JASM Transmission Adequacy

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15 December 2020

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Why an adequacy assessment?

Energy System Models

- Yearly energy generation and usage numbers
- Investment choices

Swissmod Electricity Model

High-resolution temporal/spatial patterns:

- Hourly weather variability
- Nodal electricity grid
- Hydropower structure
- European market context

➔ Analyze robustness of energy system results to high resolution spatial/temporal patterns on the electricity market

➔ Determine whether the resulting system is adequate to meet demand at all times/places

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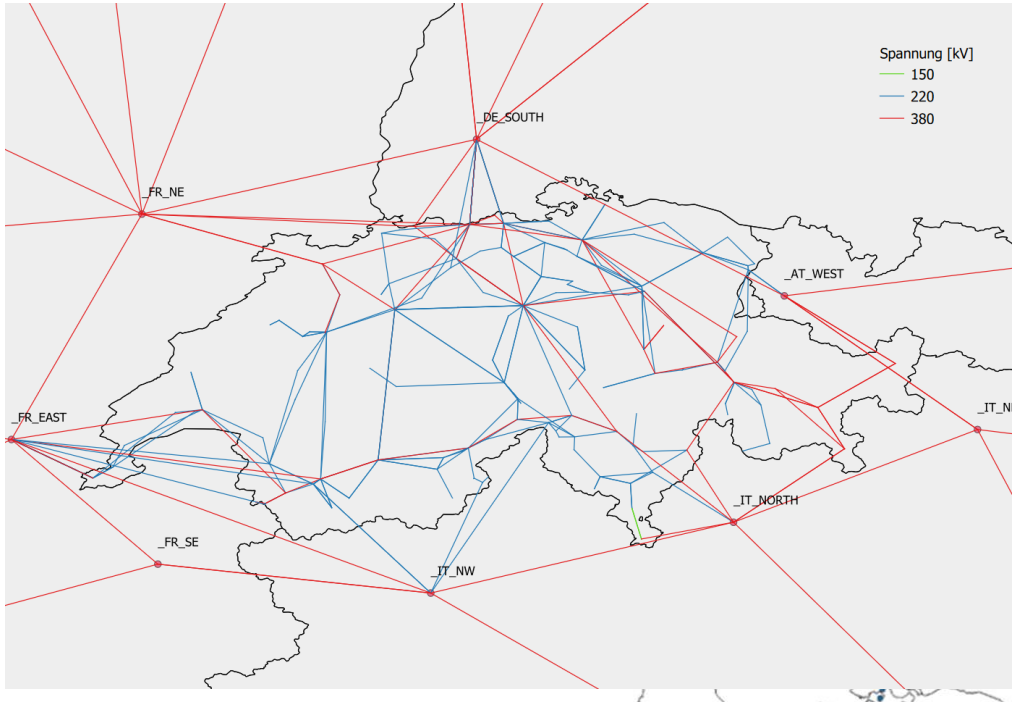
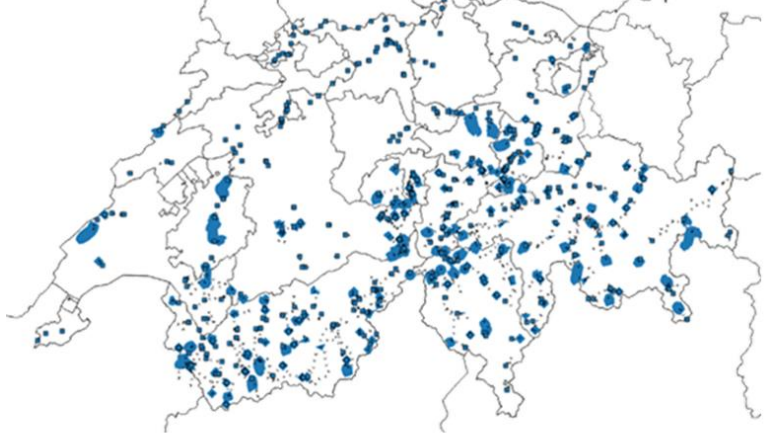
Swissmod electricity model

