Scenarios for the future energy systems in Switzerland and the role of energy storage

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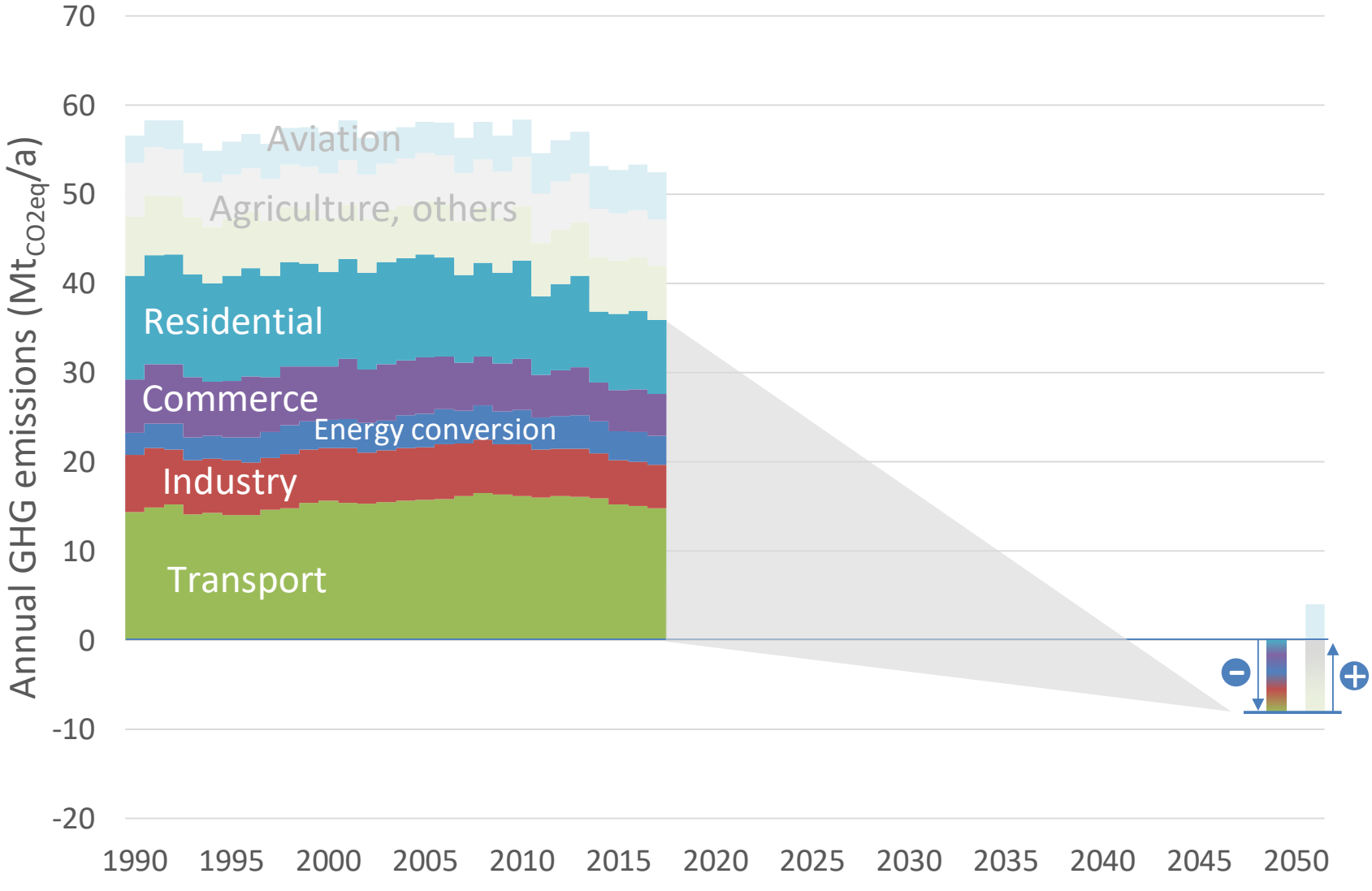
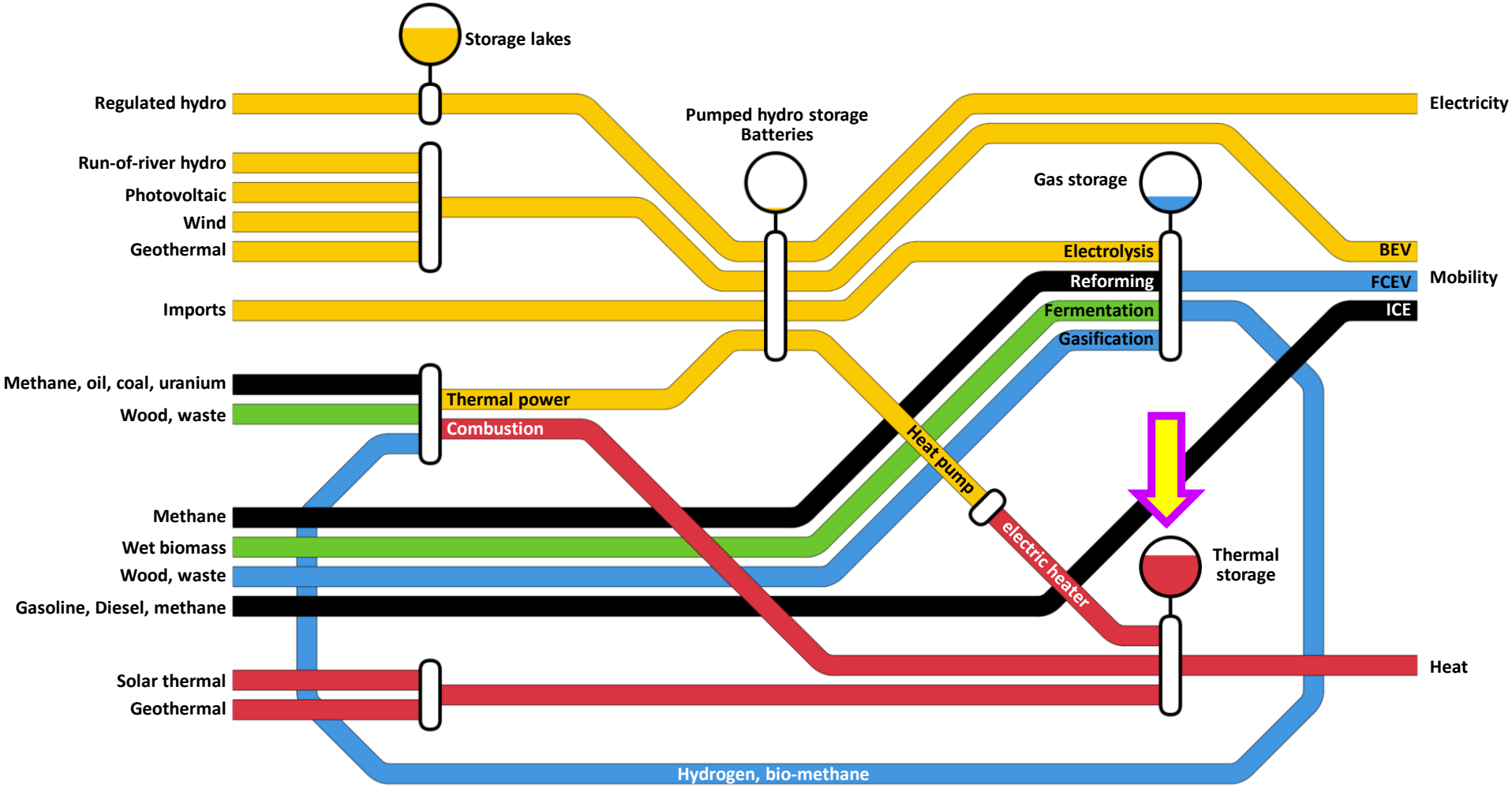
The net-zero emission target



