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Pilot-Scale Demonstration of Advanced Adiabatic Compressed Air Energy Storage

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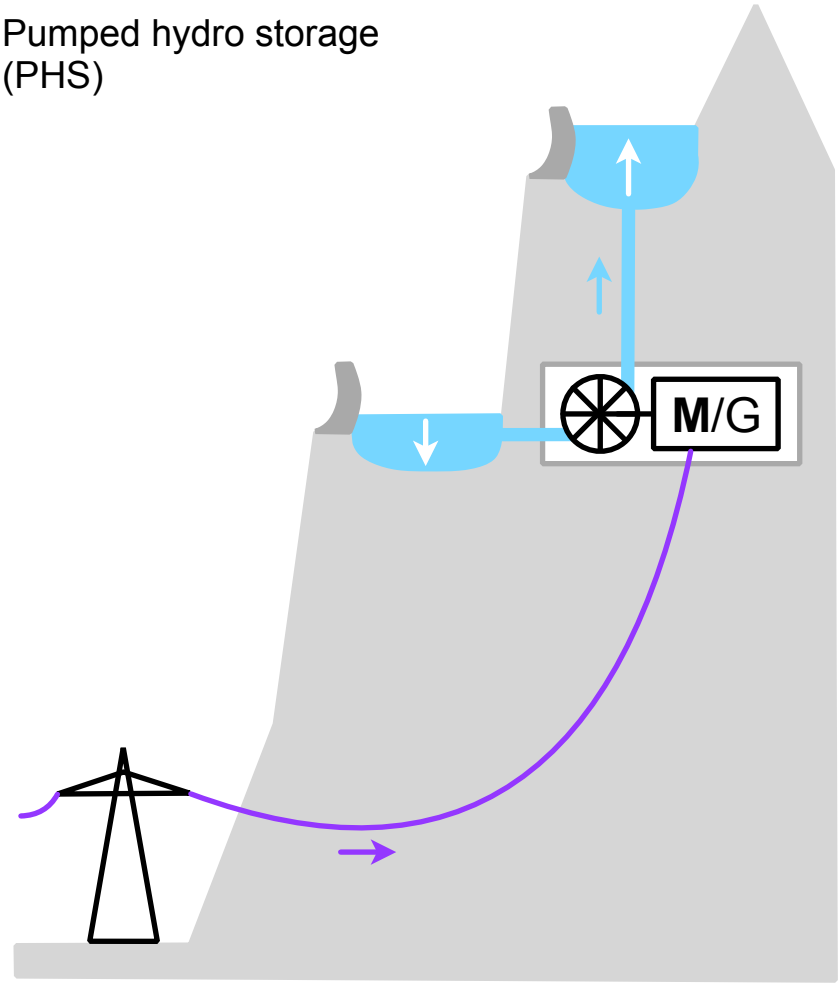
PREC
Professorship of Renewable Energy Carriers

Electricity Storage

Pumped hydro storage
(PHS)



Electricity Storage

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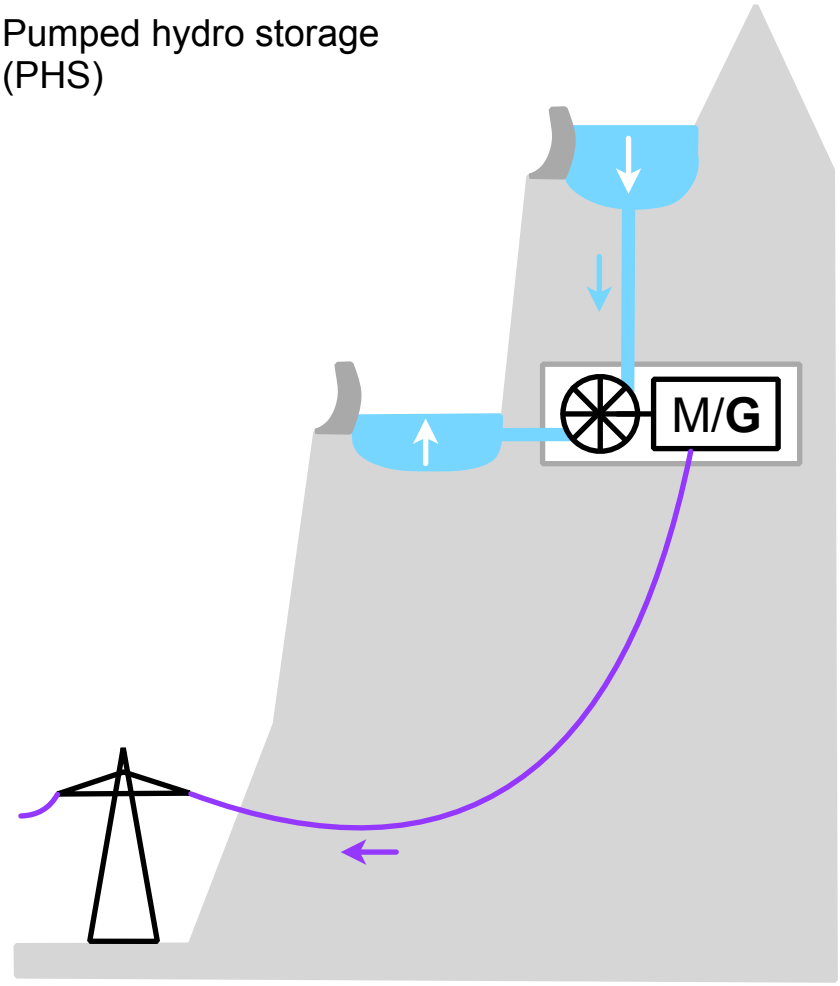
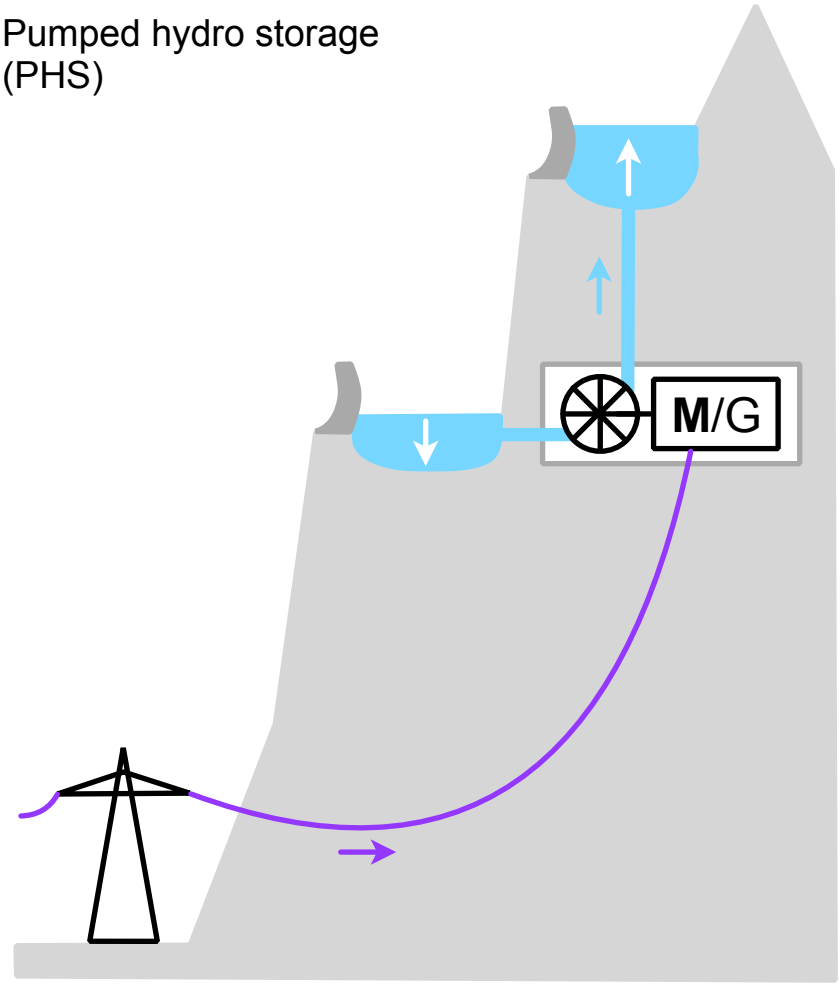
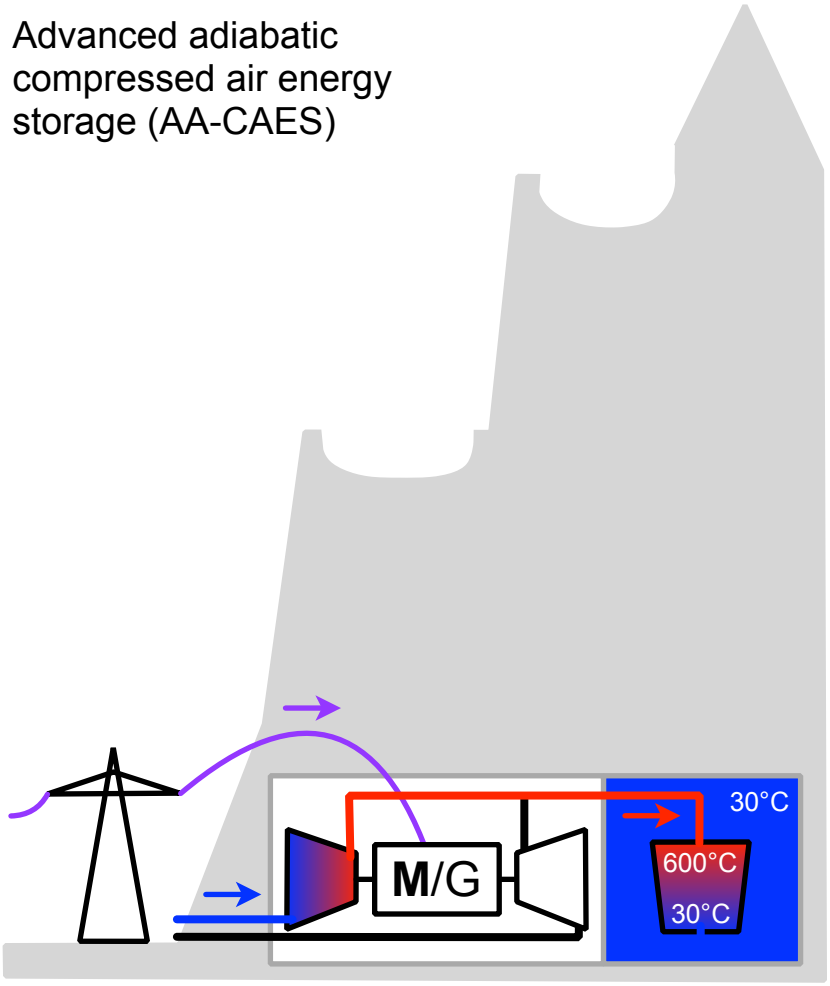


