Net-Zero-CO_2 by 2050 is NOT Enough!

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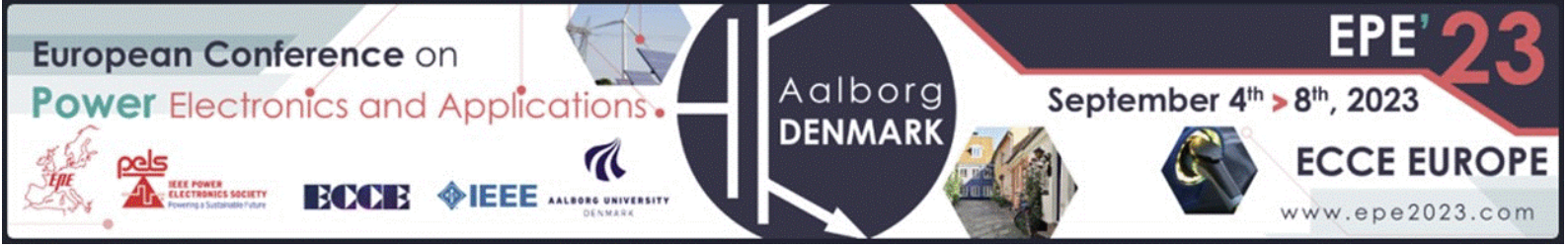
Abstract of the Keynote Speech:

The transformation of the fossil-fuel-based energy system into a new Net-Zero-CO_2 all-electric system will rely on a massive extension of the electric grid infrastructure and a massive installation of power electronic converters and energy storage systems. However, assuming a typ. 20 years lifetime, converter systems installed today will need to be replaced already by 2050, i.e., at the commonly accepted date for reaching the Net-Zero-CO_2 target. Given the scale of the future Internet of Energy, the maintenance or replacement effort at some point will potentially run into depletion of scarce raw materials and large volumes of waste and associated environmental problems. This clearly indicates that "Net-Zero-CO_2 by 2050 is NOT Enough" and underlines the urgency of a transition from a Linear Economy to a Circular Economy, which ensures that the Net-Zero-CO_2 target is reached on a sustainable basis, i.e., with minimized environmental impact in all aspects. The talk will first introduce metrics for measuring the environmental impact of power electronic converters and explain the concepts of Life Cycle Analysis of systems and of a Circular Economy in contrast to the Linear Economy dominating today. Next, the utilization of degrees of freedom of the design of power electronic converters for maximizing repairability, reusability, and recyclability while minimizing the use of critical materials, toxic substances, and ultimately waste will be shown at the example of EV chargers and PV inverters employing different power semiconductor technologies and circuit topologies. Finally, a roadmap for the introduction of environmental awareness into the power electronics design process will be proposed in order to ensure that power electronics as the main enabler of a Net-Zero-CO_2 society reaches full compatibility with a Circular Economy at the earliest point in time possible.

Curriculum Vitae:

Johann W. Kolar is a Full Professor and the Head of the Power Electronic Systems Laboratory at ETH Zurich, a Fellow of the IEEE, and an international member of the U.S. National Academy of Engineering. He has proposed numerous novel converter topologies and related control concepts, incl. the Vienna Rectifier and the Sparse Matrix Converter, has spearheaded the development of x-million rpm motors, and has pioneered fully automated multi-objective power electronics design procedures. The focus of his current research is on ultra-compact/efficient WBG converter systems, ANN-based design procedures, Solid-State Transformers, ultra-high speed drives, bearingless actuators, and life cycle analyses of power electronics converter systems.



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