

Joint project: Electricity storage via adiabatic air compression

Overview

Background

- Advanced adiabatic compressed air energy storage (AA-CAES) is the only large-scale energy storage technology with the potential to complement pumped hydro energy storage (PHES)
- CAES technology has been proven in practice with plants in Huntorf, Germany (321 MW) and McIntosh, AL, USA (110 MW)
- With an efficient thermal energy storage (TES), the efficiency of an AA-CAES power plant is estimated to be 70-75%
- Combined sensible/latent-heat storage has the potential to increase plant efficiency and reduce storage costs



CAES Plant in McIntosh, AL, USA

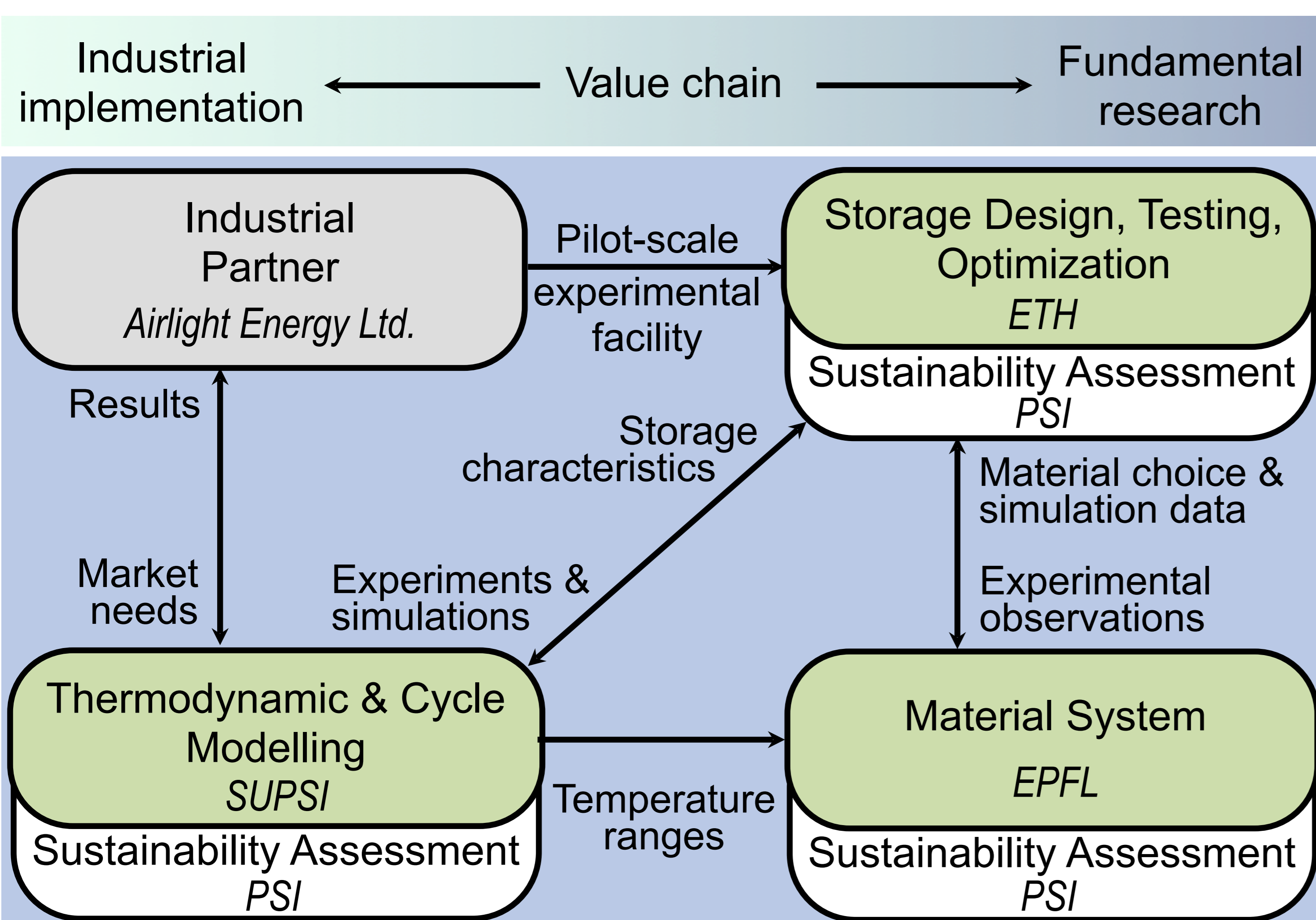
Comparison between AA-CAES and PHES

	Capacity (MW)	Efficiency (%)	Estimated capital cost (\$/kW)	Land requirements (m ² /MW)
AA-CAES	50-300	70-75	400-800	140
PHES	100-1000	75-80	600-2000	1100

