AWES

AIRBORNE WIND ENERGY SYSTEMS

WHERE INNOVATION MEETS SUSTAINABILITY

SUSI
SWISS U-SPACE IMPLEMENTATION

AIRBORNE WIND ENERGY SYSTEMS

AWES stand for an innovative way to produce sustainable energy with the force of nature. Even though there are still many questions in terms of the successful implementation of this new technology, it could have the potential to have a major impact for a sustainable future.

The practical use cases of aerial vehicles are almost inexhaustible. Just think of operational concepts in agriculture, commerce, search and rescue, meteorology and surveillance, to mention a few. However, the fact that drones also can be used to produce electricity is often forgotten. Indeed, the concept of Airborne Wind Energy Systems (AWES) is still very exotic, even in the arena of "clean" energy production.

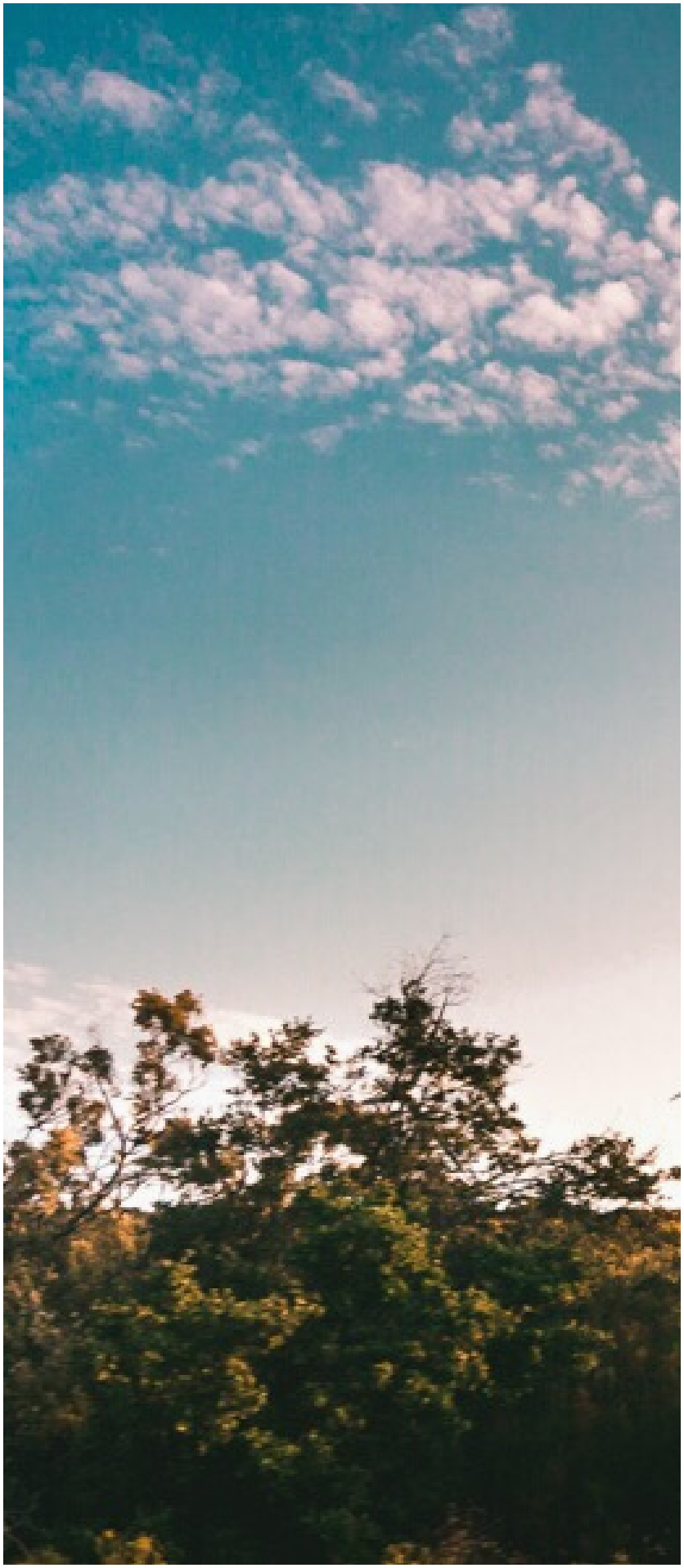
AWES is the umbrella name for a series of technologies wherein aerial vehicles are used to "collect" wind energy as they are attached to one or several tethers. While flying patterns in the wind, they harvest energy that is then transformed into electricity and conducted to the ground via power cables. Interestingly, even though this concept has been known for nearly fifty years, its practical implementation started only several years ago, thanks to the recent technological progresses in terms of automation, sensors, and materials.

THE GLOBAL GOALS
For Sustainable Development

Many expected comparative advantages

From an ecological point of view, it is clear why AWES can be seen as a potentially game-changing concept: the demand for energy is steadily increasing. More people are using electricity than ever before, with the proportion of the global population having access to this service rising from 83 percent in 2010 to 87 percent in 2015, and then accelerating to 89 percent in 2017, as the United Nations (UN) reports. Meanwhile, the economy has become reliant on fossil fuels, creating a devastating impact on our climate. Such developments definitively call for an "increased policy attention to the deployment of modern renewables," as the UN points out. In the light of this, AWES could have a major impact on meeting the goals for a sustainable future.

