

BALLARD™



CASE STUDY

World's First Fuel Cell Tram for Foshan, China



World's First Commercial Fuel Cell Powered Tram Line

Situation

Foshan is a city in Guangdong Province, China with a strong industrial and technological foundation. To proactively address industrial transformation and climate change in the City, Foshan took steps to become a pioneer in the hydrogen industry. City leaders foresee the huge potential and strategic significance of the hydrogen energy industry in green sustainable urban development. To capitalize on this opportunity, the city is becoming a center of design and manufacturing of hydrogen fuel cell products. It is also looking to the technology to meet the city's pressing need for green transportation.

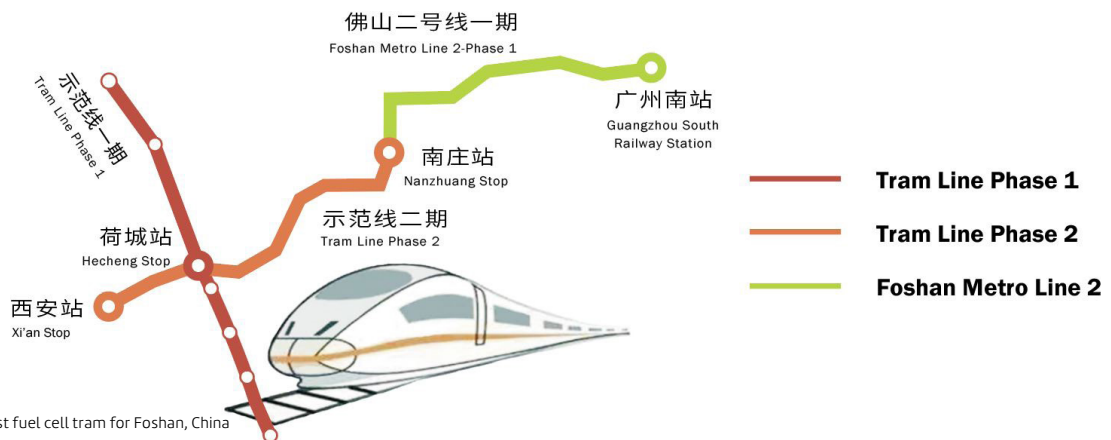
Solution

To seize a leading position in the hydrogen economy in China, Foshan has implemented many hydrogen projects. Perhaps the most famous of these is the Foshan Gaoming Modern Hydrogen Tram Demonstration Line, the world's first commercial fuel cell-powered tram line.

Five hydrogen trams operate on the tram line. The trams were jointly developed by CRRC Corporation Limited (CRRC), the world's largest railway equipment supplier, and Ballard Power Systems. The trams took two years of research and development to complete and are each powered by two of Ballard FCveloCity®-XD fuel cell modules. With six hydrogen cylinders installed overhead, the newly-developed tram can travel up to 125 kilometers per refueling. The trams employ 100% low-floor technology for their structural design. The interior structure of the tram is split into three sections with 60 seats and spacious interior design. With cabs on both ends, the design allows for two direction operation.

The tram line on the west bank of Xijiang River consists of two phases. When completed, the line will consist of 20 stops over 17.4 kilometers. Phase 1 is 6.6 kilometers, one way, with 10 stops. It begins at Cangjiang Road Station in the urban center, travelling along Zhongshan Road and Hefu Street before terminating at Zhihu in Xijiang New City. Phase 2 will extend Foshan Metro Line 2, connecting the line to the Guangzhou South Railway Station, a big new hub serving the high-speed rail network.

Site	Gaoming District, Foshan City, China
Application	4 fuel cell trams in daily operation, 1 in reserve
System	Ballard FCveloCity®-XD, 200kW
OEM	CRRC Sifang
Hydrogen Supplier	Jiangmen Linkye Gas Co., Ltd.
Hydrogen Consumption	25-30kg/100km
Run Time	>17,224 as of May 2021
Distance Travelled	>200,296 km as of May 2021



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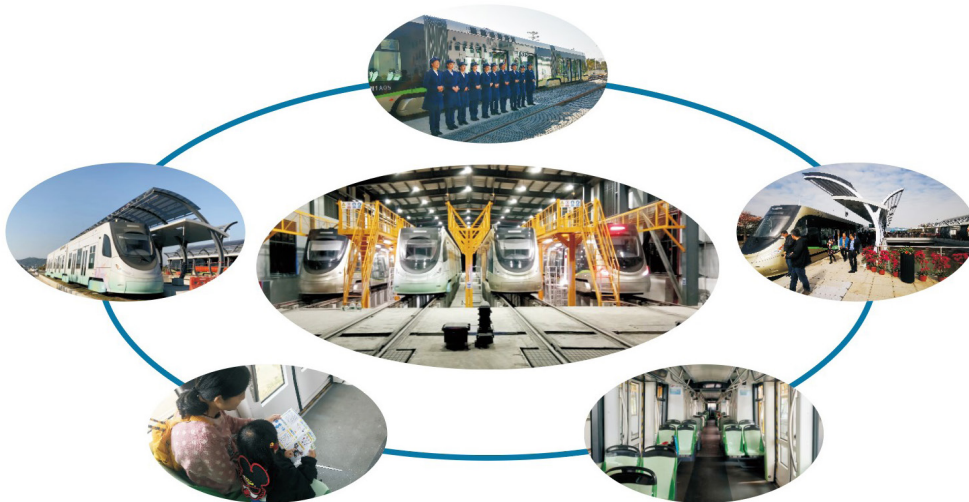
Fueling