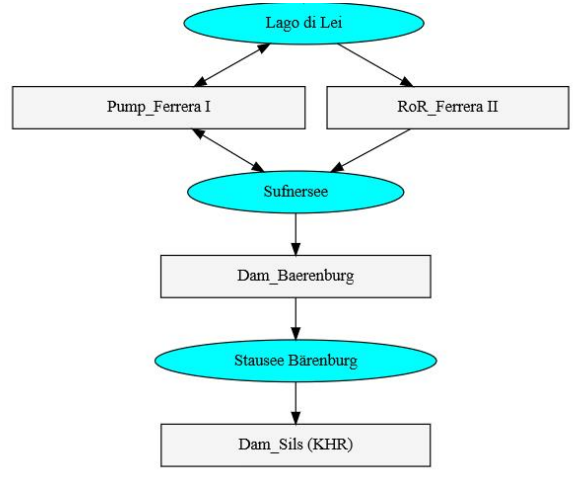


- Yearly resolution
- DC load-flow dispatch model

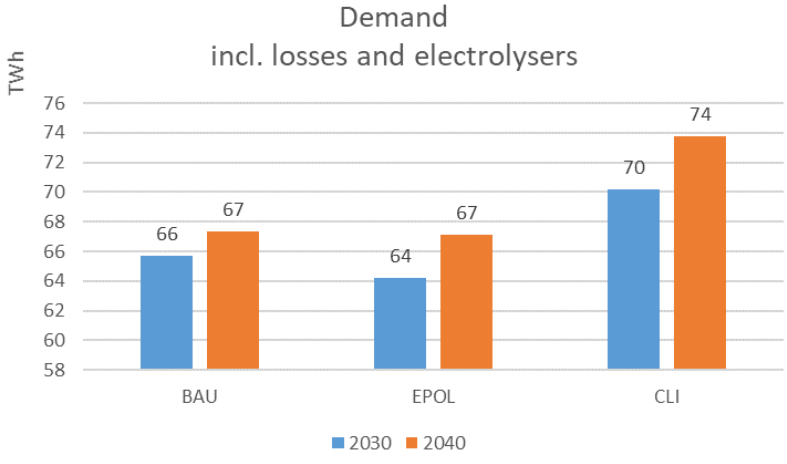
- Grid on nodal resolution for Switzerland
- Aggregated neighboring countries

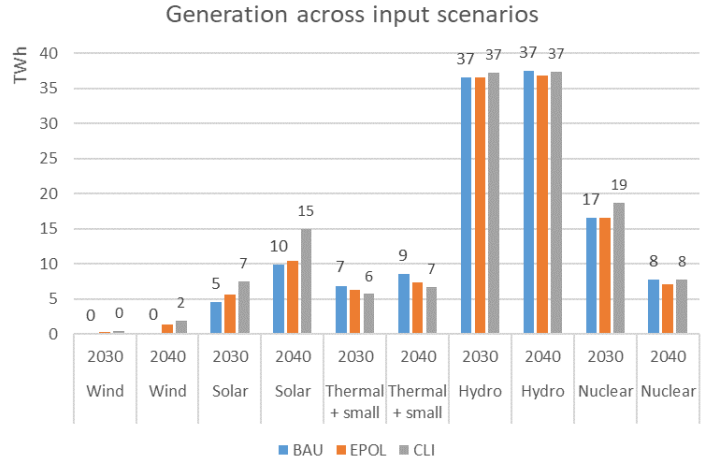
- Individual hydro cascades (260) and plants (400)

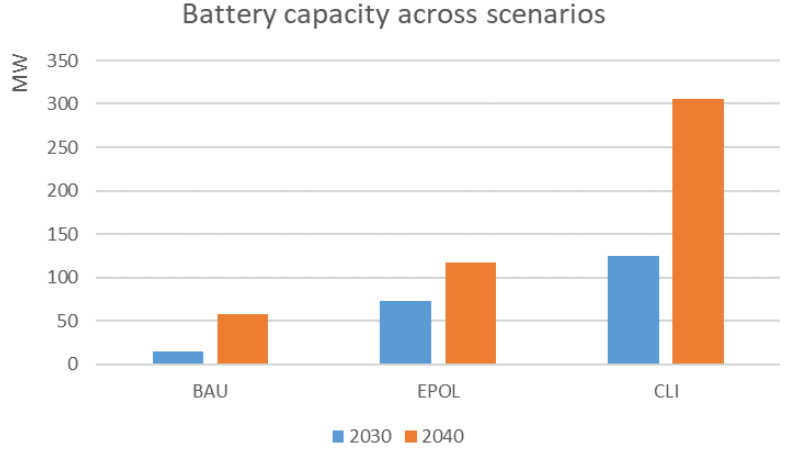


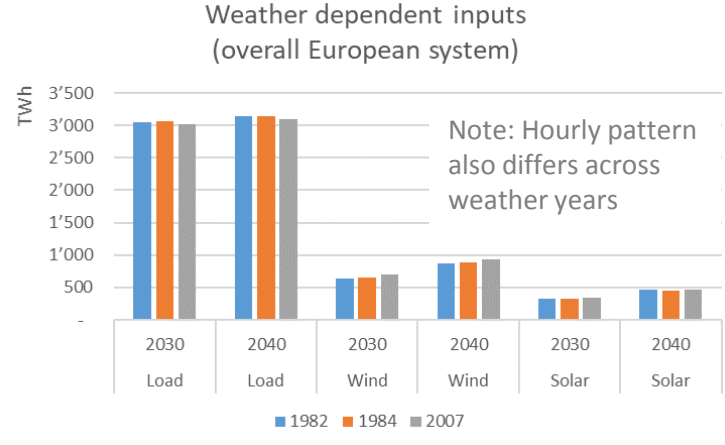


Input data









Switzerland: JASM STEM, Grid: Strategic grid 2025, TYNDP 2018
Europe: ENTSO-E TYNDP 2018 data

