

MGTES

MAGALDI GREEN THERMAL ENERGY STORAGE

HEAT BATTERY

FLEXIBILITY AND DECARBONIZATION
FOR INDUSTRIAL PROCESSES



DRIVING
SUSTAINABLE
INNOVATION

 **MAGALDI**[®]
DEPENDABLE ENERGY STORAGE

LEADING THE ENERGY TRANSITION BY ELECTRIFYING INDUSTRIAL HEAT

Heat electrification, enabled by the **integration of renewable energy** and **advanced thermal energy storage**, offers a transformative pathway to industrial decarbonization and net-zero goals.

By **converting low-cost, intermittent electricity** into high-temperature heat - up to 600 °C - it ensures continuous, reliable operation for industrial processes.



DECARBONIZE HEAT GENERATION

Store renewable energy as high-temperature heat and release steam with over 90% efficiency — effectively replacing natural gas in industrial processes.



OPTIMIZE HEAT GENERATION COSTS

Leverage energy price arbitrage across sources and time periods to significantly reduce operational costs.



CAPTURE VALUE FROM GRID BALANCING SERVICES

Adapt power intake to grid needs, supporting stability and unlocking additional revenue through flexibility services.

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.



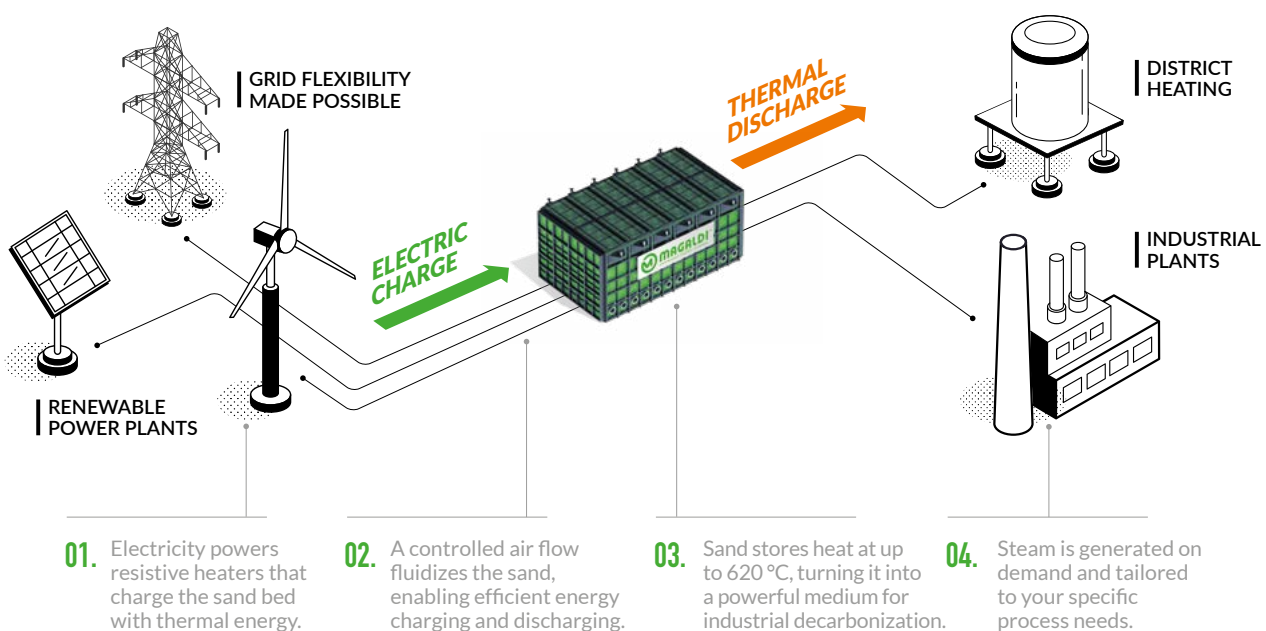
First MGTES Pilot Installed at Magaldi's Buccino Facility (Italy)

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
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 by using renewable energy or low-cost electricity from the grid. High-efficiency resistors heat a fluidized bed of solid particles, creating an optimal environment for efficient heat transfer and storage.



