

MGTES

MAGALDI GREEN THERMAL ENERGY STORAGE

HEAT BATTERY

FLEXIBILITY AND DECARBONIZATION
FOR INDUSTRIAL PROCESSES



DRIVING
SUSTAINABLE
INNOVATION

 **MAGALDI**[®]
DEPENDABLE ENERGY STORAGE

PIONEERING THE ENERGY TRANSITION THROUGH **HEAT ELECTRIFICATION**

Heat electrification, through the **integration of renewable energy sources** and **advanced thermal energy storage technologies**, offers a transformative path to decarbonize industries and achieve net-zero targets. **Low-cost, intermittent electricity** turns into high temperature heat - up to 600 °C - for continuous process.



DECARBONIZE HEAT GENERATION

Store energy from renewable sources as heat and release steam with over 90% efficiency, effectively replacing natural gas.



OPTIMIZE HEAT GENERATION COSTS

Leverage price arbitrage across energy sources and time frames to reduce operational expenses.



CAPTURE GRID BALANCING VALUE POOLS

Align input power requirements with system needs, contributing to grid stability and reliability.

LARGE-SCALE STORAGE OFFERS HUGE POTENTIAL TO HELP REDUCE GREENHOUSE GAS EMISSIONS BY PROVIDING RENEWABLE HEAT AT AFFORDABLE PRICES ALL YEAR ROUND.

- IEA - Very large thermal energy storage for renewable districts

THERMAL STORAGE CAN BRIDGE THE GAP BETWEEN VARIABLE RENEWABLES AND CONSTANT INDUSTRIAL HEAT NEEDS, OFFERING AN AFFORDABLE PATH TO INDUSTRIAL DECARBONIZATION.

- World Bank, ESMAP Report on Clean Heating -

MGTES

YOUR GREEN SOLUTION FOR HIGH-TEMPERATURE PROCESS HEAT

Magaldi has developed and patented the **MGTES (Magaldi Green Thermal Energy Storage)** system, a **thermal battery for long-duration energy storage and green heat generation**.

Based on innovative **fluidized sand bed technology**, the system is charged by renewable electrical energy or directly from the grid, stores clean energy for hours, days or even weeks, and releases high temperature thermal energy - typically **superheated steam** - on demand or continuously.



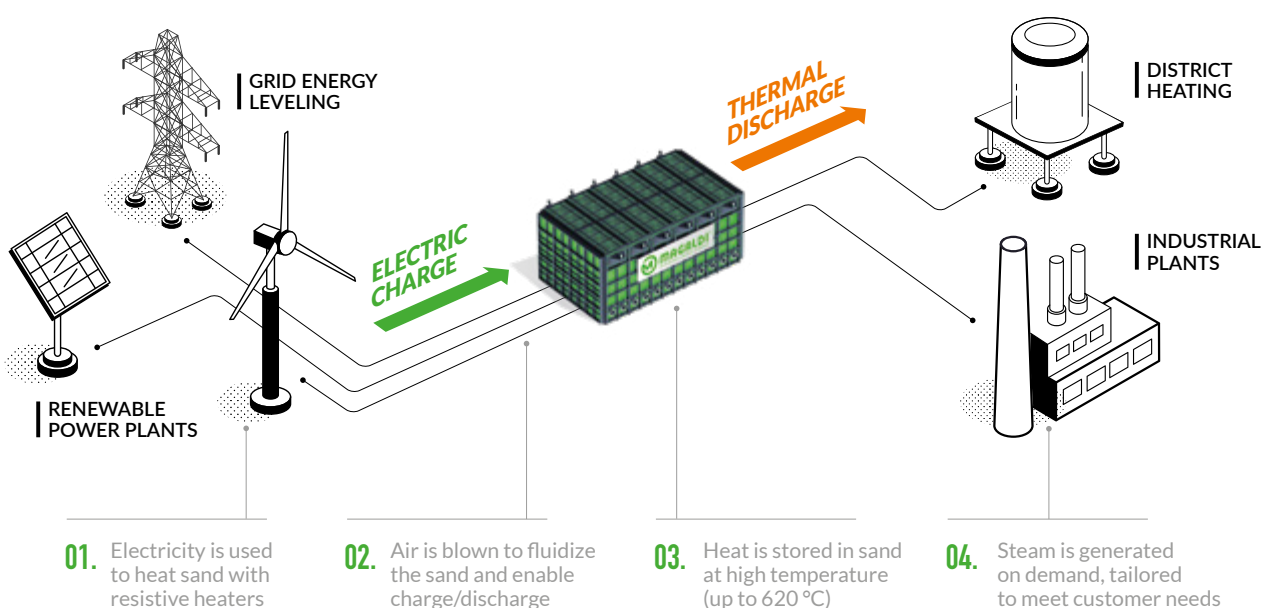
MGTES pilot at Magaldi's factory in Buccino, Italy