The energy system



The optimization problem

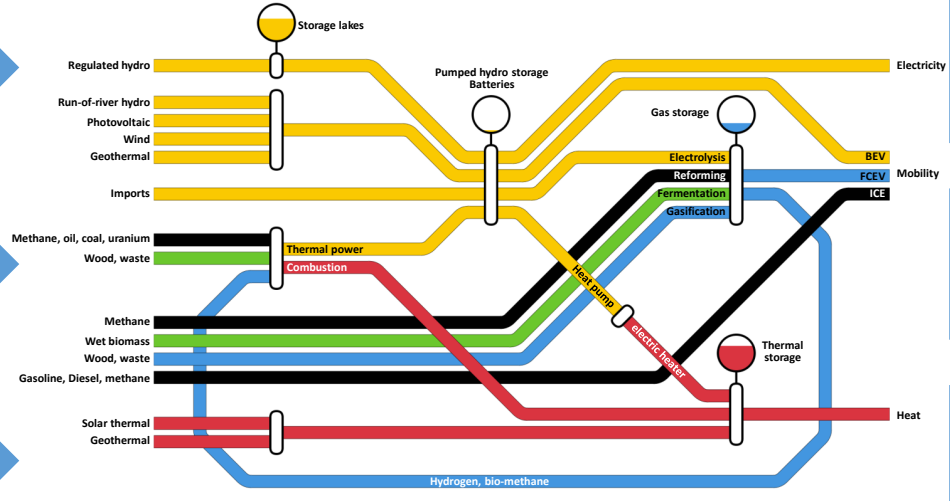
Sectoral models
UNIGE, UNIBAS, EPFL, HSLU, EMPA, etc.

