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25th IERE General Meeting and RWE TI Germany Forum  
Düsseldorf, Germany  
December 2–5, 2025

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## Thermal Long Duration Energy Storage Options to Replace Grid Flexibility Services to Integrate more Renewables in the Grids

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**Keywords:** *Long Duration Energy Storage, Grid Flexibility Services, Synchronous Inertia, Combined Heat and Power, Thermal Storage for Coal Plants and CCGTs*

### Abstract

This presentation shows, how long duration thermal energy storage in connection with thermal Brayton or Rankine cycles of existing or new thermal power plants can absorb excess generation of renewables to avoid their curtailment, instantaneous balance supply and demand to maintain frequency with the synchronous inertia of its turbomachinery and during charging, provide voltage control with the generator acting as a synchronous condenser.

Integrating large scale thermal energy storage with combustion turbines can transform gas fired combined cycle power plants into low-carbon resources that deliver capacity, synchronous inertia, grid flexibility services and time-shift renewable energy competitively. In the charging period, renewable and/or curtailed grid electricity heats the thermal storage with an electric heater or a heat pump. At discharge, the thermal storage generates steam that is fed into the (oversized) steam turbine of the combined cycle. This improves the fuel heat rate to increase spark spread, reduce GHG emissions, and increase the unit's dispatch merit to raise capacity factor in high renewable markets. It also maintains equipment in a warm condition using stored thermal energy to enable fast startup and increases the new power output (for simple cycle add-ons) to provide zero carbon incremental capacity.

Also, retiring coal power plants can receive a decarbonized new life by storing excess renewable energy in thermal storage, delivering the stored energy back to the grid using the former coal plant's existing power blocks and grid connections. This August 2025, China is the first to integrate a large (1000MWht) molten salt storage into a coal plant to increase its flexibility and reduce its GHG emissions in Suzhou in Chinese Anhui province.

Finally worldwide and European built and commercially operating utility scale thermal storage systems are presented as reference to their commercial maturity.

Molten salt thermal storage systems have become worldwide a mature stationary utility scale storage system for firming variable solar power over many hours with a discharge power rating of some 100s MWe in concentrating solar power plants – over 4000MWe with over 35GWhe storage capacity are commercially operating worldwide. To charge this mature long duration thermal storage technology with excess renewable electricity, Malta Inc has developed a high temperature heat pump technology for high efficient use in power and heat applications.