

KITES HARVEST THE WIND

EnerKite uses wind energy 300 meters up

Double the output, half the costs, resource efficient and economically viable worldwide, – these are the powerful sales arguments of EnerKite GmbH, based in Kleinmachnow near Berlin, Germany, for using their airborne wind energy systems. Together with Bachmann electronic as partners for the control solution, they are working on the series phase of their product, which enables green electricity to be produced at an unbeatable price.



“Conventional small-scale wind turbines worldwide are commercially viable at less than two percent of possible inland sites,” Dr.-Ing. Alexander Bormann, CEO of EnerKite GmbH, explains the background to his work. “With our kites, electricity can be produced at 80 percent of possible sites worldwide – and at a considerably more economical price than with photovoltaic or diesel electricity.” They are in fact kites that EnerKite flies in the sky. These are flown at previously unattained heights: “Our kites fly at altitudes of up to 300 meters. The wind at this height is firstly stronger and more constant, and EnerKites can even supply maximum output at low speeds,” explains Alexander Bormann. Airborne wind energy systems can also be optimally adapted to

constantly changing wind conditions with an intelligent operational control. With well over 5000 full load hours on inland sites, the use of wind energy offers a previously unknown level of profitability and supply security.

» We rely on partners who are worldwide leading experts in their field.«

Dr.-Ing. Alexander Bormann, managing partner of EnerKite GmbH

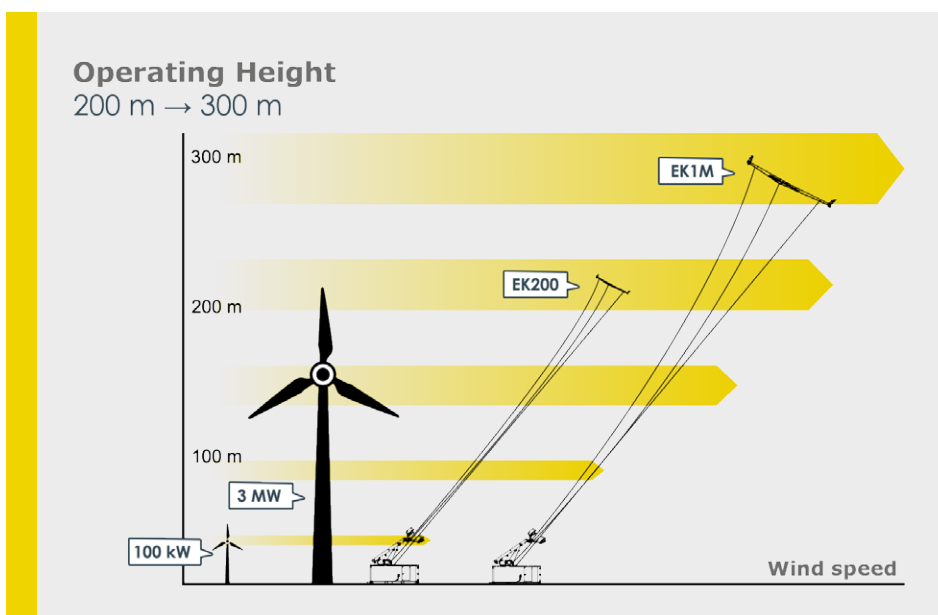
High-tech system with only a few components

Ultralight and highly efficient wings make up the core of this technology. They are optimized for optimum lift and, thanks to their rigid construction, have the flight capacity of a glider. These are the basic requirements for productive operation of the airborne wind energy plant. The wings are connected with the winches on the ground by means of three wear-proof high-performance synthetic lines. A generator is located in the main line drum. “We are proud of ▶▶

EnerKite

EnerKite GmbH, headquartered in Kleinmachnow near Berlin, Germany, was founded in 2010. The core team has been working on the development of automated kite systems since as far back as 2006.

▶ www.enerkite.de



◀ The winds at altitudes of 200 to 300 meters at inland locations are more powerful and constant. For wind power plants, these are heights that are only achievable with a great deal of expenditure and effort.

▶▶ this in-house development. We have patented an integrated generator unit which offers an extremely large and variable speed range, without accepting any compromises in efficiency or costs," a delighted Alexander Bormann explains. A Bachmann M1 controller is responsible for controlling the complex flight movements. Each plant also includes a battery storage system as part of the basic equipment. Power inverters transfer the electricity to the consumers or feed it into the grid.

