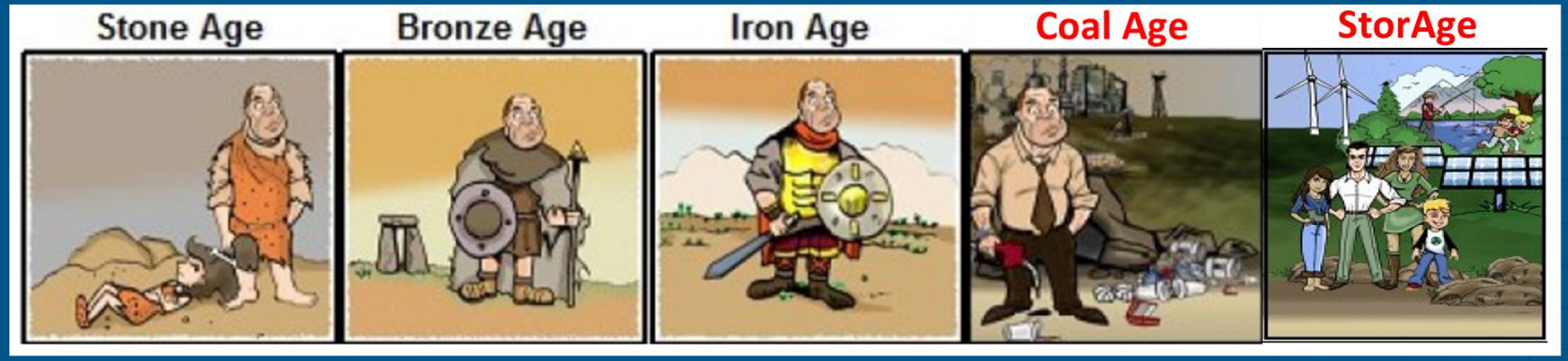
From CoalAge to StorAge



Adapted by Malta Inc from EcoEnlightened Charitable Org. Inc.

High temperature thermal storage of electricity for global energy transition from fossil to renewables – converting coal plants into storage plants

2nd Thermal Mechanical Chemical Storage Workshop, Pittsburgh

Dr.Ing. Michael Geyer, Senior Technology Advisor

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Massive shut down of Coal Plants coming