Electricity Storage

Pumped hydro storage (PHS)



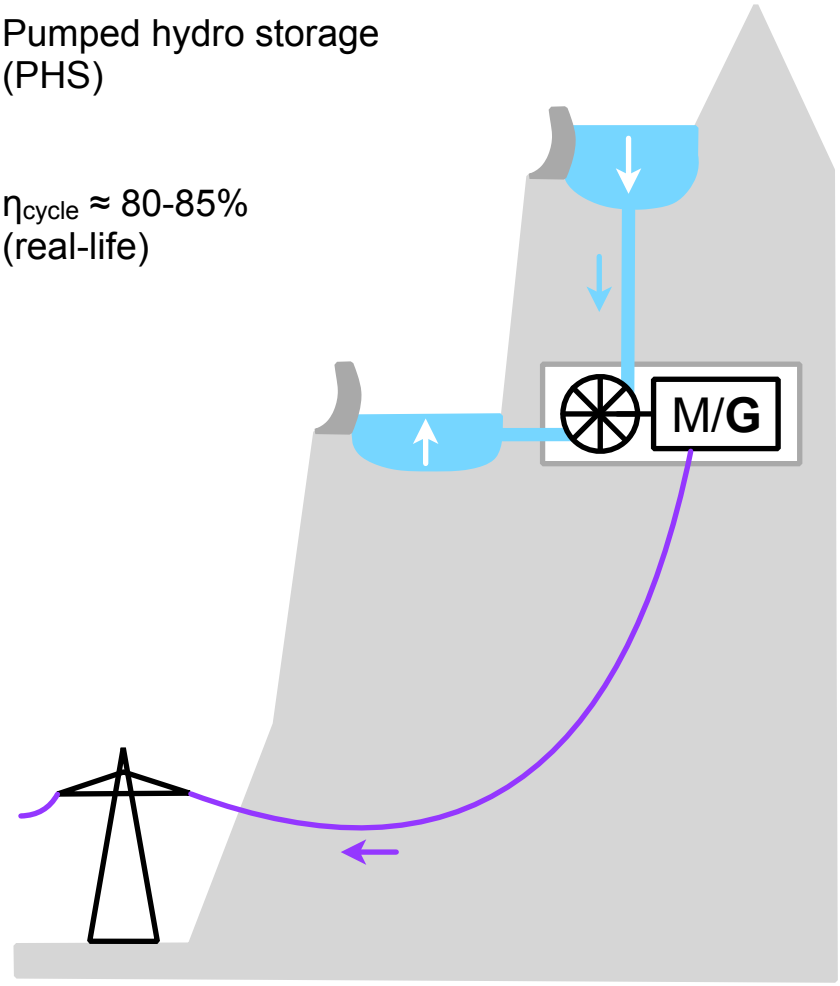
Advanced adiabatic compressed air energy storage (AA-CAES)



Electricity Storage

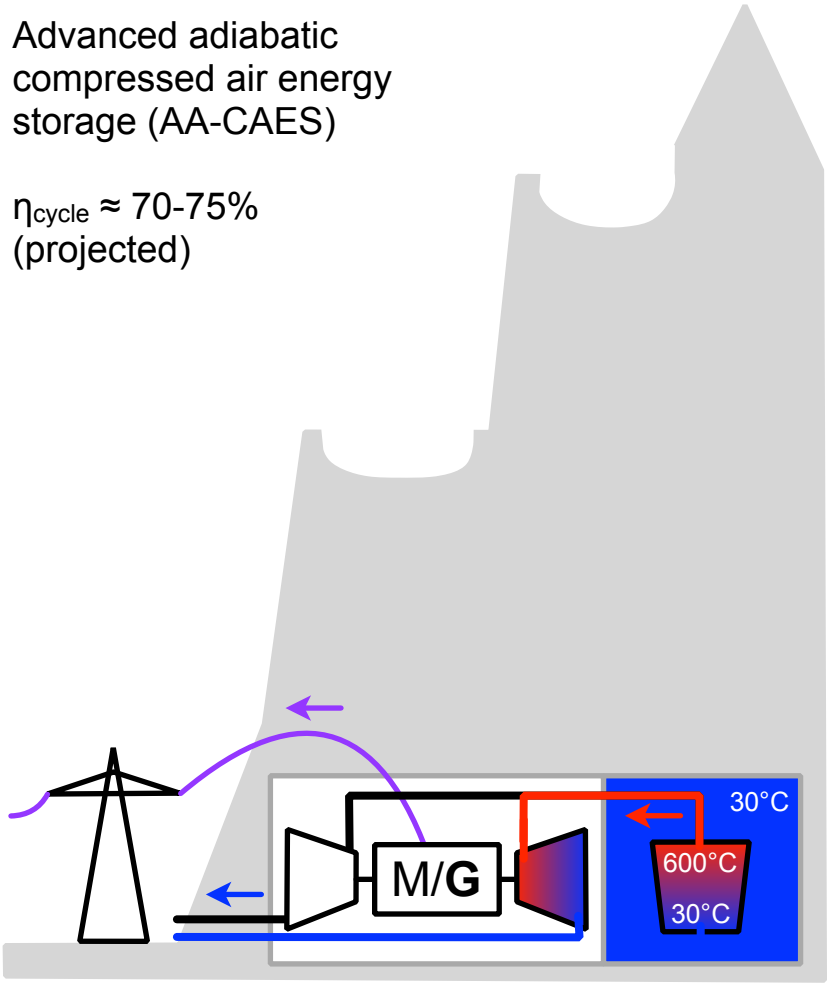
Pumped hydro storage (PHS)