Objectives

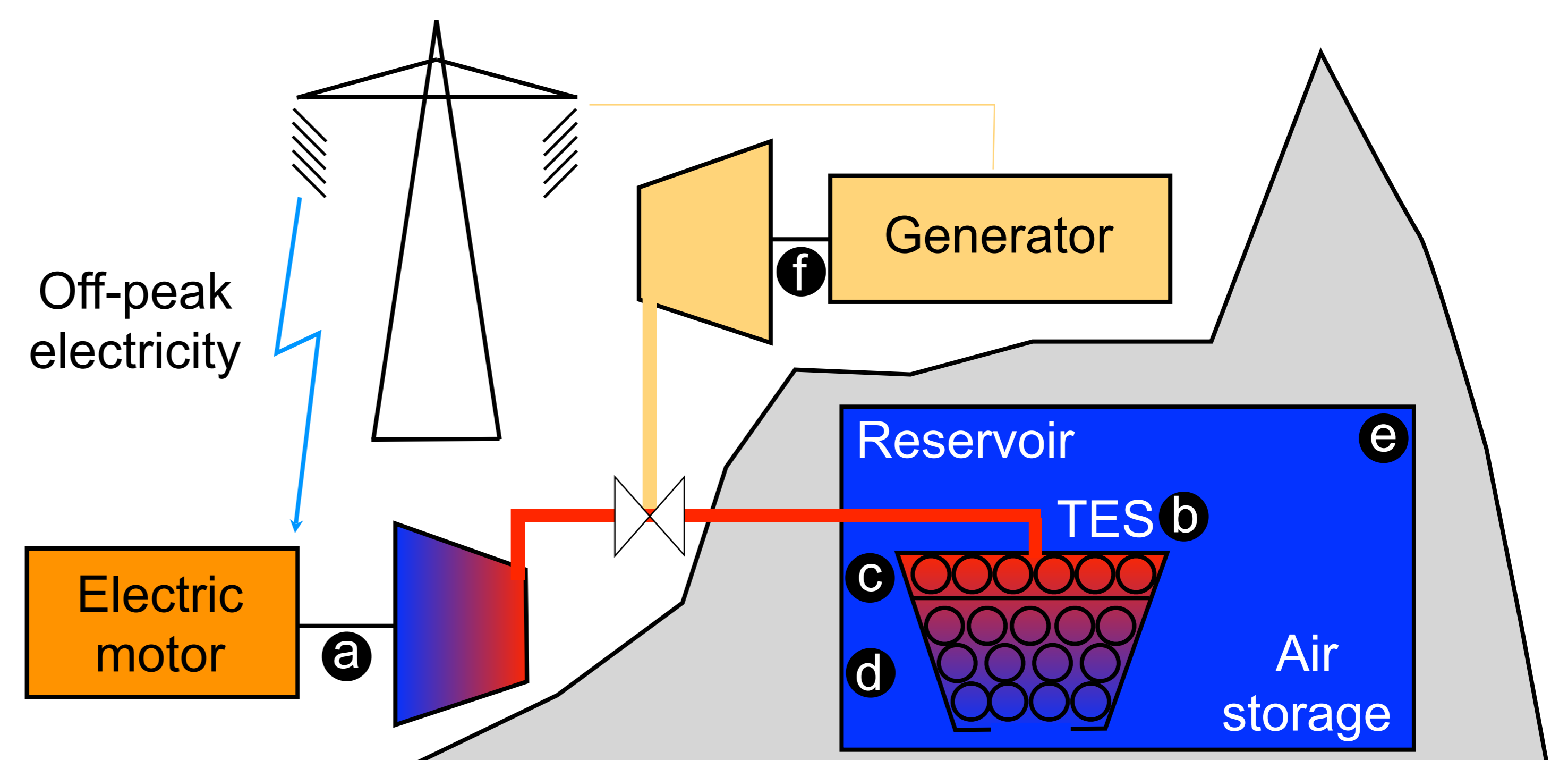
- Demonstrate a combined sensible- and latent-heat storage at an industrially relevant scale for use in AA-CAES
- Analysis of AA-CAES cycles exploiting combined sensible- and latent-heat storage
- Demonstrate stable and efficient aluminium-silicon-based phase-change material structures for high-temperature latent-heat storage
- Assess the potential of AA-CAES as an alternative to PHES in Switzerland

Subprojects



Concept

- A compressor powered by off-peak electricity compresses ambient air to about 70 bars
- Thermal energy storage (TES) is used to hold the heat of compression. The TES is made of:
 - phase change material (PCM) (Al-Si), and
 - a bed of packed rocks
- An underground reservoir (tunnel or cavern) holds the cooled, compressed air
- A turbine-generator produces power by expanding the reheated air to meet peak system loads



Schematic of AA-CAES power plant

Sustainability analysis

A sustainability analysis will be carried out to evaluate the environmental impact of a AA-CAES power plant compared to other storage systems in Switzerland

Energy Turnaround

- AA-CAES can complement renewable energy sources by providing reliable service during peak load periods
- AA-CAES is expected to have a lower and less site-dependent environmental impact than PHES
- Unused tunnels and Swiss army caverns could be used as high-pressure storage reservoirs
- Construction and operating costs of AA-CAES power plants are estimated to be competitive with PHES plants

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