Electric Thermal Energy Storage (ETES) – Industrial Decarbonization

SIEMENS Gamesa
RENEWABLE ENERGY

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 CO_2 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

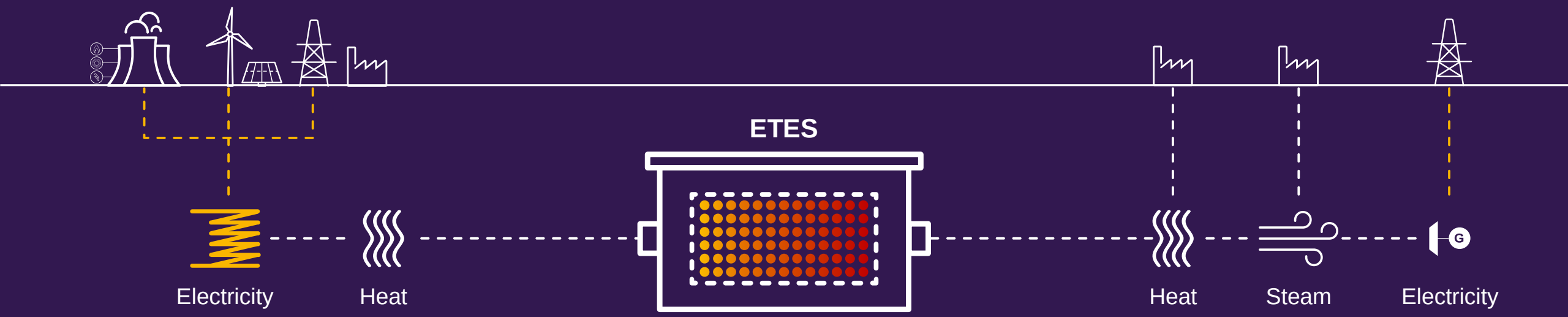
- Supply emission-free process steam or heat on a wide temperature range to ensure production
- Keep redundancy of process heat supply

Added Value for Costumer

- Enable sustainable process heat supply
- Become a recognized sustainable company
- Optimize energy procurement expenses
- Provide supply redundancy to secure production

SIEMENS Gamesa
RENEWABLE ENERGY

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 am-bient pressure & at high temperature
- Heat is stored up to weeks

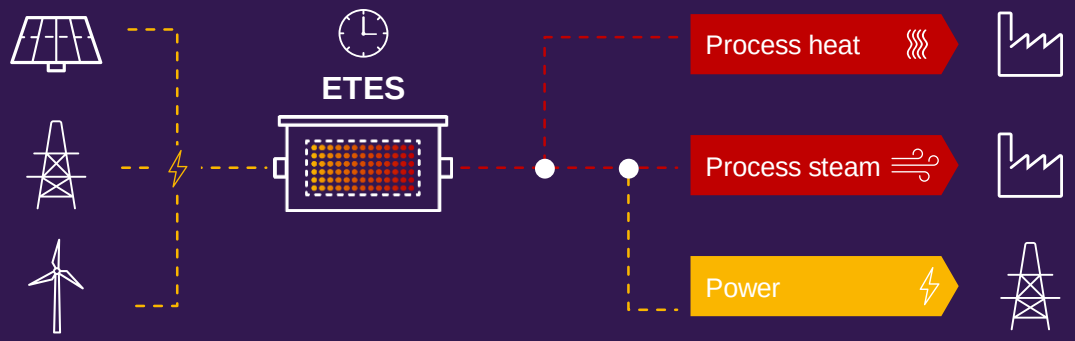
Discharge

- ETES can deliver hot air on different temperature levels
- ETES can deliver steam on different pressure levels using conventional heat exchangers

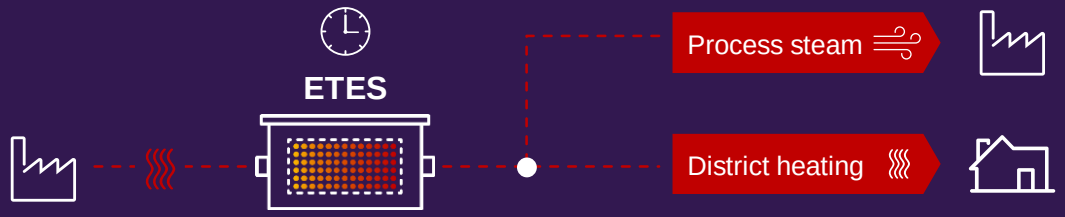
SIEMENS Gamesa
RENEWABLE ENERGY

How can ETES be applied in industrial processes?

