



In cooperation with the CTI



Energy funding programme

Swiss Competence Centers for Energy Research



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Swiss Competence Center for Energy Research Efficient Technologies and Systems for Mobility

Mission

In Switzerland, the transportation sector accounts for approximately one third of total energy consumption and greenhouse gas emissions. The *Swiss Competence Center for Energy Research – Efficient Technologies and Systems for Mobility* (SCCER Mobility) develops knowledge and technologies essential for the transition of the current fossil fuel based transportation system to a more sustainable one, featuring minimal CO₂ output and primary energy demand as well as virtually zero-pollutant emissions.

The Competence Center aims at understanding the complex dynamics of mobility and transportation, including their interdependencies with the overall energy system. It serves as a platform for the integration of a broad range of research areas to provide a coherent framework to identify, assess and develop the most promising research directions that result in sustainable and efficient interventions.

Research Areas

The Competence Center includes five Capacity Areas covering two innovation fields. Innovation field A deals with **components and devices** for e-mobility (Capacity Area A1), fuel cell technology and internal combustion engines (Capacity Area A2), lightweight structural components and improved thermal management of vehicles (Capacity Area A3). Innovation field B addresses **mobility systems** with special focus on infrastructure integration, intelligent transport systems, urban planning, monitoring and user communication (Capacity Area B1), as well as integrated assessment of mobility systems (Capacity Area B2).



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FHO Fachhochschule Ostschweiz



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SUPSI



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zhaw School of
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A1 | Systems and Components for E-Mobility

Capacity Area A1 addresses the challenge of storing electrical energy reliably and economically as the main barrier for the introduction of electric propulsion and auxiliaries for automotive applications – independent of the proposed system solution (battery electric, fuel cell or hybrid vehicles). While research in countries with a strong car industry concentrates on large volume automotive battery technologies, electric storage solutions for niche manufacturers of rail, bus, construction, agricultural or municipal utility vehicles are characterized by a low volume and highly customized vehicle configurations. By following a modular approach that allows for higher component production volumes and easier integration on different vehicle platforms, Capacity Area A1 particularly addresses the needs of the niche automotive and railway industries in Switzerland.

Research topics

- Battery cell characterization and modelling
- Development and management of battery and supercapacitor systems
- Integration of battery systems and vehicle architecture
- Testing capacities and certification procedures for battery safety and reliability

Contact Capacity Area A1

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A2 | Chemical Energy Converters

Capacity Area A2 focuses on shifting from purely fossil operated powertrains to renewable fuel operated and efficiency optimized internal combustion engines and fuel cell technologies for passenger cars, busses, utility vehicles and heavy duty trucks, where electric propulsion is not expected to establish soon due to range limits or a lack of appropriate charging infrastructure. Besides improved energy efficiency and lower greenhouse gas output, the reduction of pollutant emissions is an important goal of Capacity Area A2. For fuel cells, the main focus is cost reduction and improved operating conditions.

Research topics | internal combustion engines

- Ignition and inflammation process investigations for gaseous and liquid fuels with focus on advanced modeling, simulation and diagnostic methods
- Air path, gas-exchange and turbo-charging optimization
- Thermal engine operation management
- Experimental and numerical investigation of renewable fuels for combustion-based powertrains

Research topics | fuel cell technologies

- Complexity reduction of polymer electrolyte fuel cells (PEFC) by thermo-neutral operation leading to lower costs as well as higher operation temperature and power density

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A3 | Minimization of Vehicular Energy Demand

In addition to the development of new energy storage and propulsion systems, the reduction of non-propulsive vehicular energy demand bears great potential to improve vehicle efficiency, especially by lowering the vehicle mass and optimizing thermal management and insulation. Capacity Area A3 concentrates on new routes to high volume lightweight thermoplastic and bioinspired composites with outstanding mechanical properties to eventually replace conventional materials such as aluminum or steel. Improved thermal management is particularly important for electric vehicles (road or rail) with much less engine waste heat that can be recovered for passenger cabin heating.

Research topics | lightweight thermoplastics and bioinspired composites

- New materials for fast manufacturing of fiber reinforced thermoplastic composites
- New ecological and economical processing routes
- Investigation of biological design principles and implementation in synthetic systems for lightweight components with enhanced mechanical properties and self-healing behavior

Research topics | thermal management

- Quantification of non-propulsive energy demand in private and commercial vehicles
- Integration of heated surfaces with low thermal inertia and highly efficient thermal insulators

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B1 | System Integration, Operation & Optimization

A successful implementation of new vehicle technologies and the establishment of more sustainable mobility demand patterns strongly depend on the design and deployment of efficient mobility systems. Among others, this includes infrastructural developments, freight logistics, urban planning or individual mobility behavior. Capacity Area B1 contributes to building more efficient mobility systems by developing new infrastructures for electric mobility, new concepts for multimodal transport, mobility management and spatial planning and new monitoring and communication devices that foster changes in the personal mobility behavior.

Research topics | infrastructure and urban transport

- Charging infrastructure and catenaries, grid and stationary energy storage related interactions
- New transport carriers and technical systems integration
- Green ITS: intelligent transport systems including improved train operation

Research topics | urban planning and environmental impact

- Modelling of household mobility demand
- Mobility related cluster analysis of urban settlements
- Planning and decision making tools and processes for urban development

Research topics | monitoring and user communication

- ICT-based data acquisition of passenger mobility patterns and data use for transport simulation
- Development of user monitoring and communication devices

Contact Capacity Area B1

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B2 | Integrated Assessment

New vehicle technologies, energy carriers and infrastructure or shifts in freight management and individual mobility behavior may have various and complex environmental, economic and social impacts. Capacity Area B2 evaluates new technologies and fleet scenarios with regard to multiple criteria including energy demand, pollutant and greenhouse gas emissions, resource depletion or costs but also non-economic customer preferences. An integrated, system-wide, long-term perspective is developed by the quantification of long-term scenarios. In addition, key factors affecting the mobility behavior and demand will be analyzed to formulate policy recommendations and to develop possible visions for transportation and mobility in Switzerland in 2050.

Research topics

- Drivetrain technologies and fleet scenario analysis for personal and freight transportation
- Impact assessment of current and future Swiss mobility and transportation covering environmental, economic and social dimensions
- Energy-economic modeling allowing for an analysis of interactions between mobility and the whole energy system
- Transformation potential for (passenger) mobility in Switzerland
- Vision development for transportation and mobility in Switzerland

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