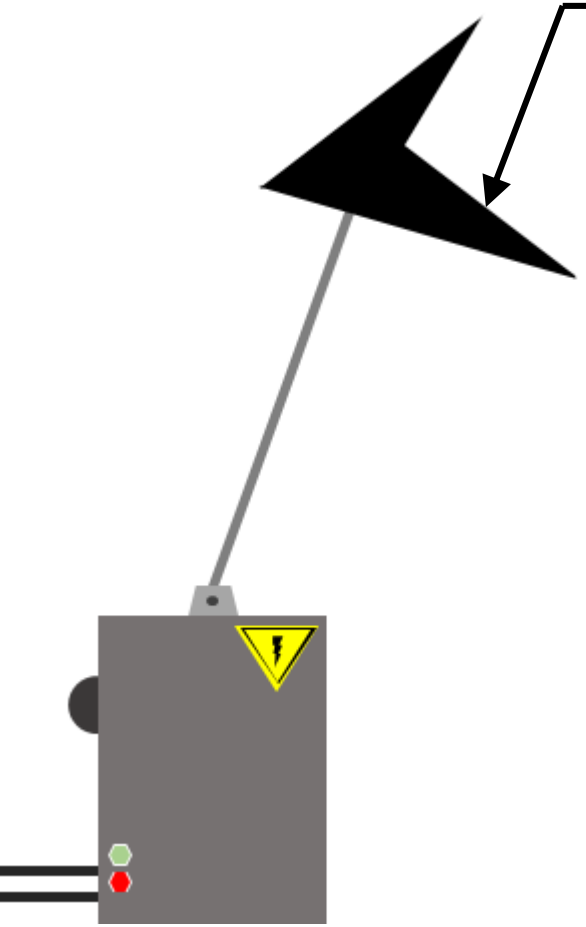
Jared Gremley

Glider Delivery System

Functional Decomposition



Kite/Glider System

- Take off and land autonomously.
- Oscillate flight based on environmental noise factors.
- Convey instantaneous wind speed and altitude of kite.

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Glider Delivery System: Concept 1

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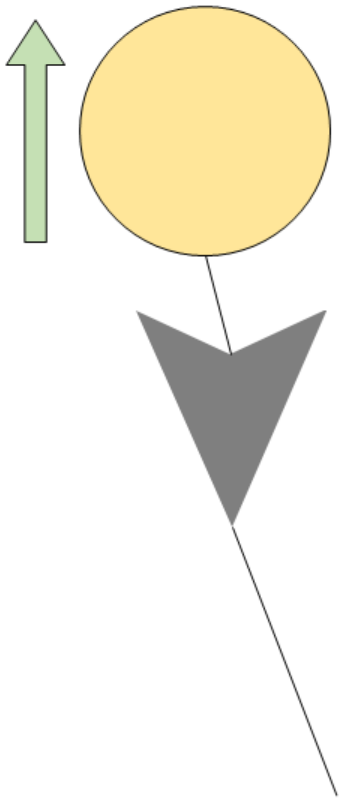
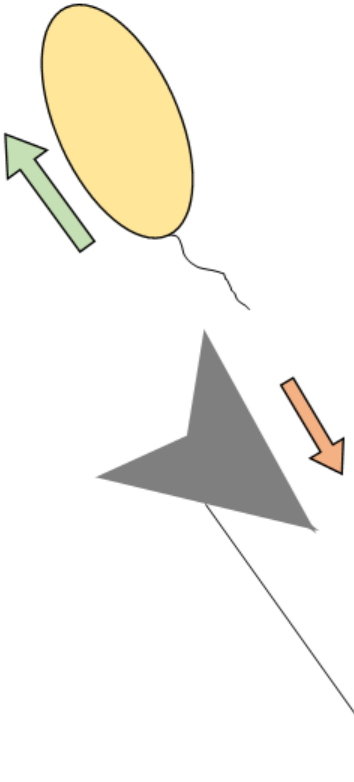
Glider Delivery System: Concept 2

