

Long-duration energy storage within the energy system - An analysis of barriers to the deployment of hydrogen and thermal energy storage

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Extended Abstract

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Abstract Summary

While short-term flexibility options for renewable energy integration are maturing rapidly, the deployment of long-duration energy storage (LDES) remains critically underdeveloped. This discrepancy is partly explained by a fragmented understanding of deployment barriers. Hydrogen storage appears particularly promising for long-duration electricity storage, potentially supplemented by methanol tank storage. For district heating, thermal energy storage (TES) technologies such as pit, borehole, or aquifer TES offer considerable potential. Although future flexibility requirements and various options for meeting them have been examined in several publications, to the best of our knowledge a structured overview of barriers to LDES deployment is still lacking. This study addresses this gap by analyzing the key barriers hindering LDES deployment, focusing on long-duration hydrogen storage and long-duration TES in district heating. Building on a comprehensive literature review of 80 publications, we identify critical barriers and gaps in policy frameworks that limit investment in LDES. Our analysis reveals that barriers to LDES deployment are deeply interconnected rather than isolated. Political and economic barriers frequently reinforce each other: the absence of long-term regulatory commitments increases investment uncertainty, which in turn raises the cost of capital and discourages private financing. The findings highlight the need for coherent, long-term policy frameworks to unlock deployment at scale.

Presenting Author Biography

Anna Billerbeck has been a researcher and project manager at Fraunhofer Institute for Systems and Innovation Research ISI since June 2019. She works in national and international research and consulting projects on renewable energies. Her research activities focus on policy measures for the decarbonisation of energy systems. She studied industrial engineering in Mannheim and then energy economics in Darmstadt. In May 2024, she completed her doctorate in energy economics on the topic of "District heating in a

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