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Energy Economics Modelling of the Swiss Transport Sector

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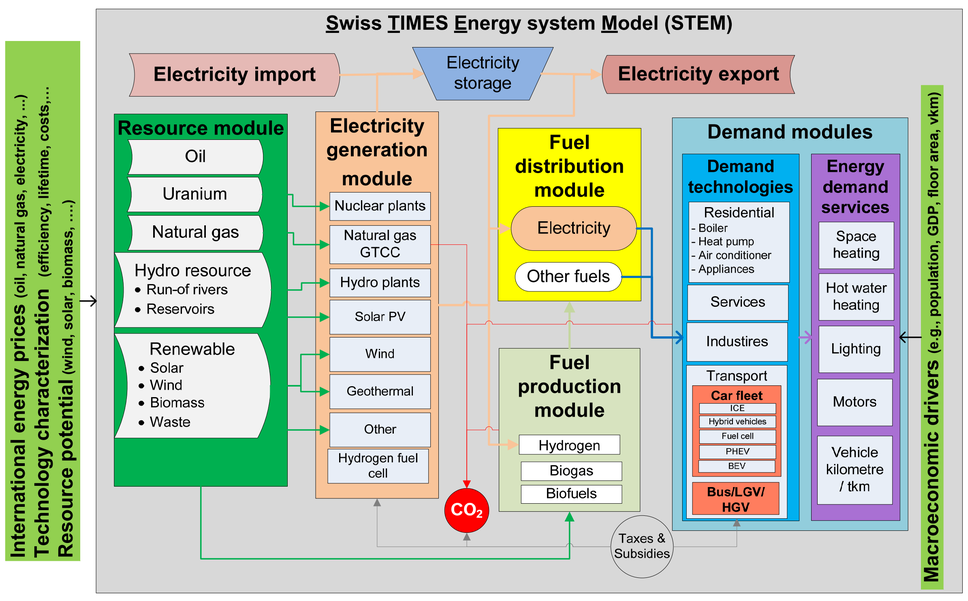
Background and Methodology

The goal of «Energy Economic Modelling» in the Capacity Area B2.3 is to establish and strengthen competences for integrated analysis of interactions between the Swiss Transport and other energy sectors over the long term. This is done by integrating the transport and other energy sectors in detail, for long-term scenario analysis.

We use the Swiss TIMES Energy System Model (STEM) developed at PSI. The Swiss energy system is depicted from resource supply to end-use energy services demands via a range of energy commodities, technologies and infrastructure (see Figure 1). The model has a time horizon of 2010-2100 with an hourly representation of weekdays and weekends in three seasons (summer, winter, and an intermediate season).