Industrial Electrification



Industrial Heat Recovery



Added Value of ETES

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 CO_2 and fuel prices	**Decouple** energy demand and supply
Stabilize and optimize electricity cost (€/kW and €/kWh)		

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		

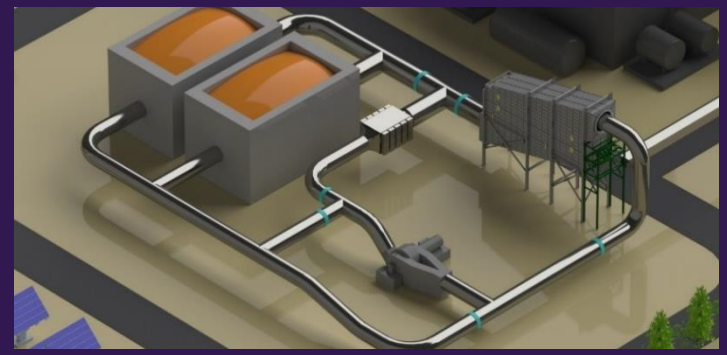
SIEMENS Gamesa
RENEWABLE ENERGY

ETES track record

Technology Development Since 2011

2014

2019



2021

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

SIEMENS Gamesa
RENEWABLE ENERGY

Customer use case – Green process electrification with energy storage

Specifications

Thermal storage capacity:
300 MWh_{th}

Cycle times for charging/ discharging: **12 h/12 h**

Electrical charging power:
25 MW_{el}

Discharging power:
25 MW_{th}

Added Value

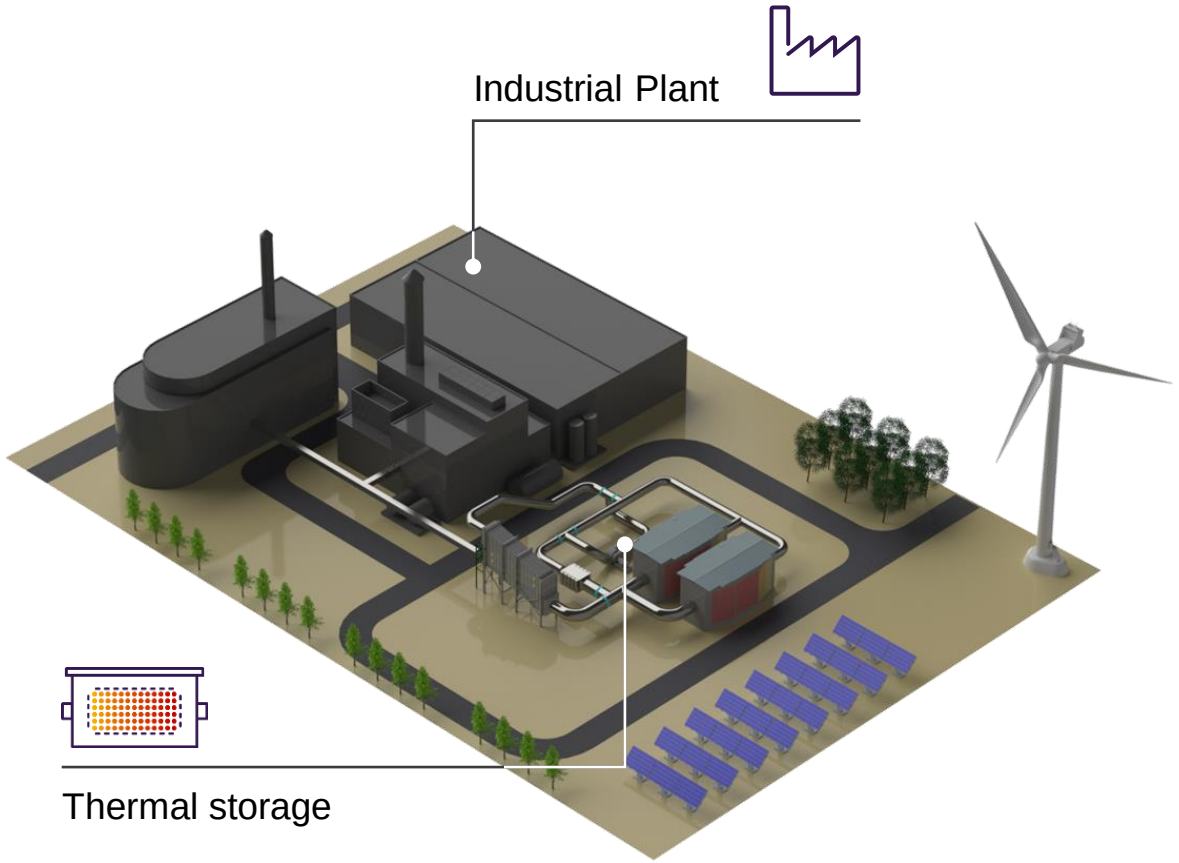
Reduction of CO_2 emissions and related cost

Utilization of public funding

Profit from periods of low electricity prices

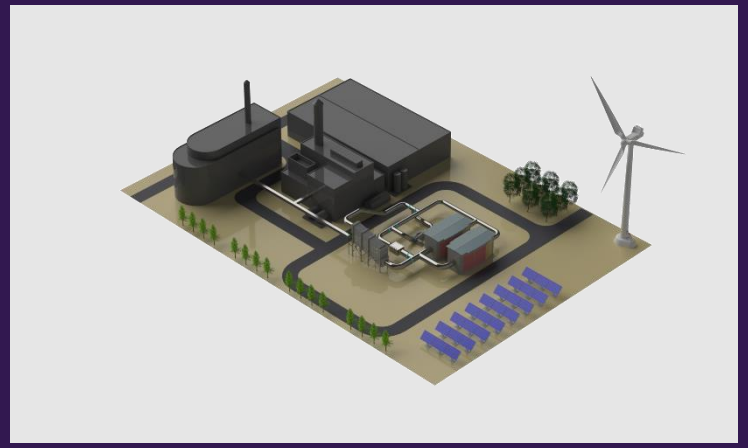
Improved public **awareness** and **green image**