Bloomberg

Climate Changed

Germany's Coal Plants May Be Converted to Giant Batteries

By Brian Parkin and William Wilkes
10 de abril de 2019 9:01 GMT-4

Bloomberg

Jan 29, 2020

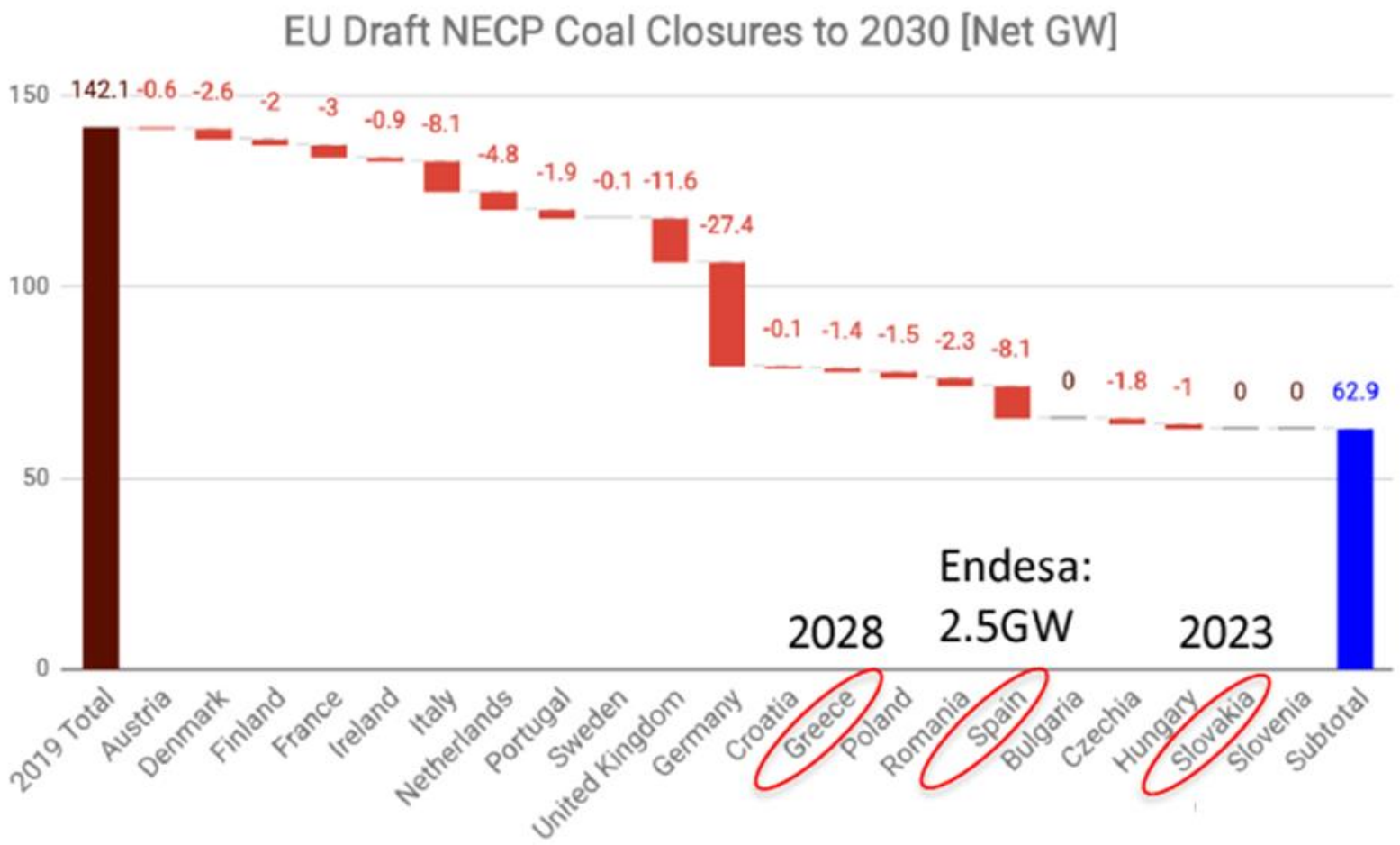
, Saying Policy Is Appropriate Read More

Politics

