



ETES – 2nd Life Option for Fossil Power Plants

Decarbonization challenges



COAL PHASE-OUT

Maintain asset value

Offer a 2nd life for existing assets by substituting fossil fuels

Security of supply

Provide backup power in case of low RE generation

STORAGE

New business models

Embrace the energy transition and tap new revenue streams in a changing business environment

Flexibility of power generation

Covering increasing flexibility requirements for fossil power plants due to growing share of RE

Utilities need a storage solution that is



Versatile

Broad field of applications



Scalable

Doubling the size without doubling the cost



Clean and Safe

Environmentally safe materials and supply chain



Geographically Unrestrictive

Can be built anywhere in the world



Low Cost

Abundantly available and cheap storage materials

ETES' reliable working principle



Charge

- Low price electricity is converted with conventional equipment to heat during charging
- Alternatively direct charging with heat possible as well

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

- Discharged heat is converted to electricity in water steam cycle
- Alternatively, direct use of heat and process steam possible

Conversion of coal power plants to emission-free storage plants

Coal-fired Power Plant



Power plant based 100% on coal combustion

- High CO₂ emissions related to fossil fuels
- Facing the shutdown due to strong restrictions and coal phase-out
- Political pressure forces plant operators to innovate and decarbonize
- Declining profitability due to limited operational flexibility in an ever more fluctuating energy market

Hybrid Storage Power Plant



Partial conversion into storage plant

- Installation of ETES storage parallel to existing fossil firing
- Integrate renewable energies and reduce CO₂ emissions
- Evaluate technical and commercial operation for future scale-up
- Integrate energy storage into company portfolio
- Increase flexibility to follow increasingly challenging market requirements

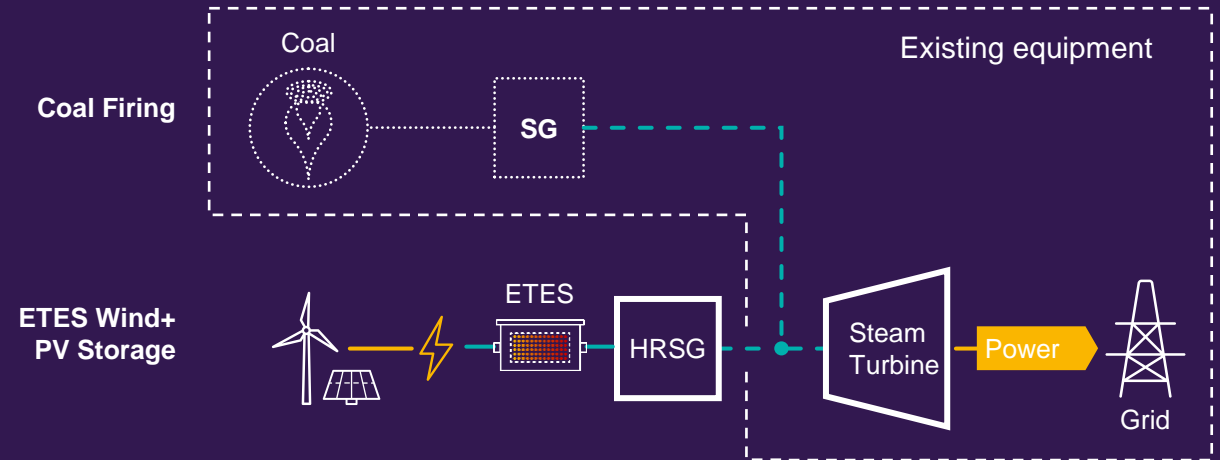
Emission-free Storage Power Plant



Full conversion into storage plant

- Complete decommissioning of combustion equipment
- 100% of the steam coming from ETES
- Leverage full technical and economic potential of existing infrastructure
- Avoid emission-related operational cost
- Manage fluctuating renewable energies and complete the energy transition

Customer use case – Partial conversion of coal power plant to CO₂-free storage plant



Electrical charging power: **140 MW_{el}**



Thermal storage capacity: **1.4 GWh_{th}**



Discharging power: **140 MW_{th}**



Cycle times for charging/
discharging: **10 h/10 h**

- Dual-use of equipment: Steam and condensate systems, switch yard, control system; as well as trained staff
- Direct charging from renewable energies (PV + wind)
- Time-shifting of several hours to optimize revenues from electricity generation
- ETES discharges high-pressure superheated steam for re-electrification in existing steam turbine

ETES track record

● Technology Development Since 2011



2014



2019



2022

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

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

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

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 technical sizing and commercial 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.**



Get in touch with us:

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ETES Recognitions

2018



La Razon Sustainable Technology Award

Innovation award for continuous renewal of knowledge, skills and processes

2019



Best Innovation Award

Best Innovation in Offshore Energy

Award for the best innovation in the entire offshore energy industry



Innovation for Cool Earth Forum

Japanese Government/ICEF

Selected as one of the top 10 innovative technologies of 2019

2020



R&D 100 Award

Winner in the category "Process & prototyping"



SDG Tech Award

Award winner for the best sustainability solution in Denmark



Solar and Storage Award

Award winner in the category "Storage Product & Innovation"



Power Technology Excellence Awards

Award winner in the category "Best Newcomer".

2021



German Innovation Award

Winner in the category "Energy Solutions"



The smarter E Award

Winner in the category "Outstanding Projects"