STEP 2 STORAGE

When heat transfer is not needed, fluidization is paused, allowing the sand bed to securely retain stored energy. Superior insulation and minimal internal convection reduce heat loss, ensuring efficient, long-duration energy storage.



STEP 3 DISCHARGE

The fluidization system activates on demand, transferring stored heat directly to the working fluid via in-bed heat exchangers—typically producing superheated steam. This delivers reliable, high-efficiency heat exactly when you need it.



MGTES OFFERS UNMATCHED FLEXIBILITY: CHARGE AND DISCHARGE SIMULTANEOUSLY OR INDEPENDENTLY



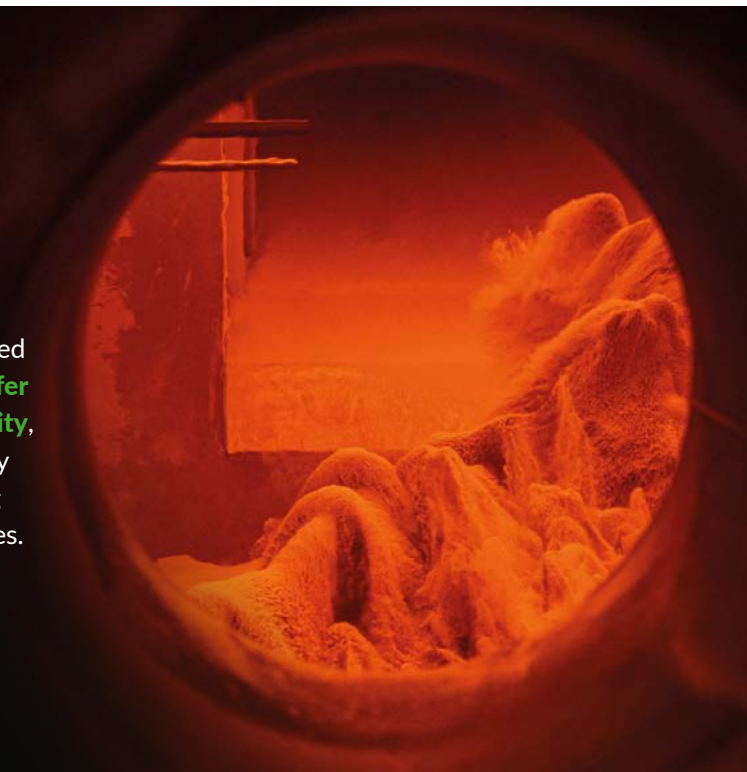
KEY FEATURES

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

Fluidizing the sand bed enhances **heat transfer and internal diffusivity**, maximizing efficiency during both charging and discharging cycles.





SCALABLE AND MODULAR DESIGN FOR FLEXIBLE DEPLOYMENT

MGTES is available in modular configurations, providing 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.

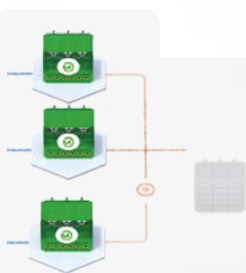


**UP TO 1 GWH
STORAGE CAPACITY
IN LESS THAN 1
HECTARE**

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+			

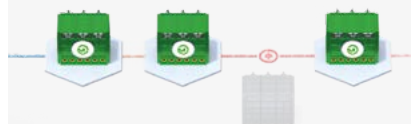
*steam temperature 200 °C

Thermal storage capacity per module can be customized by selecting the mass of solid particles, ranging **from 5 MWh up to over 100 MWh** - offering scalable solutions to fit a wide range of energy needs.



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

Multiple modules can be combined - either in series or parallel - to tailor the **MGTES system** to your power and storage requirements, enabling even massive installations with GWh-scale thermal energy 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 **round-trip efficiency exceeding 90%**, efficiently converting variable renewable electricity into fossil-free heat. This heat is dispatchable to match your process conditions and demand profile.

HIGH RELIABILITY & SAFETY



No corrosion or freezing risks - as seen with molten salts - and **zero fire hazard** thanks to the non-flammable storage medium. Additionally, the system offers easy access for maintenance.

