High Altitude Solar Kites

Zaki Akhtar (AE), Christopher Girouard (ECE), Dylan Billings (AE) , Robert Allen (ME)

Advisor: Professor Brian Savilonis (ME)

Abstract

This project is meant to determine the feasibility of high altitude solar kites. We analyzed the weights, strengths, and efficiency of materials currently on the market to use in a high altitude kite. We concluded that a solar kite with our specifications is feasible as well as cost competitive with other forms of energy.
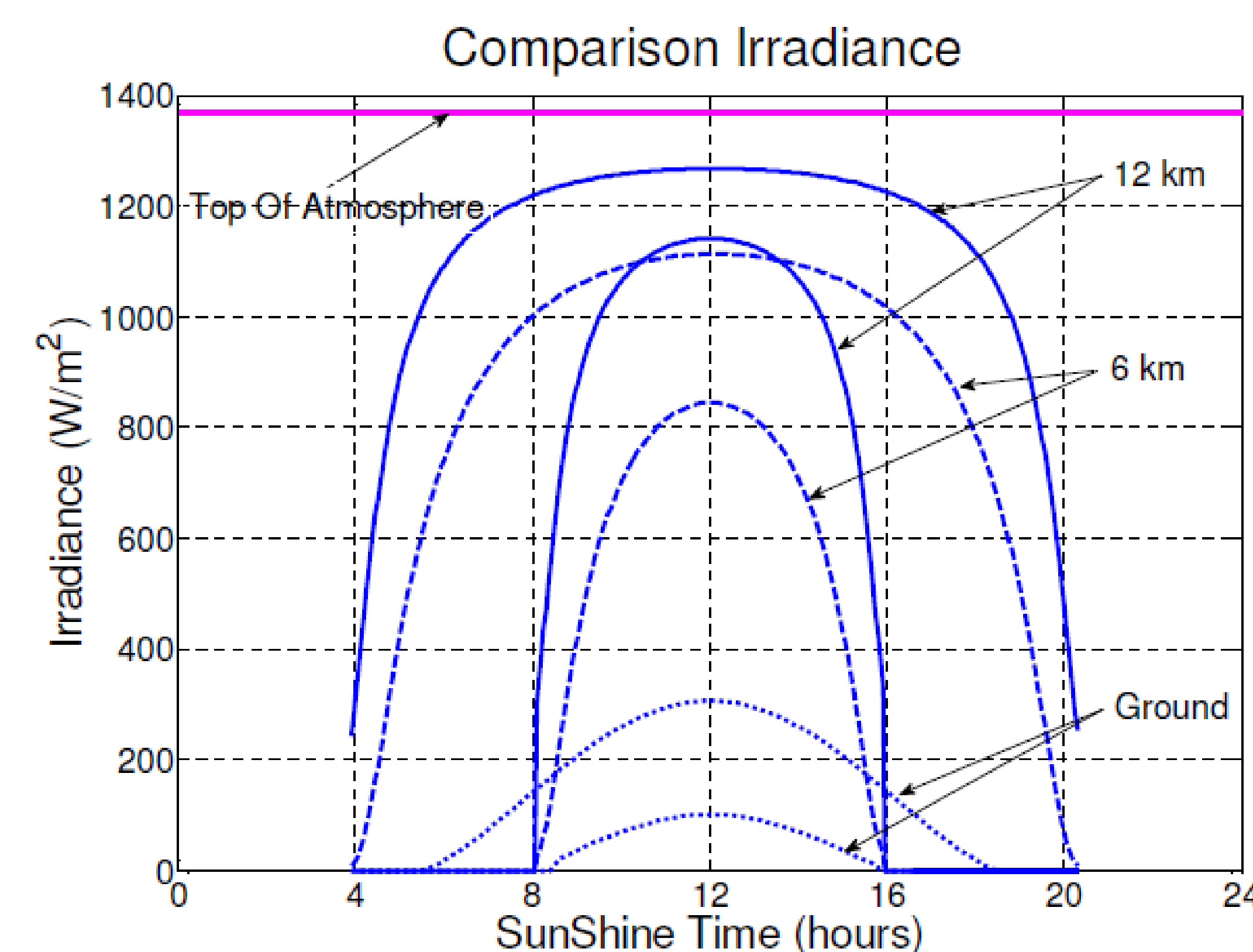
What is a Solar Kite?