$\eta_{cycle} \approx 80\text{-}85\%$ (real-life)



Advanced adiabatic compressed air energy storage (AA-CAES)

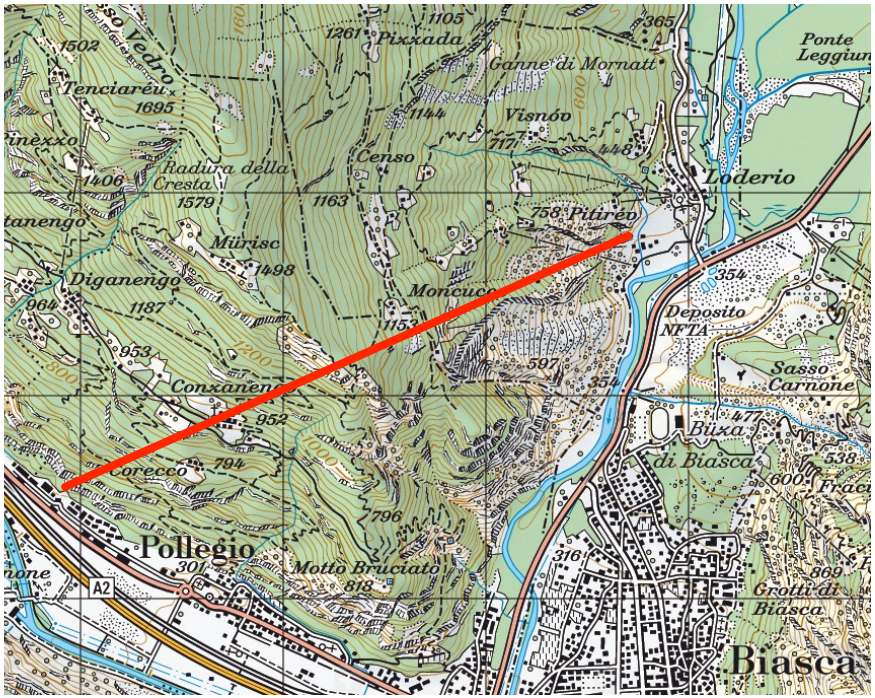
$\eta_{cycle} \approx 70\text{-}75\%$ (projected)



AA-CAES Pilot Plant

- Built by ALACAES in decommissioned tunnel
- Experiments with sensible and sensible/latent heat storage:
  - Capacity of sensible heat storage (SHS): 12 MWh
  - Capacity of latent heat storage (LHS): 171 kWh
- World firsts:
  - First AA-CAES pilot plant (no turbine)
  - First AA-CAES pilot plant with rock cavern (mostly unlined)
  - First pilot-scale experiments with combined SHS/LHS

AA-CAES Pilot Plant



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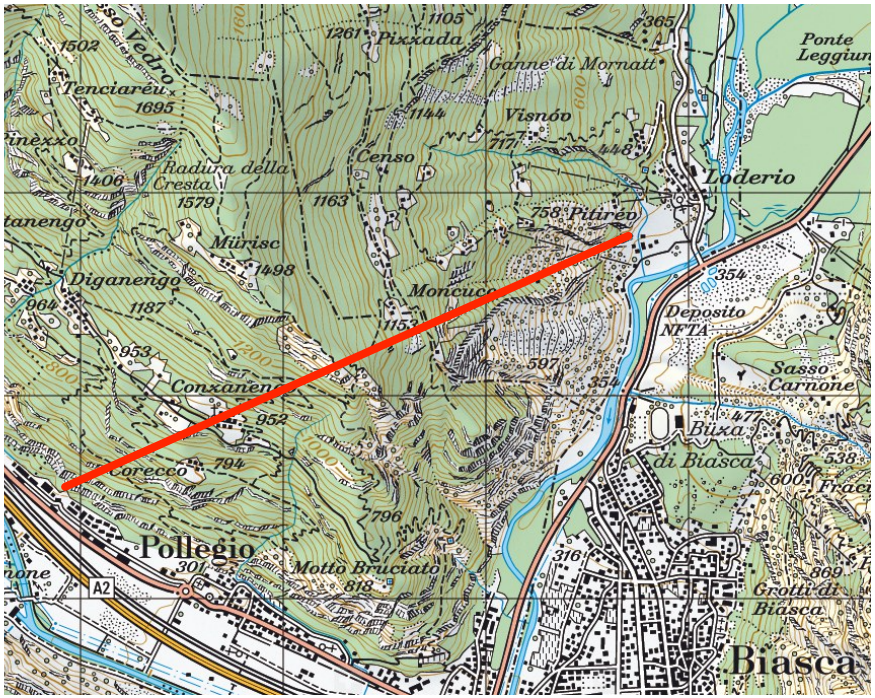

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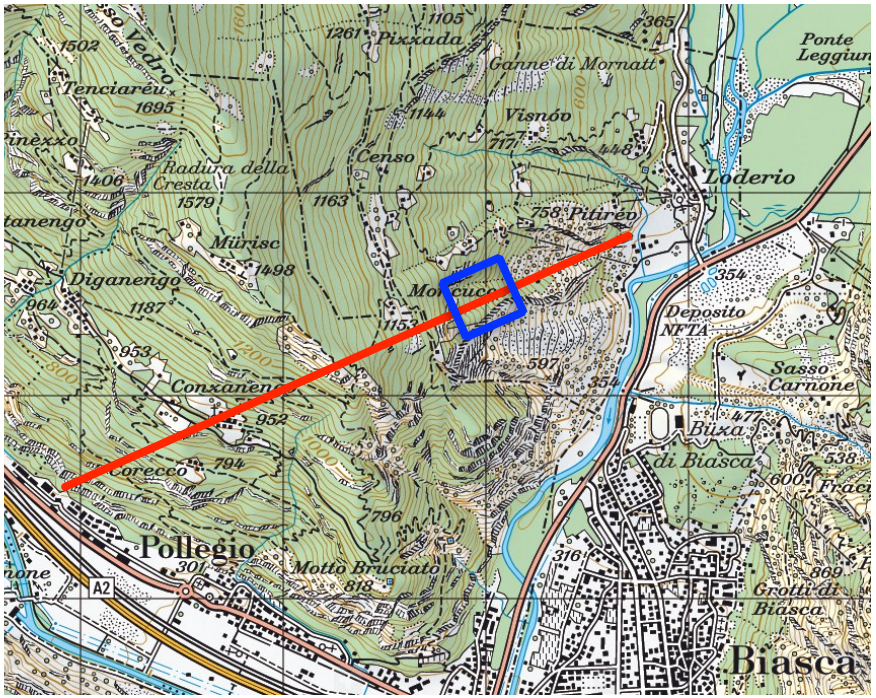

