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Thermal Electricity Storage

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Overview

- Why energy storage?
- Types energy storage:
  - Electro-thermal
  - 2-tank / active
  - 1-tank / passive
- VGBe study: scope and conclusions

Why Energy Storage?

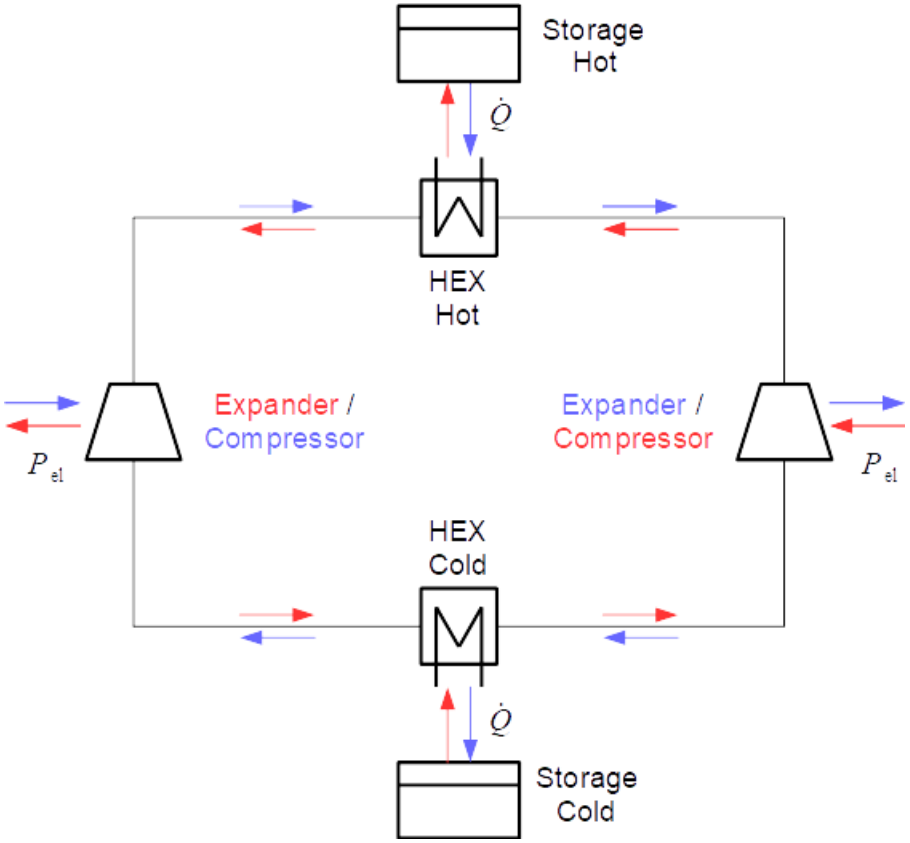
More flexibility:

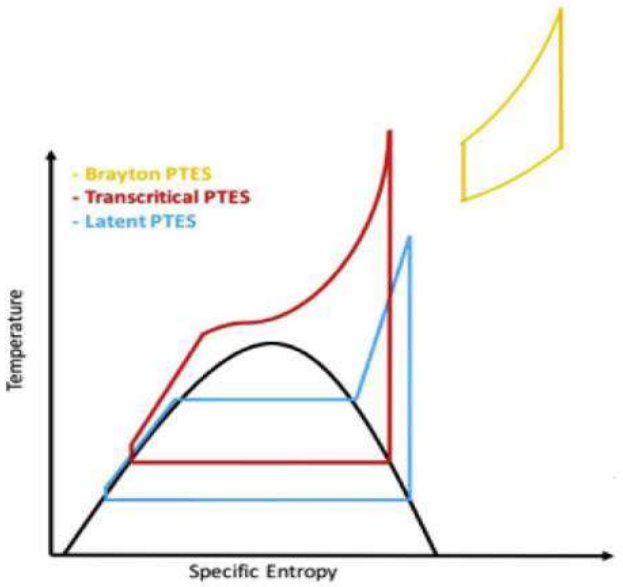
- Keep power plant at constant load
- Reduce minimum turbine load
- Cover peaks

Reduce emissions:

