ETES
Electric Thermal Energy Storage

Strommarkttreffen Mai 2019 - Maximilian Schumacher
Increased RE penetration causes challenges to electricity systems.

Most challenges (e.g. increasing flexibility of conv. Power plants, RE curtailment, security of supply) require high power and high capacity storage solutions.

ETES is the most cost-competitive and efficient GWh-scale storage solution to solve the majority of challenges.

- Main application options for ETES:
  - ETES base: Utility-scale storage solution with 80% off the shelf components to make renewables baseload capable.
  - ETES add: Upgrade fossil fuel power plant to hybrid power plant with additional revenue streams.
  - ETES switch: Conversion of fossil fuel power plant to storage plant to provide second-life for power plant infrastructure.
- Proven technology:
  - Test Site: Storage technology extensively tested since 2014 → results outperformed expectations
  - Demonstrator: With 8.9 mio€ biggest German publicly funded storage R&D project → currently under construction.

- Low CAPEX makes ETES most cost-competitive universal storage solution.
- CAPEX of ETES up to 10-times lower than CAPEX of Batteries.
- Technical feasibility is proven and extensively tested → GWh-scale Prototype scheduled for CY2020
Siemens AG: 59%
Iberdrola: 8%
Free-float shares: 33%

Annual Revenue: €9.1 B
Employees: 23,000
Globally Installed: 90.6 GW
GWh-scale storage solutions needed to solve majority of challenges
ETES doesn’t compete with MWh-scale batteries
ETES base: make renewables base-load capable with 80% off the shelf components

Charging power, storage capacity and discharging power are independently scalable.

- **Charging**
  - Resistive heater

- **Storage**
  - Volcanic stones

- **Discharging**
  - Water steam cycle
ETES base: make renewables base-load capable with 80% off the shelf components

ETES Technology: Applications & technology

ETES storage components

- Resistive heating
- Heat storage
- Condenser
- Pump
- Steam Generator
- Steam Turbine
- Generator
- Optional: Process steam
- Electricity
- Optional: District heating

Power-to-heat-to-power technology

- Charging cycle: non-pressurized air-cycle with
  - Resistive heater to convert electricity into heat
  - Blower to move the air through the storage

- Heat storage: pebble bed heat storage
  - Vulcanic stones store heat
  - Insulated containment

- Discharging cycle: conventional water-steam-cycle
  - Heat recovery steam generator generates steam from hot air
  - Steam turbo generator to generate electricity
  - Auxiliary equipment (condenser, pumps etc.)

Electric energy: High temperature
Medium temperature
Low temperature
ETES switch: Converting a conventional power plant into an emission-free storage facility

- Second-life option for conventional power plants
- Replacing boiler by steam generator
- Utilization of existing steam cycle and infrastructure
- Well known O&M processes
- Mitigation of negative effects from closing power plants
- CAPEX up to 10 times lower compared to batteries
ETES: Proven and reliable technology with 80% off-the-shelf components

Test Site

- Dis-/Charging Power: 0.7 MW
- Storage Capacity: 5 MWh
- In operation since: 2014

Demonstrator

- Dis-/Charging Power: 5.4 MW
- Storage Capacity: 130 MWh
- Commissioning: 2019
ETES Technology: Cost & commercial roll-out

Four steps towards commercialization of ETES technology

**Proof of concept**
- Step I
  - Test site
  - 0.7 MW
  - 5 MWh
  - In operation since 2014

**Proof of system**
- Step II
  - Demonstrator
  - 5.4 MW
  - 130 MWh
  - Commissioned in H1/CY2019

**Commercial application**
- R&D on:
  - optimization of scaling effects
  - elaboration of various business cases

**Rollout of proven solution**
- R&D on:
  - continuous O&M optimization

**Serial production**
- Step III
  - Pilot plant
  - ~30 MW
  - 1 GWh

- Step IV
  - Commercial platform
  - >100 MW
  - >5 GWh

**Technical details**
- GWh prototype
  - System efficiency
  - Proof of concept
  - Proof of system