Die Rolle von

Hochtemperatur-Wärmespeicherung

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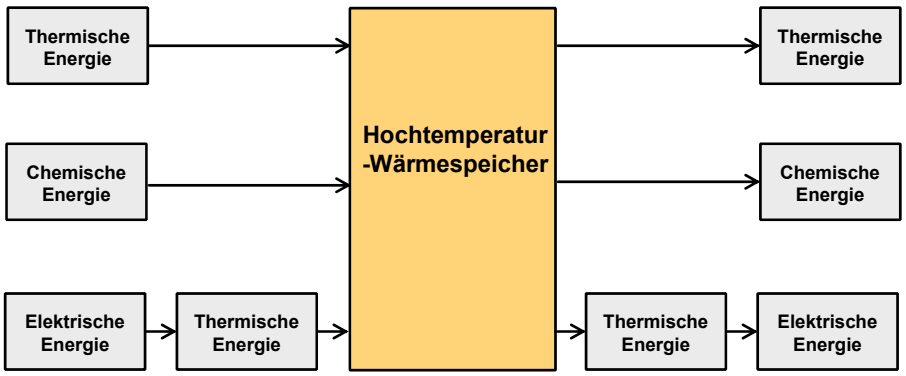
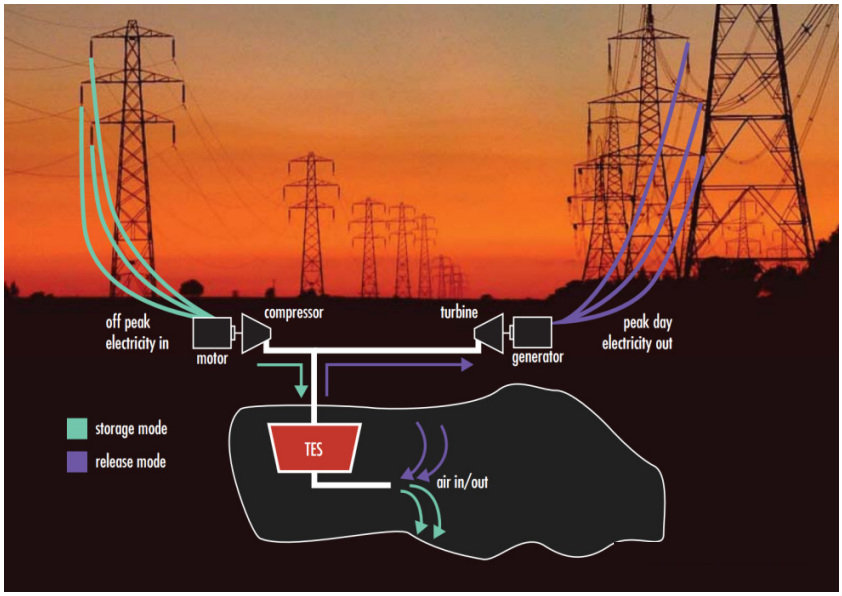
Hochtemperatur-Wärmespeicherung



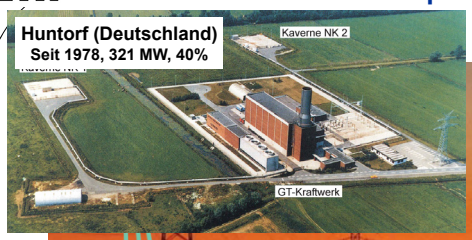
Stromspeicherung

AACAES – Advanced Adiabatic Compressed Air Energy Storage

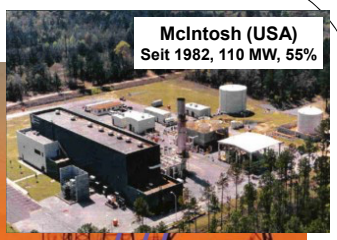


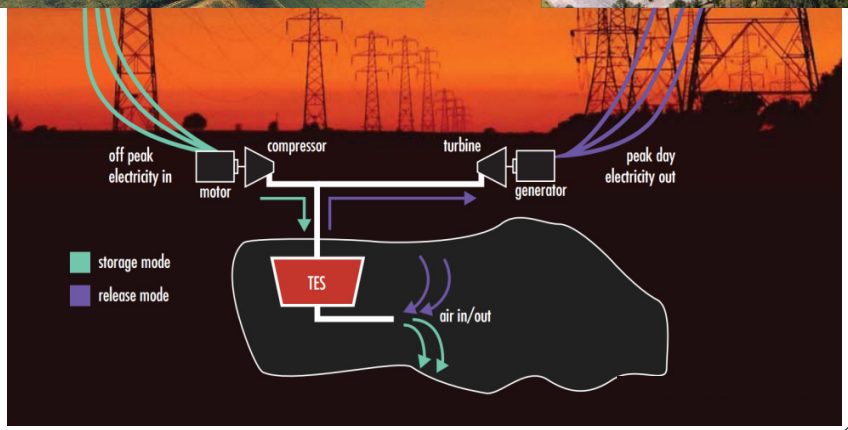
Akhil et al., DOE/EPRI 2013 Electricity Storage Handbook