- Refit / only use renewables, reuse plant infrastructure

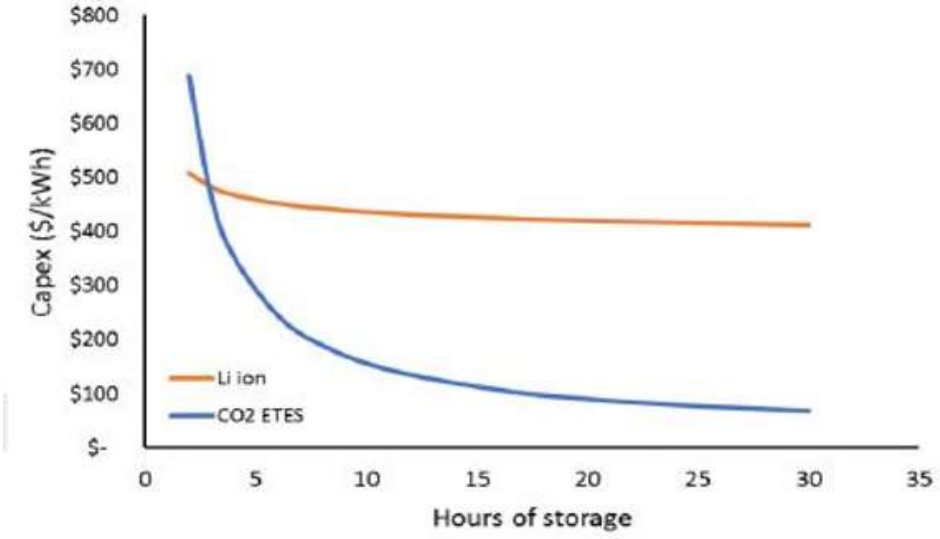
Electro Thermal Energy Storage (ETES)





Electro Thermal Energy Storage (ETES)

- Reversible heat pump ←→ Rankine cycle
- Electricity is stored as thermal energy
- Advantages:
  - Electricity in – electricity out
  - High round trip efficiencies (RTE)
  - Economies of scale
- Disadvantages:
  - Working fluid is sCO2



ETES Example: ABB / MAN

- RTE 51-65%
- Water is hot SM, ice cold SM

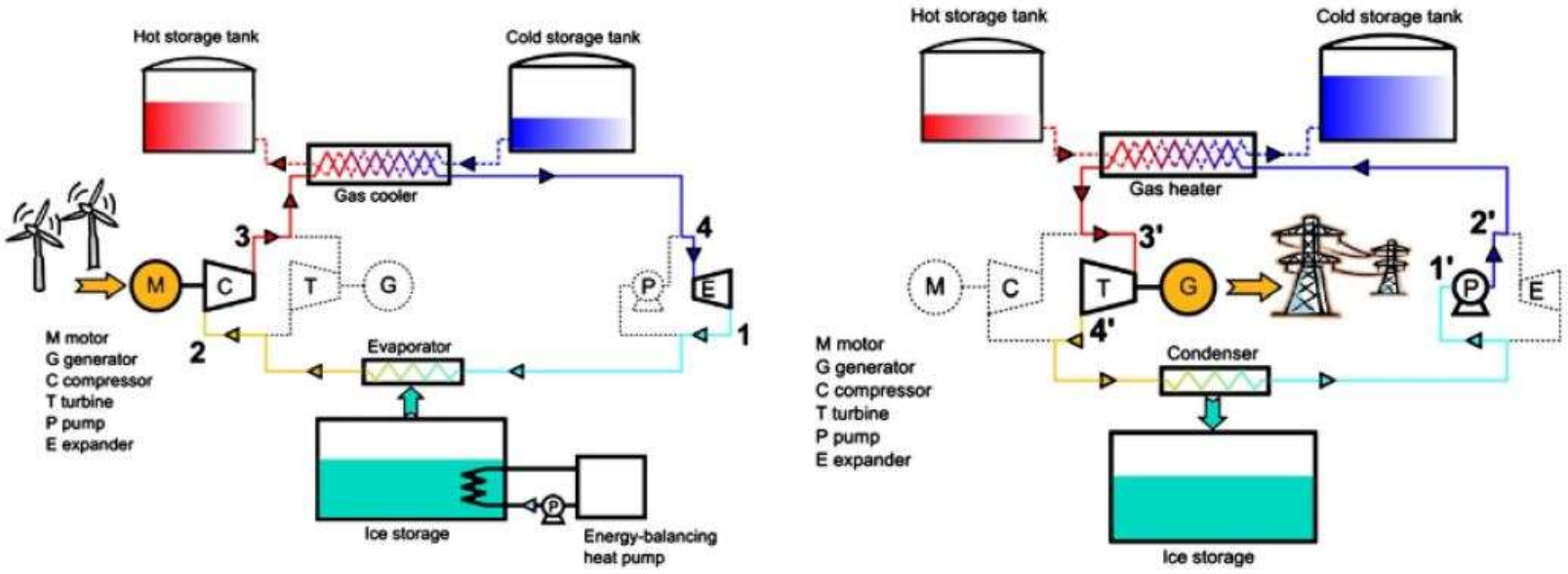
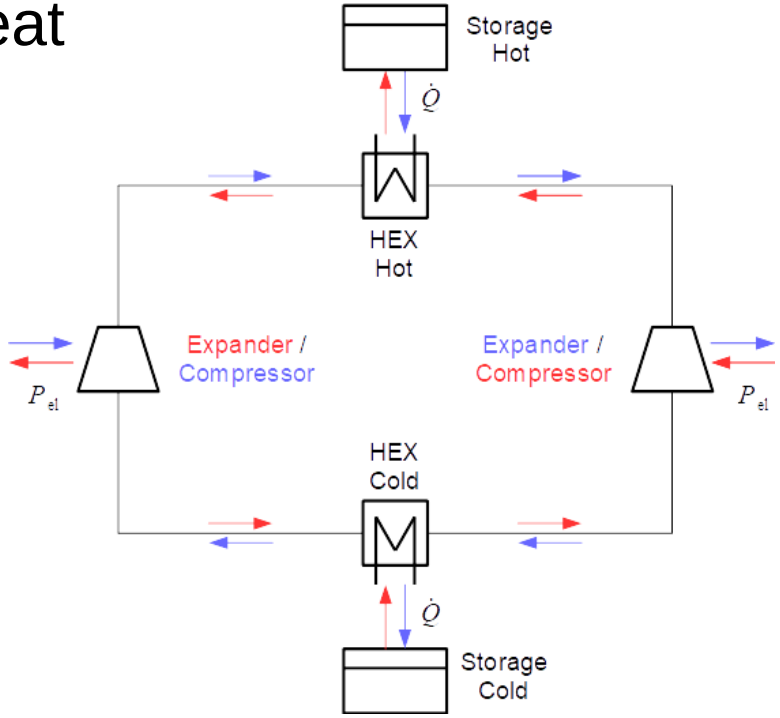