German $55 Billion Plan to Scrap Coal Clears Cabinet Hurdle

By Brian Parkin, Birgit Jennen, and Patrick Donahue
29 de enero de 2020 10:21 CET *Updated on 29 de enero de 2020 16:22 CET*

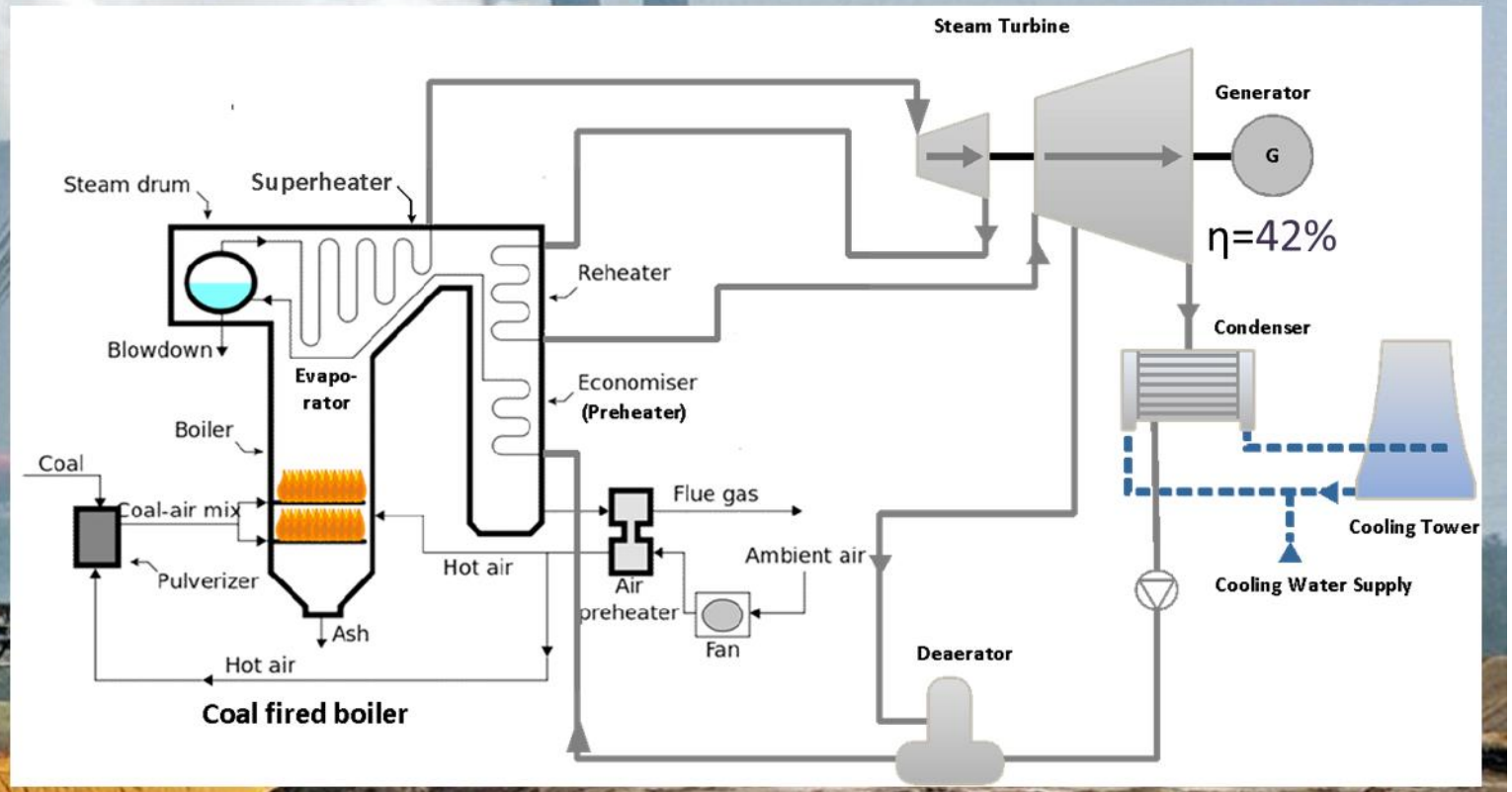
Europe 2030: 80GWe of Coal Plants to be shut down