AFFORDABLE, SUSTAINABLE MATERIALS



Utilizes safe, well-known, and abundant materials to deliver a **sustainable solution**. Its modular design ensures easy scalability to meet growing demands.

PLUG & PLAY



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

FLEXIBILITY



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

DURABILITY



Sand's ability to withstand repeated heating and cooling cycles ensures **MGTES delivers reliable performance for decades**.

GLOBAL APPLICABILITY



Unrestricted by geography or weather, **MGTES delivers reliable performance anywhere**.

REDUCED FOOTPRINT



Energy-dense design minimizes system footprint. Modules can be configured in parallel or series for tailored performance.

TARGET INDUSTRIES AND APPLICATIONS

MGTES systems

enable decarbonization across a broad spectrum of process heating applications, covering medium temperatures from 100°C to 600°C.

FOOD &
BEVERAGE

PULP &
PAPER

CHEMICALS

TEXTILE

MINING

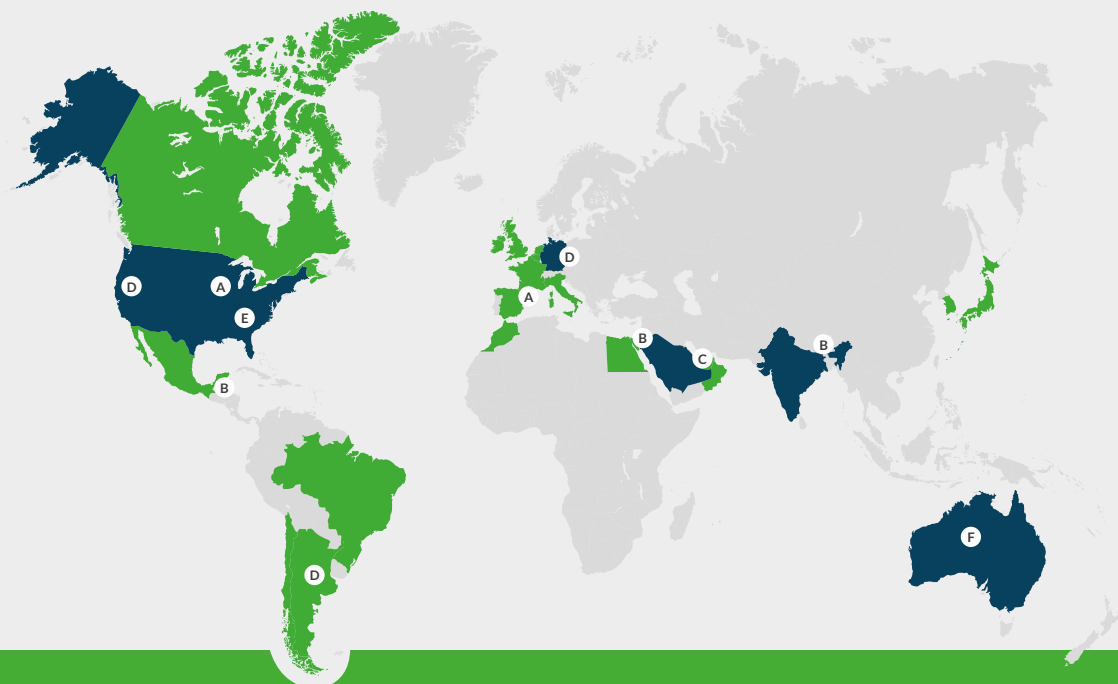
OIL & GAS
PROCESSES

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), established in 2021 as a dynamic division of the Magaldi Group, leads the way in cutting-edge renewable energy storage and green heat generation technologies.

Building on nearly a century of engineering excellence from its parent company, MGE leverages deep expertise in material handling systems tailored for demanding industrial environments to create innovative solutions addressing today's energy challenges.

Driven by a strong commitment to innovation and sustainability, MGE is a trusted partner for industries worldwide, supporting their transition to decarbonization and helping to build a cleaner, more sustainable future.

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