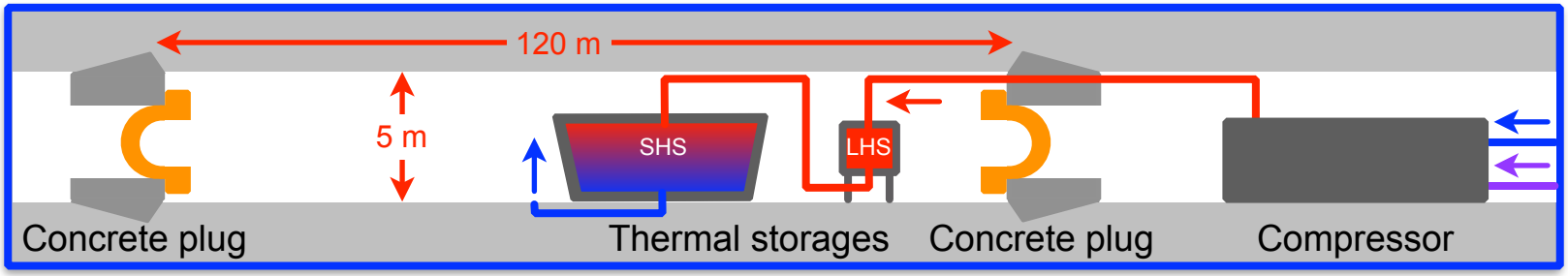

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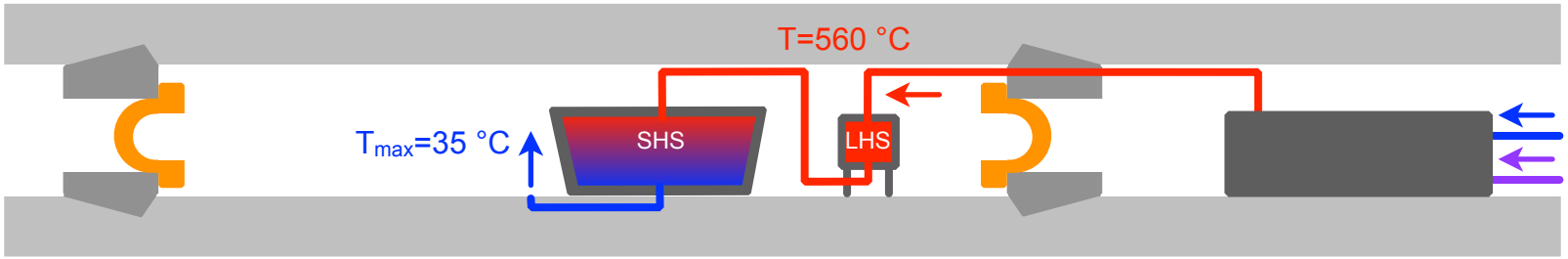

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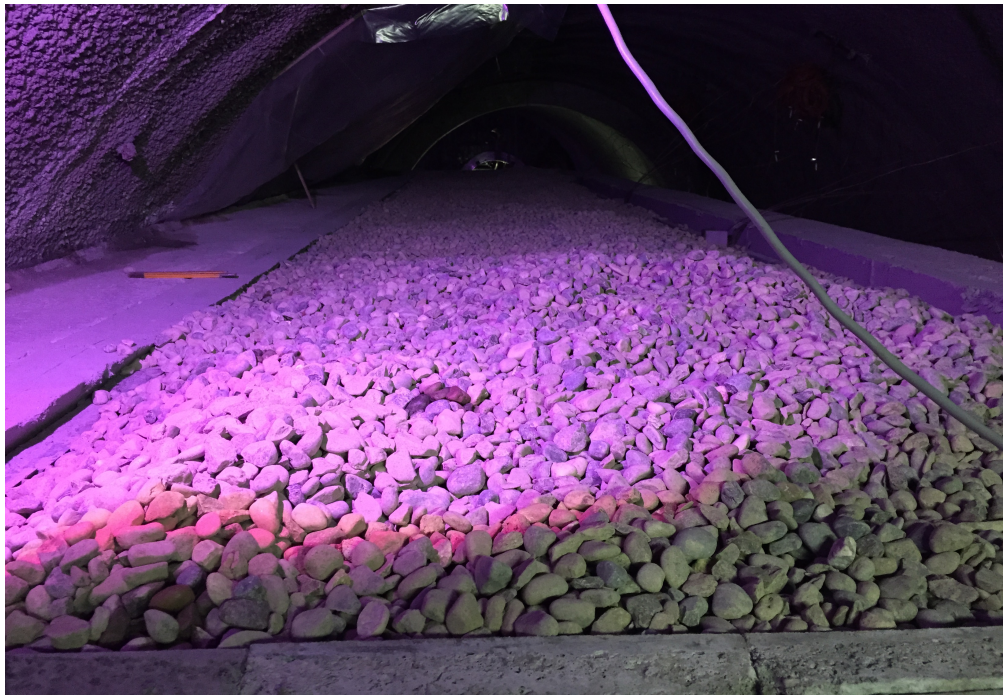

