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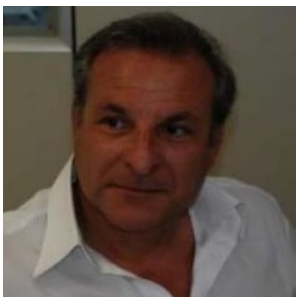

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Abstract

Title: Onboard Energy Storage Systems for Rail Vehicles: Challenges and Perspectives

The railway sector, renowned for its relatively low carbon footprint compared to other modes of transport, has faced challenges in achieving complete electrification, particularly for medium- and low-traffic routes. While traditional electric trains offer zero local emissions, the high investment costs and infrastructure modifications associated with electrification can be prohibitive. In certain cases, physical or legal constraints may entirely preclude external electrification.

To address these limitations and contribute to global climate goals, rolling stock manufacturers have increasingly integrated onboard energy storage systems (OESS) into rail vehicles. OESS, including batteries, supercapacitors, and hydrogen fuel cells, enable trains to operate catenary-free, reducing emissions and eliminating the need for infrastructure modifications.

While OESS offer numerous benefits, such as energy efficiency through regenerative braking, reduced load on the electrical grid, and zero local emissions, their integration into rail vehicles presents significant challenges related to design, operation, reliability, safety, and cost. The demanding operational and regulatory conditions specific to the railway sector can further exacerbate these challenges.

This keynote will provide a comprehensive overview of onboard energy storage technologies for rail vehicles, exploring their current status, characteristics, and potential applications. It will discuss the various powertrain configurations and energy management strategies employed in OESS-equipped trains. Additionally, the challenges associated with OESS adoption and future trends in this field will be examined, with a focus on the transition towards climate-neutral rail transport.

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