

UNITED KINGDOM

# BATTERY-DRIVEN BOMBARDIER ELECTROSTAR

Electrical multiple unit



ELECTROSTAR electrical multiple unit in operation on British railways

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## ALTERNATIVE DRIVE CONCEPTS FOR ENVIRONMENTAL FRIENDLINESS

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The first battery-powered train to run on UK's rail network in more than half a century began passenger service in January 2015, marking a game-changing development in the field of eco-friendly public transportation viability.

Battery-powered trains will offer a real alternative in areas where diesel or electrified rail services are not suitable; for example, in rural areas where there are gaps in the overhead wire system and where diesel normally would have to be implemented.



PROPULSION & CONTROLS

**BOMBARDIER**  
the evolution of mobility



### A NEW PROPULSION CONCEPT

The project is part of a research program, funded by Network Rail (NR). Bombardier received this refurbishment order in competition with other train suppliers and could provide a solution with a short time-frame – seven months design phase – by modifying an existing Class 379 train leased from Abellio Greater Anglia.

The target is to operate a 185 tons four-car *BOMBARDIER\* ELECTROSTAR\** train on battery up to 120 km/h for a distance of up to 50 km, which requires battery capacity in the range of up to 500 kWh. The design solution charges the batteries with the existing line converter equipment and connects the motor converters to the batteries when the 25 kVAC overhead line is not available. The lithium-ion batteries weigh less and can charge more quickly than industrial-form batteries, such as those used in automobiles.



Batteries and assembly in one of six rafts

### THE PROJECT SETUP

The retrofitted *ELECTROSTAR* train was modified at Bombardier's site in Derby, UK and converted into what is referred to as an Independently Powered Electric Multiple Unit (IPEMU). This IPEMU can now be driven either under 25 kVAC-networks or with batteries.

The battery-powered train project will not only benefit retrofitting techniques for future IPEMUs, but also assist future technological and design development in creating trains solely intended to operate on rechargeable battery power. Project partners include service operator Abellio Greater Anglia, industry research group Future Railway as well as Britain's Department for Transport.

Bombardier's objective in this project was to offer a fully integrated and flexible IPEMU technology to meet customer aspiration and needs. Those included developing a product that gives carryover potential, risk reduction, advance technology readiness, knowledge of vehicle integration/interfaces and battery performance.



Mounting of three battery rafts on the *ELECTROSTAR* train



The catenary-free operation tram for Nanjing is based on *BOMBARDIER\* FLEXITY\* 2* tram technology, equipped with the *PRIMOVE* lithium-ion traction battery systems for trams, *MITRAC\** propulsion equipment and *FLEXX\** Urban 3000 bogies.



Modular *PRIMOVE* battery system for trams and light rail vehicles

### BATTERIES INCLUDED: WHY NOW?

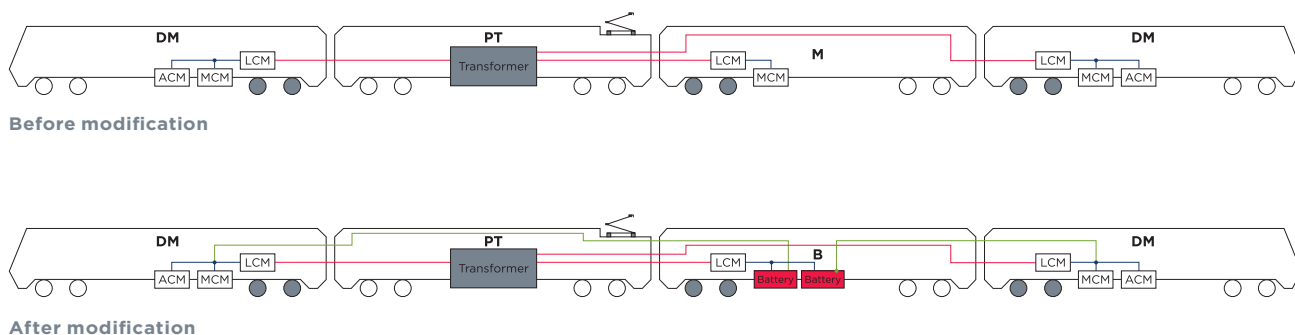
The technology for battery-powered locomotives has existed since around the 1930s, and as an example, is currently used in maintenance locomotives for track improvement work for the London Underground in the UK. This innovation in battery-powered passenger rail proves how serious the rail industry is considering eco-friendliness in the future and marks an innovation milestone.

The main benefit of long distance battery operation is that the train can bridge parts of the network that are not electrified. They can also use branch lines where it is not cost-effective to install overhead electrification. Existing diesel trains can also be used in a more flexible way which increases rolling stock capacity.

Another successful application of Bombardier's advanced battery technology is the introduction of the *BOMBARDIER PRIMOVE*-based, catenary-free operating trams in Nanjing, China. They entered regular passenger revenue service just in time for the Youth Olympic Games in August 2014.

# OVERVIEW OF THE ELECTROSTAR TRAIN

## Before and after modification to battery-driven mode



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