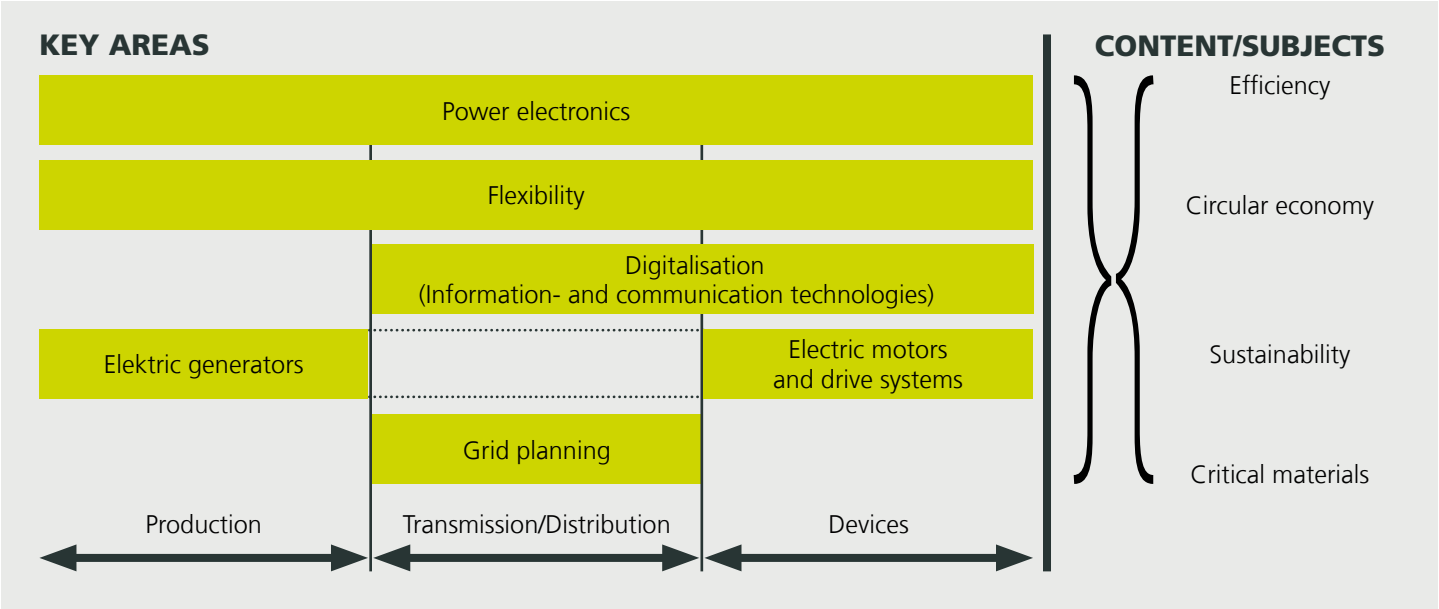
RESEARCH PROGRAMME ELECTRICITY

For the period 2025–2028, the Electricity Research Concept covers strategically relevant research aspects along the entire electricity supply chain, from electricity production to transmission and distribution through to utilisation. It thus lays the foundation for the sustainable and efficient further development of the electricity system and electricity utilisation. By combining technological innovations, digital transformation and international networking, it will contribute significantly to the Energy Strategy 2050.



KEY AREAS

Power electronics: As a relevant transversal technology, power electronics is the key to the conversion, control, distribution and use of electrical energy.The aim of technology-oriented research is to investigate power electronic components and systems with higher efficiency and extended lifecycles. New converter topologies and innovative semiconductor materials such as silicon carbide (SiC) and gallium nitride (GaN), so-called wide band gap semiconductors, enable a significant reduction in energy losses and better thermal performance in a much smaller volume. They also enable efficient system integration of renewable energy sources.

The focus of system-oriented research is on electrical drive systems and the electricity grid. In the case of drive systems, SiC- and GaN-based converters are to be used primarily to increase drive efficiency. In the grid, new approaches can help to ensure system stability and voltage quality (e.g. with grid-forming inverters, active and reactive power control and regulation, and reliable protection and fault location systems). Future-oriented methods and concepts of system operation serve to increase resilience and to restore the power supply after an outage.

