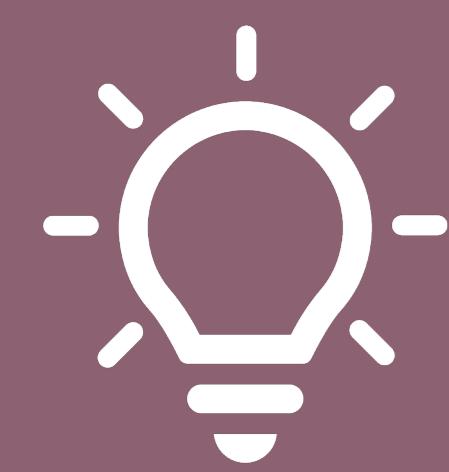


Bridging the Seas: A Review on Integrating Energy Storage with MRE Sources

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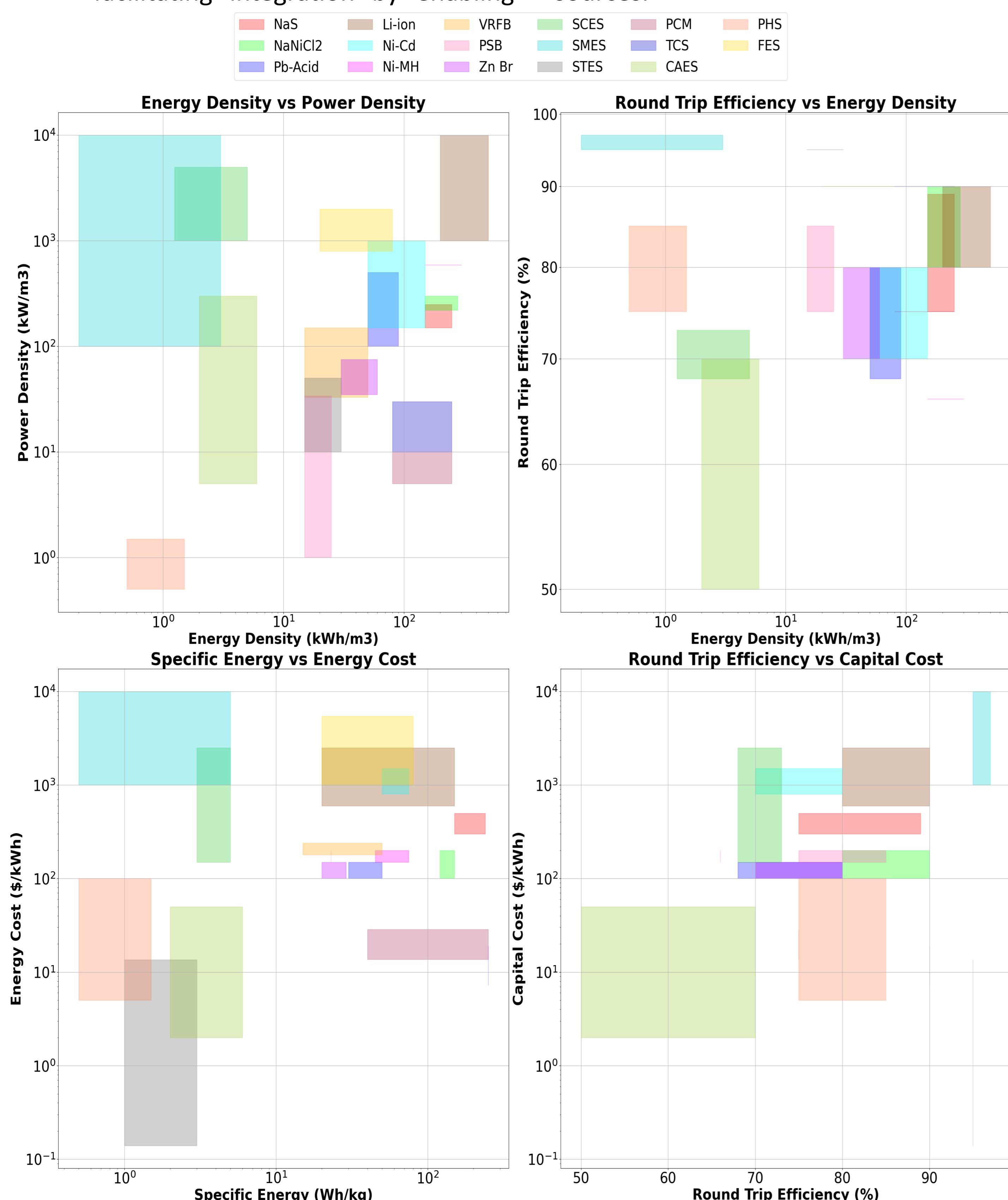
Integrating energy storage with marine renewable energy (MRE) systems enhances grid stability and reliability, addressing the variability of MRE sources. Despite challenges, this synergy is crucial for advancing renewable energy, achieving energy resilience, and mitigating climate change impacts.



Abstract

Marine renewable energy (MRE) sources, including tidal, wave, and ocean thermal energy, hold significant promise for sustainable power generation. However, their intermittent and variable nature presents challenges for grid integration and stability. **Energy storage systems (ESS)** offer a solution by mitigating this variability, thus enhancing reliability, grid stability, power quality, and grid compatibility. Various ESS technologies are evaluated based on parameters such as energy density, efficiency, response time, lifespan, cost, scalability, and environmental impact. **Integration strategies and operational considerations** are crucial, with power electronics converters playing a key role in facilitating integration by enabling

bidirectional power flow, voltage regulation, and synchronization. The design and deployment of converters tailored for MRE applications aim to maximize system efficiency and stability. Nonetheless, **significant challenges and barriers** remain, including technological limitations, regulatory frameworks, and economic viability. Environmental and socioeconomic considerations are also critical, highlighting the importance of holistic planning in project development. **Current trends, challenges, and future directions** emphasize the need for interdisciplinary collaboration, innovative technology development, and supportive policy frameworks to advance the integration of MRE sources.



RESULTS

