The potential of high-speed rail and urban rail energy storage field

What are energy storage systems for urban rail?
Energy storage systems (ESSs)for urban rail have become an excellent alternative for reusing regenerated braking energy. ESSs can be installed either on board vehicles or at the track side,thanks to the fast development of energy storage technologies and power electronics converters.

Are energy storage systems a problem in urban rail transit?
There are three major challengesto the broad implementation of energy storage systems (ESSs) in urban rail transit: maximizing the absorption of regenerative braking power,enabling online global optimal control,and ensuring algorithm portability.

What is a significant characteristic of urban rail?
Given that numerous and frequent stops are a significant characteristic of urban rail,recuperation of braking energy offers a great potential to reduce energy consumption in urban rail systems.

What affects potential energy recovery in urban rail systems?
The potential energy recovery in urban rail systems mainly depends on the track profile and the frequency of stops.

Can ESSs improve efficiency and reliability in urban rail systems?
The high number of scientific studies,demonstration projects,and commercially available systems demonstrates that Energy Storage Systems (ESSs) can be regarded as a valid solution to improve efficiency and reliabilityin urban rail systems. From the literature review,it can be concluded that energy savings between 15% and 30% can be achieved by utilising ESSs.

Can urban rail systems save energy?
Yes,urban rail systems can save energythrough regenerative braking. Studies have reported energy savings between 3% and 14% for different systems. This is a relatively low-cost measure that could be considered as the first option to increase energy recovery,although its application might be limited by service requirements.

The high-speed rail track increases strongly in Europe and China. The Chinese high-speed rail expanded since 2005, and now accounts for nearly two-thirds of the world"s high-speed rail lines. The urban rail lines increase gently in Europe and North America, but they expand significantly in Asia.

speed rail (HSR) is conducive to economic and productivity growth, especially in developing coun - tries. Rail transport is more energy-efficient and emits less greenhouse ...

In this paper, a hybrid energy storage system (HESS) composed of supercapacitors and lithium-ion batteries and its optimal configuration method are proposed for the purpose of obtaining maximum economic benefits

for railroad ...

The reliability of the bidirectional converter plays an important role in the energy storage system. However, the power devices that make up the converter are prone to failure under complex operating conditions. Therefore, how to extend the service life of devices in this case becomes a tricky problem. Due to the typical intermittent, random, and fluctuating nature ...

We investigate the effects of high-speed rail (HSR) operation on urban growth disparity in China. Using urban panel data from 2005 to 2019 and difference-in-differences estimation, we find that the operation of HSR has ...

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The unfolding high-speed railway (HSR) network is expected to have a great impact on Chinese cities. This paper discusses the international experience of the direct and indirect development effects of the HSR network on cities at ...

With the continuous, stable, and sustainable energy supply from self-powered devices, 15 intelligent algorithms deployed for optimizing and monitoring rail transit can adapt to changing environments and improve performance. Many algorithms directly process the electrical signals generated by the power supply devices, performing tasks such as recognition, ...

With the promotion of "double carbon" plan in China, the energy-saving problem of urban rail transit, as a major energy user of the government, has garnered significant attention. In urban rail train operations, the energy storage devices (ESDs) can temporarily store the regenerative energy from braking trains and feed it back to other accelerating trains. However, the ESDs comes ...

Low-speed rotors use conventional heavy materials, which offer cost advantages, high-speed rotors on the other hand require the use of specialized components (e.g graphite and composites) to allow rotational speeds between 10 000 and 100 000 rpm [16]. ... X. Huafeng, and F. Jingjing, âEURoeAn ultra-capacitor based regenerating energy storage ...

It is essential to explore the effect of high-speed rail on energy efficiency to develop medium and long-term green development plans and realize the "dual-carbon target" in China. ...

The simulation results show that fuel tax and motorcycle parking management policies are the most effective ways to restrain the growth of private vehicles, fuel consumption and CO2 emission. Jani? [24] estimated the energy consumption and CO2 emission of high-speed rail, rapid maglev train and ultra-high-speed passenger transport systems. The ...

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Using the difference-in-differences method combined with the propensity score matching, this study identifies the causal relationship between high-speed rail (HSR) and ...