Stromspeicherung

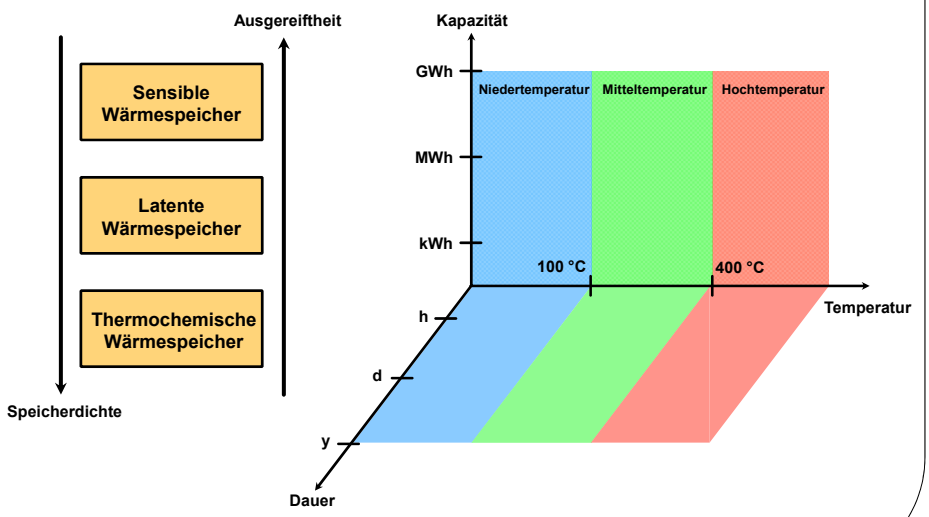


Diabatic

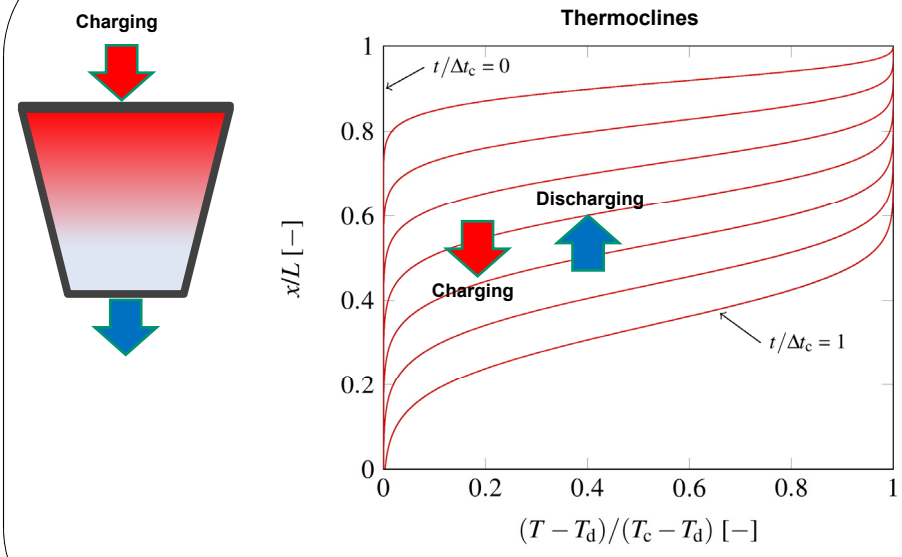




Hochtemperatur-Wärmespeicherung

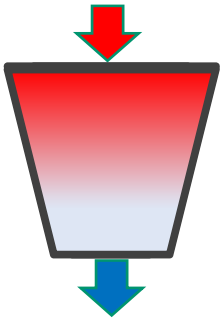


Packed-Bed of Rocks – Concept



• *Applied Energy* 137, pp. 812–822, 2015.

