

Competence E – Focus on Electric Energy Storage

Generation, storage and use of electric energy on a sustainable and cost-efficient basis for stationary and mobile applications are among the biggest global challenges for the next decades. In the long run, only those institutions will be successful, which pursue a comprehensive, interdisciplinary approach along the complete value chain. Therefore, KIT launched the Competence E umbrella project on January 01, 2011 in order to pool the competencies of KIT along the value chain and set up an open technology platform for future electric energy stores and electric drive trains. Thus a research and competence center will be established in several phases to help Germany assume its place among the leading nations in this field worldwide.

With a so far unique focus on the entire system, Competence E develops industrially applicable, cost-efficient solutions for stationary storage systems and electric drive trains of the next generations. Simultaneously to the development and prototypical construction of new kinds of cells, batteries and drive trains, new manufacturing processes for the cost-efficient production of those components are being developed and demonstrated. The objective is to develop battery systems for the use in electric vehicles and stationary applications within seven years that feature a gravimetric density of 250 Wh/kg, producible on an industrial scale at the costs of 250 €/kWh.



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Power Stores for Renewable Energies and Electric Drive Trains for E-Vehicles

COMPETENCE E



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Solar energy at night and wind energy in calms – this is feasible with the use of energy stores. Thus efficient and economic energy storage technologies contribute in the German “Energiewende” and allow a sustainable energy supply based on renewable energies. Considering the economic use of electric vehicles, such storage technologies also take over a key function. Special challenges lie in the fields of battery design and configuration of the entire system.

Electric energy storage 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.
- KIT has been working on improved battery materials more than 10 years.
- KIT links nanotechnology with latest methods of materials research.
- KIT pools competencies along the value chain from materials over modern production technologies to system configuration.
- KIT accepts the challenge of designing holistic solution concepts for stationary energy stores and e-mobility.
- KIT advises politics and society in establishing adequate framework conditions for energy stores and e-mobility.

KIT aims at a worldwide leading role in the fields of stationary electric energy stores and battery electric drive trains.

KIT research consistently covers the entire system “electric vehicle” and “stationary store” along with its components:

- Electrochemical energy stores
- Control and regulation units for energy stores (storage control)
- Inverter and motor control
- Central control of the complete vehicle / the storage system with combined photovoltaic or wind power system (Central Control Unit)

Competence E's objectives are in line with the requirements of conventional and modern storage and vehicle technologies.

- Cost optimization (manufacturing and operational costs as well as reduction of target costs)
- Efficiency optimization
- Improvement of intrinsic safety
- Increase of calendaric lifetime and cycle stability
- Increase of operation tolerance in terms of environmental impacts and operation conditions (temperature, air humidity, vibration, mechanical shock, crash)
- Improvement of maintainability
- Increase of reliability



Research for mobile and stationary applications at KIT

Materials Development (Cathode, Anode, Electrolyte)

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

Energy Storage Systems Development

- Optimization of assembly and disassembly
- Electrically well conducting and permanent connection of battery cells
- Reliable control of thermal loading
- Optimized control algorithms including prognosis software (BMS)

Engines Management

- Low-cost and modular setup
- High specific power-weight ratio (> 3 kW/kg)
- High specific torque-weight ratio (> 10 Nm/kg)
- Maximum peak efficiency (objective >95 %) and wide operation range with high efficiency (objective >90 % in the part-load range)

Integration of the Entire System

- Coupling of stationary energy stores with photovoltaic and wind power systems
- Control of power to grid and isolated operation
- Central compilation of all subsystems data
- Central control of the overall system
- Communication of the relevant data at the man-machine interface

Production Infrastructure

- New production technologies for cells and batteries
- Functional validation of stationary stores and the entire electric drive systems
- Development of prototypes and small series