

## COMPANY

**enbreeze GmbH**

## LOCATION

**Cologne, Germany**

## SOFTWARE

**Autodesk® Inventor®  
Autodesk® Simulation CFD  
AutoCAD® Mechanical**

# Compact, light, sophisticated

## enbreeze creates durable small-scale wind turbines using Autodesk software

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—Jan Dabrowski  
Founder  
enbreeze GmbH



Image courtesy of enbreeze GmbH.

### Project summary

Wind power is a leading form of renewable energy. It is not only one of the safest and most eco-friendly sources of clean energy, but it also has an extremely small environmental footprint and offers almost constant availability. It is hardly surprising then that turbines—sometimes forming giant wind farms—are becoming a more and more integral part of our landscape. Yet there is no intrinsic reason why this particular form of renewable energy has to be produced on such a grand scale. As energy prices continue to rise, there is an opportunity for ordinary consumers to contribute to a more sustainable world, and create long-term cash savings in the process. Hence the popularity of domestic wind turbines, which can either be mounted on a rooftop or sited in a garden.

The problem with many of these small-scale systems, however, is that they require high wind speeds in order to operate efficiently and are therefore not suitable for all locations. It was precisely this point that inspired Martin Riedel and Jan Dabrowski to develop a new generation of compact wind turbines. Based in Cologne, Germany, the two young entrepreneurs founded enbreeze GmbH in April 2011 and, in collaboration with the Karlsruhe Institute of Technology and a number of other research bodies, developed an innovative technology to make small-scale wind turbines a viable proposition in low-wind areas.

### The challenge

Most conventional wind turbines have a rotor diameter of between 40 and 90 meters. On the enbreeze, it is just 3.5 meters. "Our turbine is compact, light, and sophisticated in its design," says Jan Dabrowski, director of enbreeze. "Weighing no more than 25 kilos, it can be mounted easily on a domestic rooftop." The unique characteristics of the enbreeze design mean that it can also generate significant amounts of energy in low-wind areas: Riedel and Dabrowski aim to produce a small-scale wind turbine that can be used in any location throughout Germany. They approached the problem by creating a totally new turbine control system. The key feature of the technology is the way the rotor blades can be turned out of the wind when the wind speed reaches a given threshold.

"The wind turbine generates a lot of energy at low wind speeds, but if the speed increases above six meters per second, output is automatically capped. Even in high winds and stormy conditions, it produces exactly the same amount of energy as it does at six meters per second," Dabrowski explains. "The key advantage of the system is that the loads on the turbine remain the same at all times. As a result, it is possible to make all of the components that much lighter, which in turn provides a crucial cost saving."

The Autodesk Clean Tech Partner Program supports clean technology innovators with design and engineering software they can use to accelerate their development of solutions to the world's most pressing environmental challenges. For more information, visit [autodesk.com/cleantech](http://autodesk.com/cleantech).

# With Autodesk Inventor, enbreeze can identify and correct potential weaknesses in the turbine early in the design process

## The solution

enbreeze plans to bring its first small-scale wind turbine, designed primarily for domestic installation, to market in spring 2013. Being entirely noise-free, and therefore owner- and neighbor-friendly, the system is the perfect complement to existing solar installations. The obvious disadvantage of solar power is that most output is produced during the warmer months of the year and only during daylight hours. By combining both technologies—wind and solar—it is possible to generate sufficient energy even when the solar component is reduced.

“Combining photovoltaic systems and small-scale wind turbines like ours is a long-term, cost-efficient way for householders to meet their energy needs. We believe we’re on the path to what may be total energy independence for private households,” says Dabrowski.

How much of that demand can be met by the enbreeze turbine is largely down to location. Under typical wind conditions in Germany, the system produces around 800 kilowatt hours per annum, approximately one-quarter of the annual energy consumption of the average four-person household. Used in conjunction with photovoltaic panels, a single enbreeze turbine can therefore produce more than 50 percent of domestic energy requirements. In other words, this investment has financial as well as environmental benefits. “Our turbine is built with durability in mind and should be entirely maintenance-free for up to 15 years,” says Dabrowski.

## Simulation software makes development easy

enbreeze developed an initial prototype with a rotor diameter of 1.4 meters. It has since been used to test and optimize the new blade control system and as a result, all necessary modifications will be fully implemented by the time the first production units are installed in private households in 2013. Riedel and Dabrowski used

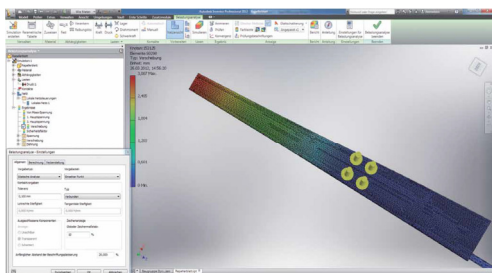


Image courtesy of enbreeze GmbH.

product design software from Autodesk® when developing the prototype, creating all of the digital 3D models required during development using Autodesk® Inventor®. With Inventor, it is possible to determine the centrifugal forces and moments on the blades, quantities that are key to the operation of the new control system. It is also possible to identify and rectify potential weaknesses in the design at an early stage in the process, saving time and money later on. In addition to Inventor, the company plans to use two other Autodesk products: Autodesk® Simulation CFD® and AutoCAD® Mechanical.

Dabrowski had already worked successfully with Autodesk Inventor while completing his degree. When he and Riedel made contact with Autodesk, they learned about the Autodesk® Clean Tech Partner Program. The purpose of this initiative is to provide qualifying startups in the clean-tech industry with Digital Prototyping software worth up to 120,000 euros for a nominal price of just 50 euros. This enables them to develop, visualize, and simulate their ideas in digital form before finally committing to a physical product. As a result, these companies can reduce the time to market and devote more resources to innovation.

“The future lies in the development of alternative energies. At Autodesk, we consider it our responsibility to support young and innovative businesses such as enbreeze in the development of clean energy technologies. By bringing their ideas to life, these startup companies can help to protect our environment,” says Erwin Burth, head of Clean Tech Business Development at Autodesk.

For enbreeze, the program is a unique opportunity to acquire professional-grade software at virtually no cost. “Autodesk software is extremely important for us; without it, we wouldn’t have been able to develop our ideas to the extent that we have,” says Dabrowski.

## The result

enbreeze plans to source the components for their first production turbine from local manufacturers to ensure a ready supply of replacement parts in the event of damage or failure. As Dabrowski explains, “Obviously we want the product to look good, but the main consideration is that it is reliable and tough enough to withstand environmental conditions. ‘Made in Germany’ is a quality hallmark that immediately creates confidence among consumers.”

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The dealers and installers who will market the turbine are also based in Germany. enbreeze gave preference during the selection process to those who also specialize in photovoltaic systems, in order to make it easier for customers to source a combined wind and solar installation. Looking forward, enbreeze has its sights firmly set on expansion. A number of students currently work with the company, either in preparation for a final thesis or as trainees, and the aim is to increase the workforce to more than 20 employees over the course of the next three years. The longer-term goal is to augment the existing domestic turbines with larger systems for higher-volume consumers, such as agricultural operations.

## For more information

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