Electric Thermal Energy Storage (ETES) – Industrial Decarbonization
Green Industrial Processes as a Challenge – ETES as the Solution

Current Challenges for the Industry

Economical
- Become independent from increasing energy and material costs
- Increasing emission costs create the need to reduce the CO₂ footprint

Social
- Pressure from customers, society and politics to decarbonize

Technical
- Maintain productivity in shift to renewables
- Ensure business continuity and mitigate risks

Solution: Integration of ETES to Production Site

- Profit from low price periods on electricity markets
- Utilize existing equipment
- Reduce emission costs by process electrification or industrial heat recovery

- Contribute to a more sustainable industry by relying on renewable energy, thereby enhancing attractiveness for investors and customers

- Supply emission-free process steam or heat on a wide temperature range to ensure production
- Keep redundancy of process heat supply

Added Value for Costumer

- Enable sustainable process heat supply
- Optimize energy procurement expenses
- Become a recognized sustainable company
- Provide supply redundancy to secure production
ETES working principle for industrial applications

**Charge**
- Low price electricity is converted to heat during charging using conventional equipment
- Alternatively, ETES can be directly charged with heat

**Store**
- Volcanic rocks are used as a storage medium
- Heat storage is operated close to ambient pressure & at high temperature
- Heat is stored up to weeks

**Discharge**
- ETES can deliver hot air on different temperature levels
- ETES can deliver steam on different pressure levels using conventional heat exchangers
How can ETES be applied in industrial processes?

**Industrial Electrification**

- Supply process heat, steam, power on demand for multiple consumers
- Decarbonize by shifting to renewable electricity
- Ability to meet high power and energy demand
- Comply with emission reduction regulations
- Become independent from increasing CO₂ and fuel prices
- Decouple energy demand and supply
- Stabilize and optimize electricity cost (€/kW and €/kWh)

**Industrial Heat Recovery**

- Capture waste heat or high caloric byproducts
- Solve mismatch between availability of waste heat and heat demands
- Recover energy for process steam or district heating
- Increase overall efficiency
- Ability to supply various temperature levels
- High-capacity heat storage
- Decouple combined heat and power

**Added Value of ETES**

- ETES for industrial decarbonization
- How can ETES be applied in industrial processes?
- Industrial Electrification
- Industrial Heat Recovery
- Added Value of ETES
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- Decarbonize by shifting to renewable electricity
- Ability to meet high power and energy demand
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ETES track record

Technology Development Since 2011

**Demonstrator**
- Demonstrator with a capacity of **130 MWh** stored in volcanic rocks
- **5.4 MW** resistive heating charging power
- Inauguration and connection to the Hamburg grid in June 2019
- Biggest German public funded storage R&D project

**Test Site**
- Small-scale demonstrator in Hamburg Bergedorf with **5 MWh storage** capacity
- Testing of various storage concepts, materials and setups
- Over 2,500 testing hours per storage module

**Commercial Pilot**
- We are currently working with world-class partners on various projects around the world in order to build the first series of commercial pilots in a range of
  - Power: 10 – 100 MW
  - Capacity: 100 – 2,000 MWh
  - Steam temperature: 300 – 620°C
Customer use case – Green process electrification with energy storage

Specifications

- **Thermal storage capacity:** 300 MWth
- **Electrical charging power:** 25 MWel
- **Cycle times for charging/discharging:** 12 h/12 h
- **Discharging power:** 25 MWth

Added Value

- **Reduction** of CO₂ emissions and related cost
- **Utilization** of public funding
- **Profit** from periods of low electricity prices
- **Improved public awareness** and green image
ETES for industrial decarbonization

How the ETES team can support you

Individual assessment
Customer-specific advice through:
• Technical workshops with our experts
• Analysis of potential applications and identification of the best use case
• First commercial sizing and evaluation

Full feasibility study
Joint working group for:
• In-depth analysis of the previously defined use case
• Conceptual engineering and business case calculation
• Basis for decision making

Project realization
Dedicated project team for:
• Project Management
• Basic and detailed engineering
• Erection and commissioning of the storage plant
Mature and Ready
ETES is based on 80% existing and mature technologies and has been validated in 130 MWh/5.4 MW demonstration plant.

Adaptable and Flexible
ETES allows for different power sources, such as electricity and heat, and it provides multiple energy products: electricity, heat and steam.

Scalable and Modular
ETES is a large-scale GWh storage solution with low investment and operating costs due to significant economies of scale.

Economical and Sustainable
ETES does not require environmentally or physically harmful material.

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ETES Recognitions

2018

La Razon Sustainable Technology Award
Award for continuous renewal of imagination, creativity, knowledge, skills and processes

2019

Best Innovation in Offshore Energy
Award to highlight the best innovation in the entire offshore energy market

Japanese Government/ICEF
Award for recent innovative developments in energy and climate change mitigation

2020

R&D 100 Award
The R&D Award honors the greatest R&D pioneers and their revolutionary ideas in science and technology

SDG Tech Award
The SDG Tech Award highlights the best sustainability solutions in Denmark

Solar and Storage Award
The Solar and Storage Award highlights the best product innovations for solar and storage solutions

Power Technology Excellence Awards
The Power Technology Excellence Awards celebrates the greatest achievements and innovations in the power industry.