A hydrogen refueling station is located at Zhihu Depot, near the last stop of the tram line. The depot covers an area of 8,779 square meters and also includes an operations control center and maintenance center. The hydrogen refueling station is operated by Guangdong Guolian Hydrogen Energy and has a daily capacity of 1,000 kilograms of hydrogen. Currently, the station is equipped with two sets of 144 kilogram hydrogen storage tanks (5m³, 45MPa) and two 355 long tube trailers (26m³, 20MPa) and can serve a maximum of two trams at once. Future expansion plans will provide capacity to refuel up to three trams at once. It only takes fifteen minutes to refuel the hydrogen tram's six 35MPa 140 liter hydrogen storage cylinders. This provide twenty kilograms of hydrogen, sufficient for 125 kilometers of range. The trams can depart from the depot and stop by the refueling station before routine operation to urban area when refueling is required. Hydrogen is transported from Jiangmen Linkye Gas in Jiangmen City to Gaoming District of Foshan city by tanker trucks. The trams return to the depot once the operation ends at night. Service personnel then perform routine inspections and maintenance to ensure the trams are in good and safe condition for operation the next day.



Result

The first hydrogen tram was delivered to the site in July 2019. In December 2019, the Foshan Gaoming tram line was officially in revenue service and available for public passengers. The project management team, lead by Foshan Metro, plans to run four trams during peak hours, with departures every 10 minutes and 115 departures per day. Each tram consists of three coach bodies with a total carrying capacity of 360 people, a maximum speed of 70 kilometers per hour and a range of 125 kilometers per refueling.



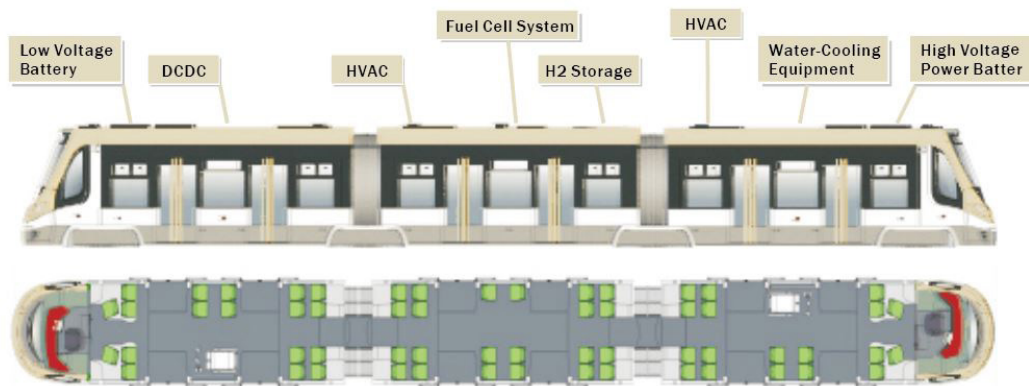
The tram line connects bus stations, large residential communities, administrative centers, commercial centers, parks, and factories. It brings a new zero-emission transit experience to residents of Foshan City and has strongly supported the development of Xijiang New City. When Foshan Metro Line 2 is complete, it will integrate into the national railway network at Guangzhou South Railway Station. Ballard's customer care team has been providing service support with quick response to ensure tram availability remains high.

The advent of the hydrogen tram introduced a new application of fuel cell technology and made China the first country to apply the technology for trams in the world. The tram operation is not only a milestone for the project itself, but also a big step forward for hydrogen fuel cells in China's rail sector. It provides valuable real-world experience and a reference point for the application of future hydrogen rails. The operation of this tram line powered by green technology is the first step on the journey to the hydrogen-powered era with ecological and economic benefits.

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Fuel cell tram technology

A fuel cell-powered tram uses hydrogen as the energy source. In a hybrid configuration, fuel cells and large-capacity lithium titanate batteries work together to power the tram. The tram emits no emissions; the only by-products from operation are water and heat. High-pressure tanks on the top of the tram store hydrogen fuel. An innovative hydrogen storage and heat dissipation system increases the hydrogen capacity and cruising range. This fuel cell tram carries sufficient fuel to meet the operating requirements of more than 13 hours a day.



Configuration	3 coaches 2 locomotives	Max Passenger Capacity	360 people	Daily Operation	13 hours
Vehicle Size	35.19m x 2.65m x 3.58m	Max Speed	70km/hour	Refueling Events	2-3 times/day
Vehicle Mass	55 tons	Max Range	125km	Refueling Time	15 minutes



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