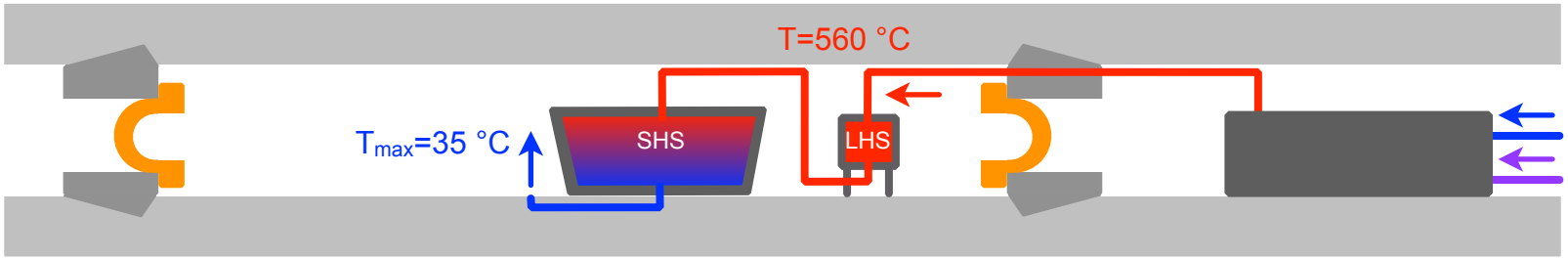

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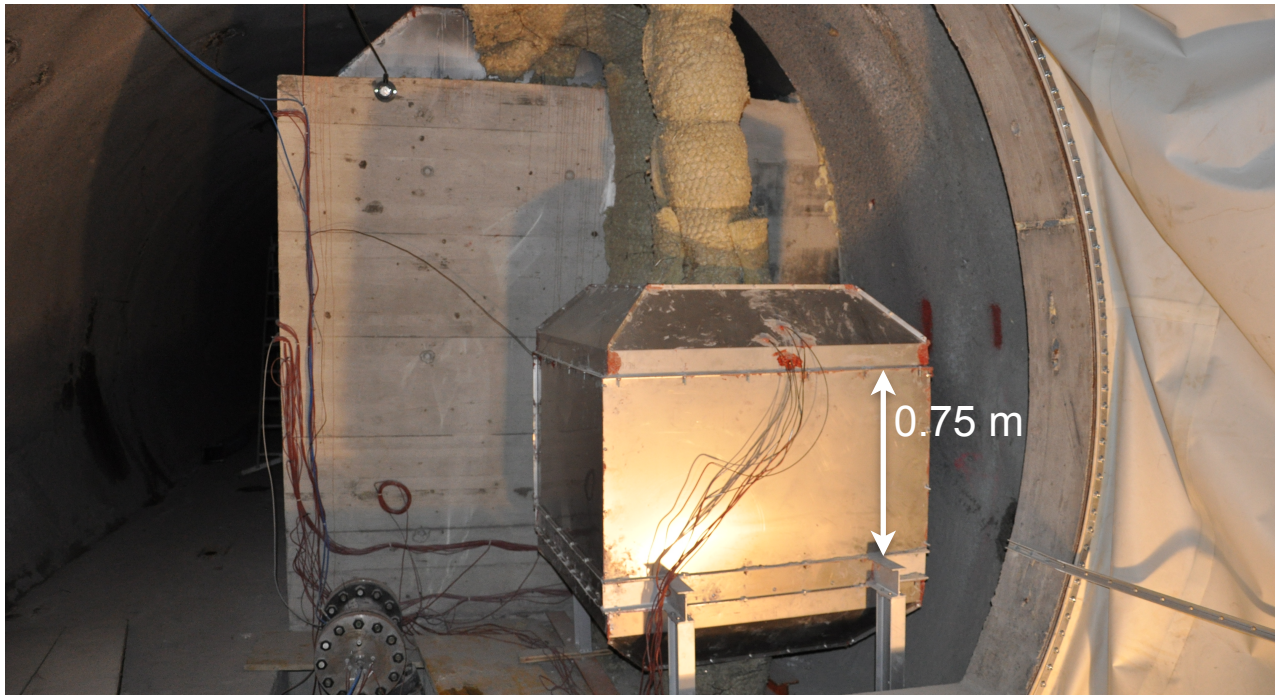
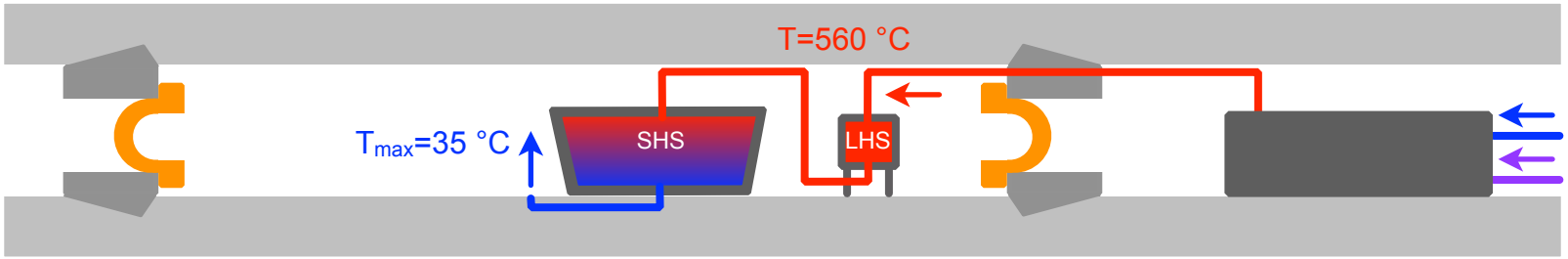
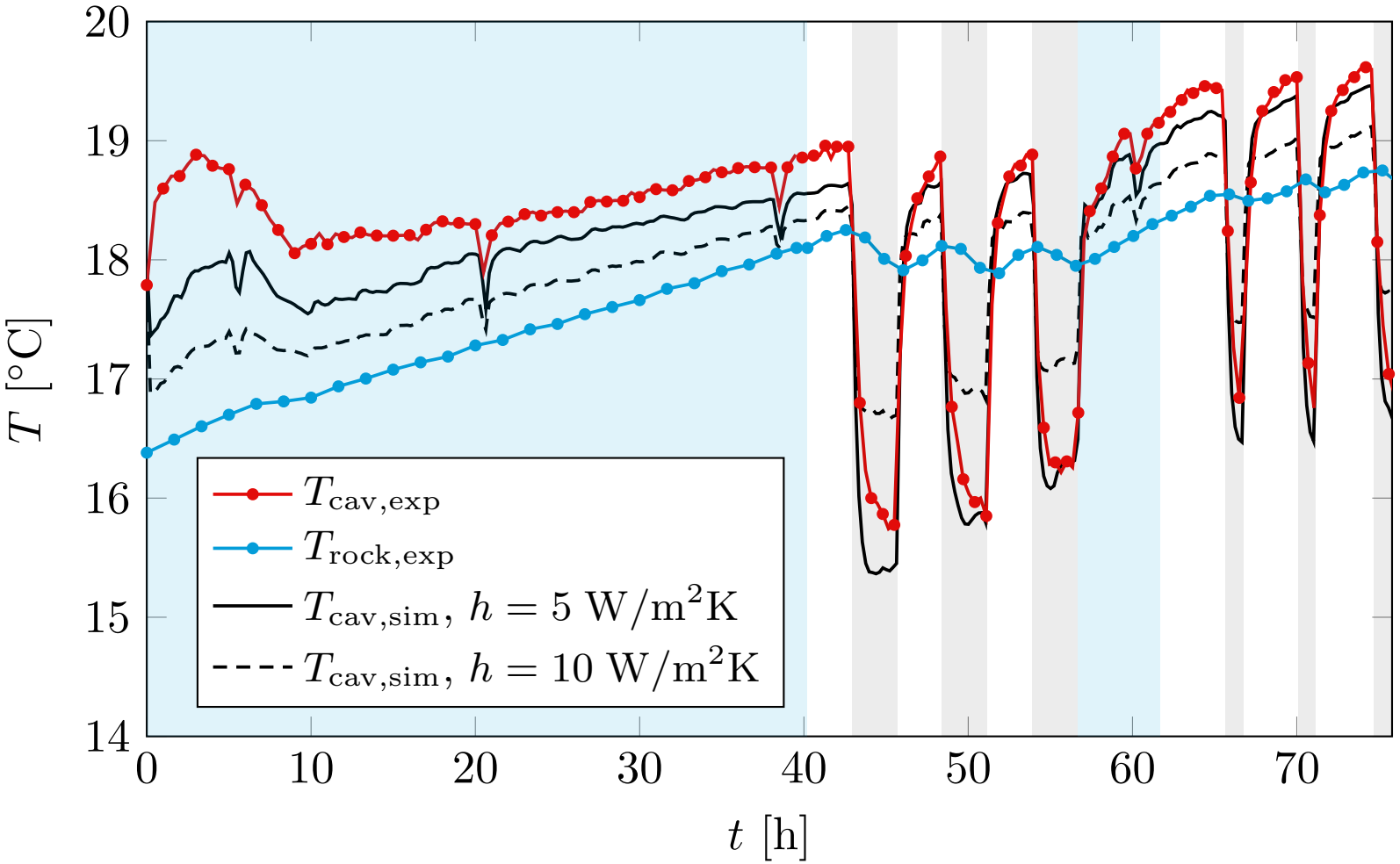


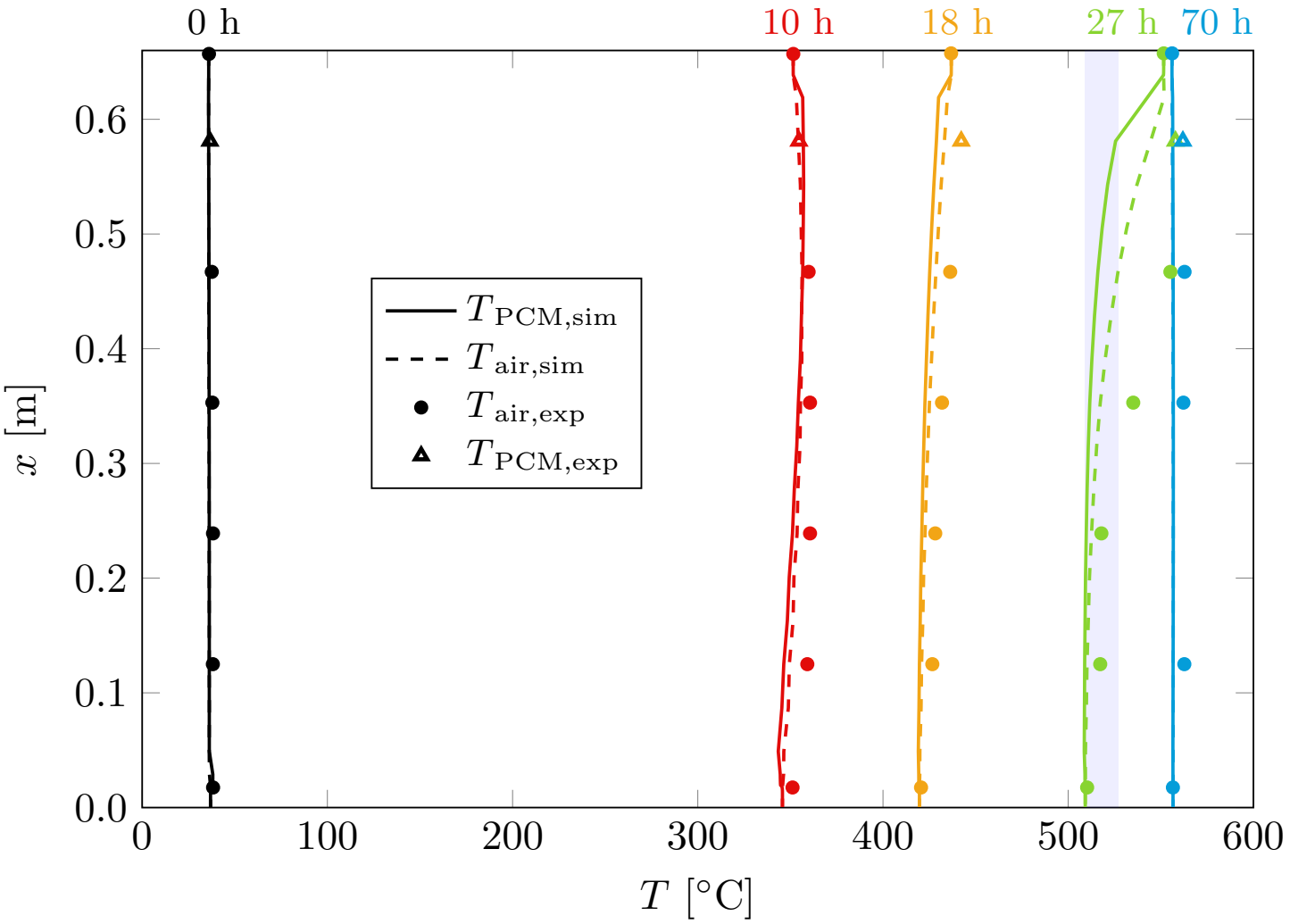


AA-CAES Pilot Plant: Cavern



Geissbühler et al., *Pilot-scale demonstration of advanced adiabatic compressed air energy storage, Part 1: Plant description and tests with sensible thermal-energy storage*, in preparation