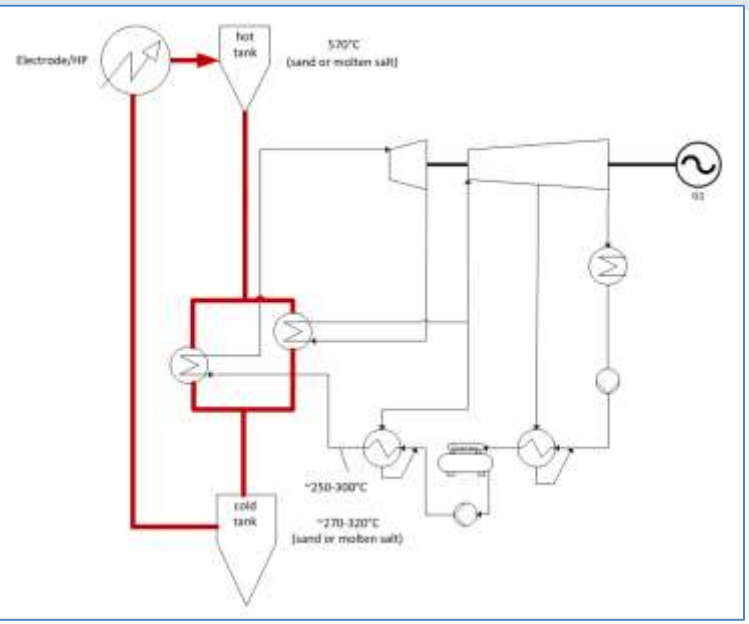
Figure 3.42: Sample plant layout during charging (left) and discharging (right) mode. [15]

Other heat sources

- Compressor is main source of heat in ETES
- Can be replaced with:
  - Steam from plant
  - Electrodes → “TSPP”
- “Cold storage” = environment
- Hot storage:
  - 1 or 2 tanks (active / passive)
  - Different materials