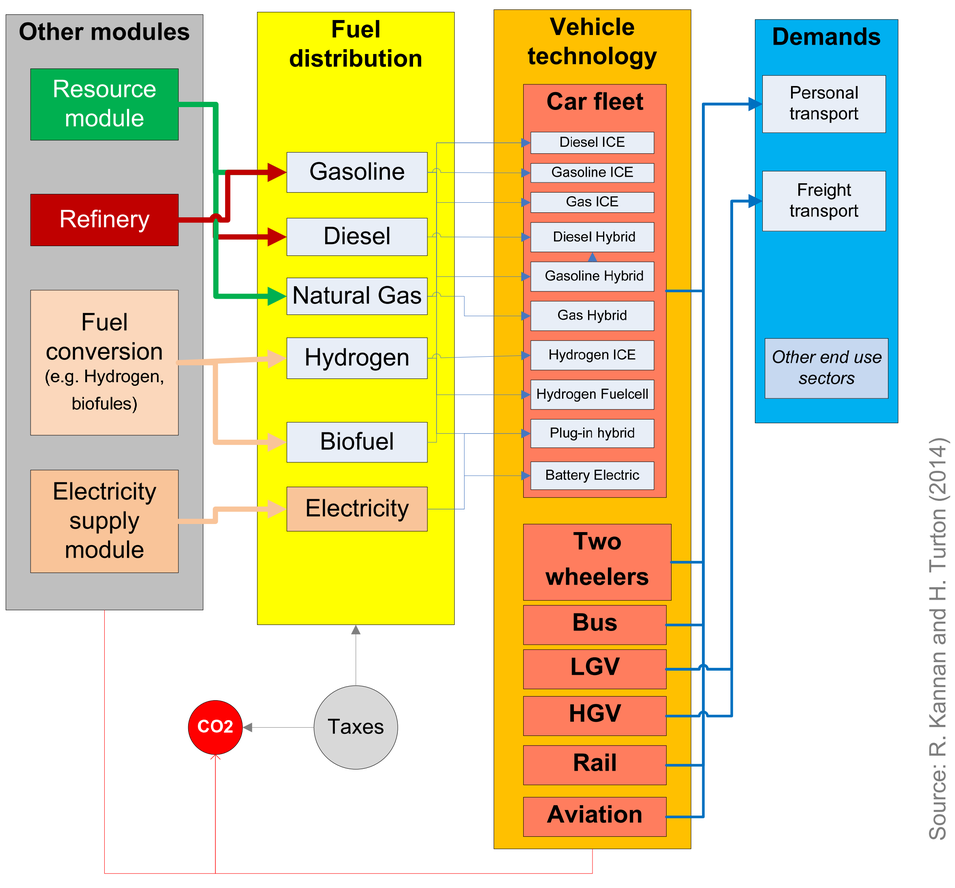


Source: R. Kannan and H. Turton (2014)

Figure 1: Simplified Reference Energy System of STEM

The transport sector in the model covers two broad transport service demand categories, viz. personal and freight transport, which are quantified in terms of vehicle kilometre (vkm) and tonne kilometre (t-km). Figure 2 shows a simplified reference energy system (RES) of the transport module and its link to other modules.

The analytical framework on which the STEM model is based, is called The Integrated MARKAL/EFOM System (TIMES). This is a dynamic and technology-rich energy system optimization framework, which can be used to determine the energy system configuration which results in the lowest discounted system costs.



Source: R. Kannan and H. Turton (2014)

Figure 2: Simplified RES of the transport module
LGV: Light goods vehicle, HGV – heavy goods vehicle

The STEM model can be used to perform scenario based analysis and to design energy policies. Currently our model is being updated with a new vehicle fleet technology data set containing 11 vehicle technologies (see Figure 3). The vehicle fleet is divided in four power categories (less than 60kW, 60-100kW, 100-140kW and more than 140kW). This allows full technology competition within each vehicle power category. Besides the car fleet, also other sectors like buses, trucks, aviation, etc. are included at various aggregation levels (see R. Kannan and H. Turton (2014) for more details).

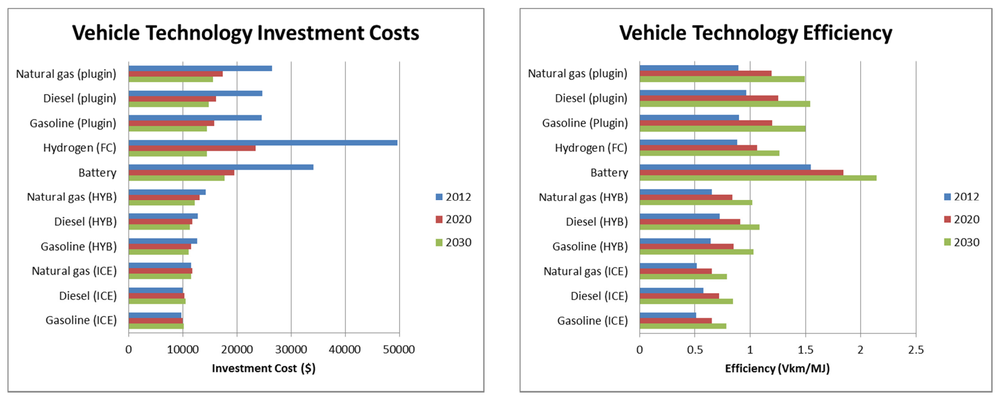


Figure 3: Vehicle Investment Costs and Efficiency

Scenarios

Our models is not meant to predict the future, but serves as a tool to conduct "what-if" resp. scenario-based analysis. Due to limited resources, we plan to restrict ourselves to around 2-3 scenarios with 2-3 variants within the current SCCER. At the moment we are in the process of defining these scenarios (inputs are welcome). Some possible scenarios and variants:

- Reference scenario with no special constraints on generation or emissions
- Low-carbon scenario with CO_2 emission reduction goals for all sectors combined with the option of specific goals for the mobility sector
  - Centralized vs. decentralized power generation option
  - Restriction on net electricity imports

Outlook

- Development of algorithms and tools for creation of so-called «**Alternative Technology Sets»**: While the TIMES optimization framework just finds a single technology set per scenario which minimizes system costs, it is interesting to find out what alternative technology sets exist, which only slightly increase system costs or what technology set would minimize system costs if input conditions are slightly changed? Within this SCCER project, we are developing algorithms and tools, which allow us to semi-automatically create such alternative technology sets.
- Detailing the transportation model and updating/checking model input data.
- Definition of scenarios, performing simulation runs and analysis.

Acknowledgements

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References

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