Energy system models
PSI, EPFL, ETHZ

Technologies
Costs, efficiency

Primary energy
Potential, cost, time series

Drivers
Population, GDP, climate



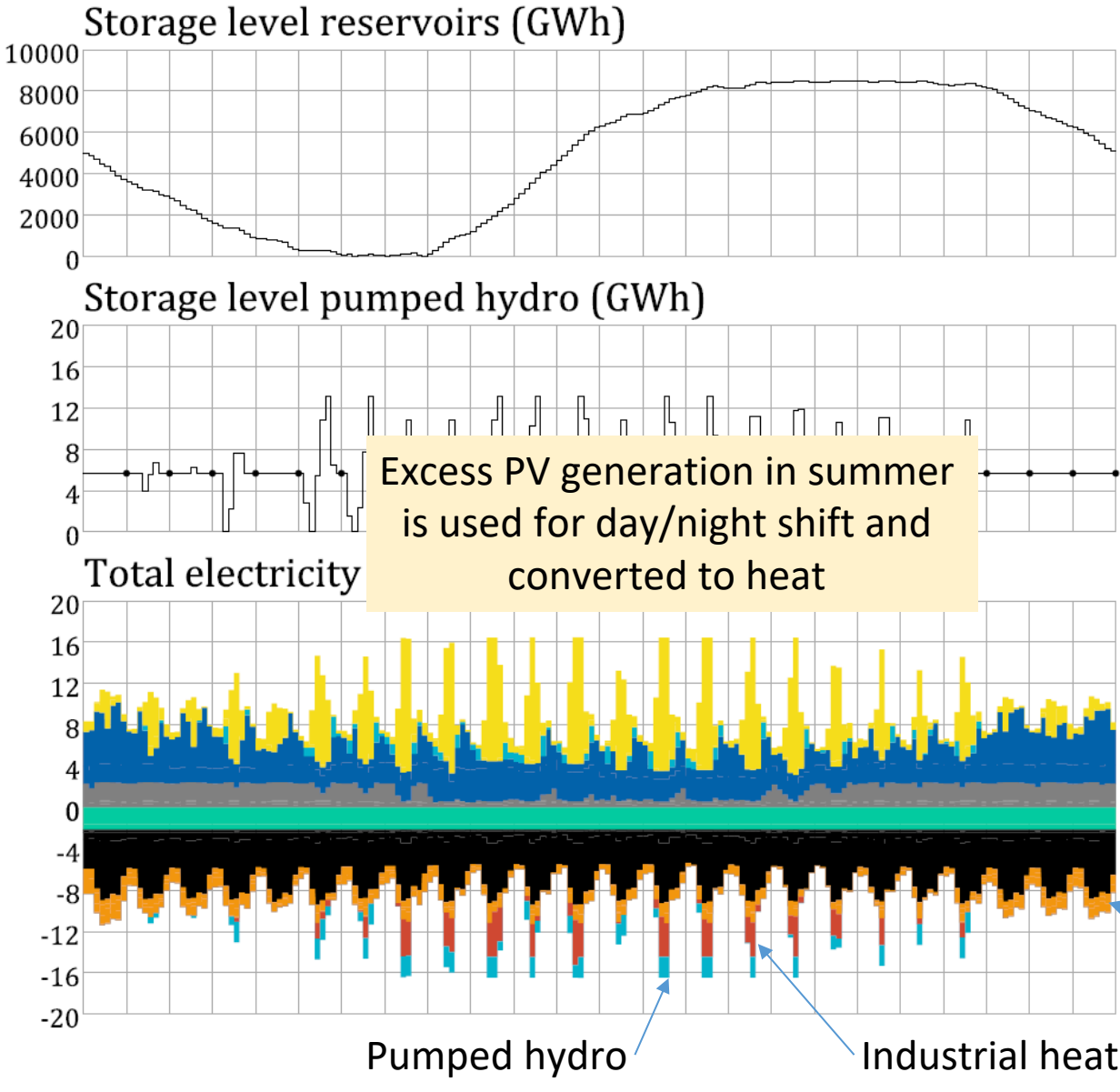
Macro-indicators
Emissions, system costs

Technology mix
How much PV, BEV, etc.