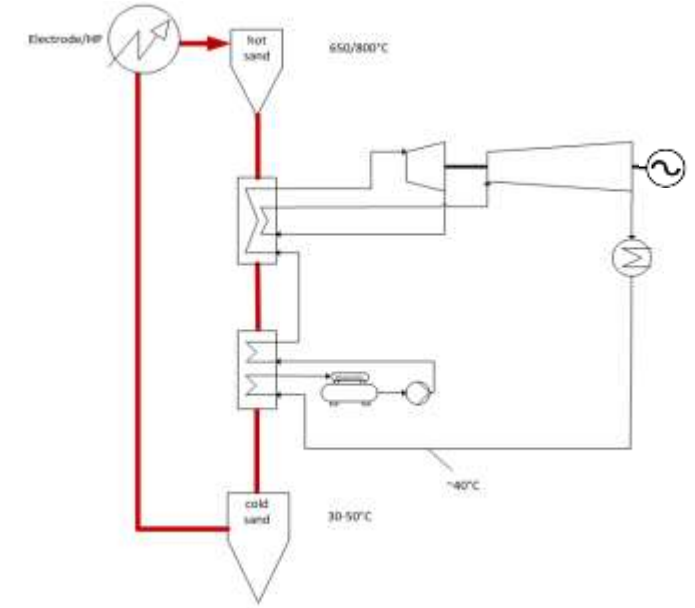


2 Tank Systems: Active TES



Molten salt

- 60% NaNo3, 40% KNO3 (“solar salt”)
- Range 240°C – 560°C
- Feedwater heating required
- State of the art in CSP
- High cost: 700-1000 €/t

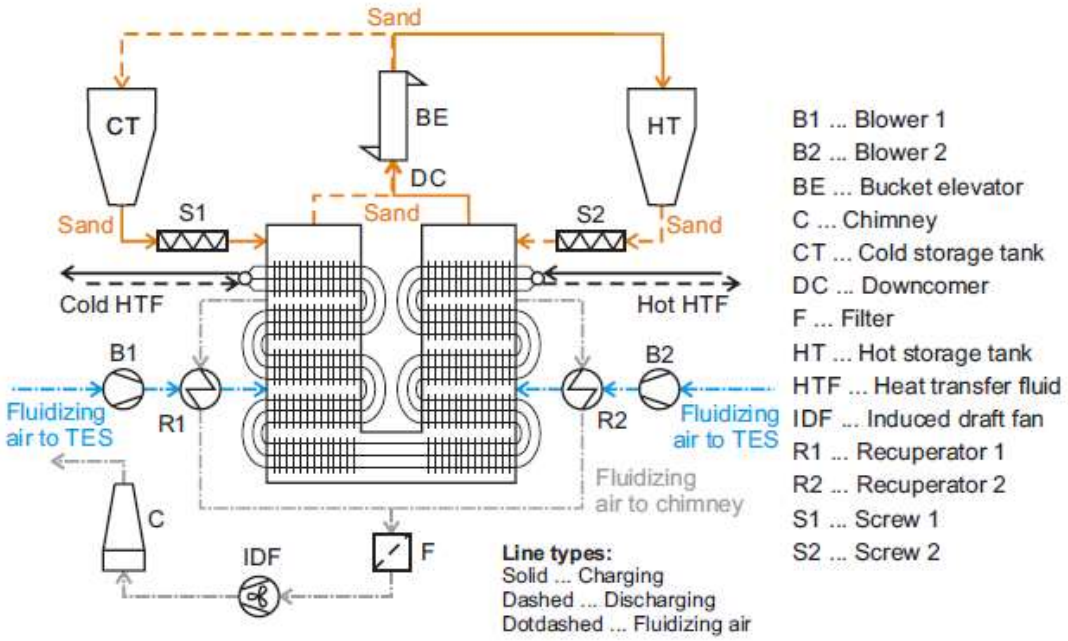


Sand (sandTES)

- SiO2 sand
- Range 20°C – 850°C
- No feedwater heating required
- Lower TRL
- Low cost: 40 €/t