Our solar kite is a rectangle with approximate area of 150m^2. This area is covered with flexible photovoltaic cells. The kite is attached to a copper wire reinforced with carbon fiber. The cable is attached to a generator on the ground. The kite harnesses solar energy at about 8 km in the air, which maximizes the solar irradiance available to us.
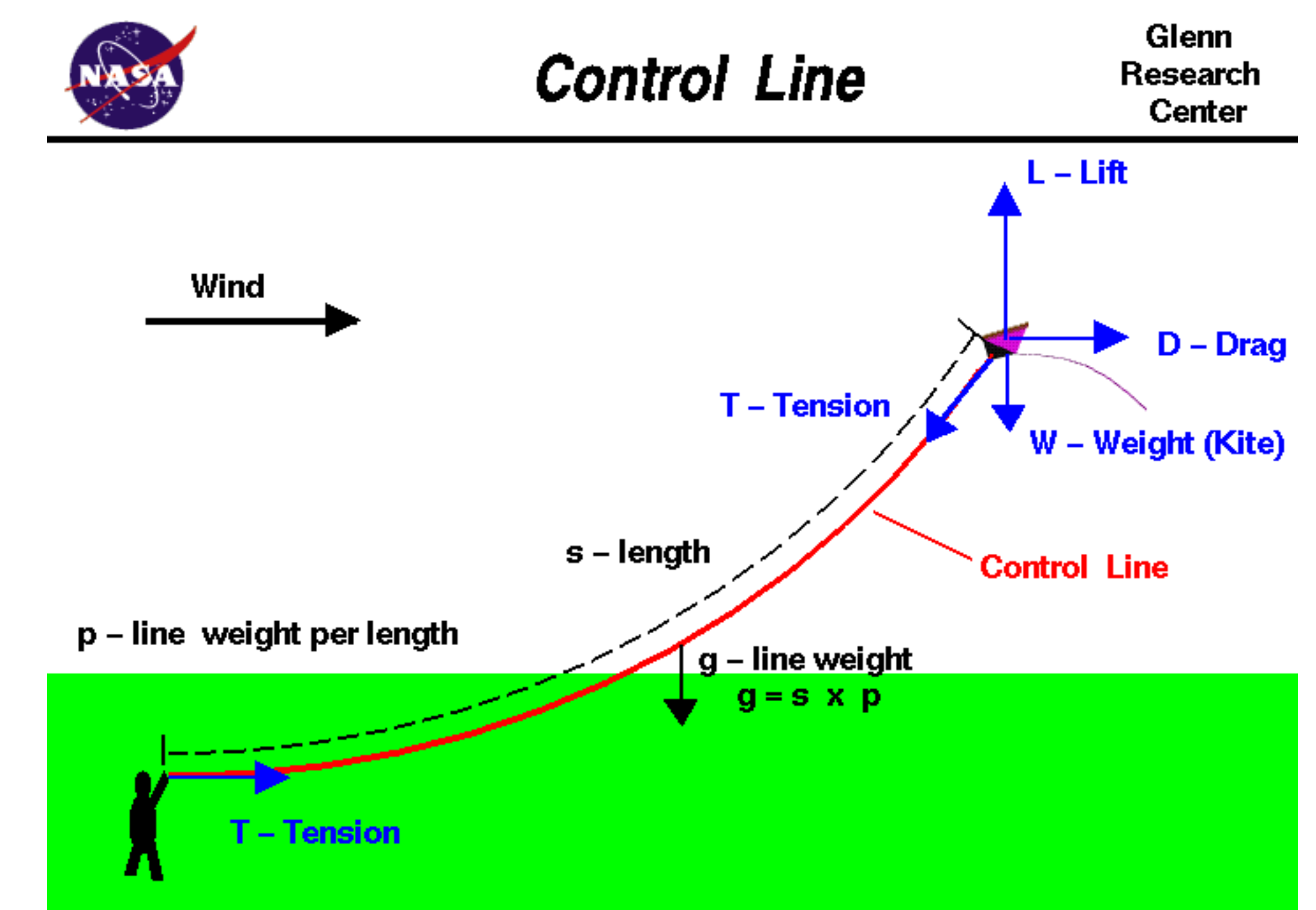
Project Goals/Objectives

•To determine the physical possibility of a high altitude solar kite
•To compare the cost of a potential system to its energy output
• Determine the best geographical area/altitude to operate in
•Compare this to other renewable energy sources

Methods/Process

•First, we looked at the forces acting upon the kite.
  •Determined that 150m^2 would create enough lift and drag
  •Found lift, drag, and weight of kite and cable
  •Found tension at the ground and at the kite and respective angles
•Then, we looked at how much stress the cable can hold.
  •Found maximum stress on cable to be 4.2x10^{9}N/m^2.
  •The tensile strength with carbon fiber reinforcement is 7x10^{9}N/m^2.
•Next, we determined total cost of a 12,000m cable.
  •The copper used would cost $57,000
  •The carbon fiber would cost $87,000.
•We obtained the energy produced by the kite system
  •Found the average solar irradiance at 8,000m
  •Calculated efficiency of solar panels and resistance in the wire
  •System produces about 154 KW

Credit: NASA

Conclusions/Recommendations

•A solar kite is feasible and cost effective. We found that through reinforcing the cable with carbon fiber that it will not break under the maximum stress and that enough lift can be generated.

Form of Energy	Cost per MW
Solar Kite	$800,000
Wind Turbine	$1.3 million
Coal Power Plant	$1.6 million
Solar Array	$4 million

•7 of our kites will produce over 1 MW of energy. This would require free air space because of the length of the cable.
•Our system is a better fit for third-world areas where air traffic is significantly less. Our system could still provide energy in the United States, but in lesser quantities since it would realistically only work in no-fly zones.

Credit: "Kite Power for Heifer International's Overlook Farm " IQP

References

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