AA-CAES Pilot Plant: LHS



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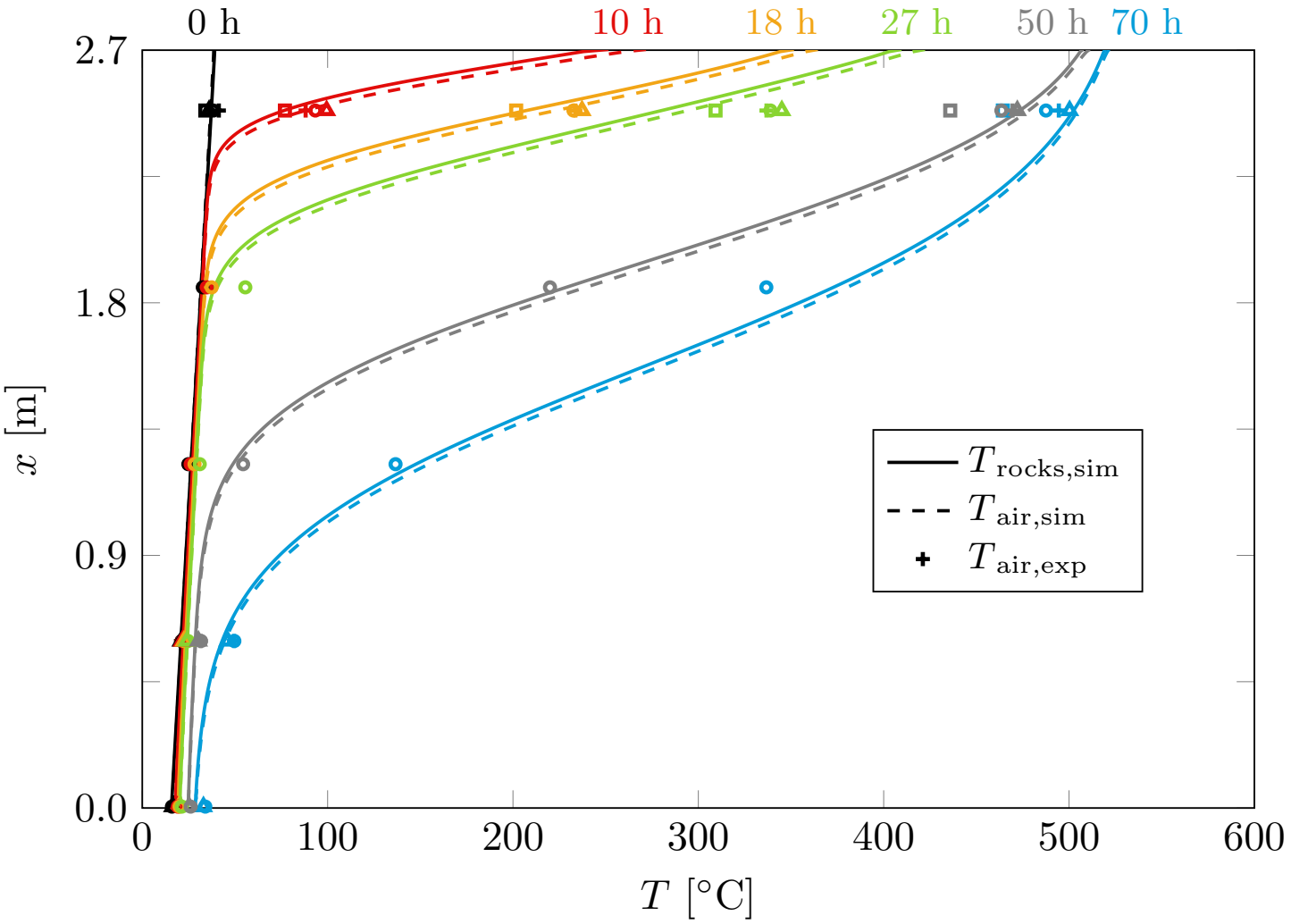
AA-CAES Pilot Plant: SHS



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AA-CAES Pilot Plant: Efficiency

Run	Cycle	η_{TES}	$\eta_{\mathrm{plant,est}}$
1	A1	90.3%	73.8%
	A2	83.0%	68.4%
	A3	76.1%	62.7%
2	A1	87.6%	70.2%
	A2	82.3%	66.2%
	B1	89.1%	69.6%
	B2	86.7%	69.7%
	C1	84.2%	70.4%
	C2	84.1%	70.2%
	C3	77.7%	65.2%

- Efficiency estimated for case of sensible TES only
- Assumptions:
  - Turbine modeled
  - $\eta_{s,comp} = \eta_{s,turb} = 0.85$
  - $\eta_{mot} = \eta_{gen} = 0.97$
- Efficiency w/o TES: up to 79.8%

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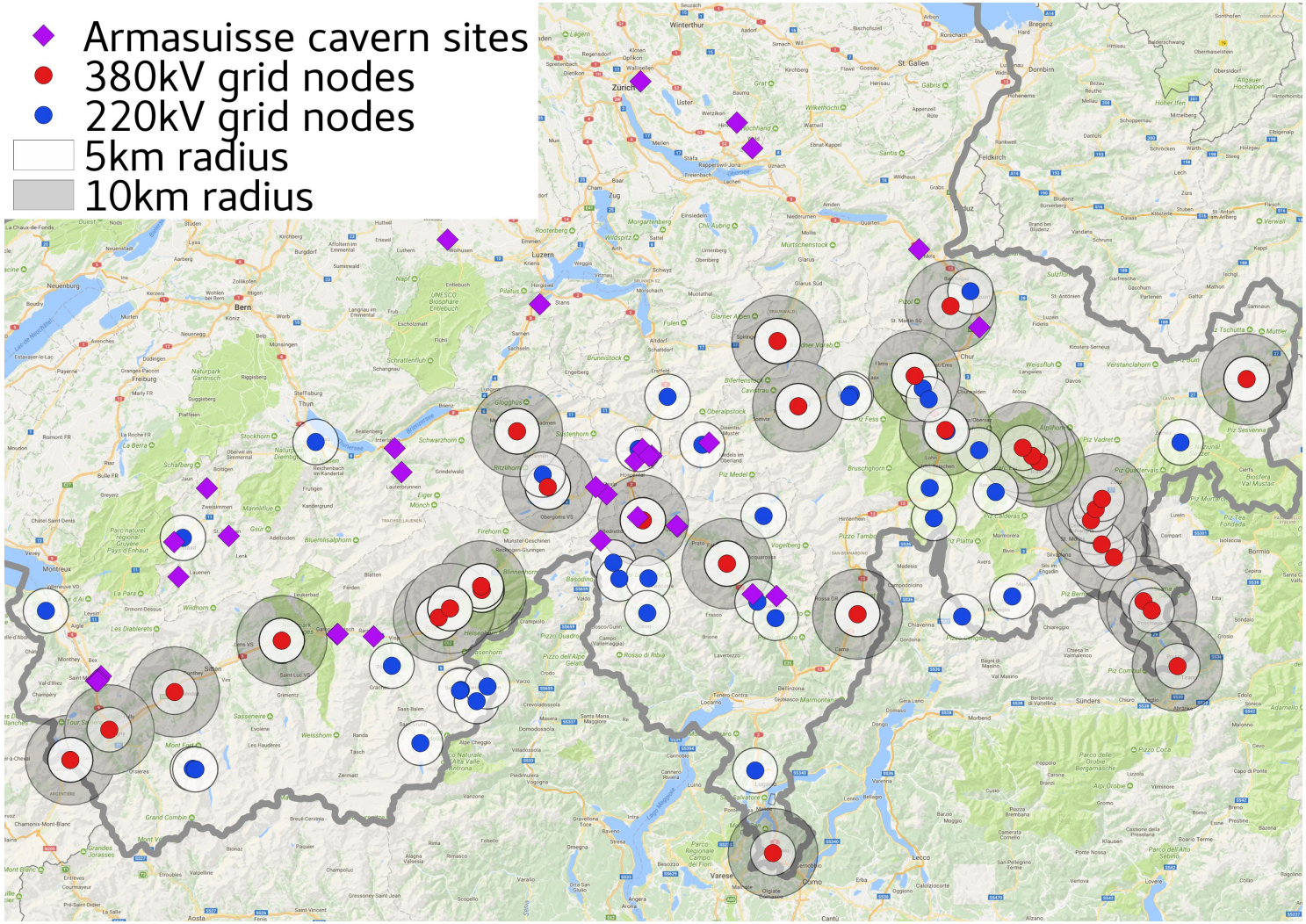
Concluding Remarks & Outlook