Example sandTES

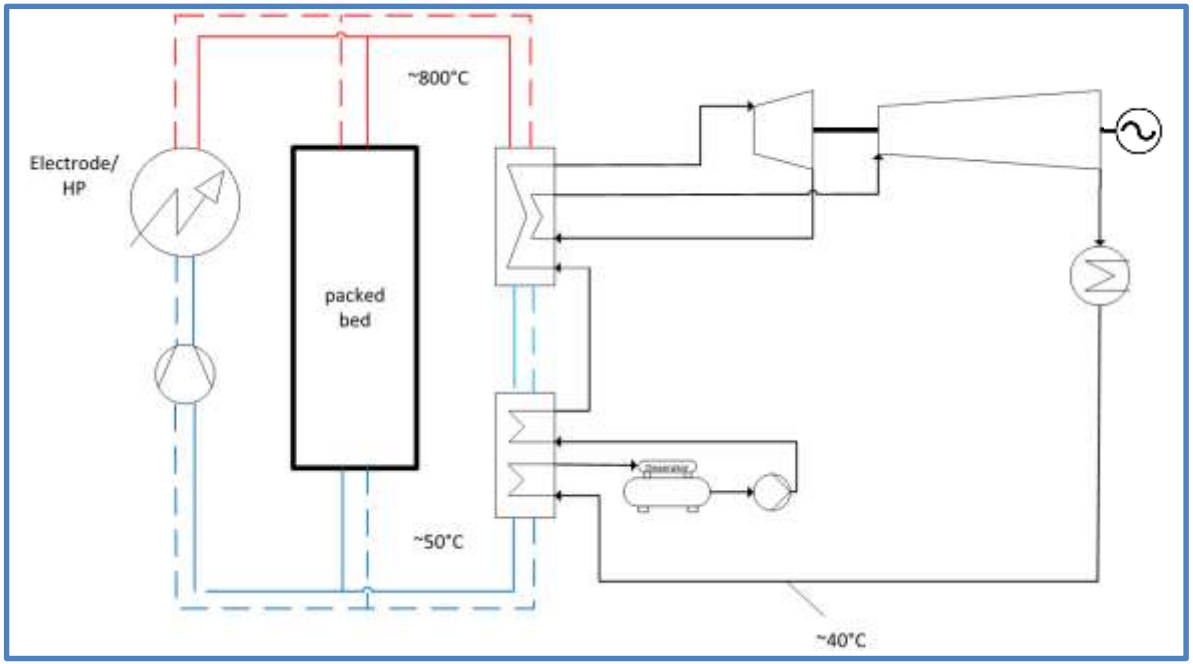
- Developed by TU Wien, licensed to Andritz
- Fluidized bed heat exchangers
- Particle conveyors
- Auxiliary power required for fluidization and conveying



1 Tank Systems: Passive TES

Packed bed regenerator

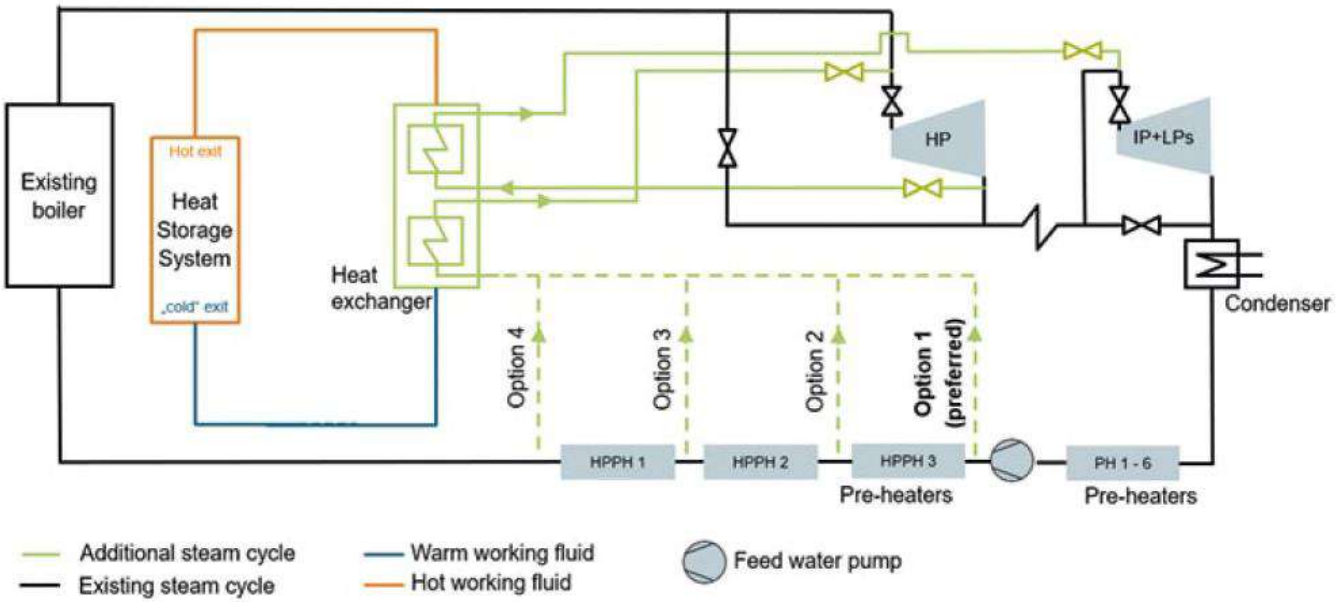
- Rocks as storage material
- High operating range
- No feedwater heating required
- Simple system, high TRL
- Thermal ratcheting, hysteresis and self discharging issues