Indeed, the expected advantages of AWES are promising. Proponents claim that the technology would disrupt the way we will gather our energy in the future, as they are expected to be lower in cost, less complex in construction and installation, and 90% less consumptive in terms of materials, as compared to wind turbines, as presented at the IEA Wind TEM#102 event on Airborne Wind Energy on 23 September 2020.



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UNITED NATIONS

SDG 7

Ensure access to affordable, reliable, sustainable and modern energy for all

MORE PEOPLE ARE USING ELECTRICITY THAN EVER BEFORE [...] MORE FOCUSED ATTENTION IS NEEDED TO IMPROVE ACCESS TO TECHNOLOGIES FOR 3 BILLION PEOPLE, TO EXPAND THE USE OF RENEWABLE ENERGY BEYOND THE ELECTRICITY SECTOR

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Need for more statistical evidence

In light of these promised advantages, Andreea Perca, airspace engineer in the Swiss Federal Office of Civil Aviation (FOCA), advises that, at this point of technological development, several questions are still to be answered. Among the 10 companies in Europe developing AWES technologies with various technical and market approaches, the technology is still in the phase of research and development. In other words, no product is yet on the market. Thus, there is not enough supporting evidence to demonstrate the expected advantages in quantitative terms, "Due to the lack of statistical data, it is still to be seen how AWES are to bring progress in terms of energy reduction, cost savings, noise emissions, or social acceptability."

Furthermore, Perca argues that, as long as the technology has not been extensively tested and operationalized, "predictions about consequences" remain on fragile ground. However, research and collaboration are present. The International Energy Agency Wind Technology Collaboration Programme (IEA Wind TCP)—an international co-operation that shares information and research activities to advance wind energy research, development, and deployment in 24 member countries and sponsor members, including Switzerland and European Commission—supports information exchanges and research activities to advance wind energy deployment.

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ANDREEA PERCA
AIRSPACE ENGINEER AT FOCA

on the future operationalization of AWES

AS NEW AIRSPACE USERS, THE OPERATORS NEED TO TEST THEIR INNOVATION IN A SAFE MANNER.

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CHALLENGE IN COMMERCIALIZATION

One key component to address these open questions is testing. Perca explains that testing represents the key means to advance and assess the empirical consequences of the technology. Thus, the active involvement of national aviation authorities, such as FOCA, becomes crucial at this point. As Perca explains: “As new airspace users, the operators need to test their innovation in a safe manner.”

Companies need to have the possibility to develop their devices in real-world conditions and gain a deeper understanding of the operationalization of the technology.

Whereas most of the research in the last decade has focused on the modelling and simulation of AWES, as well as on the design and testing of prototypes, the focus is now also on take-off and landing and on reliability against changing wind conditions. Nevertheless, there are still many questions in terms of energy yields or capacity factors, “Quantitative answers can be expected to emerge once continuous flying is achieved,” Perca explains.

SWITZERLAND AS IDEAL TESTBED

Currently, there are two companies doing AWES testing in Switzerland, namely TwingTec and Skypull. Furthermore, there is further contribution through research activities in ETH Zurich and EPFL Lausanne. For issuing of flight permits, FOCA treats AWES as drones in the specific category, assessing the risks by following the Specific Operation Risk Assessment (SORA) methodology. Nevertheless, the conditions applicable in the testing environment are most probably not suitable to be maintained during the following commercial operation phase. Perca explains, “this discrepancy poses a significant challenge from a regulatory point of view, because a large-scale, appropriate airspace integration approach still needs to be developed.” For example, operating in low altitudes and in airspace class G would imply that AWES could interfere mainly with general aviation. Moving higher and operating in other airspace classes would trigger the need for additional considerations. Furthermore, the “tethered characteristic” poses additional challenges, as Perca highlights, “In certain conditions, the cable attached on the drone could pose a considerable risk to other airspace users that needs to be mitigated in order to be able to operate.”

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ANDREEA PERCA
AIRSPACE ENGINEER AT FOCA

THE U-SPACE ARCHITECTURE WILL GIVE MORE POSSIBILITIES TO DEAL WITH DYNAMIC OPERATIONS, SUCH AS OF AWES, BY INCREASED AUTOMATION AND EFFICIENT DATA SHARING

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U-Space as viable solution for the successful implementation

Overcoming these regulatory challenges requires early close coordination and open dialogue between AWES developers and FOCA, Perca argues. Furthermore, regulatory harmonization on a global level is key. “No extensive standards dedicated to AWES are available at the moment. Here, the IEA Wind TCP can play an important role by bringing together the relevant stakeholders.” Another focal prerequisite for the smooth and safe integration of the technology in the airspace will be the implementation of U-Space. Perca points out, “The U-Space architecture will give more possibilities to deal with specific operations, such as of AWES, by increased automation and efficient data sharing” Perca describes AWES as a “dynamic operation,” meaning that they are dependent on real-time weather conditions in order to operate. Furthermore, the usage of remote identification and other services within U-Space, would guarantee a more sustainable, safe, and flexible usage of the airspace, while supporting the use-case of AWES, as she highlights. Therefore, AWES would be connected to a whole network of interconnected devices, taking advantage of the information provided by the USSPs in the U-Space ecosystem.