Karlsruhe Institute of Technology

Faculty of Electrical Engineering and Information Technology

Institute of Electrical Engineering (ETI)

Innovative Storage Systems with Increased Energy Efficiency

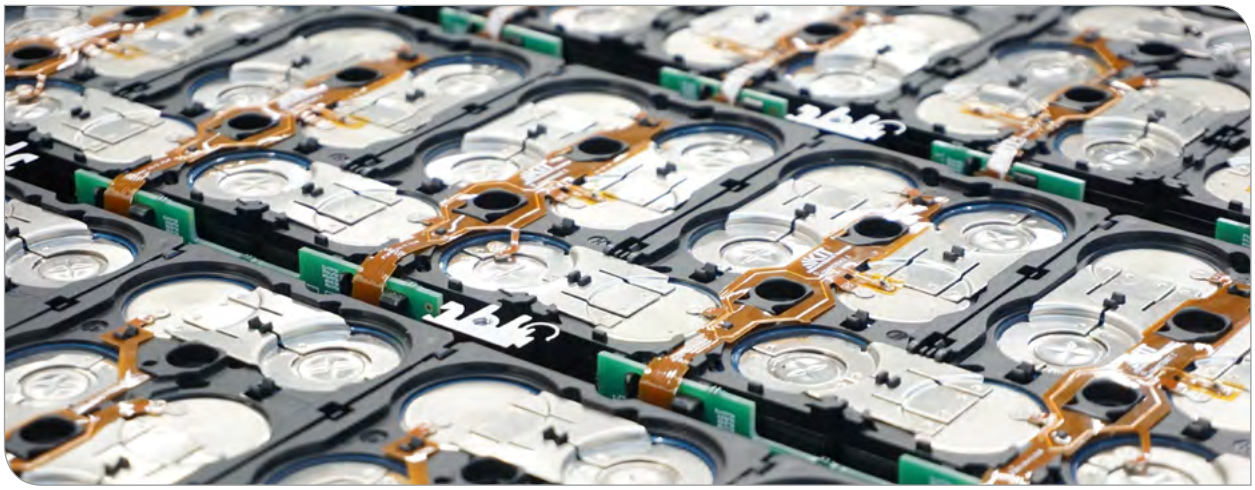
Important aspects of the energy transition are intelligent power usage and energy efficiency optimization. In this respect highly performing hybrid storage systems can significantly reduce peak loads and recuperate braking energy. The objective of the project "FastStorage Baden-Württemberg II" was the development of such high performance hybrid storage systems. Therefore, capacitor's high-current capability was paired with the high energy density of Li-ion batteries to generate a new cell technology, the so called Powercaps. The Karlsruhe Institute of Technology (KIT), among others, was responsible for the development and production of Powercap based storage systems. Those prototypes were integrated and tested in industrial applications for the first time.

Storage system requirements

- Transfer of **high-current capability (20C)** from cell to system level, using low resistance cell connection technology and an appropriate heat dissipation concept
- **Modular manufacturing concept** to serve a variety of applications (24V-690V)
- **Reliability and safety** of the storage system through automated production and incorporation of an intelligent Battery Management System (BMS)

The main focus was to convert the high-current and pulse load capability of the Powercaps to the storage system level. For this purpose an adequate cooling concept, which ensures a homogeneous cell load and sufficient cooling, as well as a suitable high power module concept was developed. Through a fully modular design all components such as BMS, cell packs and housing are scalable. Therefore, various requirements can be met.

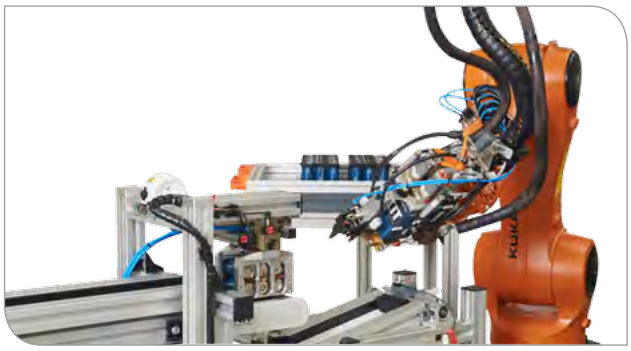
The BMS development is based on the requirements of Powercaps. It monitors continuously all relevant process parameters like single cell voltages, temperatures and current loads and turns off the storage system when exceeding a defined limit value. A redundant and multi-level safety concept guarantees a safe operation of the system in industrial applications.