Therefore, a sound urban development model involves first utilizing urban rail to promote intensive urban development, focusing on the development of metro corridors, followed by the improvement of transportation infrastructure systems, including high-speed rail and urban rail in large cities, as well as road construction in medium and small ...

Small vertical axis wind turbines installed close to the track and driven by passing trains show great potential, capable of harvesting several orders of magnitude more energy than vibration-based EH.

The extensive maintenance and replacement of these batteries escalate costs and environmental issues, making them unsuitable for intelligent transportation"s low-cost and sustainable energy needs. 2 Therefore, harnessing clean and ...

As a hypothetical example of application, the paper concludes that the energy consumption in existing urban rail systems could be reduced by approximately 25-35% through the implementation of energy-optimised timetables, energy-efficient driving strategies, improved control of comfort functions in vehicles and wayside energy storage devices.

Urban rail is regarded as an ideal solution to reduce the impact of urban mobility because of its great capacity, safety, reliability and excellent environmental performance [5].This is so much so that urban rail systems have been gaining increasing appeal as effective and sustainable methods of mass-transport for the last decade in the EU, as shown in Fig. 1 [6].

High-speed rail (HSR) is a substantial upgrade in transport technology, and it is an efficient, green, and environmentally friendly type of transportation (Li & Cheng, 2022) 2003, the Chinese government proposed the "Leapfrog Development of China"s Railways" strategy to develop a complete and modernized railway system for China (Yao et al., 2019).

WITH the increasing scale of high-speed railways, the problem of high energy consumption for high-speed railway (HSR) traction has become increasingly prominent [1], [2].When a locomotive is running downhill in the slope section, the locomotive usually adopts a regenerative braking strategy, and the potential and kinetic energy of the locomotive is ...

Urban rail transits (URTs) have become essential transportation infrastructure in densely-populated urban regions worldwide due to their social and economic benefits in providing convenient and sustainable mass transit services (Xiao et al., 2020).With the rapid growth of passenger demand and network scale, frequent short-distance train traction results in ...

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These studies aimed to analyze the energy consumption of the train and establish the uniqueness and necessary conditions of the optimal switching point. (Pappaterra et al., 2021) introduced a novel approach for the control of high-speed railway trains using the fuzzy control method. The authors implemented this control system in MATLAB ...

The potential contributions of this research include examining the concurrent impact of high-speed rail on urban air pollutants and carbon emissions, assessing variations in this link among cities, analyzing how high-speed rail influences structural changes in the sector and technical innovation, contributing to theoretical studies on high ...

Nowadays, improvement of energetic efficiency has become pushing even in the railway sector, typically the most efficient transport sector. In this research, the authors have investigated the feasibility of one of the most promising strategy, i.e. regenerative braking and energy storage, within a DC high-speed railway system.

There are three major challenges to the broad implementation of energy storage systems (ESSs) in urban rail transit: maximizing the absorption of regenerative braking power, ...

In contrast, urban and high-speed rails have experienced rapid growth in passenger activity and track length, primarily due to unprecedented investments made in Asia. Between 2005 and 2016, high-speed rail tracks ...

High-speed rail transportation utilizes 80-90% less energy and produces 3-4 times less pollution than air travel [30]. The goal of achieving net-zero global CO 2 emissions by 2050 must now be maintained by ensuring that the 2021 global emissions recovery was an anomaly and that sustainable investments paired with increased clean energy ...

The high-speed rail mileage in the Yangtze River Delta increased 84.9% from 3250 km to 6008 km. Meanwhile, the high-speed rail mileage in Guangdong-Hong Kong-Macao Greater Bay Area was 1232 km at the end of ...

High-speed rail is defined as rail services over long distances between stations, operating at a maximum speed above 250 kph. Metro rail refers to high-frequency, high capacity urban services which are fully separated from ...

Different energy storage technologies are assessed for use in urban rail. Optimising timetables is a preferential measure to improve energy efficiency. Energy storage systems ...

The Chinese railway industry will be encouraged to reach its high-quality and sustainable development goal by seizing the opportunity presented by the evolution of the high-speed railway traction power supply system in energy supply-side cleaner, energy demand-side electrification, as well as operation control intelligent.

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In a word, the principles for selecting energy storage media suitable for electrified railway power supply system are as follows: (1) high energy density and high-power density; ...

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