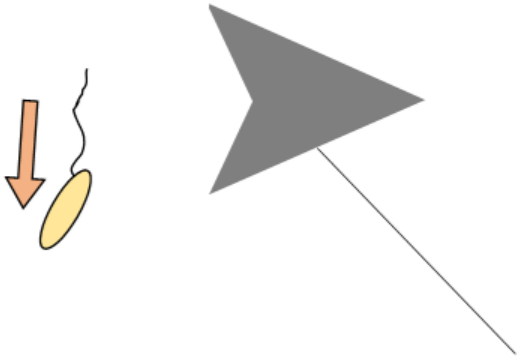
Stage 1
1. Balloon Raises System



Stage 2
1. Balloon Detaches and Deflates



Stage 3
1. Stability Achieved
2. Oscillation Begins
3. Balloon Lands for Collection



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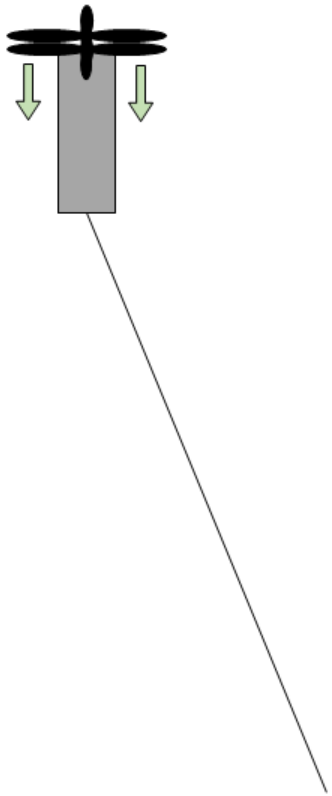
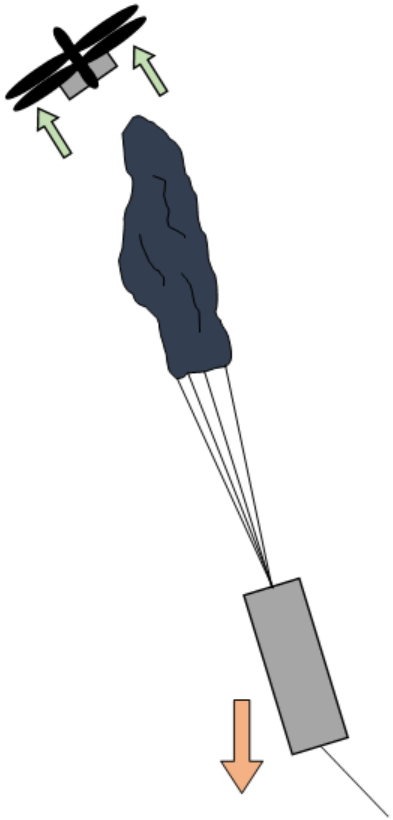
Glider Delivery System: Concept 3

