Energiewende: Integrating Renewable Energies

Under the New Research Program SCI of the Helmholtz Association, Energy Storage Systems and Infrastructures Are Developed/About EUR 310 Million for Five Years of Research

Thanks to modern battery and information technologies, solar power produced by the KIT solar power storage park is reliably fed into the grid. (Photo: Markus Breig, KIT)

The transformation of the energy system in Germany is a long-term challenge facing society. A number of political and economic aspects have to be considered. The central technical challenge consists in extending the existing energy system such that all energy sources can be integrated and transmitted reliably. The new research program SCI of the Helmholtz Association is coordinated by the KIT and aims at developing the technologies required for this purpose. The budget for the project period of five years totals about EUR 310 million.

"The transformation of the German energy system, called Energiewende, is one of the most challenging tasks facing our society. It is required to establish a viable energy system taking into consideration all societal, economic, and political aspects. We make a central contribution to this task," says Professor Holger Hanselka, President of the Karlsruhe Institute of Technology (KIT) and Vice-President Research Field Energy of the Helmholtz Association. "To close the gaps in research relating to energy storage systems and

KIT Energy Center: Having future in mind

Monika Landgraf
Chief Press Officer

Kaiserstraße 12
76131 Karlsruhe, Germany
Phone: +49 721 608-47414
Fax: +49 721 608-43658
E-mail: presse@kit.edu

For further information, please contact:

Kosta Schinarakis
PKM – Science Scout
Phone: +49 721 608 41956
Fax: +49 721 608 43658
E-mail: schinarakis@kit.edu

grid technologies, the SCI program now pools our competencies and experience."

"Power supply based on renewable energies requires three important technical solutions," emphasizes Professor Mathias Noe, KIT, scientific spokesperson of the SCI research program. "Adequate energy storage systems to bridge fluctuations, efficient infrastructures to manage energy distribution, and a cross-sector grid to increase the flexibility, efficiency, and profitability of energy systems." These requirements are addressed by the newly conceived research program SCI "Storage and Cross-Linked Infrastructures". It focuses on studying technical options for fast implementation, sustainable production, high efficiency, and secure and reliable system integration.

The SCI research program concentrates on six topics: Batteries and Electrochemical Energy Storage Systems, Electrolysis and Hydrogen, Synthetic Hydrocarbons, Fuel Cells, Thermal Energy Storage Systems, and Grids and Integration of Storage Systems.

Partners of five Helmholtz Centers conduct research under SCI: Karlsruhe Institute of Technology (KIT), German Aerospace Center (DLR), Forschungszentrum Jülich (FZJ), Helmholtz-Zentrum Berlin (HZB), and Helmholtz-Zentrum Dresden-Rossendorf (HZDR).

Examples of Previous Research Activities of the Partners

Electrochemical Energy Storage Systems

Activities of the centers KIT, FZJ, DLR, HZB, and HZDR cover the complete chain from the basic material to the complete battery system. This includes modeling, material and cell characterization, as well as methods in operation, electrode coating and cell production, battery and thermal management, as well as system integration, e.g. at KIT's solar power storage park. In-depth materials research is the basis of cost-efficient large-format battery cells of enhanced specific energy and power density and improved reliability and safety.

Electrolysis and Hydrogen

Safe and efficient use of hydrogen as an energy carrier requires studies of the construction, complexity, and dynamics of innovative systems. The Helmholtz centers DLR, FZJ, and KIT contribute major and most comprehensive expertise relating to electrolysis technology and hydrogen safety in Germany. The Hydrogen Test

Center (HYKA) of KIT, for instance, is a unique facility for the execution of hydrogen safety experiments on the industrial scale.

Fuel Cells

Research of FZJ and DLR is aimed at reaching an application-specific service life of fuel cells. For the fuel cell types SOFC and DMFC, service lives suited for commercial application were achieved by the use of functionally optimized materials and industrially relevant production processes. As regards PEMFC, studies focus on reducing the noble metal content of the cells.

Thermal Energy Storage Systems

Thermochemical storage of heat on a temperature level of 500°C in the order of 10 kW was demonstrated with slacked lime for the first time. The innovative thermal energy storage systems developed by the DLR for this purpose combine the potential of very high storage densities with an excellent cost efficiency.

Grids and Integration of Storage Systems

The gigantic changes associated with the Energiewende require new, distributed, and autonomous grid structures as well as an efficient integration of heterogeneous energy storage systems. Studies are to cover new technologies, such as superconducting cables or hydrogen pipelines, as well. The Energy Lab 2.0, an integrated technology and system platform of KIT, DLR, and FZJ, focuses on investigations and experimental tests of new approaches and high-performance tools for the stabilization of power grids in the future (smart energy system).

Synthetic Hydrocarbons

Power-to-gas technologies allow for the production of sustainable fuels of high energy density from excessive renewable energies. To develop appropriate technologies for storing hydrogen from renewable energies for decentralized use, the KIT studies novel process concepts, system components, and catalysts for highly dynamic operation in the area of synthetic hydrocarbons. Work is aimed at developing modular and flexible systems for decentralized use.

The **Helmholtz Association** contributes to solving grand challenges which face society, science, and industry by performing top-rate research and strategic programs in six research fields: Energy, Earth and Environment, Health, Key Technologies, Structure of Matter, as well as Aeronautics, Space and Transport. The Helmholtz Association is Germany's largest scientific research organization. Nearly 36,000 employees work at 18 research centers, the total annual budget being about EUR 3.8 billion. The Association is named after one of the greatest natural scientists of the 19th century, Hermann von Helmholtz (1821 – 1894).

The Karlsruhe Institute of Technology (KIT) is one of Europe's leading energy research establishments. Research, education, and innovation at KIT foster the energy turnaround and reorganization of the energy system in Germany. For this, KIT links excellent competences in engineering and science with know-how in economics, the humanities, and social science as well as law. The activities of the KIT Energy Center are organized in seven topics: Energy conversion, renewable energies, energy storage and distribution, efficient energy use, fusion technology, nuclear power and safety, and energy systems analysis. Clear priorities lie in the areas of energy efficiency and renewable energies, energy storage technologies and grids, electric mobility, and enhanced international cooperation in research.

Karlsruhe Institute of Technology (KIT) is a public corporation pursuing the tasks of a university of the state of Baden-Württemberg and of a national research center of the Helmholtz Association. The KIT mission combines the three strategic lines of activity of research, teaching, and innovation. With about 9,400 employees and 24,500 students, KIT is one of the big institutions of research and education in natural sciences and engineering in Europe.

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