Generation Expansion Planning in Switzerland Considering Climate Change Scenarios

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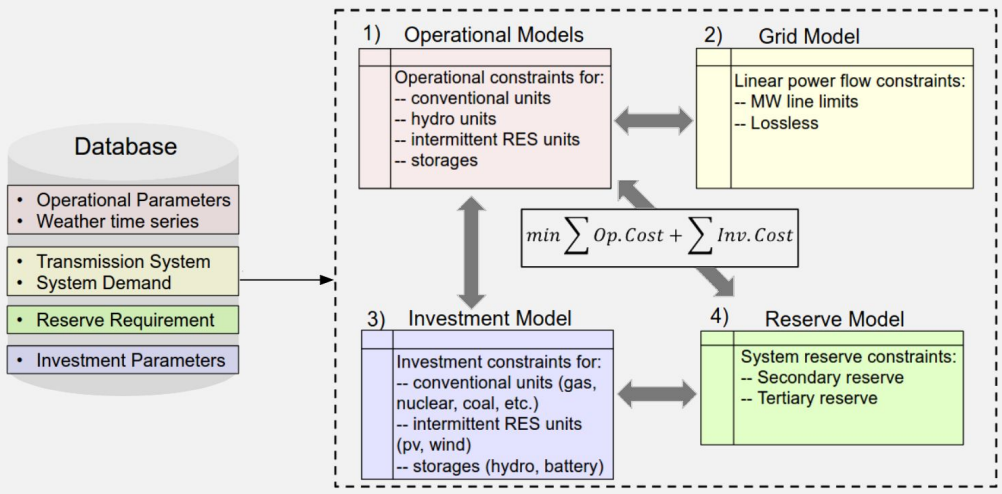
1 Introduction

With global climate change, the availability of water for hydro power production is expected to change [1], [2]. The goal of this work is to investigate the impacts of climate-driven changes in hydro inflows on the electricity supply in Switzerland for the year 2050.

Contributions:
1) Apply a **Generation Expansion Planning (GEP)** formulation with **high temporal and spatial resolution** to the detailed Swiss power system.
2) Determine the **optimal size and location for new generators** under **different hydrological conditions** impacted by climate change.

2 Method Overview

Use the **Centralized Investments module (CentInv)**, a core module of the energy systems modeling platform **Nexus-e*** [3].



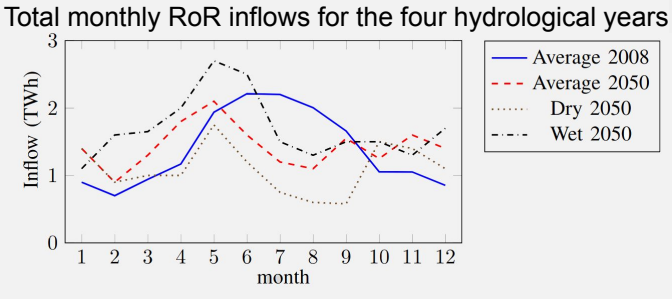
* For more information about our modeling platform Nexus-e, please scan the QR code next to the poster title.

3 Simulated Scenarios

Simulate every second day of the target year (2050) with **hourly resolution** for five different scenarios including four hydrological years.

	Scenario Name	Description	Tot. Inflows [TWh]
1	Hist. Avg.	"avg." hydro year + no climate change (CC)	38.3
2	Hist. Avg. - No Inv.	"avg." hydro year + no climate change + no invest.	38.3
3	Average CC	"avg." hydro year + climate change	36.7
4	Dry CC	"dry" hydro year + climate change	28.6
5	Wet CC	"wet" hydro year + climate change	44.8

Total monthly RoR inflows for the four hydrological years [4].



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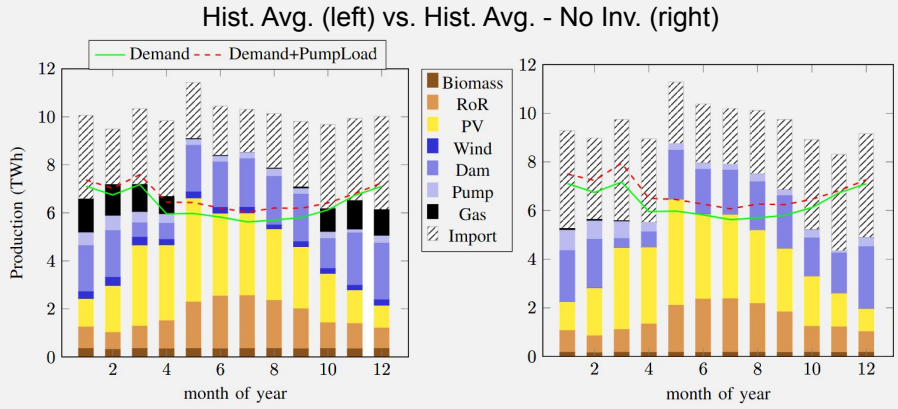
4 Results

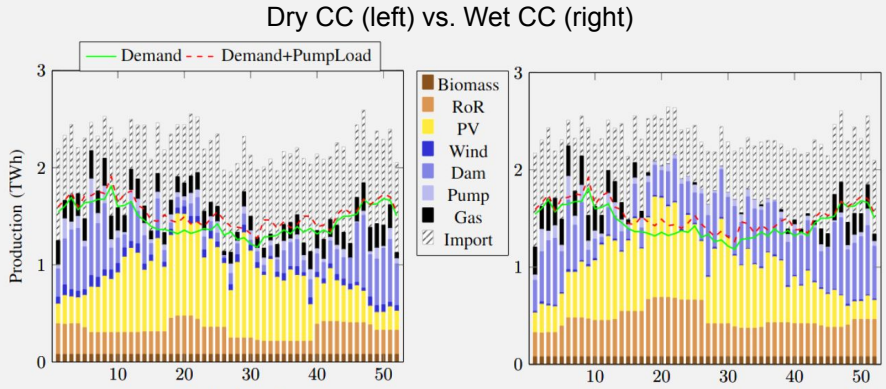
New investments in Switzerland in 2050 for the five scenarios. All scenarios take as input 33.6 TWh of PV [5], therefore PV is not in the set of candidate units.

Scenario Name	Wind [MW]	Gas [MW]	Biomass [MW]	Objective f-n [-]
Hist. Avg.	1'727	2'400	240	–
Hist. Avg. - No Inv	✗	✗	✗	↑ ↑
Average CC	1'714	2'000	240	↓
Dry CC	1'865	2'000	240	↑
Wet CC	380	2'200	240	↓ ↓

Monthly production per technology type in 2050.
Hist. Avg. (left) vs. Hist. Avg. - No Inv. (right)



Weekly production per technology type in 2050.
Dry CC (left) vs. Wet CC (right)



5 Discussion and Conclusion

- Under the given assumptions, investing in new generators in Switzerland in 2050 is more economically viable than relying only on imports regardless of the simulated hydrological conditions.
- Depending on the distribution of monthly inflows due to climate change effects, the investments in gas units may differ.
- The projected wetter winters as a result of climate change are favorable in terms of lowering overall system costs (more water in months when the system load is higher).
- Both the investment and operational decisions are heavily influenced by our assumptions on input parameters (need for sensitivity analyses).

References

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