BALLARD®

Fuel cell solutions for zero emission rail applications.

Alan Mace
March 2019

H2@Rail

Content

- Fuel cell Technology for Rail
- Rail Applications
- Ballard Experience and Solutions
- Hydrogen as a fuel for trains

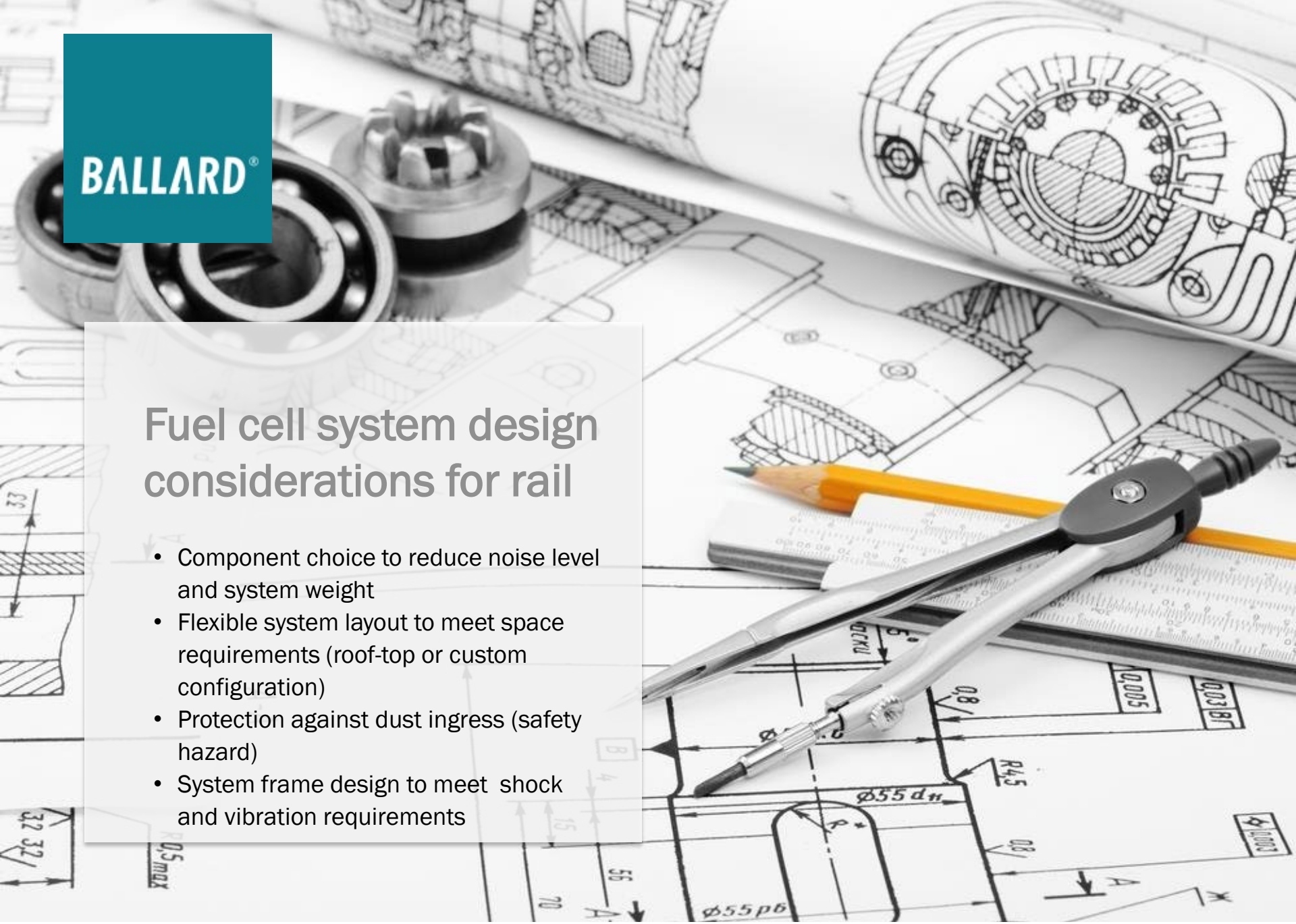

BALLARD®
Fuel cells offer the environmental benefits of electrification without significant infrastructure investment and with the flexibility of diesel

Fuel cells offer the benefits of electrification without significant infrastructure investment

- No requirement for overhead catenary infrastructure and power substations
- No impact on existing bridges, over-path and level crossings

Fuel cell technology addresses several rail applications.