Packed-Bed of Rocks – Concept



- Air as HTF
- Applicability in a wide range of temperatures
- No degradation or chemical instability
- No safety concerns
- Mechanical stability due to conical shape
- Direct heat transfer between storage material and HTF
- High efficiency charging-discharging
- Low-cost (~15 SFr/kWh)

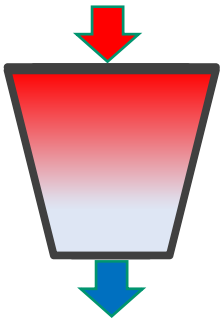
Transient energy conservation in two phases (solid/gas):

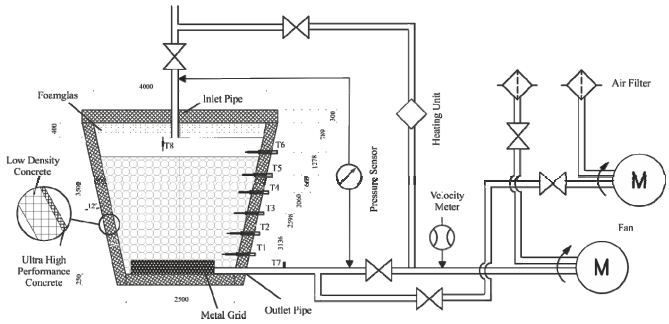
Rate of change in Internal Energy = ***Convective + Conductive + Radiative heat transfer***

• *Applied Energy* 137, pp. 812–822, 2015.

Packed-Bed of Rocks – Pilot

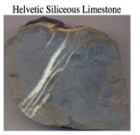
6.5 MWh_{th} Thermal Storage Pilot in Biasca, Switzerland

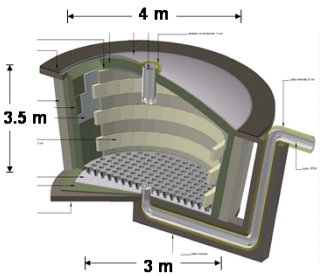


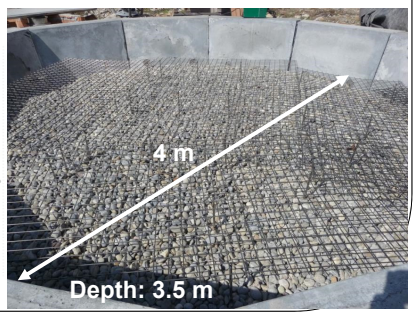


$T_{out} = 640°C$

$\eta = 95\%$



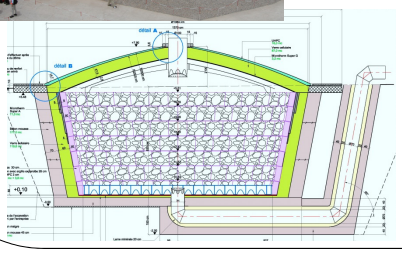


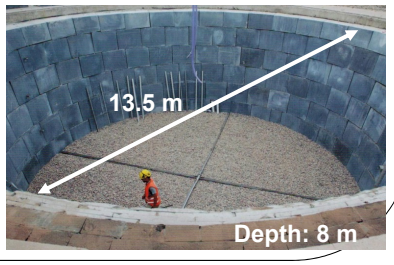


Packed-Bed of Rocks – Industrial

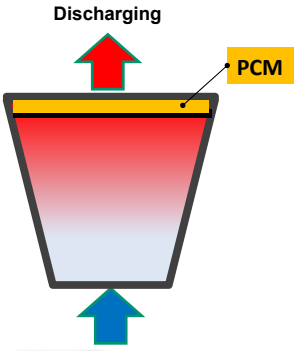
7 GWh_{th} Thermal Storage in Ait Baha, Morocco