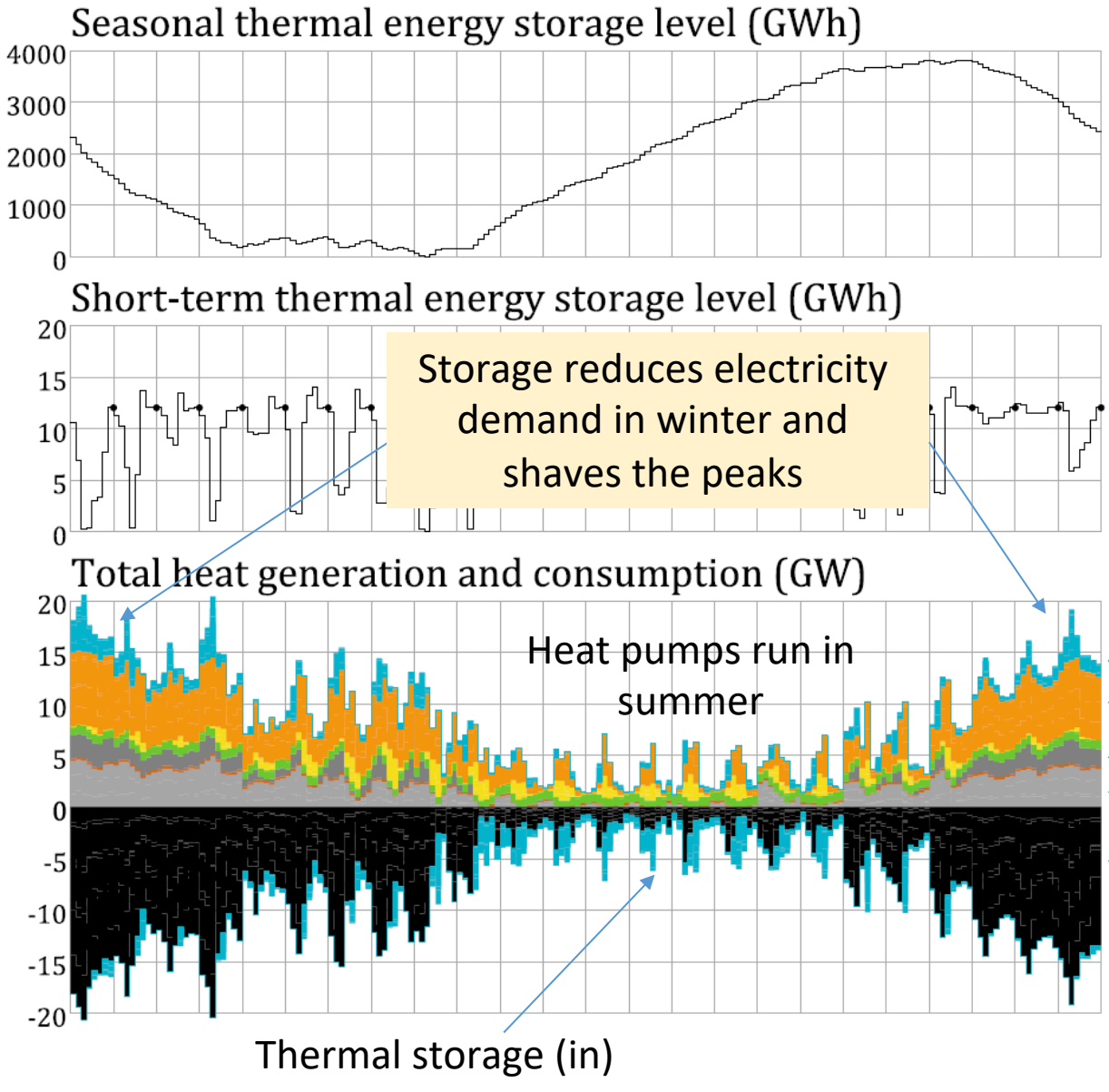
Recommendations
Measures, P&D priorities