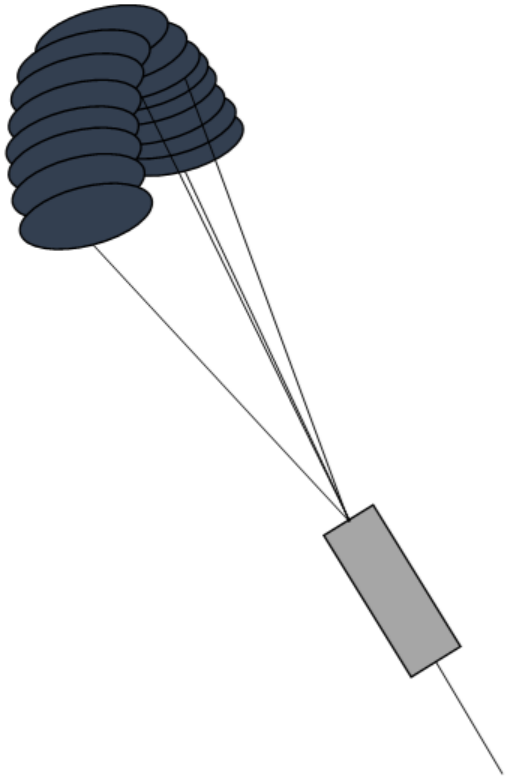
Stage 1
1. Propellers Launch System



Stage 2
1. Propellers Decouple
2. Chute/Glider Deploys



Stage 3
1. Stability Achieved
2. Begin Oscillation



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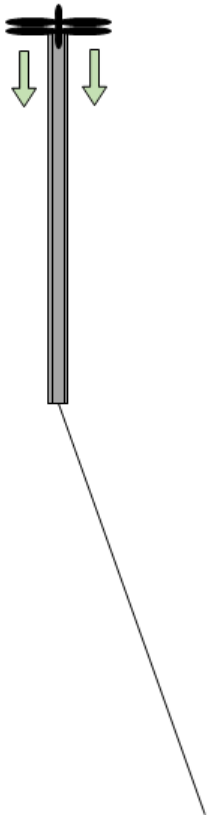
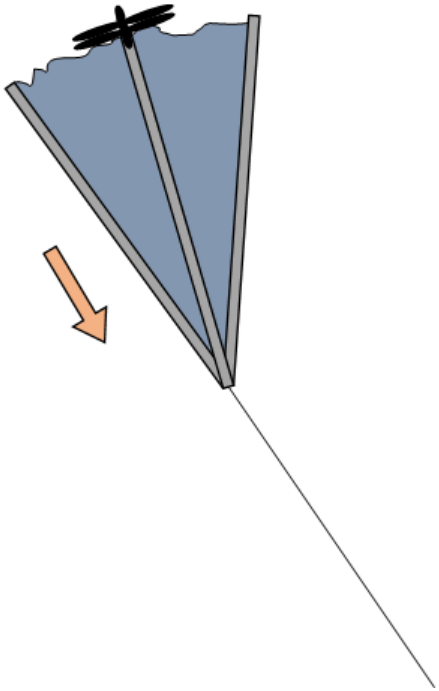
Glider Delivery System: Concept 4

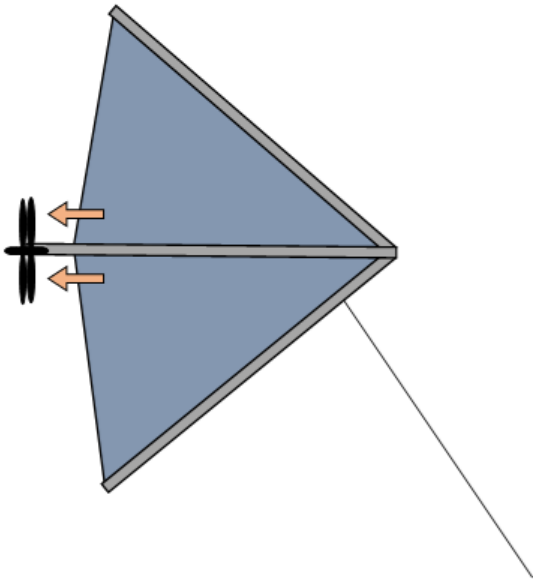
Stage 1
1. Propellers Launch System



Stage 2
1. Propellers OFF
2. Wing Release



Stage 3
1. Stability Achieved
2. Propellers Power Onboard Electronics
3. Oscillation Begins



