KITESCORE #5

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WIND FOR ENERGY

I want to talk about wind energy generation using kites, dirigibles, and other airborne objects. Ever since people have first generated electricity, they have sought cheaper and easier ways to generate more of it from any source possible. This has resulted in humanity's creation of engines that burn any number of fossil fuels to turn a generator; fuel cells and batteries that transform chemical energy into electrical energy; solar panels that dislodge silicon electrons in the presence of sunlight, and most notably turbines which are turned by pressure differentials of steam, water, or wind.

The first windmills have been in existence by some accounts for over 1,500 years, where they have been used to pump water, grind grain, and later, handle other early industrial processes. With the discovery of the electric generator, and bernoullis principles laying groundwork for the creation of the wing, a newer device came into being - the wind turbine. This utilized "lift" - the same phenomenon that enables fixed-winged flight - to rotate a shaft and generate electricity. Many early prototypes were created in the age of the wright brothers. The horizontal axis variety was first tried at industrial scales in the 1940s by Palmer Putnam, an engineer and author. It has since been further scaled up to create massive devices with wingspans larger than 747s and the ability to power hundreds of homes. The vertical axis variety on the other hand has been pitched continually as a better option based on its attractive form factor and innovative-feeling design, yet none have been built so far that have been commercially viable enough to generate power for purposes other than vanity.

HIGH ALTITUDE WIND POWER

There is yet a third class of wind based power producers that have been explored in this time as well, wind energy capture devices that themselves are airborne! Today's models can be broken up using many different classifications. The units themselves can be kites, or dirigibles. They can generate electricity through airborne wind turbines, or through less conventional means such as alternating tension systems attached to the tether. These can be placed at high altitude (600m+) or low altitude (anything less) for the purposes of wind power generation. All are in various stages of development, having both many advantages and drawbacks as they relate to traditional wind energy generation methods. High Altitude Wind Power (HAWP) is a common term for systems of this type.

// for the fifth edition of kitescore, I invited Cullen Kasunic to write about recent developments in wind power. -dg //
What makes these devices attractive is their ability to access high speed, low turbulence wind that can only be found at near-geostrophic heights. At this height, the friction of the earth's surface no longer affects the flow of the wind, so the air can move freely and rapidly. Wind speeds are more consistent as well at this height, reducing the need for complex resource assessments. Separate, but also important is the fact that 30% of the cost of a typical wind turbine goes to pay for the foundation and tower on which the turbine sits. By hoisting the energy capture method in the air on a kite or dirigible, these costs are eliminated. Further, by removing the need for a tower and foundation, these units can be rapidly redeployed.

Innovations such as these do not come without drawbacks, and these have thus far held back their widespread adoption. A primary challenge is that while they themselves take up very little space, their presence affects a large area. A tethered device 600 meters in the air is a hazard for air navigation, and may require a large area for takeoff and landing. The engineering challenges of keeping a system in the air operating are also considerable, and still being addressed.

**KITE TYPE WIND POWER**

Eastern civilizations have used kites for over two years, sometimes at sizes large enough to lift loads, and even pick men up to perform reconnaissance in times of war. Early kite power in the west seems to have begun with George Pocock, an inventor who in the early 18th century utilized kites to pull carriages for races across the English countryside. Despite the renewed interest in kites during the age of early flight, not much progress was made towards using kites for powered applications. It wasn’t until 1980 when Miles L. Loyd produced a detailed set of mathematical models in a research paper produced for Lawrence Livermore national laboratory that the idea of Kite Power took off again.

**CHARVOLANT BY GEORGE POCCOCK**

Makhanis are one contemporary example of kite styled wind power generation. They raised over $25 million before being acquired by Google in 2013. They use what looks like a large glider with propellers to generate power. The rotors are actually used to help get the kite in the air. Once aloft, the kite flies in circles on its strong tether, generating power as it goes. This tether also contains electrical wires, sending power down to the ground, and control signals up to the kite to keep it revolving in place.

**FINAL ASSESSMENT**

There are many experimental methods for harvesting wind energy. While almost all of them have some interesting aspects, but most fail a critical test of science or engineering. High Altitude Wind Power however shows considerable promise as a technology of tomorrow. While individual designs may be proven ineffective, the advantages of cost reduction and increased production inherent in this class of energy generation seem to ensure that major mainstream applications will be found before long.

**ALTAEROS PROTOTYPE WITH 3KW TURBINE**

High Altitude Wind Power (HAWP) is a term for systems of this type. They can generate electricity through airborne wind turbines, or through less conventional means such as alternating tension systems attached to the tether. These can be placed at high altitude (600m+) or low altitude (anything less) for the purposes of wind power generation. All of these methods require a large area for takeoff and landing. The engineering challenges of keeping a system in the air operating are also considerable, and still being addressed.

**DIRIGIBLE TYPE WIND POWER**

The use of dirigibles – lighter than air crafts with steering mechanisms – for power generation is a somewhat newer idea. Lighter than air flight itself dates to 1783 when the montgolfier brothers launched the first manned flight of a hot air balloon over Paris, first tethered, then free floating, landing 8 km away from where they launched. While envisioned as a means of transportation, cargo delivery, and entertainment, the dirigible only became thought of as a platform for energy generation in 2010 when several students at the Massachusetts Institute of Technology realized there may be a valuable application.

These students formed Alteas, which has created the leading dirigible style system to harvest energy from high in the air; they have gained significant interest for initial use in remote areas, and as a quickly deployable source of electricity. It uses helium to stay aloft, and is tethered to the ground using a similar system to other airborne wind energy systems. It has as an advantage the ability to take off an land in place, meaning that less area is required for deploy or repair it. The intelligent control system also allows the unit to be brought down every few months so that adjustments can be made, and helium can be added if needed.

**SMALL MAKHANI PROTOTYPE**

KiteScore #5
February 25, 2017

for
Socrates #EAF16

Set in Devanagari // Montserrat // Lato

Text and image selections by Cullen Kasunic.

Dylan Gauthier, accidental flight (2016/7)
submissions: dylan@floatingcity.us

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