

## **Techno-economic comparison of Long-duration energy storage and peaker plants for peak load coverage in the german energy market**

**Tom NESSELHAUF**

**Master's Student, Industrial Engineering, University of Duisburg-Essen**

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### **Abstract**

The ongoing transformation of energy systems towards climate neutrality is accompanied by a fundamental change in the role of flexible generation and storage technologies. With the increasing share of variable renewable energy sources such as wind and solar, balancing supply and demand reliably and cost-effectively becomes a key challenge. Traditionally, peak demand has been met by conventional peaker plants, which can be dispatched quickly but are associated with high costs and significant CO<sub>2</sub> emissions. In parallel, long-duration energy storage (LDES) technologies are emerging as a promising alternative to provide flexibility and ensure system reliability, particularly for longer periods of low renewable generation.

This presentation presents a techno-economic comparison of LDES and peaker plants in the context of future developments in the German energy market. The analysis explores how both options can contribute to peak load coverage, highlighting differences in efficiency, investment and operating costs, scalability, and their ability to support energy security. While peaker plants remain the established solution, their role is challenged by tightening climate policies and volatile fuel markets. LDES, on the other hand, may enable a cost-competitive and carbon-neutral alternative, but its viability depends strongly on technology maturity, cost reductions, and appropriate market mechanisms.

The analysis is expected to provide insights into the conditions under which each technology may play a dominant role in covering peak demand. The findings are not only relevant for Germany but also for other energy systems undergoing rapid decarbonization. By comparing conventional and emerging flexibility solutions, the research project contributes to the ongoing discussion on how to achieve a secure, sustainable, and affordable electricity supply in the decades ahead.