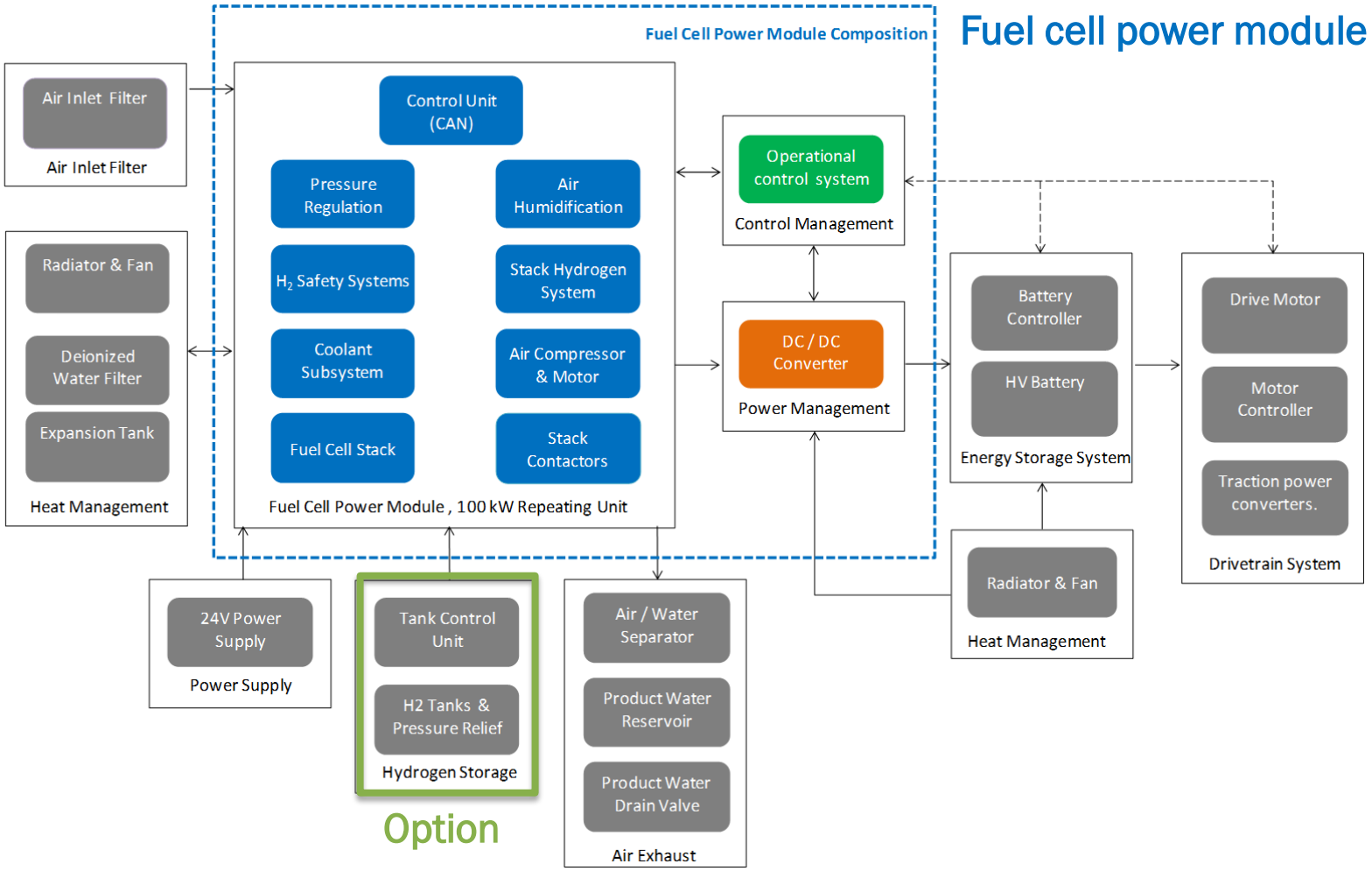
- Shunter / yard locomotives
- Regional and commuter trains
- Trams and Light rail
- Underground mining



