Energy Lab 2.0

Test Field for Future Energy Systems

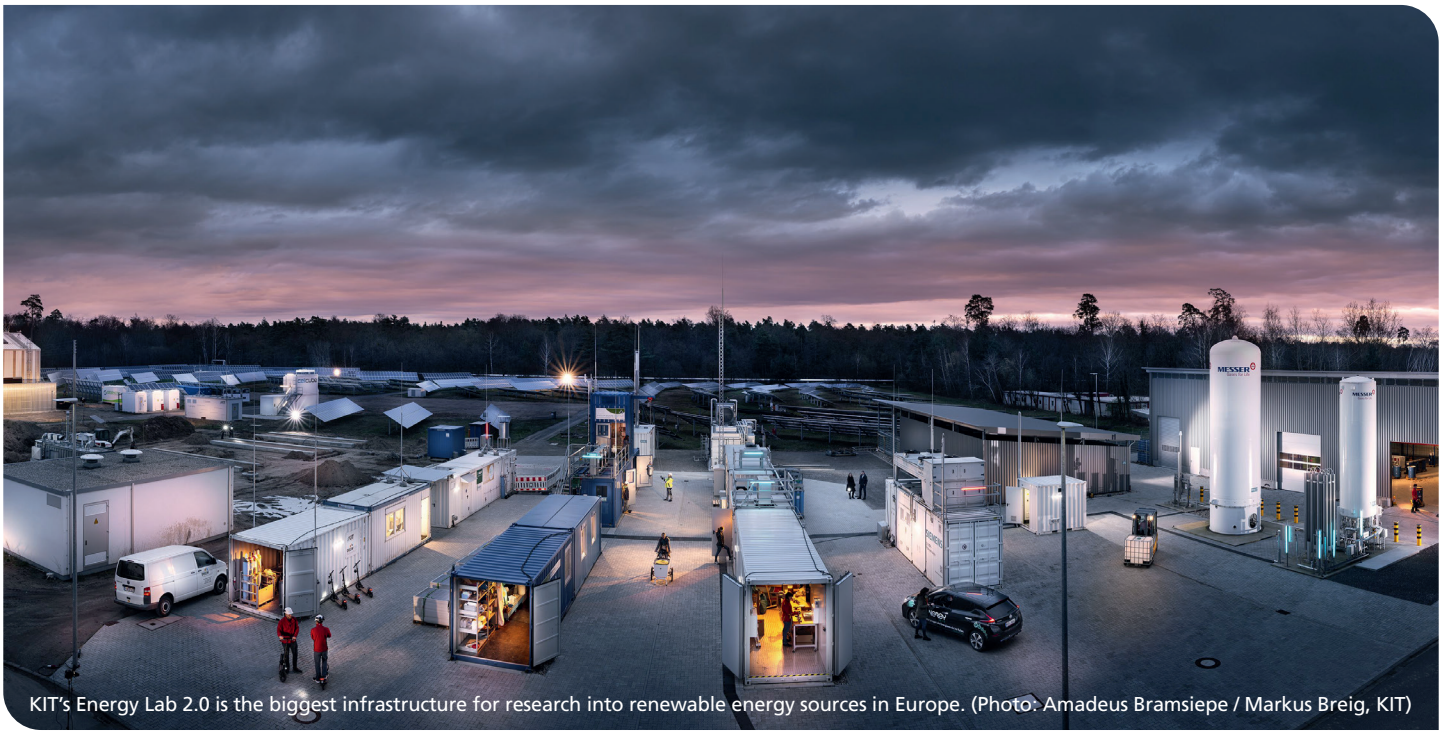
Germany has committed to climate neutrality by 2045 and to greenhouse gas emission reduction of at least 65% compared to 1990 until 2030. The challenge to be managed is that wind and solar energy production is highly volatile. Moreover, energy is often required far away from where it is produced. Not least, the peak loads expected at certain times have to be balanced. At the same time, energy supply should be affordable and environmentally compatible.

Research for the Energy Transition

These challenges are addressed by the Energy Lab 2.0, Europe's biggest research infrastructure for renewable energy. Here, researchers study smart networking of various environmentally compatible ways of producing, storing, and supplying energy. Based on real consumption data, they simulate and test future energy systems. The Energy Lab combines electric, thermal, and chemical energy flows with latest information and communication technologies. The goal is to improve the transportation, distribution, storage, and use of electric power, thus creating the basis for the energy transition. At Hannover Messe 2023, the focus will be on energy system integration, power-to-X technologies, and geothermal energy.

Energy System – Grids – Simulation

Coupling of the different energy sectors and fluctuation of energy production from renewable sources are major challenges in control. To simulate control and monitoring tasks as closely to reality as possible, the Smart Energy System Simulation and Control Center (SEnSSICC) is part of the Energy Lab 2.0. SEnSSICC is the "brain" of the Energy Lab and pools IT-related activities and research. SEnSSICC collects all information from the different systems and partners. Measurement currents are stored, controlled, analyzed, and visualized. Based on the findings obtained, further energy systems can be simulated. In this way, the real energy world – e.g. on the adjacent photovoltaic field and in the corresponding battery storage systems – is connected with the virtual energy world.



KIT's Energy Lab 2.0 is the biggest infrastructure for research into renewable energy sources in Europe. (Photo: Amadeus Bramsiepe / Markus Breig, KIT)

Power-to-X: Methanation and E-fuels

For the energy transition to be successful, the renewable power sector must be coupled with other energy sectors. In the area of chemical energy carriers, such as fuels and combustibles, this can be achieved using power-to-X approaches (P2X). In this case, synthetic chemical energy carriers are produced from hydrogen and CO_2. If hydrogen is produced by electrolysis with green electricity and CO_2 comes from a non-fossil source, the P2X products are nearly CO_2-neutral. Research at the Energy Lab 2.0 covers the corresponding plants. A Power-to-Liquid container produces so-called e-fuels, the Power-to-Gas plant generates climate-neutral methane for later power production by a gas turbine.

Container for the production of e-fuels. (Photo: Cynthia Ruf, KIT)

Geothermal Energy

KIT's Campus North is located in the geothermally relevant Upper Rhine Graben and on Germany's biggest heat anomaly detected so far. Hence, it offers high potential for sustainable heat supply. During the summer months, baseload-capable production yields a heat surplus. Its use is in the focus of the DeepStor project. Researchers test a high-temperature heat storage system that is filled in summer and discharged in winter. The geologically well-explored former oilfield in Leopoldshafen serves as the storage reservoir. DeepStor will be integrated into the existing heat network of Campus North and will be used to demonstrate feasibility and efficiency of such a storage system.

The Energy Lab 2.0 is a research infrastructure run by Karlsruhe Institute of Technology (KIT) in cooperation with the German Aerospace Center (DLR) and Forschungszentrum Jülich (FZJ), all of which are members of the Helmholtz Association. The Energy Lab 2.0 is funded by the Federal Ministry of Education and Research (BMBF), the Federal Ministry for Economic Affairs and Climate Action (BMWK), and the Baden-Württemberg Ministry for Science, Research, and the Arts (MWK).

More information and fact sheets on all topics covered by KIT's Energy Lab 2.0 can be found here:

https://www.elab2.kit.edu/factsheets

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