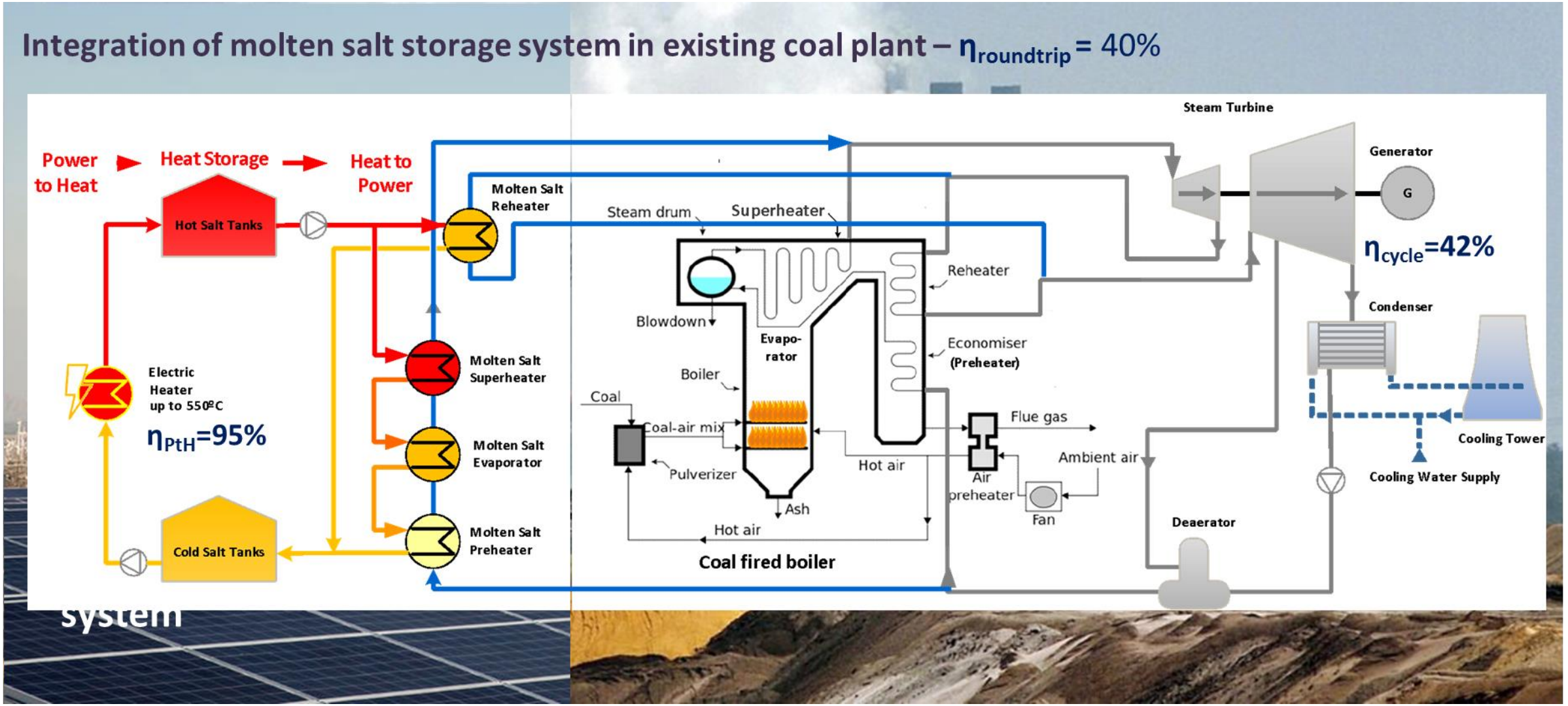
Thermal storage – the missing link for energy transition