- AA-CAES pilot plant demonstrated technical feasibility:
  - Mostly unlined cavern
  - Combined sensible/latent TES at temperatures up to 560°C
  - TES located inside cavern to simplify construction/reduce cost
  - Estimated plant efficiencies of 65-70% based on experimental data
- Focus shifting toward techno-economic analysis of industrial-scale plant:
  - Optimal plant configuration (power and capacity)
  - Optimal plant site in Switzerland (cavern, grid connection)

Concluding Remarks & Outlook



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Confédération suisse
Confederazione Svizzera
Confederaziun svizra

Swiss Confederation

Commission for Technology and Innovation CTI

Schweizerische Eidgenossenschaft
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Confederazione Svizzera
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Swiss Federal Office of Energy SFOE

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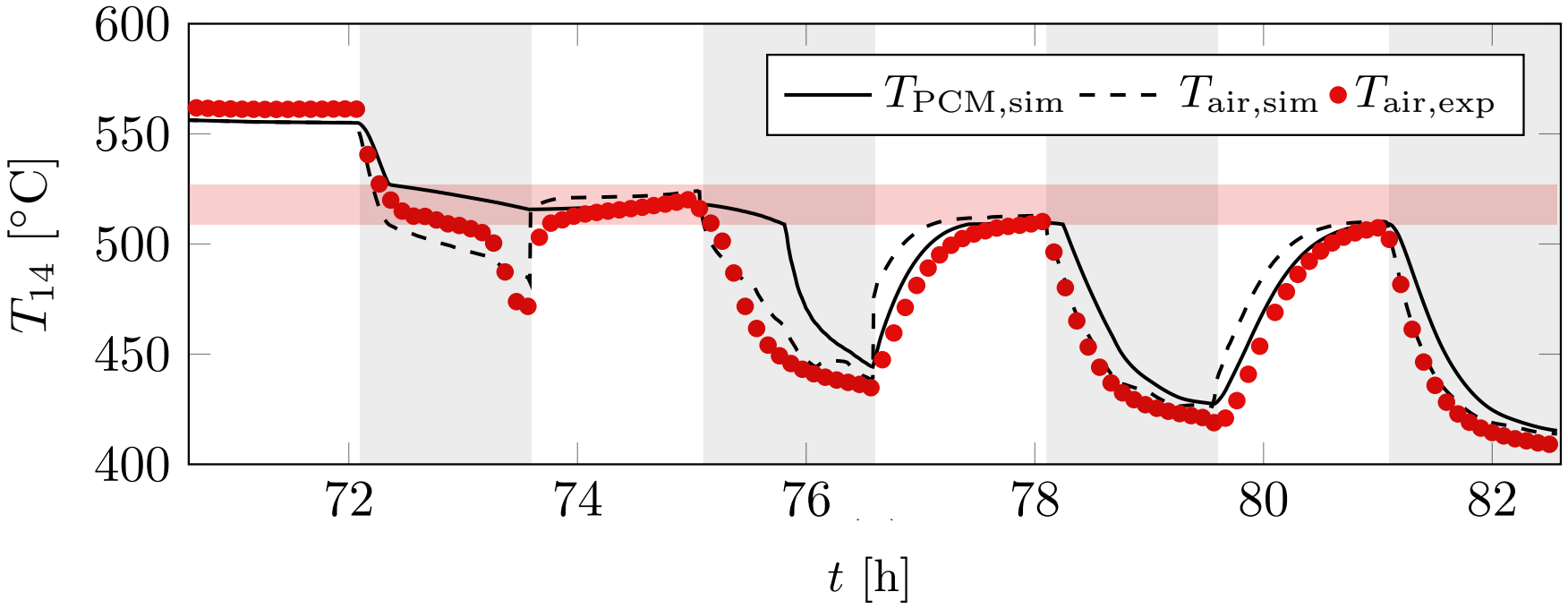
AA-CAES Pilot Plant: LHS



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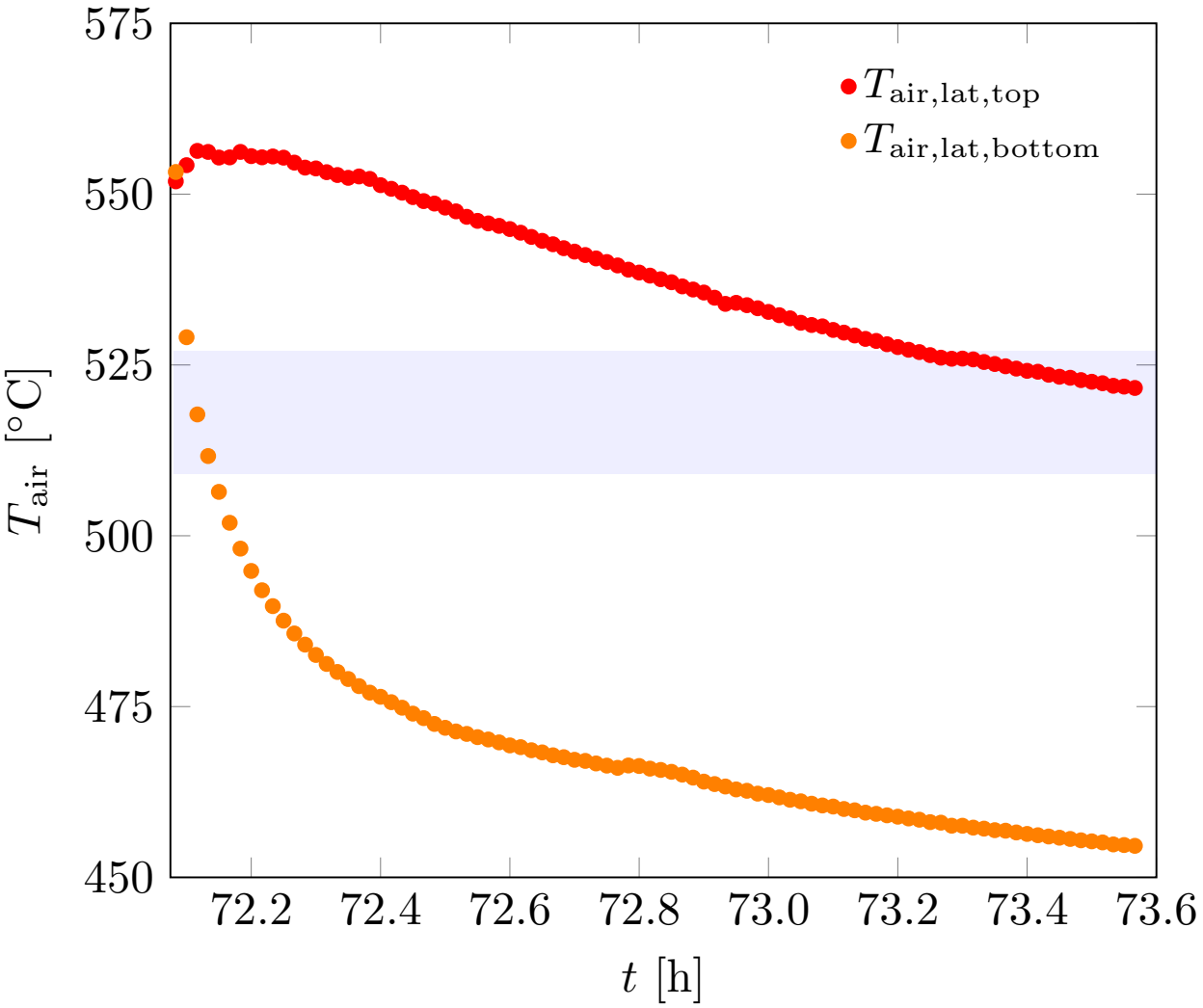

