

Holistic Analysis Ensures Tomorrow's Energy Supply

The KIT Energy Center Pursues All Research Approaches to Ensuring Reliable Supply



Work of the KIT Energy Center covers seven topics. Social aspects are also covered by research. (Graphics by: Wilfrid Schröder).

What is the risk of us sitting in the cold? The gas dispute that troubled entire Europe shows clearly: The larger the dependence on a single energy carrier is, the higher is the risk of shortage. Only a broad energy mix and the use of various technologies ensure reliable energy supply. The KIT Energy Center therefore conducts research in all fields contributing to securing tomorrow's energy supply.

“The gas dispute clearly demonstrates how dangerous and irresponsible it is to rely on a single resource only”, says Dr. Peter Fritz, Member of the Executive Board for Energy and Innovation. The KIT Energy Center bundles the energy research competencies developed by Forschungszentrum Karlsruhe and Universität Karlsruhe. Researchers are pursuing all approaches to ensuring a safe energy supply in the presence and future. As explained by Fritz, a broad energy mix will be required. Due to constantly changing boundary conditions, it will be important to always use up-to-date energy conversion systems.

For this reason, the KIT Energy Center studies all natural energy sources, such as fossil fuels, biomass, geothermal energy, nuclear energy, and water power. Investigations cover the complete chain

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and all technologies of **energy conversion**, for example, electrochemical processes in fuel cells or electromechanical processes in generators. It is focused on thermochemical processes, mainly combustion. Fuels may originate from fossil resources or various biomass feedstocks. Karlsruhe scientists are developing the basics of novel, tailored fuels with a low carbon content, concepts of combustion processes of increased efficiency and reduced pollutant emission, and innovative energy-saving fabrication processes.

Renewable energies that contribute to saving resources and protecting the climate are a major field of research of the KIT Energy Center. It is focused on biomass and geothermal energy that may be used to cover base load. Use of biomass, however, must neither compete with food production nor threaten biodiversity. The KIT Energy Center therefore concentrates on biofuels of the second generation that are produced from residues like straw and waste wood by means of the btl principle (biomass to liquid). The multi-stage bioliq® process developed by KIT in cooperation with the industry partner Lurgi GmbH allows for the economically efficient production of high-quality synthetic fuels from agricultural and forestal residues. In the region of Karlsruhe, conditions are suited for using geothermal energy: Favorable geological conditions are accompanied by high scientific and technical competence. Together with municipalities, associations, companies, and other research institutions in the region, KIT has established the Geothermie-Zentrum Karlsruhe e.V. (Karlsruhe Geothermal Energy Center). In cooperation with industry and colleagues from the University of Freiburg, KIT is preparing for the establishment of the State Geothermal Energy Research Center at Karlsruhe.

Work of the KIT Energy Center is characterized by a holistic approach. Again, the gas dispute shows how necessary such approach is: "The difficulties we currently have in gas supply clearly reveal that we should not only pay attention to the alleged high efficiencies of gas turbine power plants, but also consider the technical and political boundary conditions, under which the gas is extracted and transported", explains Dr. Peter Fritz. The KIT Energy Center covers the complete chain from extraction and conversion to storage and distribution to the use of energy.

For economically and ecologically reasonable **energy storage** and more efficient and reliable **energy distribution**, the Karlsruhe scientists concentrate on superconducting components and equipment for electrical networks, on smart grids, batteries, and on hydrogen as energy store. As a result of decentralized feed-in and the integration of renewable energies as well as of increasing efficiency and climate protection requirements, electricity grids have to meet new requirements.

Energy efficiency is of particular importance to future energy supply. Using energy more efficiently reduces the costs, increases the safety of supply, and protects the climate and resources. Scientists of the KIT Energy Center concentrate on the construction and industrial processes sectors. Work relating to buildings covers new mate-

rials and intelligent construction elements, sustainable planning, technical equipment, optimized energy utilization, comfort, and consumer satisfaction. It is always aimed at minimizing energy use during construction, heating, cooling, and illumination, protecting the basic structure of a building, and optimizing air quality and temperature as well as light conditions. In the industry sector, it is concentrated on innovative materials and product design, fabrication and process technologies as well as on intensifying energy and materials transport processes.

Research related to **nuclear fusion** is more forward-looking. If we will succeed in using this energy source, the growing world population will be supplied with electricity and heat for thousands of years in an economically efficient, safe, and environmentally compatible manner. However, highly complex technologies will be required for this purpose. Karlsruhe scientists among others work on microwave tubes for plasma heating, superconducting magnetic coils, and on components for the fuel cycle. In the field of **nuclear energy**, the KIT Energy Center represents the scientific-technical excellence center in Germany. Work focuses on the safety of nuclear reactors, nuclear waste disposal, radiation protection, and decommissioning techniques.

As energy systems are linked in various ways and interact with technical, social, and economic factors, **energy systems analysis** is an indispensable field of research of the KIT Energy Center. In interdisciplinary cooperation, scientists study future conceptions, changing energy markets, energy and materials flows as well as impacts on society.

In the future, the Karlsruhe Institute of Technology will inform regularly about the activities of the KIT Energy Center. Meanwhile, detailed information can be found in the KIT brochure "Energy for Tomorrow".

The Karlsruhe Institute of Technology (KIT) is one of the leading energy research institutions in Europe: The KIT Energy Center links fundamental research with applied research into all energy resources for industry, households, services, and mobility. Competences in engineering and science, but also in economics, the humanities, and social sciences as well as law, result in a holistic assessment of the entire energy cycle, including conversion processes and energy efficiency. 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 energy and safety, and energy systems analysis.

The Karlsruhe Institute of Technology (KIT) is the merger of the Forschungszentrum Karlsruhe, member of the Helmholtz Association, and the Universität Karlsruhe. This merger will give rise to an institution of internationally excellent research and teaching in natural and engineering sciences. In total, the KIT has

8000 employees and an annual budget of 700 million Euros. The KIT focuses on the knowledge triangle of research – teaching – innovation. It sets new standards in the promotion of young scientists and attracts top scientists from all over the world. Moreover, KIT is a leading innovation partner of industry.

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