1 Tank Systems Example

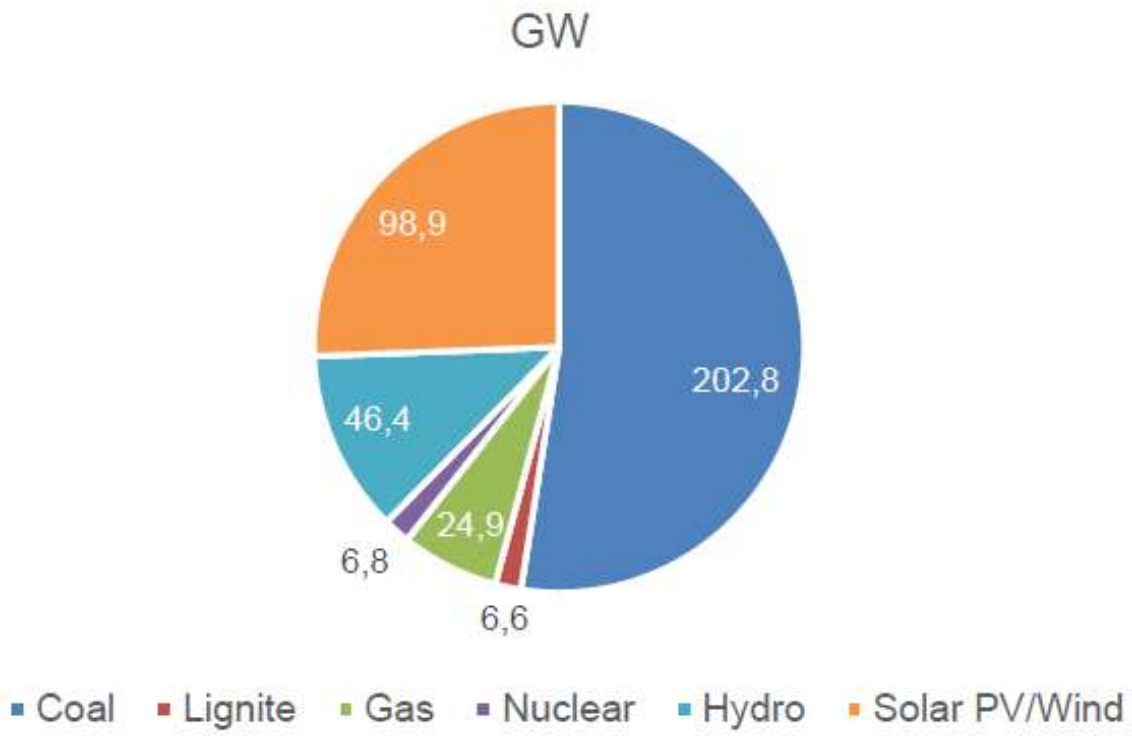
Siemens Gamesa

- 1.5 MWe output @ 750°C
- 130MWht storage at 800°C
- Storage efficiency 95%, RTE 45%
- 24 h cycle
- Heated electrically



VGBe Study – Scope

- Analysis and assessment of TSPP technologies
- Assessment of retrofitting potential in India



VGBe Study – Conclusions 1

- Heat2Heat2Power achieves RTE of 80%, Power2Heat2Power 45%
- Beneficial to have TES do feedwater preheating
- Multi-hour and large-scale electricity storage solution
- Re-use of existing infrastructure, competencies of Indian industry and expertise
- Provision of heat and process steam in addition to electricity – especially important for captive power plants
- Savings on decommissioning costs

VGBe Study – Conclusions 2

- Power plants with an operating time of about 8 to 15 years are appropriate candidates for a TSPP retrofit within the next five to eight years
- Costs are comparable to batteries
- There is an enormous retrofitting capacity of about 67GW