System Setup



SIEMENS Gamesa
RENEWABLE ENERGY

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

SIEMENS Gamesa
RENEWABLE ENERGY

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

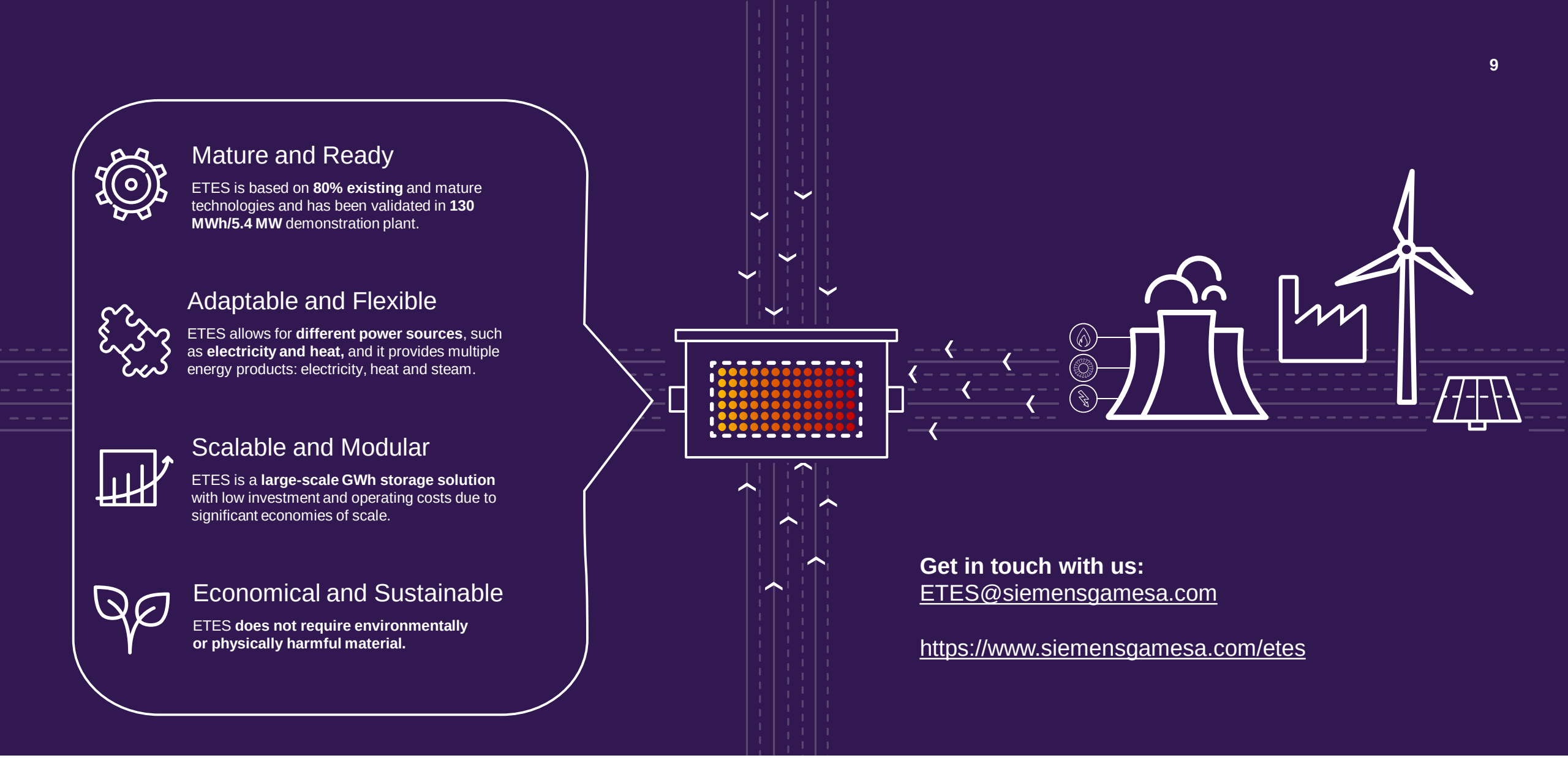
ETES allows for **different power sources**, such as **electricity and heat,** and it provides multiple energy products: electricity, heat and steam.

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:
ETES@siemensgamesa.com

https://www.siemensgamesa.com/etes

SIEMENS Gamesa
RENEWABLE ENERGY

ETES Recognitions

2018 2019 2020

La Razon Sustainable Technology Award

Award for continuous renewal of imagination, creativity, knowledge, skills and processes

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

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.