

RESAIL: Reliable and economic integration of the Swiss Federal Railways to the energy strategy

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1 Objective

Objective of this project is to identify ways for the Swiss Federal Railways (SBB) to contribute to the Swiss energy strategy while, in parallel, ensuring that SBB will be able to serve its demand in an economic and reliable manner.

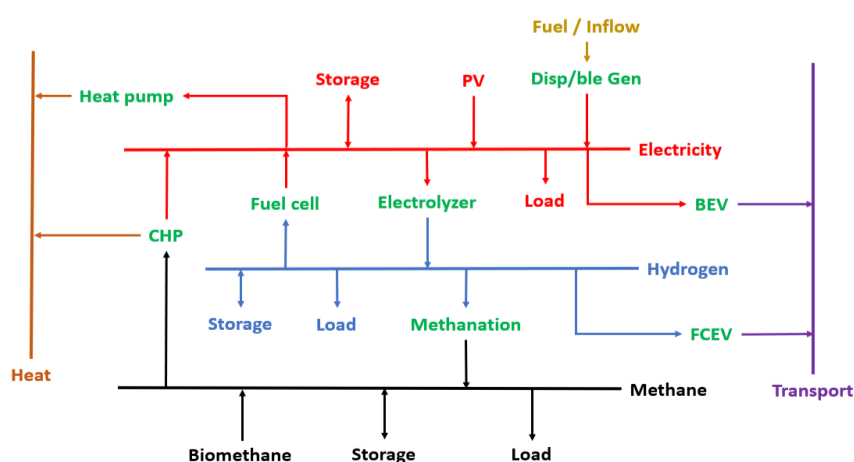
2 Methodology

- Modeling of Pan-European multi-energy systems^{1,2}.
 - Two pathways: **electrification** and **alternative fuels**.
- Evaluation of performance and **potential risks for Switzerland** using FlexECO (multi-energy economic dispatch).
 - Inputs:** capacities (generation, storage, conversion, transmission) and timeseries (demand, nondispatchable generation, availability dispatchable generation) for each energy carrier.
 - Outputs:** hourly dispatching, flows, storage utilization, and marginal energy prices for each energy carrier.
 - Risks evaluated with sensitivity analysis on various parameters (RES installed capacity, import capacity, etc.).
- From the identified risks for Switzerland, identification of **potential risks for SBB**.
- Proposals of **actions and investments for SBB** in various technologies to mitigate risks. Examples:
 - Renewable energy sources.
 - Storage technologies.
 - Alternative fuels technologies (hydrogen).



3 Tool - FlexECO

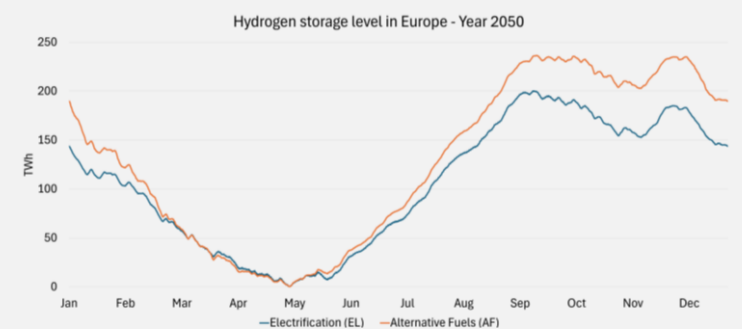
FlexECO is the FEN in-house tool for optimal economic dispatch of large-scale interconnected multi-energy systems³.



4 Preliminary results

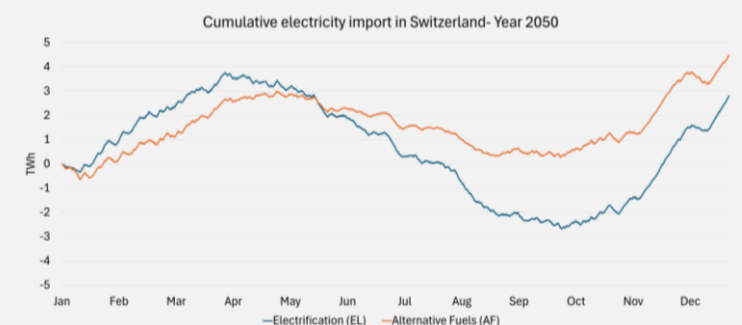
Europe in 2050:

- Solar and wind** technologies represent the major source of energy in Switzerland and Europe. However, **methane-fired power plants are still used to provide flexibility**. A significant peak capacity is necessary.
- Electricity demand for hydrogen production through electrolysis exceeds 27% of the total electricity consumption. Hydrogen is produced in summer and consumed in winter. **Hydrogen storage capacity is essential**.



Switzerland in 2050:

- Switzerland mirrors the European trends.
- Net electricity imports during the colder months of the year (**winter gap**). Europe is used as a "buffer" for electricity import/export.



5 Future steps

- Further analysis on potential risks for Switzerland and SBB.
- Development of FlexPLAN tool for optimal investment planning in multi-energy systems.
- Identification of action proposals for SBB to **mitigate potential risks and contribute to the overall Swiss energy strategy**.

References and acknowledgments

- ENTSO-E, and ENTSO-G. "TYNDP 2022: Scenario Building Guidelines." (2022).
- Swiss Federal Office of Energy. "Energieperspektiven 2050+ Kurzbericht." (2020).
- T. Demiray, "FlexEco: An optimal dispatch tool for large-scale interconnected multi-energy systems", 2018.

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