

Superconductivity for Green Energy

Tabea Arndt, and Mathias Noe

Karlsruhe Institute of Technology (KIT), Germany

E-mail: Tabea.Arndt@kit.edu

Abstract—Sustainable or Green Energy will be the basis of our energy and power supply. In 2020 renewable energies reached almost 30% of global electricity supply and it is common understanding that latest by 2050 more than 95% of our total energy needs to be low-carbon. Wind and solar energy are a cornerstone in all scenarios and they will supply the energy for the electrification of some sectors (e.g., mobility, power to X). Superconductivity enables very high current densities at low losses and is therefore ideally suited for compact and efficient power applications. Recent progress in superconducting power applications (e.g., cables, rotating machines, fault current limiters) showed many successful prototype tests and a trend towards higher ratings to cover a broader range of applications.

The main aim of this presentation is to give an overview on the opportunities for superconductivity in an all Green Energy power supply. Firstly, we elaborate on Green Energy, or better Sustainable Energy. We draw the overall picture of nature and how mankind should be part of that. There historic development of energy flow is sketched and impact on technology in general will be indicated. Selected main drivers in developed countries are identified. The overall goal of Sustainable Energy is formulated, and key options as well as roadblocks are highlighted. Following that, the state of the art and the opportunities of Superconductivity in generation, transmission and distribution and use of energy is discussed in detail. Superconducting cables, fault current limiters, transformers and rotating machines are covered in detail in stationary as well as mobile applications. Storage options are mentioned, too, and the role of Fusion in sustainable energy is discussed.

It can be concluded that the transition to Green Energy accelerates the need for new and advanced technology in many power applications ranging from reliable distribution and transmission to efficient use and powerful storage. In this respect, Superconductivity has many opportunities for promising applications but besides the technical and economic progress, the willingness of the stakeholders is mandatory.

Keywords (Index Terms) — Electrical power; liquid hydrogen; cable; fusion; generator; fault current limiter; high temperature superconductor

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