# Airborne Wind Energy- A review

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**Abstract**

This paper is a review on airborne wind energy systems. Airborne wind energy may be considered as an appropriate replacement for wind turbine in future because of its unique characteristics. Different technologies in this field are discussed.

**Key words:** Airborne Wind Energy (AWE), Wind Turbine

## I. Introduction

Airborne wind energy systems are an innovative way to harness the winds at higher altitude to generate electrical energy. These systems typically consist of a free flying airborne element such as a kite, glider or horizontal wind turbine, which is connected to ground through a polymer tether [2]. In this paper, different technologies in this field are reviewed.

## II. Soft Wing Airborne Wind Energy System

This system is a tethered soft wing flying in a crosswind path. The soft wing is connected to a ground station. Windlift developed 12 kW AWE system which utilizes a 40m$^2$ airfoil and is tethered by a ground electrical power take off station [4]. A 30kW prototype has been tested by EnerKite. This prototype has been driven by a three line ground actuated kite power system [5]. In TU Deft, University of Limerick, KU Leuven, Politecnico de Torino and University of Sussex, prototypes have been developed and are under investigation [6].

## III. Rigid Wing AWE

This type of AWE device uses a glider aircraft with a rigid wing, which is tethered to a ground station. The use of a rigid wing in this approach increases the aerodynamic efficiency, meaning this system can provide the same mechanical power with a smaller wing area in comparison with soft wing AWE system. Using glider aircraft the control challenge is simplified [6]. A 12kW prototype of such a system has been built by Ampyx Power Company in 2013. The electrical power take off for this system is a single direct driven electrical machine which is connected to grid through a power converter [7]. Makani Power has tested two 10kW and 30 kW rigid wing AWE systems which utilize high voltage brushless DC motor/generators mounted on the wing [8]. A rotorcraft AWE device is under development in SkyWindPower. This system consists of a quad rotorcraft, which can use electrical power to reach the appropriate altitude for operation. It then inflects itself to the wind at a specific angle to allow the rotor to be driven by the wind and consequently generates power from the wind [9].

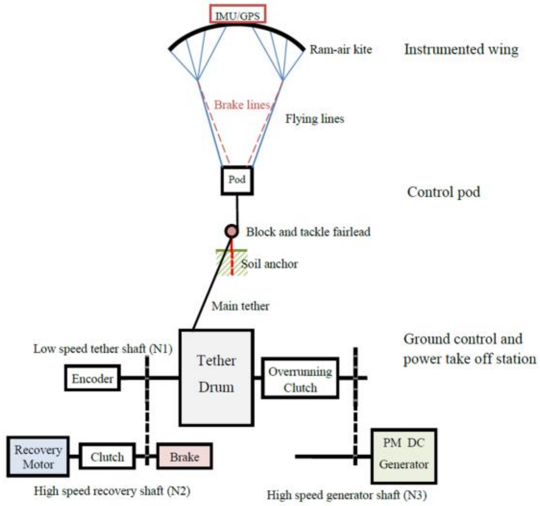


Fig1.A typical soft wing AWE as developed at the University of Limerick [6]

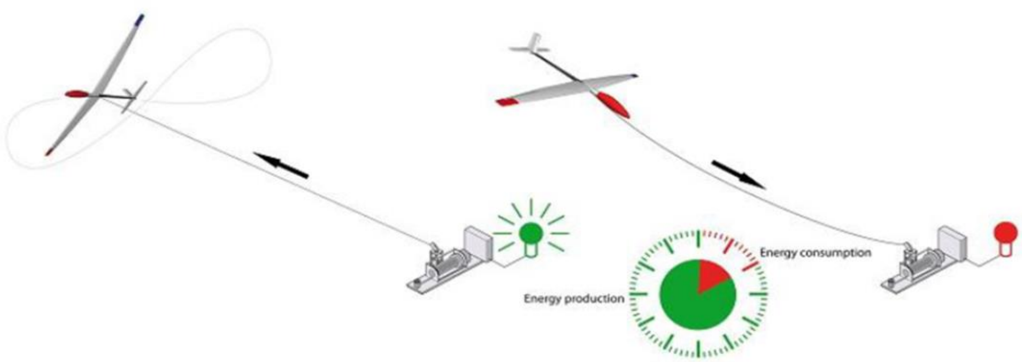


Fig.2 Ampyx rigid wing pumping mode concept [7]

## IV. Horizontal Buoyant Turbine AWEs

The use of an airborne horizontal turbine is another approach for harnessing wind energy in high altitudes. Altaeros Energies introduced a horizontal buoyant turbine which is capable of operating at 600m [10]. This system is shown in figure 3. As can be seen, an airborne turbine is installed within a duct formed by a helium-filled balloon like structure. The system is tethered to a ground station and generated power is transmitted through the tether at high voltage. No performance or testing data is provided by the company.

Figure3. Altaeros Energies horizontal buoyant turbine [10]

## V. Conclusion

Different types of airborne wind energy have been discussed. Today, designers encounter limitations for increasing the height and diameter of wind turbines in order to generate more energy. Airborne wind energy systems are appropriate devices for the further development of wind energy since they can reach stronger, more persistent winds at higher altitudes. In addition, AWE systems are able to generate electrical energy from winds with less construction effort. This is projected to lead to cheaper renewable electrical power. However, this technology is very young and requires significant research, development and testing to become commercially viable.

## VI. References

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