Uncovered Powercap battery module

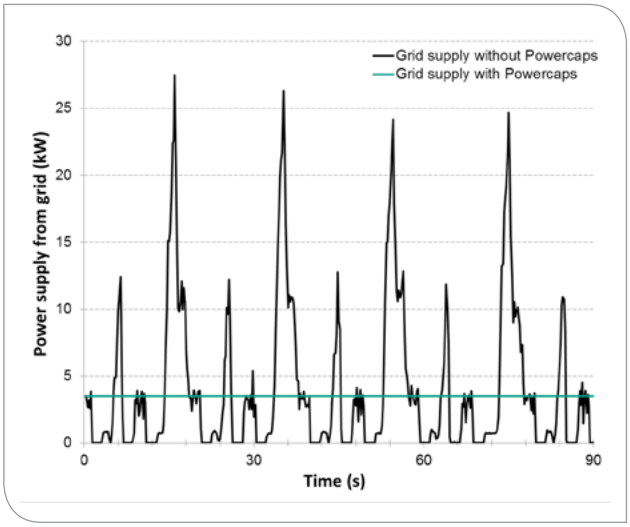
The storage systems were manufactured in a semi-automated production line. The heart of this production line consists of a welding robot which connects the single cells automatically by resistance welding. The high level of automation ensures a high quality and reproducibility.

The results of the prototype tests demonstrate: The reliable, cycle resistant and high-power storage system reduces the grid power by up to 22 kW (see figure below on the left) and fully recovers the braking energy in high dynamic operation (see figure below on the right).

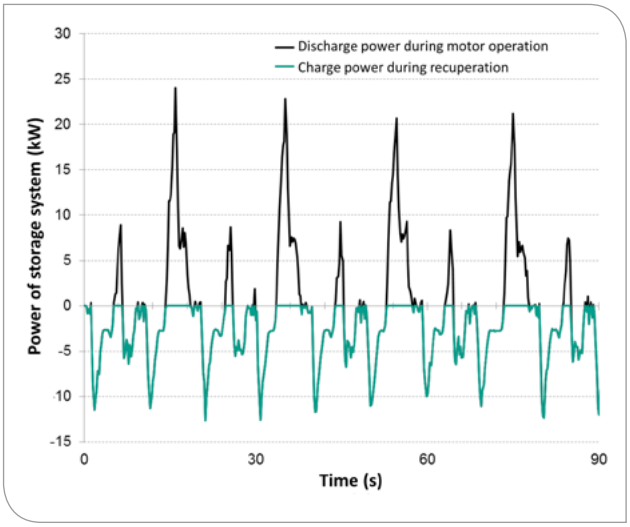


Production line for Powercap module assemby

The project „FastStorage BW II“ is funded by the Ministry of Finance and Economics Baden-Württemberg with a budget of 25 mio €. It is coordinated by the Fraunhofer Institute for Production Technology and Automation (FhG IPA) in Stuttgart. In addition to KIT, VARTA, SEW, Viastore, FhG ICT, ISW, EEP, ZSW, Freudenberg, IFSW, Kromberg & Schubert, Daimler and Porsche are involved as project partners.



Grid supply of high rack feeder without and with Powercap storage system



Charge and discharge power of storage system in operation

Karlsruhe Institute of Technology (KIT)
Institute of Electrical Engineering (ETI)
Battery Technical Center
Hermann-von-Helmholtz-Platz 1
76344 Eggenstein-Leopoldshafen
Phone: +49 721 608-28931
Email: office@batterietechnikum.kit.edu
www.batterietechnikum.kit.edu

ETI Elektrotechnisches Institut

FastStorageBW II

Karlsruhe Institute of Technology (KIT) · President Professor Dr.-Ing. Holger Hanselka · Kaiserstraße 12 · 76131 Karlsruhe · www.kit.edu