Fuel cell system design considerations for rail

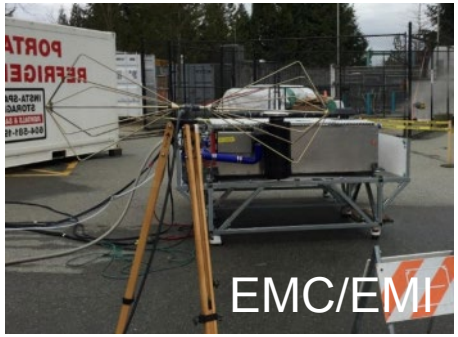
- Component choice to reduce noise level and system weight
- Flexible system layout to meet space requirements (roof-top or custom configuration)
- Protection against dust ingress (safety hazard)
- System frame design to meet shock and vibration requirements

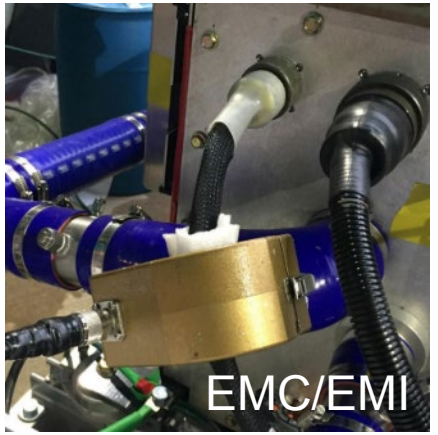
Ballard scope of supply



Rail Standards and product testing experience

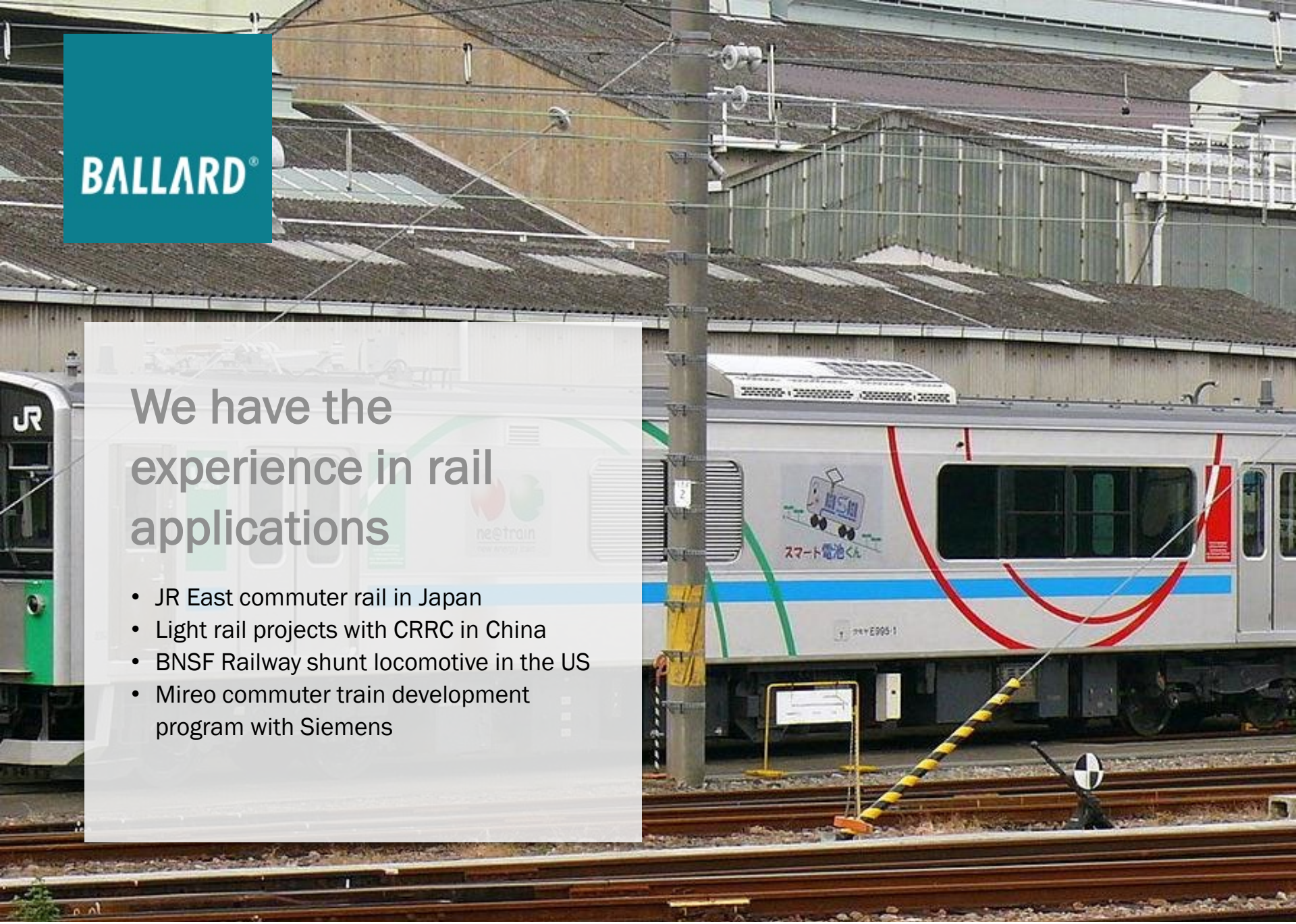
- Experienced with automotive and rail standards (~20 international rail standards)
- Extensive testing capability: vibe & shock, EMC, noise, dust ingress