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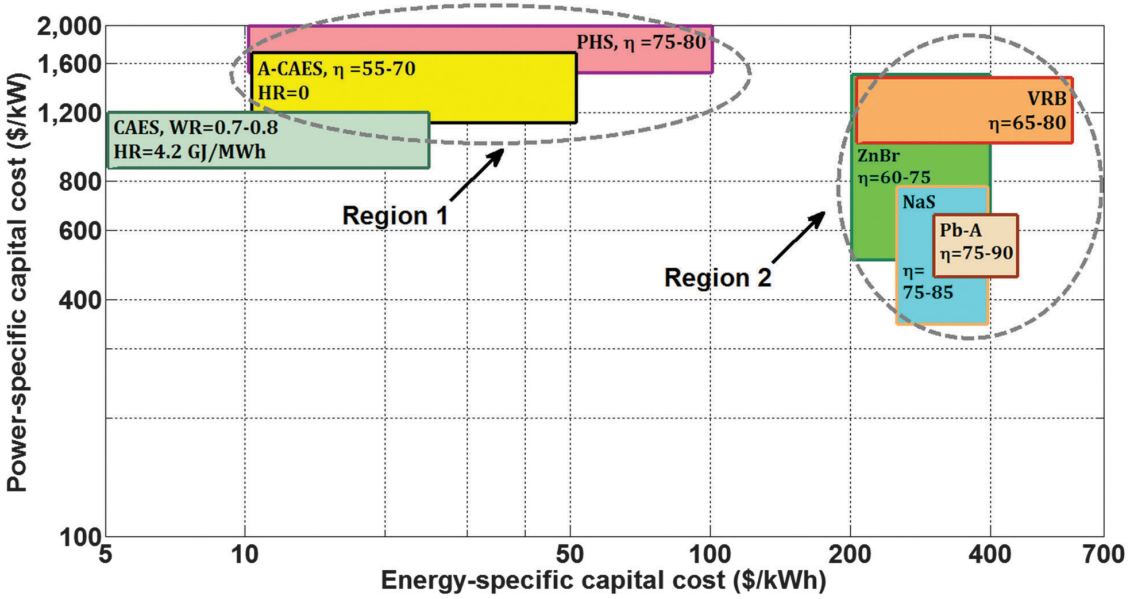
Economic and Environmental Aspects



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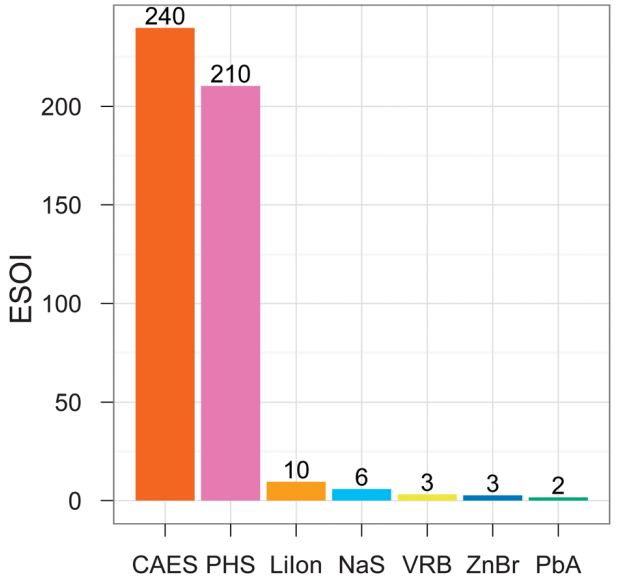

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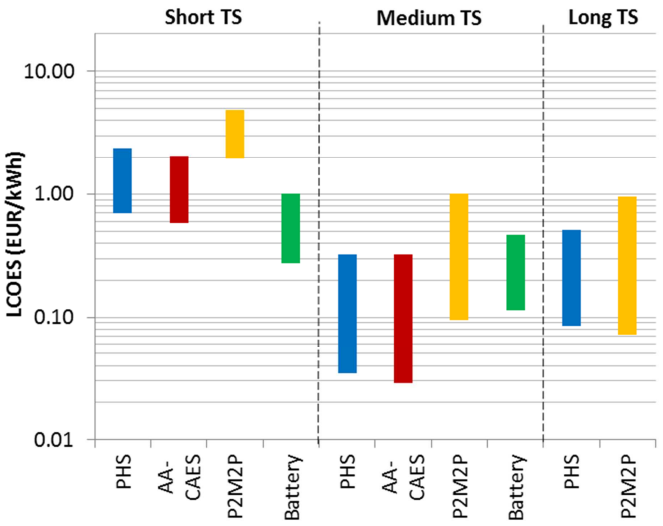

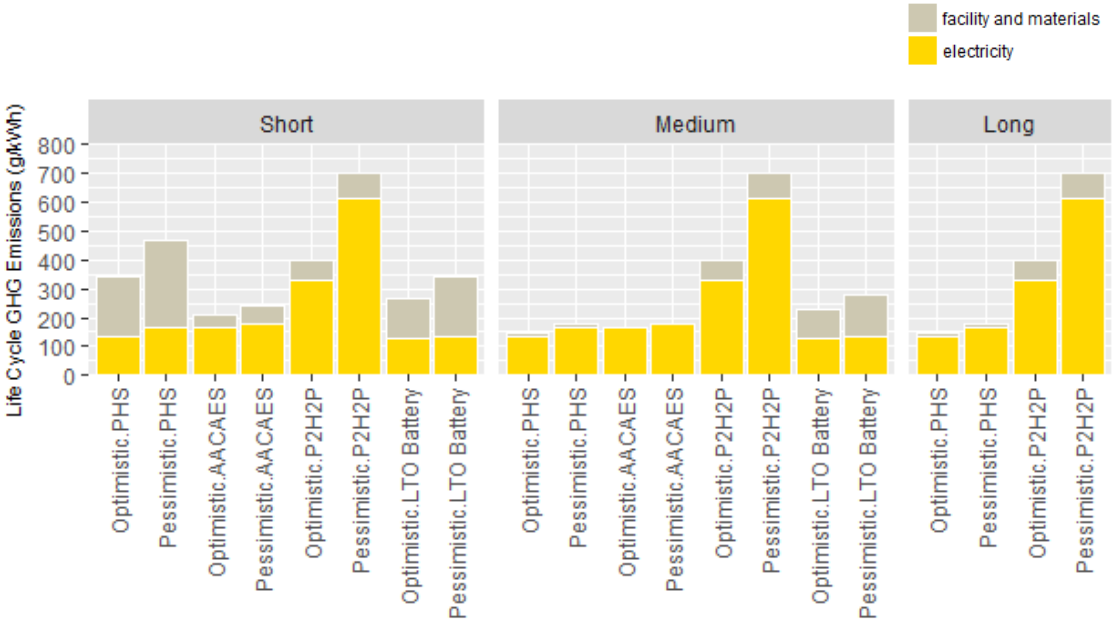

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