Directory

Rolling Stock

ABB

Powering the Future of Urban Mobility: How ABB Solutions Drive Efficiency, Comfort and Cleaner Cities

By Yevgeniy Bandukin, Global Segment Manager Rail OEM, ABB

ABB Traction Converter used for Stadler's underground metro cars operating in Berlin's BVG U-Bahn system © Stadler

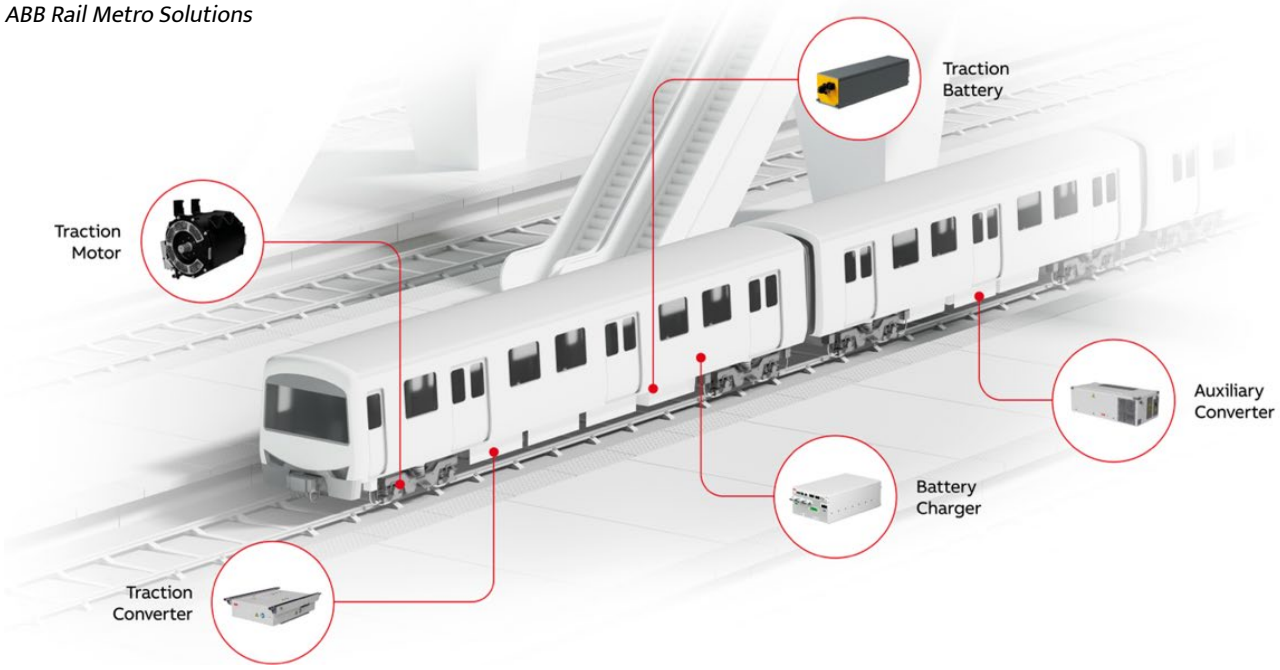
Public transportation moves billions of passengers, and as cities expand and sustainability takes the spotlight, advanced electrification and automation are key to powering smarter, greener transit systems.

The International Energy Agency highlights that rail is the least emissions-intensive mode of passenger transport, and driven by increasing road congestion and urbanisation, rail is **uniquely positioned to support global low-carbon objectives**.

Metro systems are emerging as an intelligent urban transportation solution. Of the world's operating metro systems, over one-third were put into operation between 2017 and 2021; this illustrates the increasing global emphasis on climate goals in cities. To meet this growing demand, ABB offers innovative traction solutions designed to optimise energy use while increasing reliability and passenger comfort.

Using regenerative braking technology, centralised power distribution, and the latest power electronics technology, metro systems can minimise energy

ABB Rail Metro Solutions



consumption per passenger. These rail networks serve as more than just transit infrastructure, they function as the circulatory system of modern cities, delivering exceptional energy efficiency, enhanced passenger experiences and reduced street-level pollution and noise.

ABB is leading the transformation from road vehicles to rail, helping cities around the world – from Adelaide to Los Angeles – electrify their public transit systems, driving this shift with its efficient traction solutions.