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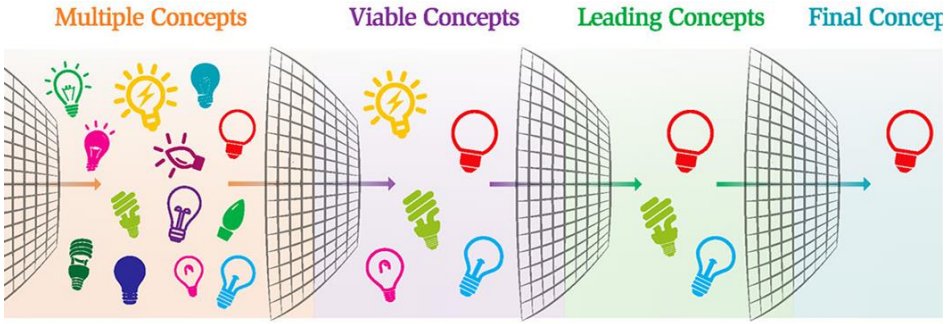
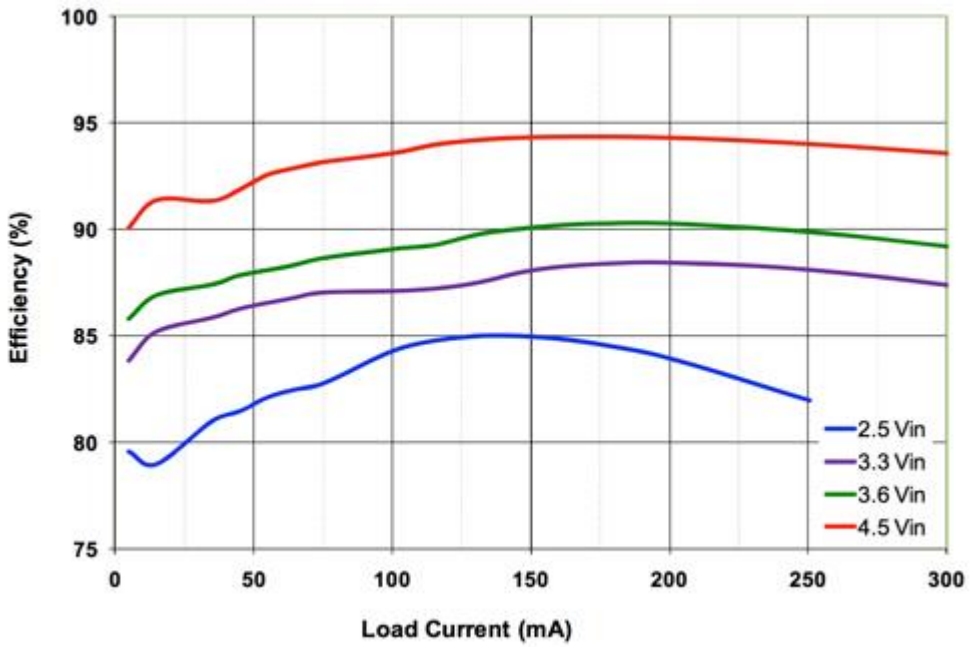
Moving Forward - Concept Selection

- Decision Matrices:
  - House of quality
  - Pugh matrix
- Iterative analysis of parameters
  - Mathematical models
  - Experimental testing
- Advisor assistance
  - Extensive knowledge of field





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Moving Forward - Reverse Engineering

- Experimentation on the solenoid:
  - Determine why previous design didn't produce sufficient power.
  - Variables:
    - Number of magnets
    - Thickness of wire
    - Number of loops in solenoid
    - Length of solenoid

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References

- Phipps, Jeffrey Sterling. Kite System for Generating Electricity. Phipps, assignee. Patent 9,013,055. 21 Apr. 2015. Print.
- “Makani Kites: Airborne Wind Energy.” *Makani,* Google, x.company/makani/.
- 9, Team. “Final Presentation.” *eng.famu.fsu.edu,* 17 Apr. 2017, www.eng.famu.fsu.edu/me/senior_design/2017/team09
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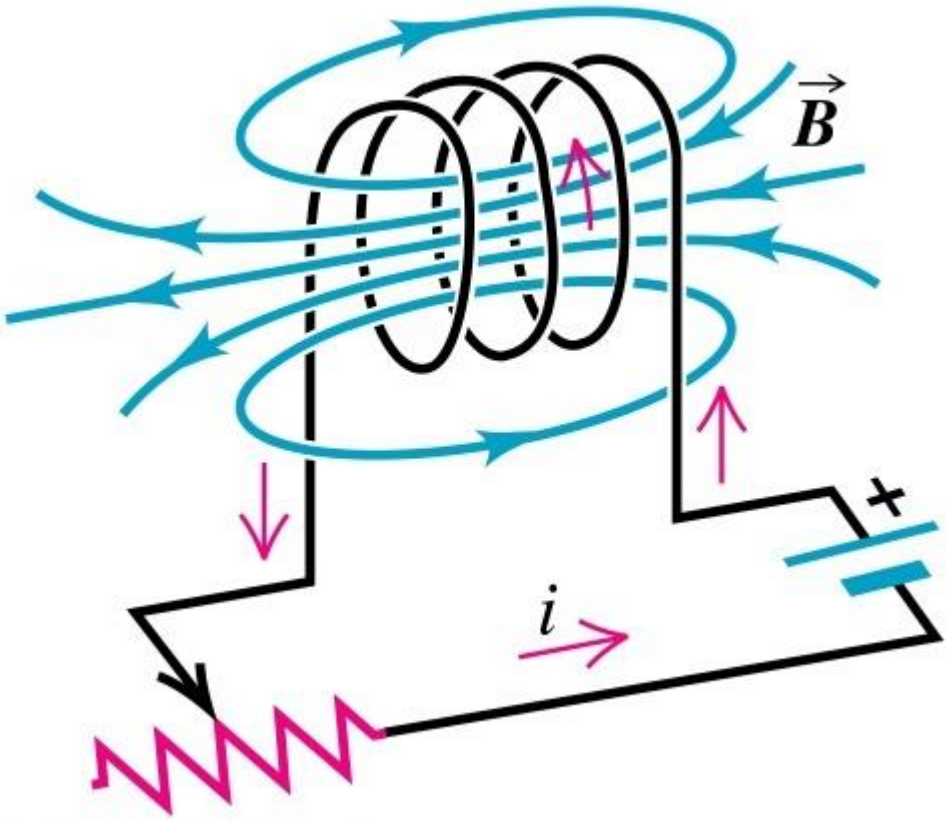
Comments or Questions?

