

Innovations to manage the energy transition

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Abstract

The global energy markets are in transition and being influenced by three major trends: Decarbonization, Decentralization and Digitalization. The COP 24 climate protection goals and increasing societal pressure ("Fridays for Future") put strong pressure on fossil power generation to reduce anthropogenic CO₂ emissions which is underlined by the recent decisions from the German "Kohlekommission" to get out of coal by 2038.

This puts a lot of challenges on German and European utilities: Fossil generation assets need to be replaced by renewable energies and integrated into the grid, existing assets need to be more flexible to balance fluctuating renewable power generation from PV and wind. Large scale energy storage will become more and more important to balance daily and seasonal load demands.

A big challenge for generation utilities is the question what to do with existing coal power plants? An alternative to just shut down and close is to make these assets fit for a decarbonized future.

A first step to significantly reduce CO₂ emissions of a coal plant is a full repowering, that means to convert a steam plant into a combined cycle power plant. High efficient GT will be added with new HRSG's – the existing fossil boiler will be replaced. Existing power plant infrastructure like steam turbine, generator, water steam cycle, transformers, etc. will be re-used. The efficiency of such a repowered plant will be increased by > 20% and CO₂ emissions reduced by > 50%.

As a second step electrolyzers can be installed at site – excessive renewable power can be used to produce green hydrogen which can be used for re-electrification in gas turbines or for sector coupling by providing H₂ for transportation purposes as a basis for a future hydrogen economy. Modular electrolyzer capacities can be added to get to a complete CO₂ neutral power generation with the combined cycle power plant assets.

Another alternative is to convert existing coal fired units into CO₂ neutral thermal storage powerplants. Siemens Gamesa has developed a new technology to store heat in volcanic stones by means of power to heat (electric heaters). Renewable power can be used to heat up the volcanic stones up to temperatures of 800C – with the stored energy steam can be produced in an HRSG and for re-electrification in steam turbines. This ETES storage system can be integrated into existing coal fired plants either as an add on (ETES ADD) or to completely eliminate the fossil boiler (ETES Switch).

Both options provide a future for installed coal fired powerplants, to avoid stranded assets by using existing infrastructure and to secure the jobs of the power plant personnel