

The Hybari train. Picture credit: Toyota Motor Corporation



# DECARBONISING TRAINS

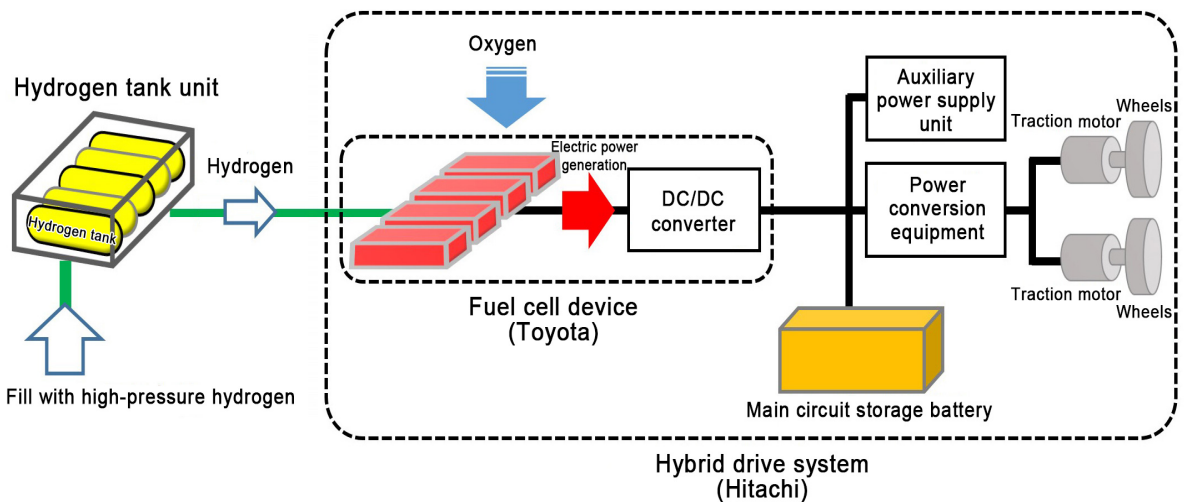
Japan is due to trial its first hydrogen fuel cell train, highlighting how the rail sector is turning to platinum-based hydrogen fuel cells to decarbonise

JR East, formerly East Japan Railway, will begin safety testing the country's first hydrogen-powered train at the end of the month. The Hybari train has been developed with Hitachi and Toyota Motor Corporation, with the latter providing the train's proton exchange membrane (PEM) fuel cell system, using its expertise garnered through producing the Mirai fuel cell electric vehicle (FCEV) passenger vehicle and the SORA FCEV bus.

The project began two years ago when the three partners entered into an agreement to collaborate on the development of railway vehicles equipped with hybrid systems that use hydrogen-powered fuel cells and storage batteries as their source of electricity. The intention is to develop next

generation rolling stock that operates using clean energy. Equipped with a platinum catalyst, hydrogen PEM fuel cells enable zero-emissions transport solutions, while providing the high-power output necessary for driving railway vehicles.

The Hybari's high pressure hydrogen tank feeds the fuel cell system, where the hydrogen undergoes a chemical reaction with oxygen from the air to generate electricity. The main circuit storage battery is charged by the fuel cell and also by energy captured from regenerative braking. The hybrid drive system supplies electricity to the traction motors from both the fuel cell device and the main circuit storage battery, maximising the power available to the train's wheel motors.



Picture credit: Toyota Motor Corporation

The Hybari train undergoing testing has a top speed of 100 km per hour and can travel up to 140 km on a single filling of hydrogen. Plans are to start commercial service in 2030, with JR East intending to replace its 440 diesel trains with hybrid hydrogen rolling stock in due course.

## Best solution

Elsewhere, Ballard, a leading supplier of PEM fuel cells, is working closely with Canadian Pacific, a major participant in the North American rail sector, which has recently expanded its Hydrogen Locomotive Programme from one to three hydrogen locomotives. Ballard is providing a total of 14 PEM fuel cell modules, each with a rated power output of 200 kW, to support Canadian Pacific's programme.

Ballard is also providing eight PEM fuel cell models to Talgo, a high-speed rail operator in Spain, to be used on the Talgo Vittal-One commuter and regional passenger train. With trials ongoing during 2022, commercial operation is expected in 2023.

The innovative modular system being designed by Talgo for its hydrogen trains is intended for installation on all types of passenger trains, as well as in upgrades or retrofits from diesel to hydrogen

power. The system is similar to that seen in the Hybari train, with hydrogen fuel cells being used for propulsion, complemented by batteries that assist the train from a standing start and take advantage of the braking system for recharging.

Talgo views hydrogen technology as the best solution for heavy transport applications such as trains, especially where railway lines do not currently have catenary (overhead) electrification systems and depend on diesel engines.

In the UK, Alstom, the first company in the world to produce a hydrogen-powered train, the Coradia iLint, which has been in service since 2018, and Eversholt Rail, a British train-owner and financier, have announced a Memorandum of Understanding aimed at delivering the UK's first ever hydrogen train fleet. The two companies have agreed to work together, sharing technical and commercial information necessary for Alstom to design, build, commission and support a fleet of ten three-car hydrogen multiple units (HMUs). The new HMU fleet will be based on the latest evolution of the Alstom Avenra platform, a modular single-deck train widely used in the UK.

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