

Competence E – Focus on Electric Energy Storage

Generation, storage and use of electric energy on a sustainable and cost-efficient basis are among the biggest global challenges for the next decades. In the long run, only those institutions will be successful, which pursue a comprehensive, multidisciplinary approach along the complete value chain. Therefore, the Executive Board launched the Competence E umbrella project on January 01, 2011 in order to pool the competencies of KIT and extend them by developing an integrated technology platform for future electric energy stores and electric drive trains. More than 25 scientific groups on KIT Campus North and Campus South are contributing to the project.

In several phases, a research and competence center will be established to help Germany assume and defend its place among the leading nations in this field worldwide. Due to its strategic importance and its interdisciplinary character, Competence E is directly subordinated to KIT President Professor Eberhard Umbach. Dr. Andreas Gutsch, a dedicated manager with decades of relevant experience, was appointed as project coordinator.



Contact

Competence E at KIT

Coordinator

Dr. Andreas Gutsch

Phone: +49 721 608-26844

E-mail: andreas.gutsch@kit.edu

Systems Management

Dr. Olaf Wollersheim

Phone: +49 721 608-28380

E-mail: olaf.wollersheim@kit.edu

Project Management

Laura Silbernagel

Phone: +49 721 608-26844

E-mail: laura.silbernagel@kit.edu

Project Office

Britta Crocoll

Phone: +49 721 608-28931

E-mail: britta.crocoll@kit.edu

Issued by

Karlsruhe Institute of Technology (KIT)

Kaiserstraße 12 · 76131 Karlsruhe · Germany

July 2011

www.kit.edu

Electric Energy Stores and Drive Trains

COMPETENCE E



Competence E at KIT

Zero emission, individual and dependable – these are the expectations our mobility will have to meet in the future. Electromobility can meet these expectations without the use of already scarce fossil resources. Special challenges lie in the fields of energy storage, drive trains, and power distribution infrastructure.

E-Mobility is a topic that meets with unique prerequisites at KIT.

- KIT assumes a leading position in the fields of energy conversion, storage, and infrastructure in Germany.
- For a long time, KIT has been working on improved battery materials.
- KIT links nanotechnology with latest methods of materials research.
- KIT pools competencies along the value chain from battery materials to vehicle and stationary integration.
- KIT accepts the challenge of designing holistic solution concepts for electromobility.
- KIT advises politics and society in establishing adequate framework conditions for E-Mobility.
- KIT serves the product development process from materials to cells and systems design to process and production engineering.

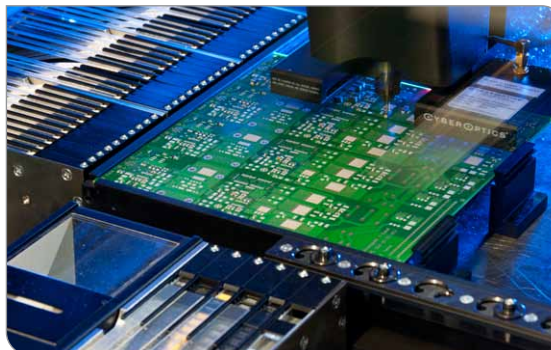
KIT will play a leading role worldwide in the fields of electric energy stores and the corresponding electric drive trains.

KIT research consistently covers the entire electric vehicle system along with its components:

- Electrochemical cell and battery technology
- Battery Management Systems (cascadeable, master-slave)
- Inverter and motor control
- Central control of the complete vehicle (Vehicle Control Unit)

The research objectives are in line with the requirements of conventional and modern vehicle technologies.

- Cost optimization (manufacturing and operational costs as well as reduction of target costs)
- Efficiency optimization
- Improvement of intrinsic safety
- Longer durability
- Increased operation tolerance in terms of environmental impacts and operation conditions (temperature, air humidity, vibration, mechanical shock, crash)
- Improved maintainability
- Increased reliability



Research for E-Mobility at KIT

Materials Development (Cathode, Anode, Electrolyte)

- Low-cost resources and manufacturing processes
- Long durability and high cyclic stability
- Low power loss
- High peak power stability
- High onset temperature for thermal runaways and intrinsic safety
- Wide operation temperature range
- Energy density above 250 Wh/kg on battery system level

Energy Storage Systems Development

- Optimization of assembly and disassembly
- Permanent connection of stores of high electric conductivity
- Reliable control of thermal loading
- Optimized control algorithms, including prognosis software (BMS)

Engines Development with Modular Components

- Low-cost setup elimination of rare earth materials
- High specific power-weight ratio (> 3 kW/kg)
- High specific torque-weight ratio (> 10 Nm/kg)
- Maximum peak efficiency, goal > 95 %
- Wide operation range with high efficiency (goal > 90 % in the part-load range)
- Modular setup

Engine and Charge Control

- Tridirectional AC/AC/DC power unit of up to 800 VDC
- Stationary bidirectional charging system DC/DC of up to 800 VDC
- Power and charge control

Control of the Complete System

- Central compilation of all subsystems data
- Central control of the overall system
- Communication of the relevant data at the man-machine interface
- Development of stationary energy stores for stabilizing local electric networks

Production Infrastructure

- Construction of an integrated research fab
- Functional validation of the entire electric drive system
- Development of prototypes and small series