Backup Slides

Circuit Analysis

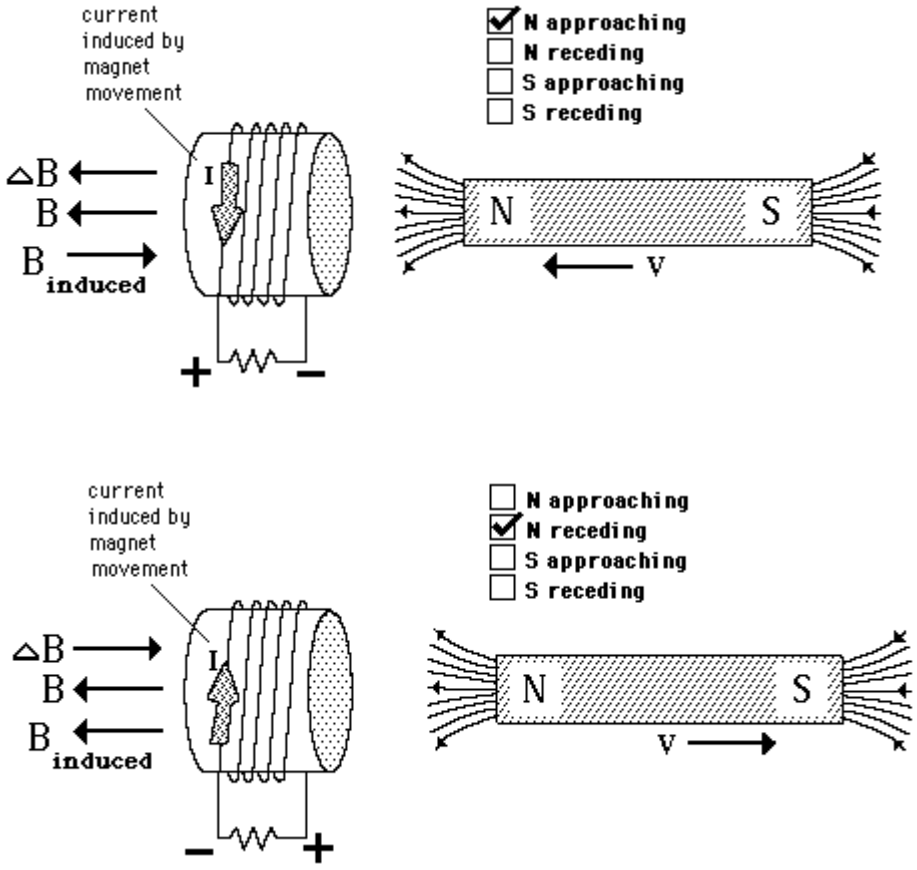
Faradays Law:

Voltage Generated V = -NBA/Δt



Backup Slides

Force Analysis



Backup Slides

Force Analysis