Retrofit of existing coal plant with thermal storage

We start with an existing coal plant

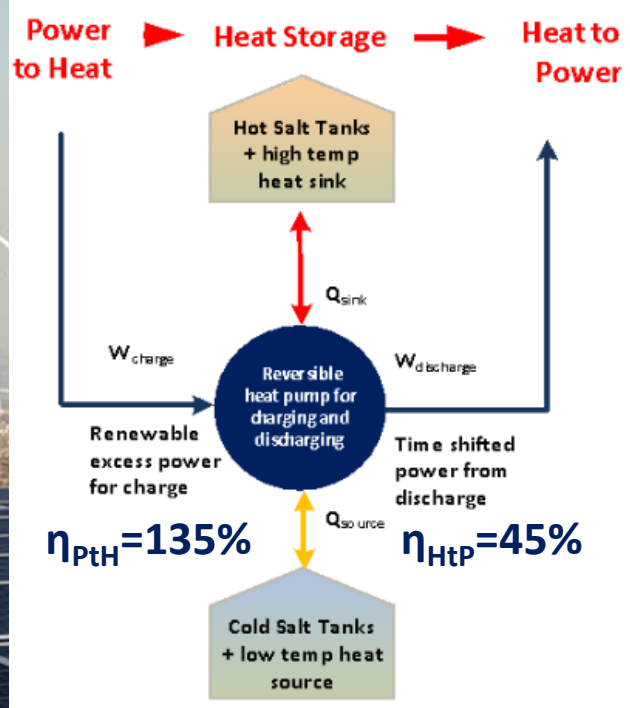


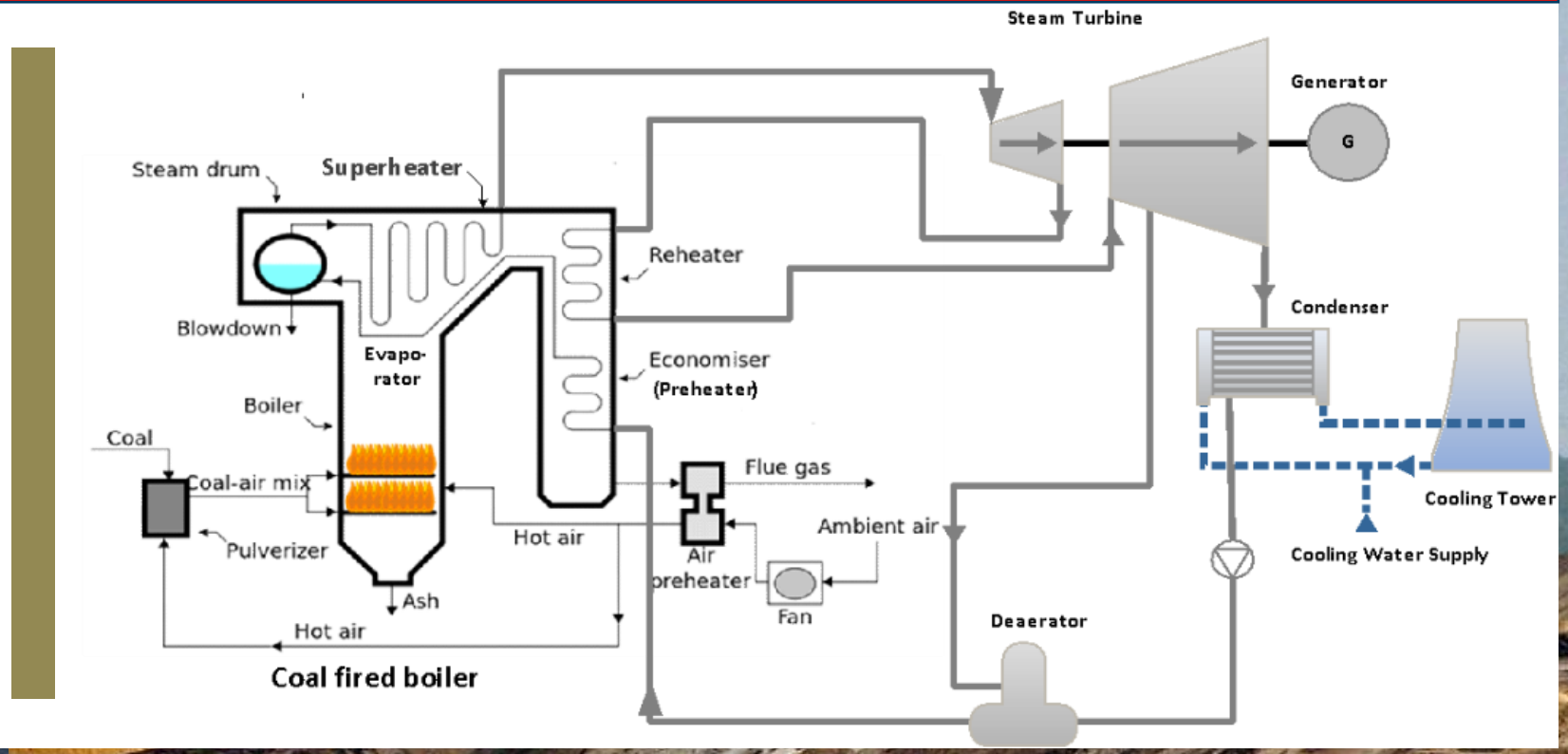
adding a molten salt storage island to the existing Rankine steam cycle



Malta is going for the next step

Next Step: Malta pumped heat electricity storage increases charge/discharge efficiency to 60%