Electronic motors and drive systems in industry, generators: Rotating electrical machines are key components of the energy sector and are among the largest consumers and producers of electricity. Research in this area aims to advance motors and generators with higher efficiency and a longer service life.

With regard to electric motors and drive systems in industry, particular attention is being paid to the development of energy-efficient technologies and control systems using innovative, power electronic components and sustainable materials. The foundations for international standards and effective regulations are also to be developed. Motor-driven applications in industrial automation are main focus here.

For generators, research focuses on optimising efficiency and using sustainable materials. Innovative designs are intended to reduce material use without compromising performance. Generators for hydropower are at the centre of this.

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Digitalisation: The digitalisation of the energy system, which involves the integration of information and communication technologies (ICT), large and complex data volumes and artificial intelligence, offers enormous potential for increasing the flexibility and efficiency of the energy system. Research is focusing on innovative approaches to sustainably optimise the operation of individual plants up to entire systems (e.g. digital twins, big data analytics). However, digitalisation itself is also leading to a significant increase in electricity consumption. Increasing the efficiency of data centres and their system integration is therefore of great importance and is also the subject of research.

Flexibility The efficient integration of renewable energies and decentralised production facilities requires flexibility on both the production and end-use side as well as the use of energy storage systems. Research is aimed at developing innovative processes to ensure system and grid stability at all times. It focuses on the aspects of digitalisation and the potential of power electronic components.

Grid planning: Technological, climatic, social or regulatory change leads to uncertainties in the maintenance and expansion planning of electricity grids on all time scales. Research should develop application-oriented planning tools that fully exploit the possibilities of current and future grid elements and digitalisation, but are also robust in the face of disruptive or unforeseeable developments.

CONTENT AND THEMATIC FOCUS

Efficiency: Improving efficiency at component and system level, taking ecological aspects into account, is at the centre of all priorities. By using advanced technologies and digital solutions, the aim is to minimise electricity consumption and make the overall system more stable and flexible in order to ensure a sustainable and reliable energy supply.

Circular economy: The circular economy promotes a sustainable economic system that uses resources efficiently through reuse, repair, recycling and longer product life cycles and minimises waste. This allows materials to be kept in closed loops. Innovative technologies, designs and manufacturing processes, longterm business models and regulatory frameworks support the transformation towards a resource-efficient economy.

Sustainability: By promoting sustainable solutions, ecological, economic and social aspects are incorporated into the entire life cycle of components and systems. The aim is to reduce the ecological footprint through the use of environmentally friendly technologies.

Critical materials: In view of the limited availability and strategic importance of critical raw materials, research is aimed at finding innovative substitutes to reduce dependence on certain materials.

NATIONAL NETWORKS AND INTERNATIONAL INTEGRATION

National networks: National networking activities and the involvement of universities and universities of applied sciences in the implementation of the research strategy are intended to promote national expertise on the one hand and support national dialogue on the other. In addition, contacts with specialist organisations such as Electrosuisse, the Research Foundation for Electricity and Mobile Communication (FSM), the Swiss Telecommunications Association (asut) and the Swiss Society for Energy and Network Research (SGEN) are established and maintained through regular personal exchanges.

Finally, by establishing and maintaining topically focussed trend-watching groups (motors/power electronics, ICT and grids/flexibility), the findings and research results are regularly presented to an interested national specialist audience.

IEA Technology Collaboration Programmes (TCP): Active participation in the ISGAN TCP (International Smart Grid Action Network) and 4E TCP (Energy Efficient End Use Equipment) enables an intensive exchange and synergetic cooperation at a global level for the standardisation and development of new technologies in almost all subject areas of the research programme. In addition, close contacts are maintained with the thematically related Hydropower TCP, Electric Vehicles TCP and Users TCP.

Conferences: Various conferences such as the Conference on Energy Efficiency in Motor Driven Systems (EEMODS), the Power Conversion and Intelligent Motion Expo and Conference (PCIM), the DACH Conference on Energy Informatics or the Grid Service Markets Symposium (GSM) are of great importance for national and international networking and the implementation of research results. The research programme is primarily involved through active participation in organising committees or the presentation of Swiss research results.

Further information is available at www.electricity-research.ch