384 - Compensation of short-term power fluctuations at the transmission grid level by centralized and distributed short-term storage technologies on the example of Austria

Sabina Nemec-Begluk Wolfgang Gawlik
TU Wien-Institute of Energy Systems and Electrical Drives, Vienna, Austria

Introduction

The role of centralized and distributed short-term storage technologies to maximize the utilization of renewable power production is examined.

Objective: Is the potential of centralized pumped-storage power plants in Austria sufficient for balancing the short-term power fluctuations at the transmission grid level?

Methodology

A linear optimization problem for the expansion and operational planning is modeled in GAMS.

Objective function:

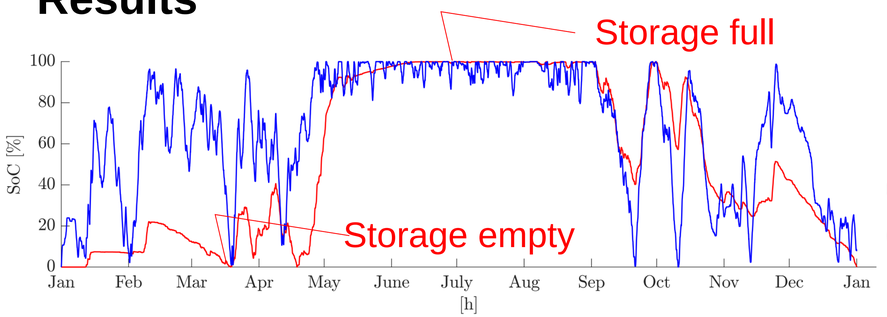
$$min\left\{\sum_{mk}\sum_{i} C_{var}(mk,t_i) + \sum_{nk} C_{inv}(nk)\right\}$$

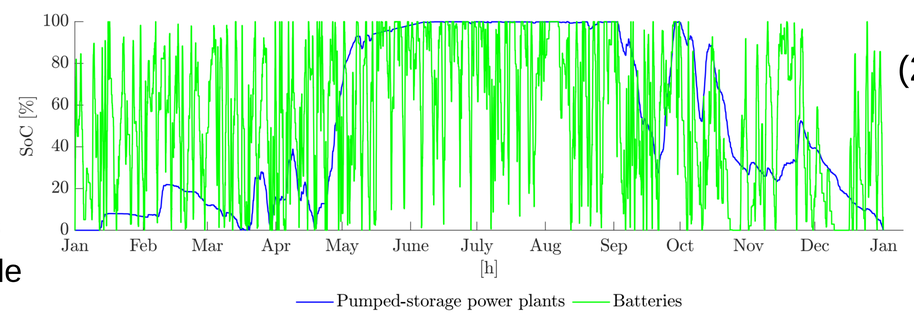
C_{var}	variable costs
mk	model components
i	sampling instances
t_i	time step
C_{inv}	annuity costs
nk	expanded technologies

Optimization topology:

- Austrian transmission grid,
- power plants (thermal and (pumped-)storage),
- distributed storage technologies,
- heat pumps,
- exogenous power consumption,
- exogenous sustainable power generation,
- import/export,
- the flexibility option of electricity curtailment.

Results





Number of full-cycles [1/a]			
Storage Technology / Scenarios	A	B	C
Pumped-storage power plants	4.8	4.2	4.1
Batteries		116	
Distributed pumped-storage			20

Scenarios	A	B	C
Non-usable surplus power [TWh/a]	7.47	7.21	6.68
Fossil load covarage share [%]	8.49	8.23	7.78

Conclusion

(1) The potential of centralized storage technologies is essential and, in general, sufficient for balancing the short-term power fluctuations.

(2) The residual load amplitude is too large during summer and winter → further expansion of batteries and distributed pumped-storage technologies do not enhance the regenerative generation/load compensation at a higher system level.

(3) A significant reduction of the fossil load coverage share can only be achieved by storing regenerative surplus electricity in a seasonal storage facility.