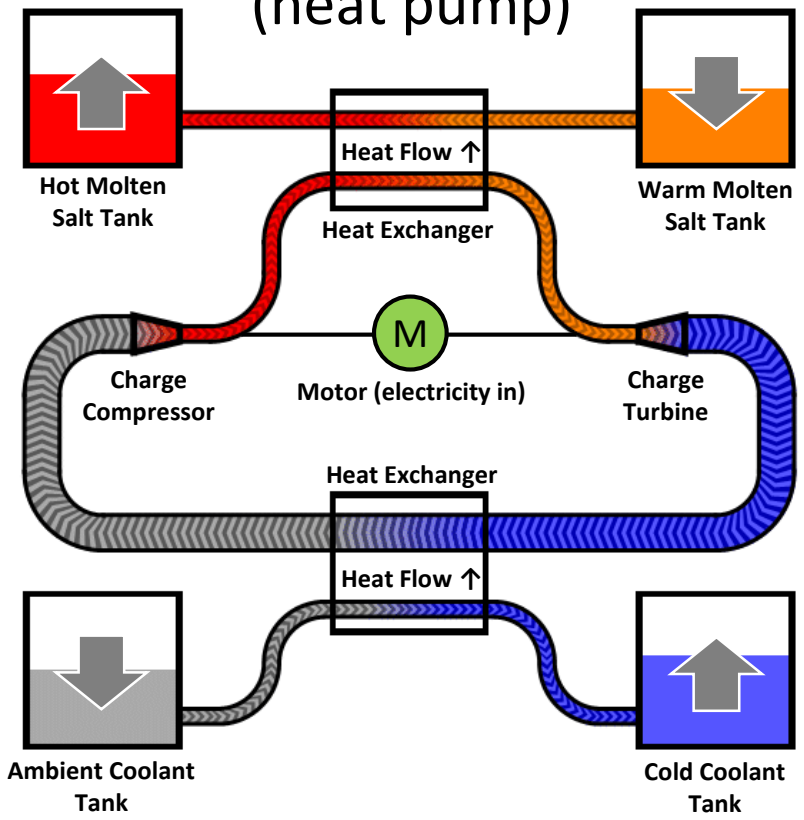




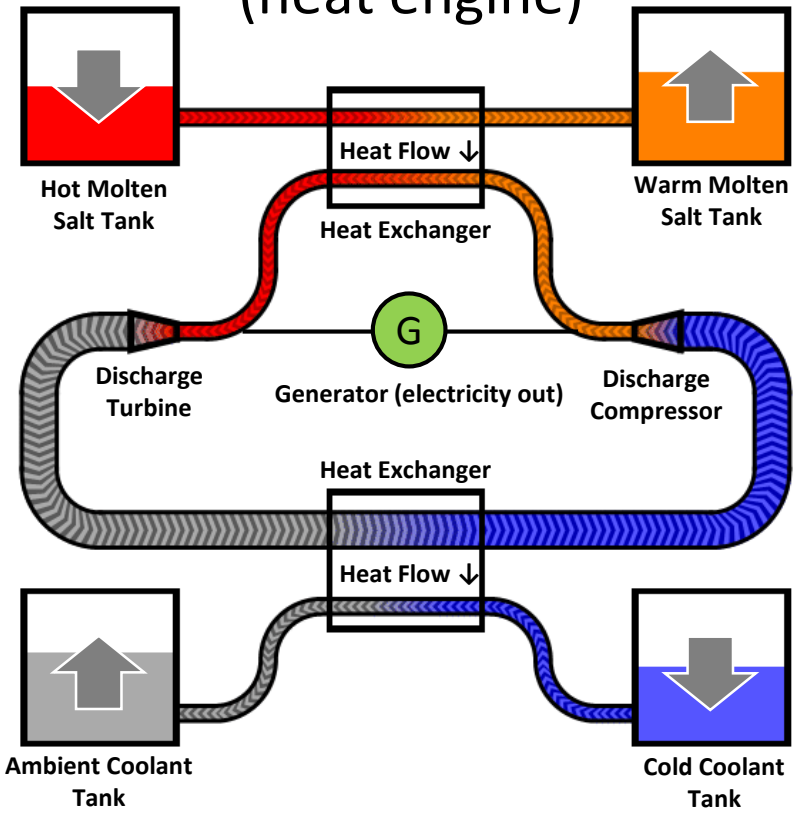
Established Concept for a New Application

In charge mode, the system operates as a heat pump, storing electricity as heat in molten salt and cold in chilled liquid.

Charge Mode
(heat pump)



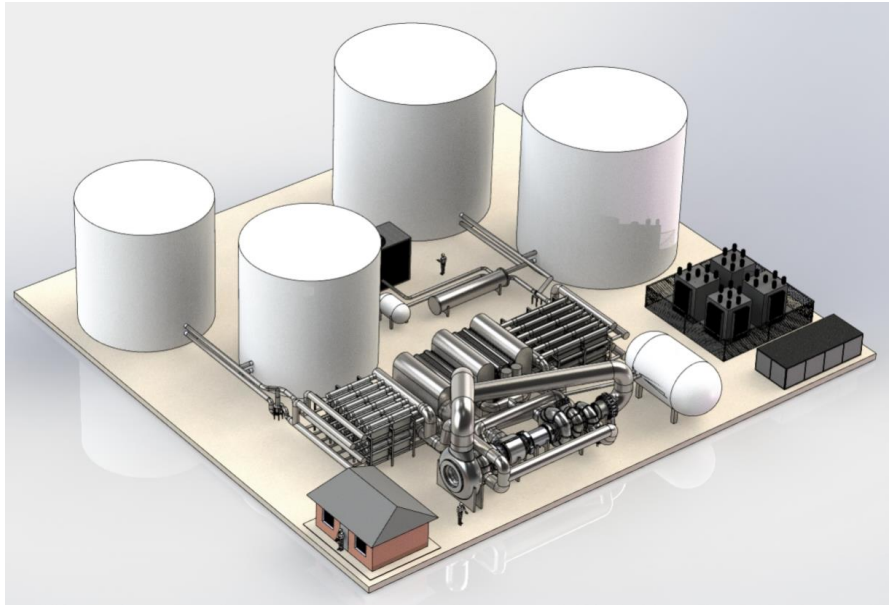
Discharge Mode
(heat engine)



