

About CCEM

The research community in the ETH domain considers ubiquitous access to affordable energy services as one of the primary goods for a modern society, with the provision that these services must be rendered in an environmentally compatible manner. A research portfolio has been formulated in a detailed report *Energy Research in the ETH Domain* that is addressed to the research community, graduate students and the public interested in energy research.

THE VISION

The vision of the Competence Center Energy and Mobility (CCEM-CH) is a more sustainable energy system, which provides the energy services required for economic growth with strongly reduced primary energy input. The system meets the societal demand for services in an economically affordable and environmentally compatible manner, thereby preserving the earth's climate. The 2000 Watt society ⁽¹⁾ is a metaphor for such a system.

Energy and climate are global issues, and hence the design of the Center takes into account the global, the European, and the Swiss dimension. As a guideline, the problems to be addressed by the Center must excel by high relevance to sustainability, science, and industry. They are defined in collaboration between the research community and industry.

THE MISSION

The mission of the Center is a contribution towards reducing the CO₂ emissions of the Swiss energy system, and to enhancing security of supply by decreasing the dependence on imported fossil energy carriers. For targeting a significant impact on society, projects will be designed together with stakeholders, and will strengthen the competitiveness of Swiss industry by development of new and innovative systems, products, and services.

In line with the focus of the ETH domain and the Universities of Applied Sciences, the emphasis will be placed on the aspects of

- efficiency increase in all energy conversion steps
- energy storage technologies to reduce losses
- substitution of fossil fuels by CO₂-free or CO₂-neutral energy carriers
- sustainability increase in CO₂-free energy sources.

The important demand side measures and socio-economic issues are addressed in collaboration with a network of partners including researchers from economic and social sciences in the ETH domain and at universities.

Institutions and laboratories from the ETH Domain and the Universities of Applied Sciences form alliances with industrial partners to engage in large projects targeting a measurable impact in the areas of Mobility, Electricity Production, and the Heat and Buildings sector.

Mobility

Within the **transportation sector**, high growth rates are associated with important environmental impacts and an almost exclusive dependence on liquid fossil fuels. Therefore, the following themes have been selected:

- low carbon fuels – methane from biomass with >60% efficiency at competitive cost, and hydrogen produced CO₂-

free and more economically than with the present renewable benchmark, complemented by electricity for purely electric battery-powered propulsion

- clean freight transport approaching the “zero impact” limit
- efficient passenger transport – hybrids based on advanced storage systems (4x improved specifications) and internal combustion engines or fuel cells that lower the fleet fuel consumption towards the CORE target of 3 litres equivalent per 100 km.

Electricity

The importance of **electricity** as an energy vector that opens the path towards high efficiency will increase in the future, on the scale ranging from a few Watts (portable devices) to Gigawatts (large centralized power stations). Reflecting this situation, the following themes will be addressed:

- Electricity from renewables (expanded hydro, competitive photovoltaics, geothermal)
- Large-scale CO₂-free production from nuclear energy (materials for Generation IV high temperature fission reactors and next generation fusion reactors)
- Control and security of electricity grids, power electronics with 50% reduced losses
- Large and medium scale production by combustion of natural gas and biogenic gas (fuel-flexible gas turbines with efficiency > 62%, combined heat and power)
- Efficient converters for small-scale electricity production from medium temperature (geothermal) heat, by miniaturized solid oxide fuel cells, or by microturbines.

Heat and Buildings

The **building stock** in the residential, commercial and industrial sector uses 40% of national final energy demand for room conditioning in Switzerland. For a major impact, CCEM-CH will tackle the three topics of

- Innovative building technologies for the 2000-Watt-Society (with the goal that no fossil energy required for heating and cooling purposes)
- Polygeneration of heat, cold and electricity (addressing increasing electricity and air conditioning demand, making efficient use of renewable energy resources, exploiting possible synergies at the urban scale)
- Advanced building renovation strategies (solutions that make it economically attractive for building owners to invest in renovations reaching passive house standard).

Researchers participating in the projects remain members of their respective home institutions, and existing technical infrastructure is used where it is best available among the participating institutions. Technology Centers will be made available for projects requiring specialized expensive or large infrastructure, and cross cutting issues are handled in a network extending well beyond the ETH domain. The goal of the Center is to contribute significantly to a sustainable energy supply for our country, and to strengthen the Swiss workplace by contributing towards technological innovation.

Notes

1 : *The 2000 W Society is a vision promoted by the Board of the Swiss Federal Institutes of Technology aiming at a sustainable society regarding eco-logical, economic as well as societal aspects. It postulates a total primary energy use of some 65 GJ per capita and year within the second half of this century, which equals an average power consumption of 2000 W per capita. Today the average Swiss citizen has a total primary energy use of about 5000 W.*