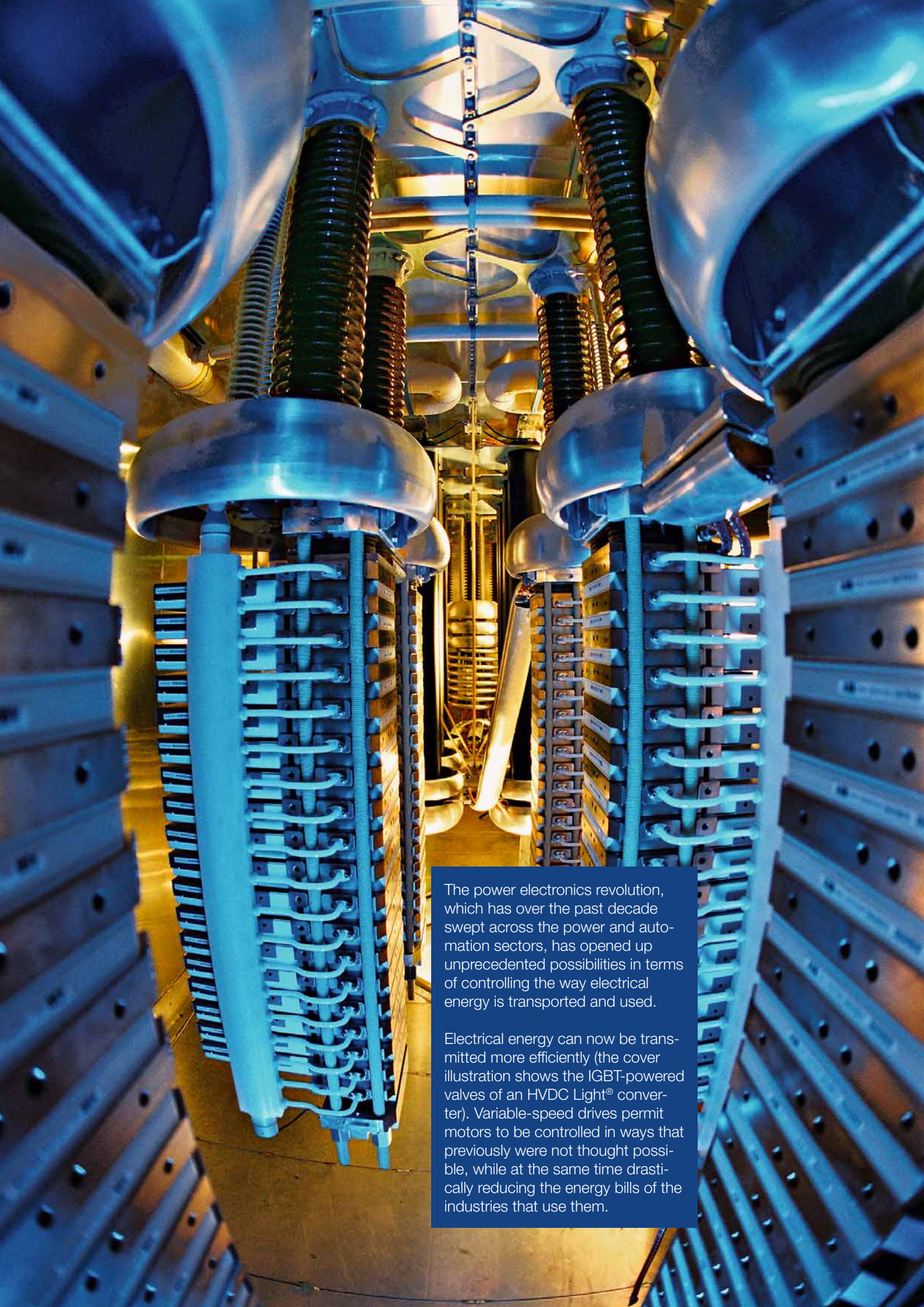

The power electronics revolution, which has over the past decade swept across the power and automation sectors, has opened up unprecedented possibilities in terms of controlling the way electrical energy is transported and used.

Electrical energy can now be transmitted more efficiently (the cover illustration shows the IGBT-powered valves of an HVDC Light® converter). Variable-speed drives permit motors to be controlled in ways that previously were not thought possible, while at the same time drastically reducing the energy bills of the industries that use them.

The unseen evolution

We have grown used to the thought that millions of transistors enable the performance of our laptops and consumer electronics. But would you have believed that someday our electrical power would flow through billions of transistors?

Whereas early rectifier and inverter stations had a handful of diodes or thyristors, a modern HVDC Light® station may have 100 billion transistors, when the number of IGBT modules, the chips within those modules and the microstructures on those chips are considered. The sheer scale of integration required leads to high demands on reliability, requirements that ABB's advanced design and manufacturing teams are well-equipped to meet.

When ABB developed its first silicon diode with 100 A and 600 V in the early 1960s, nobody in their wildest dreams could imagine that such complexity, sophistication and fine-tuned functionality could ever be reached. Nor could anyone predict that electrical current, en route from the power plant to the end customer, would flow through controlled silicon junctions, managing several hundred MW of power today, 10,000 times that just half a century ago.

No wonder power semiconductors have taken the leading role in almost all electrical applications: Drives to efficiently operate motors are available from 10 W to several hundred MW. Electrical energy up to 6 GW can now be transmitted through HVDC lines at almost 1,000 kV. Trains, elevators and cranes run smoothly with power electronics. The connection of renewable energy sources, such as wind turbines, to the electric grid is enabled by converters. Even radar systems depend on power semiconductors to securely operate air traffic.

In all these achievements, ABB has played a leading role. *ABB Review* is proud to present a collection of applications, as well as the technology itself, that makes all this possible. Not only does the technology add comfort and productivity when applied, it also helps to save energy. ABB's product and system portfolio, aimed at increasing energy efficiency, is very broad and almost all offerings depend on the use of power semiconductors.

As individuals, we see the enormous progress of electronic components in our computers, digital media players, digital cameras, etc. A similar but much less visible evolution has also occurred in electrical power – but this is one that we easily take for granted, not recognizing most of the huge progress. This edition of *ABB Review* will take you behind the scenes, revealing the infrastructure that has become a natural part of our lives.

Enjoy your reading.

Peter Terwiesch
Chief Technology Officer
ABB Ltd.