MGTES - Pilot plant

Fluidized bed sand mass	up to 40 tons
Charging power (nominal)	up to 450 kW _e
Sand operating temperatures	up to 620 °C
Nominal TES capacity	up to 4.3 MWh _t (@ΔT= 360 °C)
Steam generation	0.07 - 0.15 kg/s T/p > 190°C/ 10 bar
Operation cycle (nominal)	1 cycle per day

MGTES - First Industrial Operation

Fluidized bed sand mass	~70 tons
Charging power (nominal)	~1.9 MWe
Sand operating temperatures	~260-620 °C
Nominal TES capacity	~7.5 MWh _t
Steam generation	~0.72 tons/h 195 °C / 11.5 bar
Operation cycle (nominal)	1 cycle per day



MGTES

HOW DOES IT WORK?



STEP 1 CHARGE

MGTES charges when renewable energy is available or during periods of low electricity prices from the grid. High-efficiency resistors directly heat the storage medium made of a fluidized bed of solid particles, ensuring optimal heat transfer.



STEP 2 STORAGE

Fluidization is switched off when heat transfer is not desired, allowing the sand bed to efficiently retain the absorbed energy. Thermal insulation and the absence of internal convection minimize thermal losses, ensuring high-efficiency, long-duration energy storage.



STEP 3 DISCHARGE

The fluidization system activates on demand, releasing stored thermal energy directly to the heat transfer fluid by means of in-bed heat exchangers - typically superheated steam. This ensures reliable, high-efficiency heat delivery when needed.



**MGTES CAN CHARGE AND DISCHARGE SIMULTANEOUSLY
OR INDEPENDENTLY, PROVIDING UNMATCHED FLEXIBILITY**



DISTINCTIVE FEATURES

SAND AS STORAGE MEDIUM

Silica sand is an abundant, low-cost, and **highly durable material** with exceptional thermal stability. It can cycle between ambient temperature and over 1000 °C, enabling high energy storage density and superior system efficiency.

FLUIDIZATION

The fluidization state of the sand bed enhances the **heat transfer mechanism and internal diffusivity**, maximizing efficiency during both charging and discharging.



MODULARITY

MGTES is available in modular configurations, offering flexibility to meet specific customer needs, including process temperature, energy storage capacity, and energy demand. Charging, storage, and discharging are independently scalable, ensuring optimal performance and adaptability.

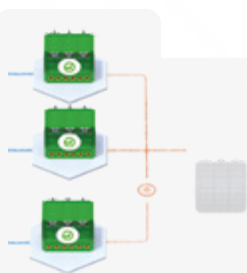


**UP TO 1 GWh
STORAGE IN LESS
THAN 1 HECTARE**

Typical MGTES module size	140 tons sand 56 m ²	280 tons sand 97 m ²	560 tons sand 178 m ²	1120 tons sand 322 m ²
Charging power (MW)	3.9	7.8	15.7	31.4
Full charge duration (hrs)	4 to 6			
Energy storage capacity (MWh)*	15	30	60	120
Discharging power and duration (hrs)	Customized to user's specifications			
Round trip efficiency	> 90%			
Response time & Losses	Fluid bed activation time < 2 minutes, daily heat losses < 1.5%			
Lifetime (yrs)	30+			

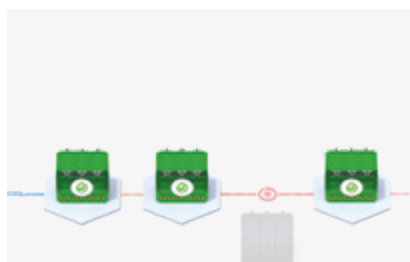
*steam temperature 200 °C

By selecting the mass of solid particles contained in each module, thermal storage capacity of a single module can be configured over a wide range starting **from 5 MWh to over 100 MWh**.



PARALLEL CONFIGURATION

Suitable to meet customer power and energy discharge demand for steam generation at T=100 - 400°C



SERIAL CONFIGURATION

Suitable to meet customer power and energy discharge demand for steam generation at T=350 - 600°C

Several modules can be assembled in one **MGTES system**, in series and/or in parallel to meet the customer power and storage demand, including massive systems with GWh thermal energy storage capacity.

KEY BENEFITS

LONG DURATION STORAGE



MGTES provides long duration energy storage, essential for **managing energy supply and demand fluctuations** over extended periods.

HIGH EFFICIENCY



MGTES delivers thermal energy with a **round-trip efficiency exceeding 90%**, effectively converting variable renewable electricity into fossil-free heat. This heat can be dispatched according to the user's process conditions and demand profile.

