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JASM Joint Activity Scenarios & Modelling

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Net-zero GHG emissions in 2050 Scenarios from the JASM project

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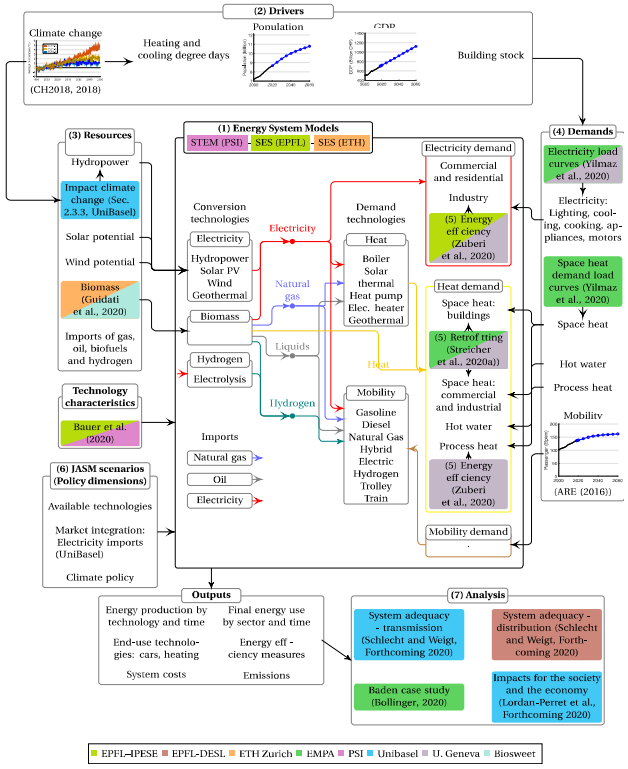
Motivation

The Federal Council set the goal to reduce Swiss green house gas emissions to net-zero by 2050. The Joint Activity Scenarios & Modelling (www.sccer-jasm.ch) generated scenarios based on the joint expertise of the eight SCCER.

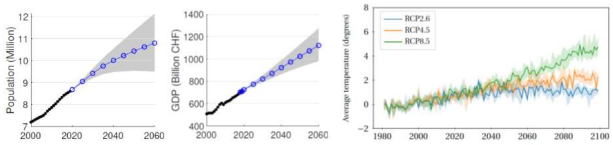
JASM Modelling framework

Three full energy system models form the core of the JASM modelling framework. They solve the combined optimization problem of designing and operating an energy system (electricity, heat, mobility) throughout a typical year. Numerous sectoral models supply key elements, e.g. cost efficiency curves for buildings renovation or the impact of climate change on hydro power generation.

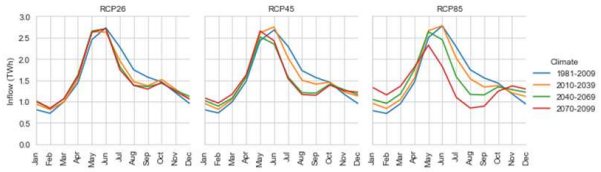


Drivers, inputs and scenarios

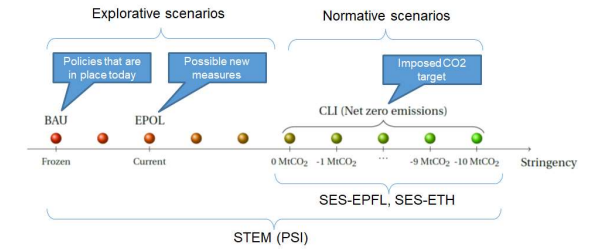
A proper scenario definition requires a multitude of inputs, such as the growth in population and GDP, the availability of resources (e.g. biomass), the costs of key technologies, etc. All assumptions have been harmonized and properly documented on the JASM website www.sccer-jasm.ch. A few examples are given to the right.



Drivers such as population, GDP and climate have a major impact on all aspects of the energy system^. Whenever possible, the uncertainty of the future development is explicitly considered and modelled.



Latest climate scenarios were used to estimate the impact on heating degree days or the monthly production of run-of-river hydro power plants. The figure shows that indeed the seasonal production pattern changes significantly for the most extreme RCP 8.5 scenario



A mix of explorative and normative scenarios are defined and analysed by the various energy system models. These form a flexible frame which can be adapted to the specific strength of single models.

Key results

A number of common insights resulted from the different sectoral and full energy system models:

- The net-zero climate target cannot be reached without deploying CO_2 Capture and Storage (CCS) at a scale of at least 9 Mt/a. CO_2 needs to be captured on cement plants, waste incinerators, and as a byproduct of hydrogen production. If geological storage cannot be realized in Switzerland, a connection to a European transport and storage infrastructure is required.
- Heat pumps and electric vehicles are the dominating technologies in a net-zero world; electricity consumption increases to 80-90 TWh/a but this can be generated without compromising the net-zero CO_2 targets
- Energy efficiency measures in buildings and industry are cost-effective to reduce CO_2 emissions
- Hydrogen plays a significant role with a turnover of 10-20 TWh/a. It is produced by a mix of electrolysis, steam reforming and biomass gasification (both with CCS), and is used for freight transport and the generation of electricity and industrial heat.
- Photovoltaic is the dominant new renewable technology with an annual production of approx. 25 TWh/a. Overproduction in summer is balanced by batteries, pumped storage and power to heat / gas.

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