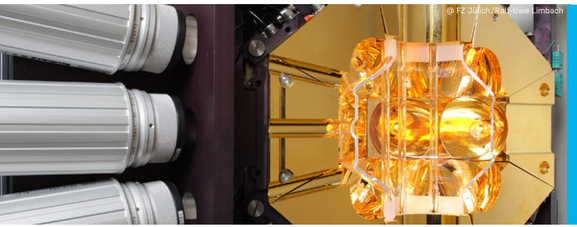
Our Topics

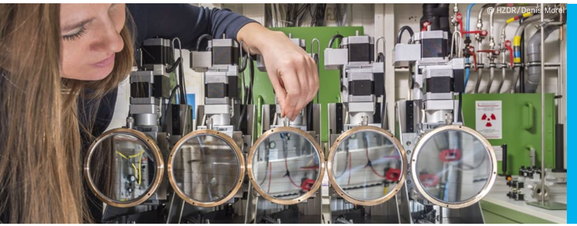
Our research focuses on these four core topics:

Design of a sustainable energy system which is characterized by mainly renewable generation. It has a higher flexibility, and couples the electricity, gas, heat, and mobility sectors.



Development of new technologies along the entire value chain – from the exploration of resources and the development of high-performance materials, through generation, conversion, storage and distribution, to the use of complementary energy carriers such as electricity, biomass and hydrogen.

Research into fusion as an additional long-term option to meet the continuously growing global energy needs.



Research for safe disposal of radioactive wastes and the safe operation of nuclear reactors.

Participating Helmholtz Centers and Helmholtz Institutes

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Version as at August 2022

HELMHOLTZ Energy

HELMHOLTZ Energy: A Strong Partner of Politics and Industry

The Research Field Energy of the Helmholtz Association

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Our research contributes to creating a secure, climate-neutral, economically independent, and socially accepted energy system.

Society is presently facing great challenges. To counteract human-made global warming, we need an energy system based on renewable sources. At the same time, the energy system must be economically efficient and supply must be guaranteed any time. In Germany as a country depending on energy imports, these two aspects have gained even more importance due to Russia's aggressive war against Ukraine. Pushing the energy transition and extending the use of renewable energy sources will increase independence from fossil fuel suppliers. In the long term, this will reduce a major geopolitical risk in our energy supply. However, dependence on critical resources will increase. These and many other relationships call for a systemic perspective that covers technical, social, as well as economic aspects. We need profound changes to master these challenges.

Helmholtz responds to these challenges. Helmholtz Energy creates the scientific basis for climate-neutral and economically and socially sustainable energy supply by conducting research into both basic principles and applications. As a scientific architect, we co-design the sustainable transformation of energy supply in Germany and worldwide. Our scientists study and develop innovative conversion, distribution, and storage technologies and they create solutions for a cross-sectoral energy system. Thanks to the wide range and diversity of research activities of Helmholtz Energy, all relevant energy conversion chains and technological options can be considered systemically and holistic concepts can be developed.

Knowledge and technology transfer is a basic element of the work of Helmholtz Energy. Collaborations with industry and startups ensure that new technologies are developed to maturity and transferred to society. In close exchange with politics, our research also addresses burning issues, such as energy supply security. Together with politics and industry, we specifically push joint research activities to ensure energy supply through the rapid transfer of key technologies and know-how.

The development, construction, and operation of research infrastructures are major prerequisites for our work. They make Helmholtz Energy a sought-after partner for research institutions, universities, companies, and startups on the regional, national, and international level.

Energy System Design Program

It is our goal to develop a sector-integrated, sustainable energy system mainly based on renewables. Energy is stored and transported in various forms. Intelligent distribution networks control the flow of energy. Consumers can also become energy producers and can feed electricity into the grid on their own.