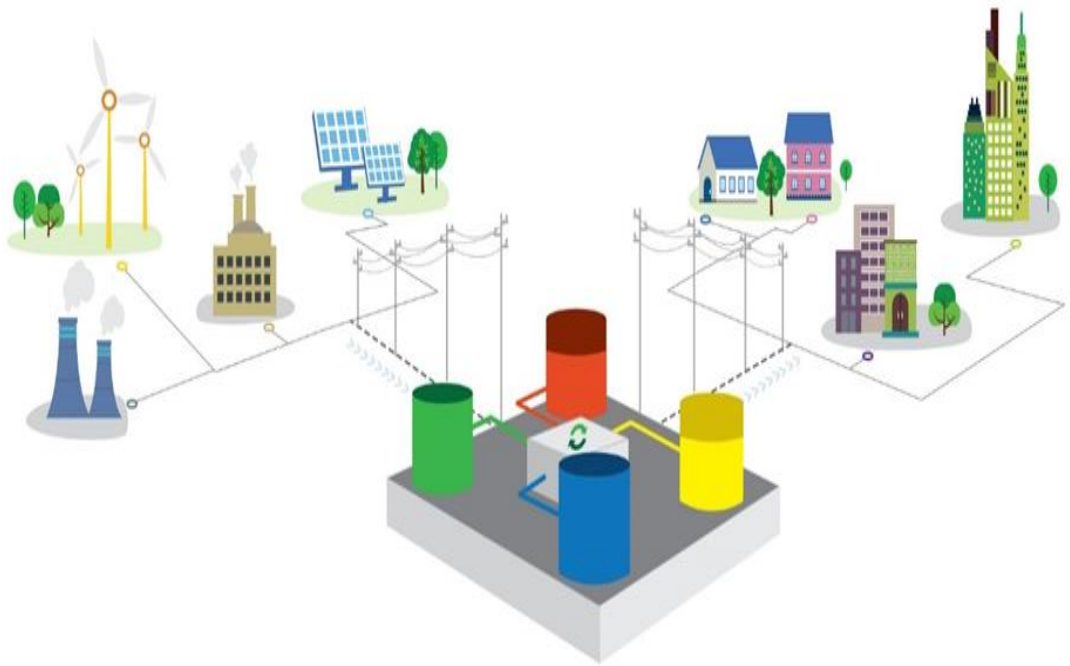
In discharge mode, system operates as a heat engine, using the stored energy to produce electricity.

Malta pumped heat electricity storage boosts efficiency to over 60%

- Malta cycle is a **closed loop air Brayton cycle** with recuperation.
- Charge cycle is a **heat pump** that uses turbomachinery to convert electrical energy into thermal energy. The thermal energy is transferred via heat exchangers to salt (hot) and coolant (cold) and stored in hot and cold reservoirs.
- Generation cycle is a **heat engine** that uses heat exchangers and turbomachinery to convert the thermal energy back to electrical energy.
- Storage mediums are **Molten Salt** and an **Antifreeze Liquid** mixture.
- Turbomachinery will be customized for cycle operation for improved efficiency and time to market project implementation focus.
- Heat Exchangers will be customized for cycle conditions but utilize well-known metals and manufacturing processes for improved time to market.
- **Target Capex for 100MWe discharge 10 hours capacity** with 60% charge/discharge roundtrip efficiency is below **100USD/kWhe**.



Malta PHES – transition key from coal to renewables



- ✓ **Yes - we can replace baseload coal plants by Malta pumped heat electricity storage plants that will be charged by excess/curtailed variable renewable electricity and be discharged upon demand**
- ✓ **The capital cost target of doing that is below 100 USD/kWhe storage capacity**
- ✓ **Assuming USDMWhe PV electricity cost for storage charging and 60% charge/discharge efficiency, the dispatchable discharging electricity will then cost about 40-50 USD/MWhe.**
- ✓ **This will convert coal plants to non-carbon plants using their existing site and grid connection infrastructure**
- ✓ **Being thermal power systems, the many jobs of the former coal plant staff will be saved for operation of the reconverted storage plant**
- ✓ **This will decarbonize the power park while granting 100% dispatchability**

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