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Results - Remaining capacity margin

	Weather years:		1982	1984	2007
CH	2030	BAU	5.33	5.18	4.67
CH	2030	CLI	4.5	4.53	3.83
CH	2030	EPOL	5.48	5.36	4.86
CH	2040	BAU	4.12	3.88	2.65
CH	2040	CLI	1.89	2.54	2.2
CH	2040	EPOL	4.03	3.82	2.69
EU	2030	BAU	78.69	72.25	78.33
EU	2030	CLI	77.98	71.3	77.49
EU	2030	EPOL	78.79	72.45	78.53
EU	2040	BAU	33.44	25.96	40.5
EU	2040	CLI	31.33	25.04	40.1
EU	2040	EPOL	33.38	25.96	40.5

- Remaining capacity is always positive
- Both in CH as well as in the European system overall

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Results - Energy not served (ENS)

	Weather years:		1982	1984	2007
CH, GWh	2030	BAU	0.05	0.06	0.06
CH, GWh	2030	CLI	0.06	0.08	0.07
CH, GWh	2030	EPOL	0.04	0.06	0.06
CH, GWh	2040	BAU	0.05	0.18	0.3
CH, GWh	2040	CLI	1.43	1.49	1.9
CH, GWh	2040	EPOL	0.06	0.21	0.32
CH, % of load	2030	BAU	0.000%	0.000%	0.000%
CH, % of load	2030	CLI	0.000%	0.000%	0.000%
CH, % of load	2030	EPOL	0.000%	0.000%	0.000%
CH, % of load	2040	BAU	0.000%	0.000%	0.000%
CH, % of load	2040	CLI	0.002%	0.002%	0.003%
CH, % of load	2040	EPOL	0.000%	0.000%	0.000%

- Very robust system: hardly any ENS
- Embedding in Europe helps Switzerland in winter
- Very small ENS in CLI scenario is due to local grid problem during two modeled days

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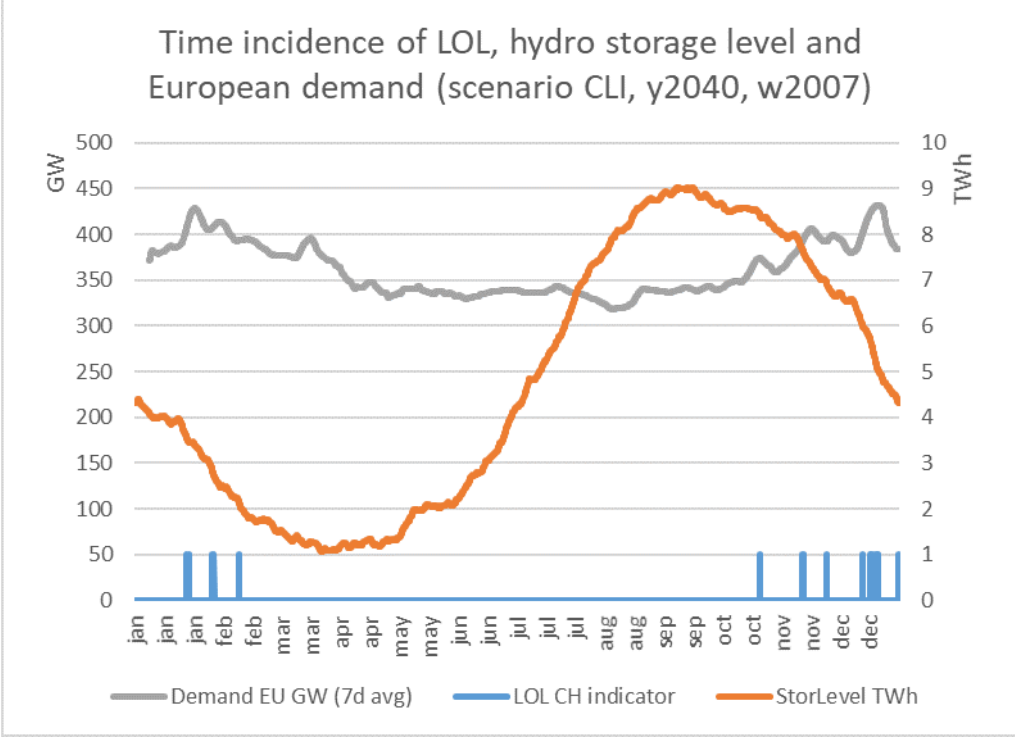
CLI 2040 scenario: Detail view



- Incidence of slight loss-of-load from local grid problems
- Occurrence is not related to hydro storage constraint
- Appears at times of high European demand

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Conclusions & Implications

- No significant loss of load even for challenging scenarios
  - Planned grid is strong enough for additional electrification
  - RCM remains positive throughout
- European embedding important
  - Trade with neighbors helps bridging the winter gap
  - In moments of tight supply, Switzerland's advantage is the large hydro capacity
  - Unrestricted access to European market therefore important

Thank you for your attention!

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