Decarbonization of coal fired power plants using high temperature thermal storage technologies from solar power plants - from CoalAge to StorAge

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Climate Changed

Germany’s Coal Plants May Be Converted to Giant Batteries

By Brian Parkin and William Wilkes
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The storage units “could be converted from the mid-2020s to innovative, long-term power plants storing surplus wind and solar power,” the Economy and Energy Ministry said in its 32-page report on coal phaseout planning. No particular storage technology has been selected for the switch yet, according to the April 4 report.
German Coal Commission published Jan 28, 2019 its report to step out from coal by 2038

Today 46GW coal plants

- 2022 to be shut down 7GW
- 2030 to be shut down additional 16GW (23GW accumulated)
- 2038 to be shut down remaining 23GW
We start with an existing coal plant and add a power to heat molten salt storage system. The diagram illustrates the addition of the molten salt storage island to the existing Rankine Cycle. In Phase 1: Pilot integration of molten salt storage in existing coal plant – proof of concept, the roundtrip efficiency $\eta_{\text{roundtrip}}$ is 40%. The cycle efficiency $\eta_{\text{cycle}}$ is 42%. The system includes components such as hot salt tanks, heat storage, and power to heat mechanisms, with efficiencies of $\eta_{\text{PtH}} = 95\%$.
We start with an existing coal plant and add a power to heat molten salt storage system. Substitution of resistance heater with heat pump to improve charging efficiency.

Phase 2: Substitute resistance heater by heat pump for charging – proof of concept $\eta_{\text{roundtrip}} = 50\%$

$\eta_{\text{PHT}} = 120\%$

$\eta_{\text{cycle}} = 42\%$
Wegweisendes Pilotprojekt: Im Rheinischen Revier entsteht ein Wärmespeicherkraftwerk

- Gemeinsame Planung von RWE Power, DLR und FH Aachen
- Flüssigsalz-Anlage integriert erneuerbare und konventionelle Energieträger und schafft Perspektive für Kraftwerksstandorte
- Land NRW fördert Planung mit 2,9 Millionen Euro
Advantages of molten salt thermal storage over batteries and pumped hydro

- Low cost – its components are mass used as fertilizer
- Inert – low corrosion with carbon steel
- Non Toxic / non penetrating in ground soil – its freezing at contact
- Durable – good for 35 years charge discharge cycles
- Capable of achieving high temperatures at ambient pressure
- Can be used as heat transfer fluid and easily exchange heat with other working fluids (water/steam, HTF)
- High mass specific energy density – magnitudes higher than water in pumped hydro and in comparable range of batteries
- Abundant availability
- Reusable
Perspectives for other countries

PacifiCorp Proposes Replacing Wyoming Coal Plants With Renewables and Storage

For the first time, the Berkshire Hathaway-owned utility has outlined a plan that could save customers money by retiring coal plants early. But it faces a challenge in Wyoming’s new coal protection law.

JEFF ST. JOHN | APRIL 30, 2019
Lithium and thermal storage salts come from the same source - the Salar de Atacama.

Lithium Mining in the Atacama

Solar Salt Mining (NaNO$_3$ and KNO$_3$) in the Atacama
Chile has world best direct normal and global horizontal irradiation