Within the Energy System Design Program, researchers develop this future energy system. At our Energy Lab 2.0, we study the smart combination of various energy production, storage, and supply options. At our Living Lab Energy Campus, we develop energy supply systems with smart, digital control strategies under real conditions. The Emulation Center for Networked Energy Systems (NESTEC) is equipped with laboratory devices to couple the electricity, heat, and mobility sectors. We provide politics and industry with energy scenarios that take into account technical, economic, and social aspects, including social acceptance.

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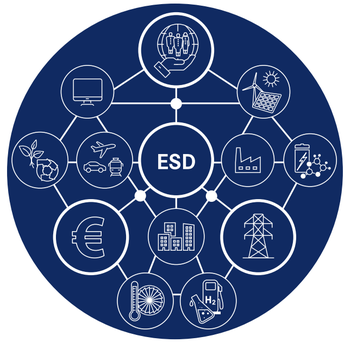

Materials and Technologies for the Energy Transition Program

In the Materials and Technologies for the Energy Transition Program, we take an interdisciplinary approach to research energy supply, conversion and storage, as well as energy and resource efficiency.

Our portfolio covers all relevant technologies in these areas, including photovoltaics, wind energy, geothermal energy, bioenergy, battery storage, fuel cells, electrolysers and power-to-X technologies, as well as solar thermal energy, gas turbines and heat pumps. The activities in the field of materials development are supported by our research platforms, the Helmholtz Energy Materials Foundry and the Helmholtz Energy Materials Characterization Platform. Technology development for the energy transition, however, requires new infrastructures such as the GeoLaB, 4D-CAT or FlexiPlant. They will contribute to securing the enormous need for resources of the energy transition and to significantly accelerating the innovation cycles for CO_2-neutral value chains.

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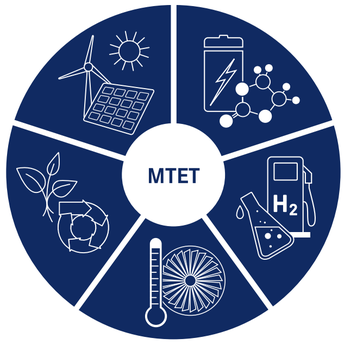

Fusion Program

A long-term option for meeting the globally increasing energy demand is nuclear fusion. As part of the research activities, coordinated and financially supported by the European fusion program, in the Fusion Program we study and develop the physical and technical basis for the design and construction of fusion power plants.

The model for this is the sun, a plasma ball consisting of hydrogen, inside which hydrogen nuclei fuse to form helium. These nuclear fusion reactions produce the energy we use as „solar power". Key facilities are Wendelstein 7-X in Greifswald – the world's largest fusion facility of the stellarator type – and the tokamak experiment ITER, which is currently being built in Cadarache/France. At the ASDEX Upgrade tokamak, within the framework of the accompanying technology and materials program, and with research into plasma-wall-interactions, we study key questions that are of decisive importance to ITER and to a subsequent demonstration power plant (DEMO).

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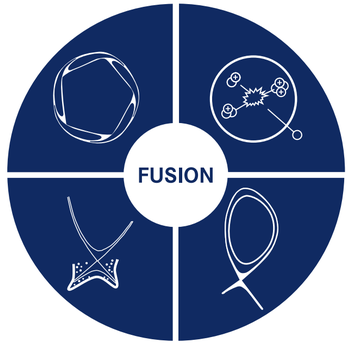

Nuclear Waste Management, Safety and Radiation Research Program

In our Nuclear Waste Management, Safety and Radiation Research Program, we deal with key issues relating to interim storage and final disposal of radioactive wastes, the dismantling of nuclear facilities, the safety of nuclear reactors, and radiation protection.

The safety assessment of the nuclear reactors as well as the safe disposal of radioactive waste and the associated protection of the population and our environment from radiation exposure are strategic, long-term goals of our research – even after the end of nuclear power generation in Germany. With our research, we contribute to the nuclear phase-out and, at the same time, not only maintain the know-how, but also constantly develop it further. The Helmholtz research and technology platform for the decommissioning of nuclear facilities and for the management of radioactive waste (HOVER), which is currently being set up, is of central importance here.

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