

# Turbine technology re-think aims to boost power production

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Harnessing the power of wind has long been recognised as an important alternative source of electricity generation. Now, a new European project is aiming to improve the technology and make it even more competitive

Germany-based Semikron, one of the world's leading manufacturers of power modules and systems, is setting its sights on overhauling power electronic components of wind turbines as part of the European Windtrust project. The aim is to reduce the number of components and interfaces by 40 to 60 percent. Thomas Grasshoff, Semikron's Head of Strategic Marketing, explains what this aims to achieve.

## **What are power electronics?**

Power electronics in a wind turbine convert non-regulated power from the generator into an AC output voltage of 690 volts. The converter has a generator and a line inverter to feed a voltage waveform into the electricity grid.

## **What are the key issues with wind turbine reliability?**

Next-generation designs of wind turbine inverters need to be more reliable, more compact and less expensive to bring down the costs of installation and operation.

Actual low-voltage designs have reached their limits for current capability, weight and size. The reliability of a wind turbine is a result of the reliability of the different parts. The inverter with the power electronics is a major functional block and essential for operation. It is located in the nacelle or in the base, depending on the design of the wind turbine.

Particularly in the nacelle, and depending on each OEM's specific implementation, the inverter can be exposed to vibration, humidity and pollution. These three factors are the major source of failure besides the statistics—the more parts that are used, the more defects can happen.

## **Tell us more about the specific challenges with power electronics?**

The challenge for power electronics is the scalability. Building blocks have to be combined to achieve power up to six megawatts or even more.

If the power electronics are not protected by a sealed rack, this is when they will be exposed to dust and humidity. If the inverter operates in a low-temperature environment, condensation may happen. Condensation causes a water flow over the electrical design and will impact the voltage isolation.

If it reaches areas of different voltage, a catastrophic failure can happen. Today, only expensive sealing and heating systems prevent such a situation.

Another critical area is the dynamic load conditions during wind turbine operation. The power electronics have to adapt to a change in conditions in a millisecond range. This causes fatigue to components, which heat up

and cool down. This is known as power cycling.

## **What are the key improvements you are working on as part of Windtrust?**

Semikron is focusing on humidity protection, scalability and a reduction in the number of components. The basic idea is to make power electronics more compact, increase reliability using less parts and boost protection.

'SKiN,' a new assembly technology of power semiconductors, is being adopted. It improves the reliability of power electronics and is a pre-condition of making the inverter smaller.

Bond wires are replaced by a flexible foil to establish a larger contact area and solder joints are replaced by sinter connections, which have a melting temperature five times higher. Thermal efficiency is improved by 30 percent, meaning power electronic chips are better cooled and more power can be extracted.

The need for compact systems, high reliability and low cost means that new technology approaches are demanded and the traditional modules used in [power electronics](#) will gradually vanish from the market.

The key here is the reduction in system costs. By equipping smaller power electronic components, racks, connectors and cables are all reduced, too.

## **What impact could the changes have on wind turbine use and what will this mean for consumers?**

If the costs of wind energy go down, and parity with fossil energy

sources is achieved, more [wind turbines](#) will be installed. Energy prices will stabilise, or even go down in the future.

In developed countries, the number of possible windfarm locations is reduced progressively. In such low-wind areas, the need for more efficient and reliable energy production, like technologies pursued by Windtrust, is a must.

The future is also in offshore, where costs must also go down and reliability increase is paramount.

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