In developing countries with fast-growing populations and low rates of car ownership, public transportation serves as a daily lifeline for tens of millions. The same holds true in many industrialised and developed nations, where extensive national and regional rail systems support large numbers of commuters.

Nonetheless, there is a stronger need than ever to facilitate the transition from road vehicles to public transport. Individual cars are the biggest contributors to global road transportation emissions and are highly energy-inefficient per passenger-km. **Between 2010 and 2023, emissions from passenger vehicles increased by around 20 percent to 3.2 GtCO**. Yet, research conducted by Nature, has used a unique panel dataset of 27 metro operations worldwide, to underline the potential in energy reduction for urban rail transit systems, finding that a **10% increase in passenger-kilometres travelled on a fixed network reduces energy use per passenger-kilometre by 3.45%**. This underlines the need for this transition.

Improved Energy Efficiency

ABB's BORDLINE® CC750 DC traction converter is designed to enhance metro systems in rapidly growing cities by combining high energy efficiency, reliability, and ease of maintenance. It converts catenary DC voltage into AC to propel the traction motors, while also offering integrated car, bogie or single axle control, low-noise operation and modular components that simplify servicing.

Besides traction converters, ABB provides auxiliary converters, traction motors, traction batteries, and train control and monitoring systems (TCMS). Together, these components create a complete and fully optimized traction system — managing power seamlessly from the catenary down to the wheels. This integrated approach ensures higher efficiency, reliability, and simplified maintenance since all subsystems are designed to work in harmony as part of one unified solution.

Surat and Ahmedabad, India, serve as prime examples of ABB delivering its full traction portfolio – including traction converters, auxiliary converters, traction motors and driverless TCMS - to provide a complete and optimized propulsion chain for metro systems. ABB, with its local production, and Titagarh Rail Systems

partner to supply and manufacture the entire traction chain for Surat and Ahmedabad metro projects, from power conversion to train control.

Regenerative Braking

Regenerative braking is another key enabler of energy efficiency and sustainability in modern metro systems, offering both environmental and operational benefits in densely populated urban areas. The process captures the kinetic energy from a slowing train and converts it into electricity. This energy can be stored in batteries, fed back into the grid, or used to power other trains on the same line while they are accelerating. **By reducing the need for additional power generation, it can cut rail energy consumption by up to 30%.** As well as energy savings, regenerative braking offers the benefit of reduced wear of mechanical breaks, which leads to reduced maintenance costs.

This efficiency leads to lower carbon emissions, less reliance on fossil fuels, and long-term cost savings. It also eases the load on electrical systems by minimizing power losses and heat generation, reducing the need for cooling in tunnels and substations.

In Europe, regenerative braking is widely used in electric, and hybrid trains and plays a key role in meeting EU sustainability targets.

The BORDLINE® CC750 DC traction converter has significantly accelerated the adoption of advanced power electronics solutions for Stadler's underground metro cars operating in Berlin's BVG U-Bahn system. ABB's solution provided a built-in inductor and braking resistor integrated into a single cabinet of the compact converter, forming a standardised lightweight traction converter metro application platform.

Enhancing Customer Experience

The safety and punctuality of metro systems, particularly when we consider that they are air-conditioned, well-lit, and accessible, means they are a popular choice for passengers. **According to a report on noise pollution recently released by the European Environment Agency (EEA), more than 110 million people – over 20% of the European population – are exposed to harmful levels of transport noise** that exceed EU reporting thresholds, posing risks to human health, the environment, and the economy.

Since road traffic has been identified by the EEA as the leading source of noise pollution, electric trains offer a quieter alternative to combustion engine vehicles in our cities. Not only that, but metros avoid road congestion and reduce emissions in central areas. The air quality benefits of electric rail, alongside its urban design synergy with car-free zones mean that integrating metro use with liveable urban planning is the appropriate choice.

In 2022 South Australia's Department for Infrastructure and Transport (DIT) tasked ABB with upgrading Adelaide Metro's trains to reduce noise and emissions and improve the overall commuter experience for the 16 million people who rely on the service annually. This encompassed converting 50 trainsets into a hybrid fleet capable of switching seamlessly between diesel and battery-electric power.

Conclusion

Whilst advancing the metro will require high investment, long-term gains in efficiency, environment, and economic value outweigh short-term costs. Metro systems are the backbone of energy-smart cities, and these emerging technologies are catalysts for sustainable, smart, and humane cities. Investment should be a core infrastructure priority.

new.abb.com/railway