AIRBORNE WIND ENERGY

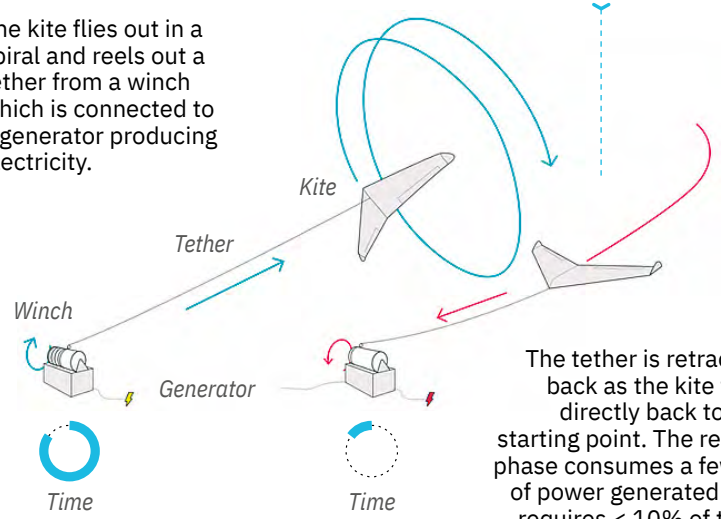
emerging renewable technology

CONCEPT

Airborne Wind Energy (AWE) is the conversion of wind energy into electricity using autonomous tethered flying devices. Most concepts convert the pulling power of the flying devices over a winch and a generator on the ground, while others combine onboard wind turbines with a conducting tether.

GROUND-GENERATION CONCEPT

The kite flies out in a spiral and reels out a tether from a winch which is connected to a generator producing electricity.



The tether is retracted back as the kite flies directly back to the starting point. The return phase consumes a few % of power generated and requires < 10% of total cycle time.

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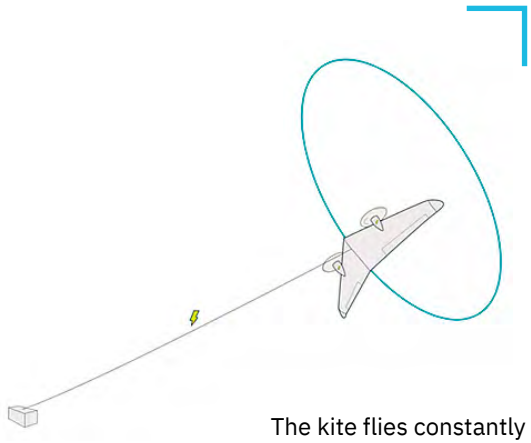

The kite flies constantly cross-wind, power is produced in the on-board generators and evacuated through the tether.

ON-BOARD GENERATION CONCEPT

ADVANTAGES

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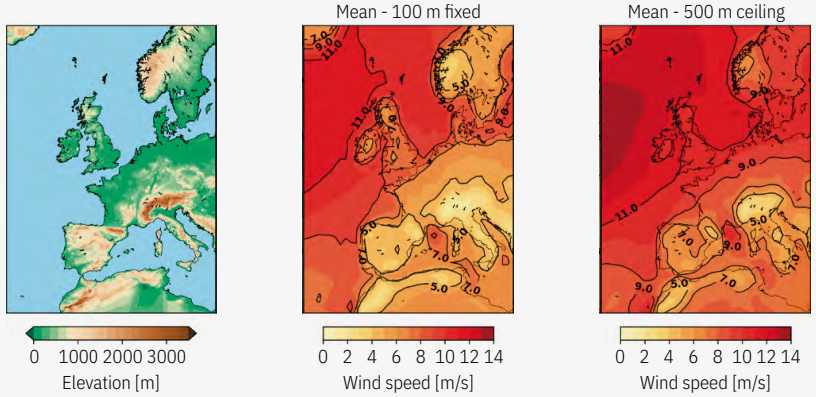
Low material use: Replacing the tower of a wind turbine by a lightweight tether substantially **reduces the material consumption by up to 90%**, thus decreasing the environmental impact with regards to the carbon footprint over the life-cycle as well as reducing visual impacts.

Additional wind resource: Wind at higher altitudes is an energy resource that has not been exploited so far. In 2018, the European Commission presented an independent, dedicated sector study which acknowledges the **potential of AWE to supply up to 100% of EU electricity demand with 1% of land use**. The maps show average wind speeds in Europe at typical hub height of wind turbines (centre) and at variable altitude of up to 500 m (right): Conditions that are usually only available offshore become accessible also onshore with AWE.



High capacity factor: AWE allows for **continuous adjustment of the harvesting altitude to the best available wind resource**. This increases the complementarity to other renewables in both stand-alone but also hybrid installations with solar PV and thus provides benefits for energy system integration.

Low costs: The decrease in capital costs (CAPEX) due to low material use, the increase in capacity factor, the easier logistics and quick set-up as well as the high power density per km² can potentially lead to a **substantial reduction of the levelized costs of wind energy** (LCOE).

Access to new markets: Since AWE systems are scalable from a few kilowatt to several megawatt (several companies plan to upscale to 1-3 MW devices over the next years), **many markets and locations can be accessed** like offshore repowering, floating offshore, mountainous and remote locations.

SECTOR DEVELOPMENT

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Deemed a potentially game-changing solution, AWE is increasingly attracting the attention of governments, policy makers and industry worldwide. Over the last decade, AWE has developed from a pool of conceptual ideas and first small-scale experiments into a vibrant field of R&D, producing a diverse array of technology demonstrators ranging up to power outputs of several hundred kilowatts.

Today, about 20 original equipment manufacturers (OEMs) are developing AWE technologies, and world-wide more than 50 research institutes, universities, industrial associations, companies along the supply chain, and utilities are involved in the sector at different levels. Every two years, the sector gathers at the AWE Conference series with over 200 delegates.

Critical technical challenges have been mastered, such as automatic energy harvesting, reliable sensors, and state estimation as well as developing tethered aircraft and kites for aerodynamic load cycles that are far more demanding than those for conventional aircraft and paragliders. Remaining challenges are the fully automated launching and landing, durable and lightweight materials to sustain a high number of load cycles, a systematically increased reliability and ensured operational safety including regulatory aspects.

The first companies have started commercialising their systems. Several others are planning to go to market in the next 1-3 years. To successfully enter the highly competitive and regulated European electricity market, AWE will require **specific policy support** to reach its full potential like other renewable energy technologies in the past. Apart from R&D and investment support – which is to some extent already available and used at European and national level – there will also be the need for revenue support schemes. First conversations with national governments have started.

AWE is currently primarily developed in Europe, thus making a strong case for EU industrial leadership in a technology that is difficult to replicate, with consequent benefits in terms of job creation and of global market leadership. **Airborne Wind Europe** was founded in 2018 as an association of European AWE industry and academia, with the objective represent the interests of the sector, establish joint working groups on important collaborative topics, like safety and technical guidelines, environmental impact etc.

To also foster international collaboration, in 2021 IAE Wind TCP task 48 on Airborne Wind Energy has been established.

If you are interested to know more about AWE, please contact Airborne Wind Europe or its members.

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