Coupled optimization problem:
Cost-optimal system design and operation

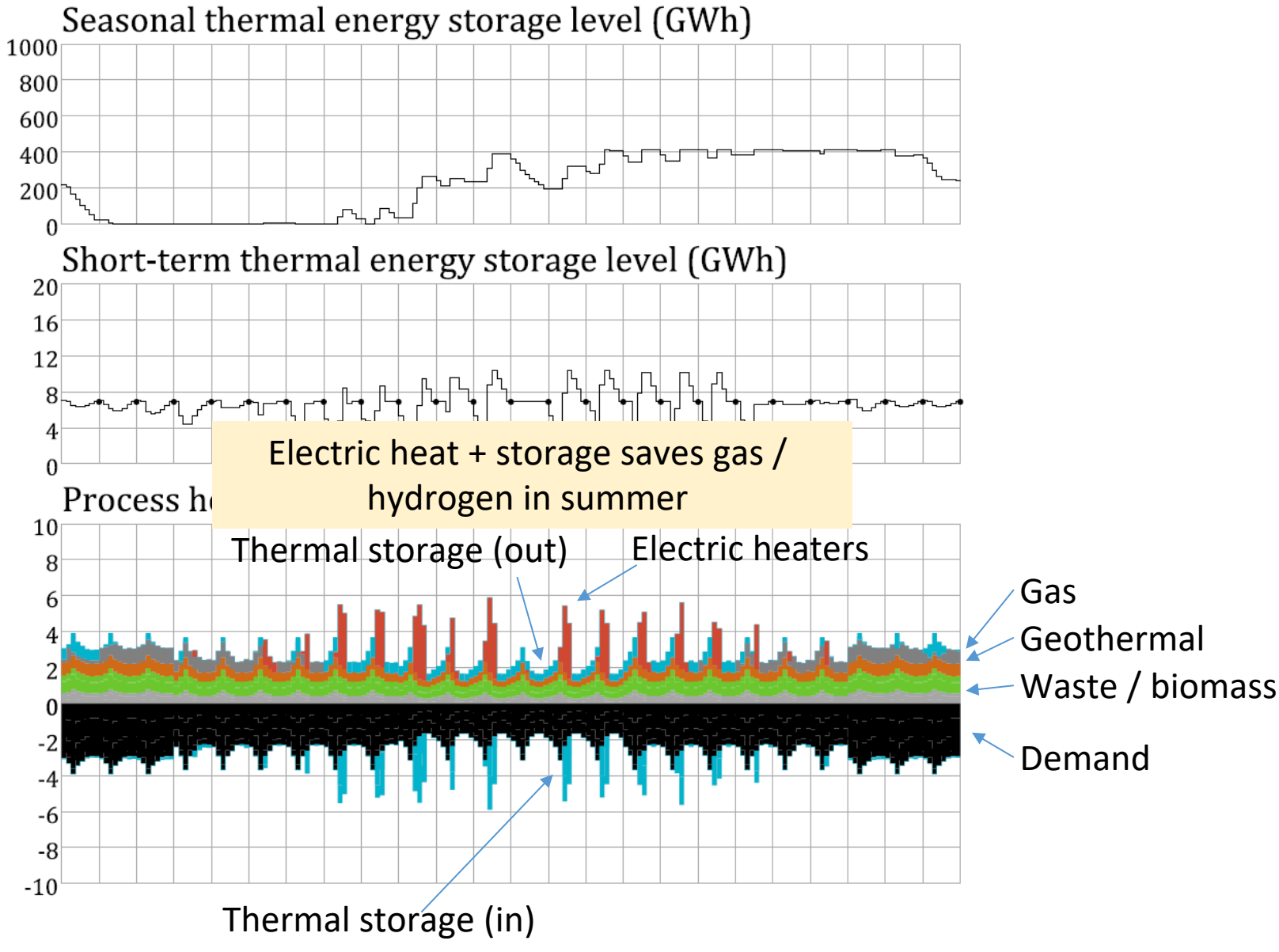
Electricity at -6 Mt_{CO2}/a



Space heat and hot water at -6 Mt_{CO2}/a



Industrial process heat at -6 Mt_{CO2}/a



Energy storage helps to integrate PV

- Day-night shift by pumped hydro storage or batteries → avoids the use of thermal power plants in summer
- Hydro reservoirs in the alps → allows to shift hydropower to winter months
- Heat pumps with short-term / seasonal storage → allows to save electricity in winter and reduces installation costs by peak shaving
- Industrial electric heaters with short-term storage → saves gas or hydrogen in summer

- **Storage helps sectors coupling**

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