A Study on Wind Power Evolutions
Airborne Wind Energy Systems in a Future Wind Energy Market

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Context of the study
ENGIE France Renewable Energy (EFRE) develops, builds, finances, and operates ENGIE’s renewable electricity generation assets in France (nearly 6,000 MW of installed capacity in 2017 [1]). In order to better understand future changes in wind power systems, EFRE has commissioned a study to 4 students of the ENSIE engineering school at Grenoble (France), under the supervision of researchers from Gipsa-lab and GAEL. The study aims at providing some decision-making elements for EFRE positioning on low wind-speed turbines (LWT) and airborne wind energy systems (AWES) in France (100-page report, 160 references, 1000h). This poster shows some key information and reflections from the study.

Wind Energy challenges

Identified barriers and challenges facing power generation from traditional Horizontal Axis Wind Turbine (HAWT):

- Availability of a proper site: onshore wind exposition, regulated distances and limitations, social acceptance, accessibility for transportation and distance to the grid strongly reduces wind farm potential sites.
- Integration into the grid: Following the penetration rates of wind energy in the power grids, the variability of production poses growing balancing problems.
- Offshore production imposes costs 1.5 to 2 times higher than onshore [3] and leads to uncertainties that discourages some manufacturers [4].

Legislative and regulatory issues can also have strong impact

Some key points on AWES

Transportation and installation
The absence of mast, reduced size of the foundations and reduced size of the kite leads to highly simplify transportation and installation.

Availability of production
By changing altitude to harvest energy, AWES is a more flexible system than HAWT. One can choose to operate where wind is maximum or go to altitude where wind is lower when the maximum power is reached. Power curves can also be adapted to wind distribution by modifying independently the size of the kite and the size of the generator, like LWT.

Compacity of wind farm to reach utility scale
MW is a minimal scale in order to reach an energy density comparable to that of conventional wind farms [MWh/(km²-year)]. Reducing the distance between AWES by sharing the same place at different altitudes has to be considered, as proposed in [8], [9].

Levelized Cost of Electricity (LCOE)
Only few studies have been found on the subject [10], [11]; for on-ground system, expected lower construction costs and higher maintenance costs could lead to intermediate LCOE. More reliable forecasts about costs necessitates a higher maturity of the technology.

Conclusion of the study for AWES

Better access to sites: Easier transportation, potentially less visual, electromagnetic and acoustic impact (to be better investigated).

Better distribution and adaptation of energy production: Possibility to harvest at different altitude, wind resource more stable at high altitude and potentially adapted to a low wind-speed design.

Potentially better adapted to offshore condition in terms of costs of fabrication and installation costs, in particular when floating farms are needed.

Strong uncertainties on the final cost: Immaturity of the technology leads to significant costs uncertainties in key areas, especially regarding flying parts, lifespan and its maintenance.

Remaining issues identified in security, energy density and automatic take-off and landing.

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