Fully automated operation

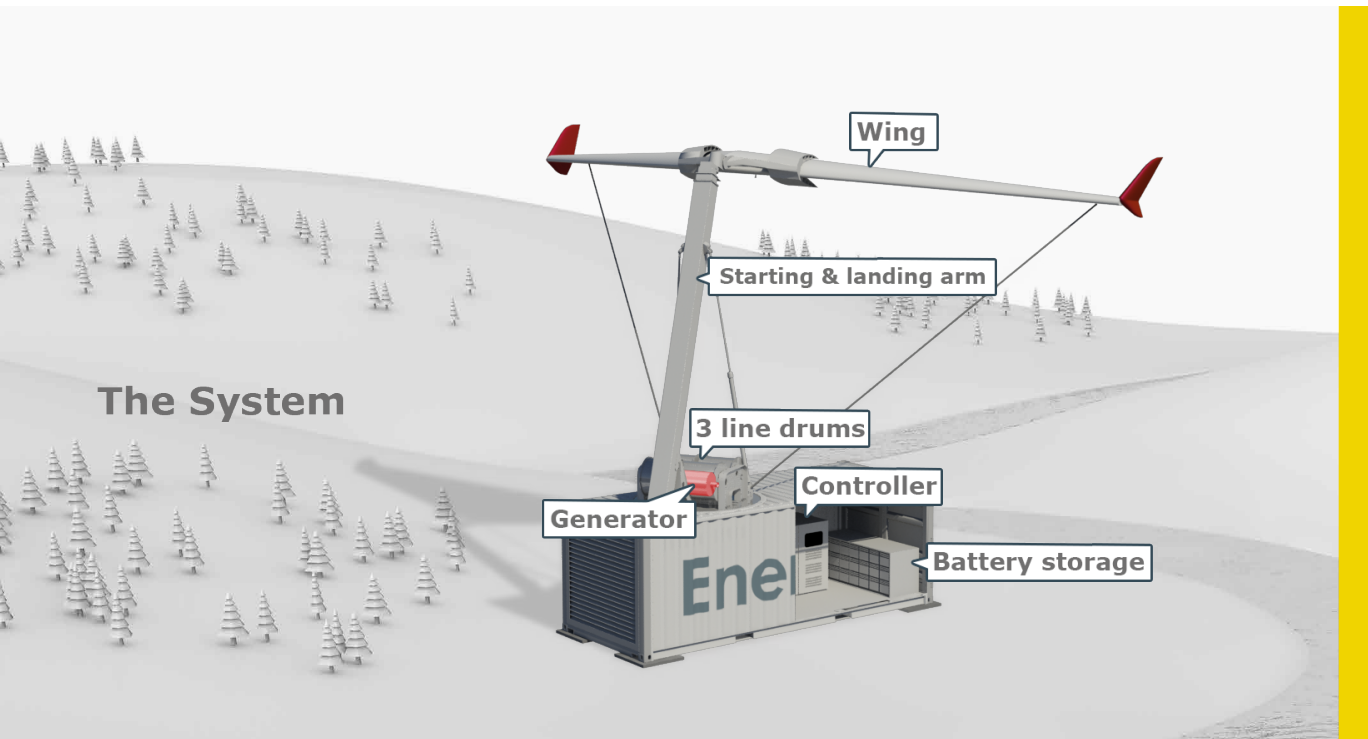
The operation of the airborne wind energy plant couldn't be simpler: The EnerKites work cyclically in two phases. During the power phase the wing flies in figures of eight and makes its ascent. At the same time the unfurled line drives a generator winch on

the ground. In the recovery phase, the kite returns directly with minimal energy expenditure – using a fraction of the previously harnessed energy – and starts a new power phase. One cycle takes around one minute, and a recovery phase only lasts 10 seconds. "Unlike conventional wind power plants, our system generates electricity on the ground," Alexander Bormann explains. "This is also where the wing is controlled, so that only the object in the air is what actually belongs there. The start, operation and landing of the wing are fully automated."

The wing is fixed to a rotating arm system which takes it up to the necessary speed for the ascent before releasing it from the end of the arm so that it starts operation. "This system allows us to start up automatically even at very low wind speeds," Alexander

▼ Only what belongs in the air is put in the air: All components that are needed for energy conversion and control are housed in a container on the ground.

The System





▲ For the test run EnerKite uses a truck as the ground unit where the electricity is produced by a generator.



▲ Dr.-Ing. Alexander Bormann, managing partner of EnerKite GmbH and Dipl.-Math. Max Ranneberg, Simulation & Control

Bormann explains the benefit. The telescopic arm is then retracted and stays in place until the wing has finally landed. "The arm then moves out again and rotates with the wing while the lines are wound in," Alexander Bormann explains. "Once the wing snaps into position at the end of the arm, it is retracted and tilted in the park and maintenance position."

Complex control implemented with Bachmann

The EnerKites can be used all round the world. "Regardless of whether you are feeding into the grid or are running an island application, require a replacement for combined heat and power units in commercial or agricultural plants, or where there is an absence of supply security in crisis regions – kites can be used in all these places," Alexander Bormann describes. He is absolutely convinced that the 2017 market launch will be successful. "Before then we still have to complete a year long test run and complete the last stages," Bormann continues. "The main priority now is the thorough testing of the automatic starting and landing."

The specialists from EnerKite and Bachmann

electronic are also working intensively together on this. The M1 automation system is used for controlling flight movements, for operational control and for condition monitoring. "We first tried our hand at building our own controller, however, we realized that this was not part of our core expertise," Dipl.-Math. Max Ranneberg, from Simulation & Control at EnerKite GmbH, openly admits. "All the more fortunate for us that we found a partner in Bachmann who helped us get the controller running problem-free already after a week and our kites have been flying reliably ever since."

Maximum safety

The wings of the kites are modeled and simulated with MATLAB®/Simulink®. The results of this then flow directly into the optimization of the controller algorithms. "We have to ensure the safe landing of the kite in all circumstances, even if all of the main functions fail," Max Ranneberg stresses. The flexibility required for the different operating conditions is also provided with the Bachmann controller: "The M1 automation system can process a host of different signals directly. This enables us to also respond to environmental influences, ►►

▶▶ such as weather or climatic conditions, and adjust operation accordingly," a delighted Max Ranneberg explains.

Overcoming challenges together

"We are really impressed with Bachmann," Alexander Bormann confirms. "The company is effectively organized to meet the needs of its customers. This is important for us and guarantees a high degree of reliability and quality. There is no alternative for us here: Faults on the product are not permissible." The Brandenburg-based startup company is also well aware of the fact that the industrialization of airborne wind technology will present the team with several more

challenges. "The idea on its own is not enough, but a complex system has to be understood. This is difficult to achieve on one's own. That is why we rely on worldwide leading experts and pioneers," Alexander Bormann explains. "We have clearly done well here with Bachmann."

▶ Cyclical process:
In the power phase, the wing ascends for approximately one minute in figures of eight and harnesses the wind energy. This is followed by the recovery phase in which the kite returns to the starting level in 10 seconds.