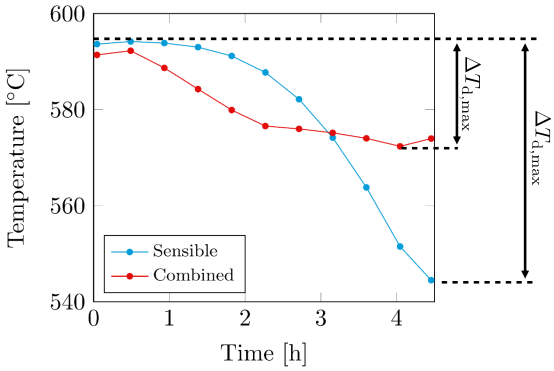
- 4 MW solar thermal power





Combined Sensible/Latent Heat

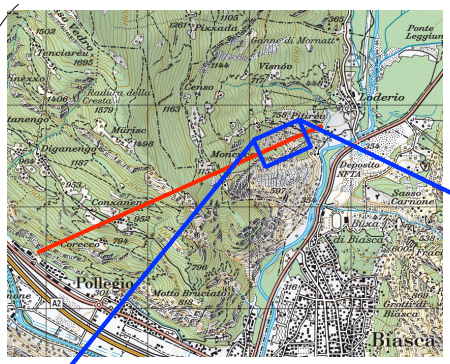


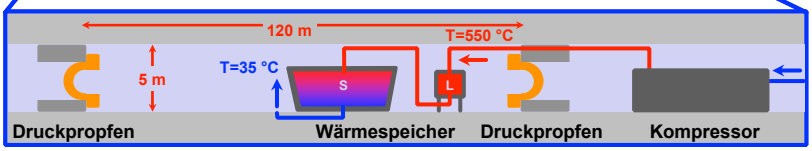


- $AlSi_{12}$ (m.p. 572 C)
- Heat of fusion = 466 kJ/kg
- Encapsulation: steel (316 mm i.d., 1 mm thick)
- m_{PCM} = 9.6 kg
- m_{rocks} = 245 kg

- *Applied Thermal Engineering* 70, pp. 316-320, 2014.
- *Applied Thermal Engineering* 101, pp. 657–668, 2016.

AACAES Pilotanlage



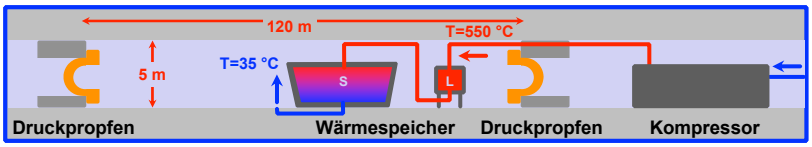


Pionierleistung:

- **Weltweit erste AA-CAES Anlage mit kombiniertem Wärmespeicher**
- **Speicherung von sensibler Wärme: 10 MWh**
- **Speicherung von latenter Wärme: 500 kWh**

2

AACAES Pilotanlage



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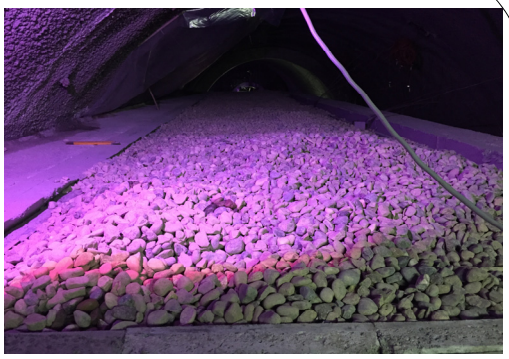

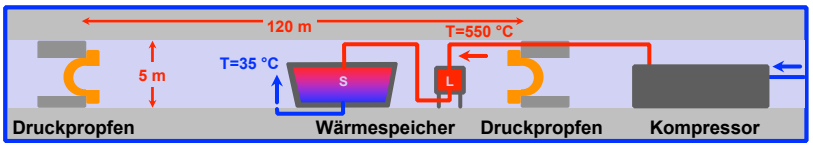

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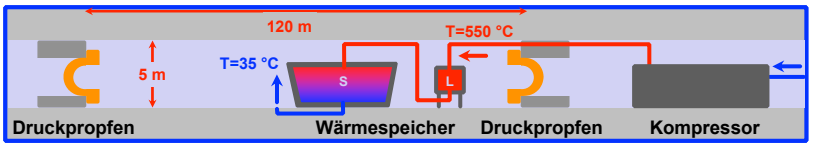
AACAES Pilotanlage

PCM: $Al_{68.5}Cu_{26.5}Si_5$

m.p. 525 °C



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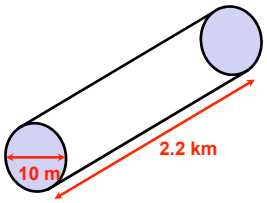
AACAES Industrial

Kapazität	500 MWh_{el}
Minimaler/maximaler Druck	80/100 bar
Benötigtes Kavernenvolumen	170’000 m^3
Berechnete Effizienz	70-75%



Kavernenzentrale PSKW Linth-Limmern: rund 200’000 m^3

2

Acknowledgments

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OFEN
UFE
SFOE

- Industrial Partner

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an airlight energy company

- Academic Partners

EPFL
ÉCOLE POLYTECHNIQUE FÉDÉRALE DE LAUSANNE

PAUL SCHERRER INSTITUT
PSI

Scuola universitaria professionale della Svizzera italiana
SUPSI

- PhD Students

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