HIGH RELIABILITY & SAFETY



No corrosion or freezing risks (compared to molten salts), and **no fire risk** (non-flammable storage media). Easy access in case of maintenance.

COST EFFECTIVE NATURAL MATERIALS



Utilizes safe, wellknown, and abundant materials for a **sustainable solution**. Modular design for easy scale-up.

PLUG & PLAY



Quick and simple integration with **existing steam systems**.

FLEXIBILITY



Ideal for **baseload steam demands**, with simultaneous charge and discharge capabilities or on demand load following profiles.

DURABILITY



Sand can be heated and cooled repeatedly, ensuring that **MGTES lasts for decades**.

GLOBAL APPLICABILITY



No limitations based on geography or weather conditions.

REDUCED FOOTPRINT



Energy-dense design minimizes system size. Modules can be configured in parallel or in series.

TARGET INDUSTRIES AND APPLICATIONS

MGTES systems

can decarbonize a wide range of process heating applications requiring medium temperatures from 100 to 600 °C.

FOOD &
BEVERAGE

PULP &
PAPER

CHEMICALS

TEXTILE

MINING

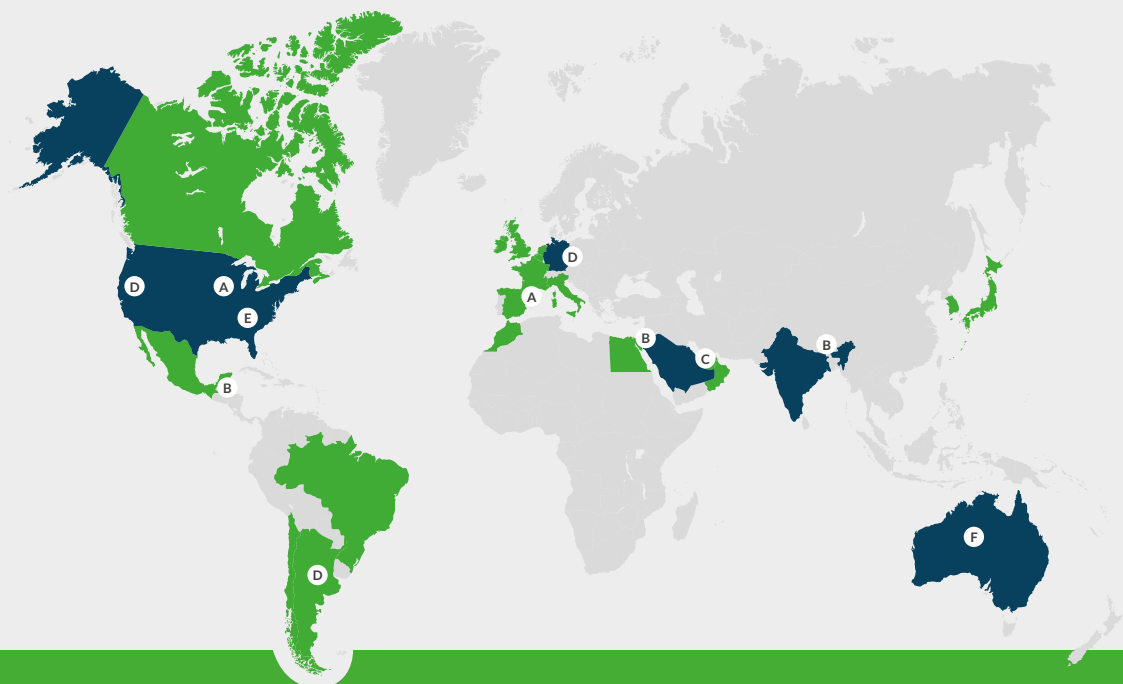
OIL & GAS
PROCESSES

DISTRICT
HEATING

MULTIPLE DISCUSSIONS FOR MGTES APPLICATIONS GLOBALLY

- Large (MW TES Markets)
- Giant (GW TES Markets)

- A Heat Electrification
- B Diesel/Gas boilers replacement
- C TES offshore/offgrid, EOR
- D Energy Storage Hubs
- E Cogen Integration
- F Green Mining



ABOUT MAGALDI GREEN ENERGY

Magaldi Green Energy (MGE), launched in 2021 as an ambitious branch of the Magaldi Group, stands at the forefront of innovative technologies in renewable energy storage and green heat generation.

Drawing on nearly a century of engineering excellence from its parent company, MGE utilizes a rich legacy of expertise in material handling systems designed for demanding industrial applications to develop pioneering solutions that tackle today's energy challenges.

With a steadfast commitment to innovation and sustainability, MGE is positioned to be a vital partner for industries worldwide as they transition toward decarbonization, helping to create a cleaner, more sustainable future.

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