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A Comparative Study on Lithium-ion Batteries and Superconducting Magnetic Energy Storage System for Energy Storage System (ESS) – A Review

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Abstract: *The increasing demand for efficient and reliable energy storage solutions has led to a growing interest in comparing various technologies. This paper presents a comprehensive analysis of Lithium-ion (Li-ion) batteries and Superconducting Magnetic Energy Storage Systems (SMES) as two prominent contenders in the field of energy storage. Both technologies are evaluated based on key parameters such as energy density, cycle life, efficiency, and environmental impact. Lithium-ion batteries, widely used in portable electronic devices and electric vehicles, offer high energy density and scalability. However, concerns about their limited cycle life, safety issues, and environmental considerations, particularly regarding the extraction and disposal of lithium, have prompted researchers to explore alternative solutions. On the other hand, Superconducting Magnetic Energy Storage Systems leverage the unique properties of superconducting materials to store and release electrical energy efficiently. SMES systems are known for their rapid response times, high efficiency, and long cycle life. However, challenges related to the high cost of superconducting materials and the need for cryogenic cooling systems pose obstacles to widespread adoption. This paper provides a comparative assessment of these technologies, considering their strengths, weaknesses, and potential applications. The analysis aims to guide decision-makers and researchers in selecting the most suitable energy storage solution based on specific requirements and constraints. Additionally, the paper discusses emerging advancements in both technologies and explores potential hybrid approaches that could leverage the strengths of both Lithium-ion batteries and SMES systems to address the limitations inherent in each.*

Keywords: reliable energy

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