From bus to rail

- 15 years of experience in designing heavy duty fuel cell engines.
- Integration experience with multiple vehicle platform (bus, truck, train..)
- Proven technology with millions of operating hours in revenue service



We have the experience in rail applications

- JR East commuter rail in Japan
- Light rail projects with CRRC in China
- BNSF Railway shunt locomotive in the US
- Mireo commuter train development program with Siemens

Fuel cell tram demonstration project in Tangshan.

- World's first Hydrogen-powered tram in pilot test phase
- 5 stations – 14 km lines
- 40 km range up to 70km/hr.
- Hydrogen refilling in 15 min
- 3 cars, 66 seats and 336 passenger capacity
- Power by 2 x FCveloCity® 150kW modules

Fuel cell tram line in Foshan

- Project with CRRC Qingdao Sifang Co, Ltd
- Expected to enter in service in 2019 in Goaming district of Foshan
- Speed up to 70km/h with 100km autonomy
- 200kW fuel cell module for rail applications

Fuel cell tram line in Foshan

FCveloCity®-XD200:

- Integrated 200kW fuel cell power module
- Robust design: reinforced frame with rigid plumbing
- Built-in fire suppression systems
- Easy service access
- Weight and noise optimized

Fuel cell tram line in Foshan

Ballard scope of work:

- Develop 200kW fuel cell system for rooftop light rail applications
- Meet rail-specific design standards
- Deliver 1 fuel cell system for engineering testing at Qingdao, China
- Deliver 9 fuel cell systems for revenue service in Foshan, China


HYDRO
FLEX
porterbrook
HYDRO
FLEX
porterbrook
UNIVERSITY OF
BIRMINGHAM
Zero emissions for a greener railway

Hydroflex project

- Conversion of a classic 'Class 319' electric unit to be supplied by Porterbrook into hydrogen powered train “HydroFlex”
- Development work has commenced and HydroFlex will undertake testing and demonstration runs in summer 2019
- Ballard supplies 100kW FCveloCity®-HD fuel cell power module to be integrated to existing electric drive as “range extender”
- The HydroFlex will retain the ability to operate across existing electric routes (on either 3rd rail or 25kV overhead power) and with the addition of a hydrogen fuel-cell it will also be capable of operating in self-powered mode, without the need for diesel engines
- This demonstrator version focuses on delivering an electric/hydrogen bi-mode to UK gauge and the need to make more effective use of existing electrification with additional emission-free running beyond the wires.

British Class 319 dual-voltage electric multiple unit

SIEMENS

Development of a new generation of hydrogen powered EMU

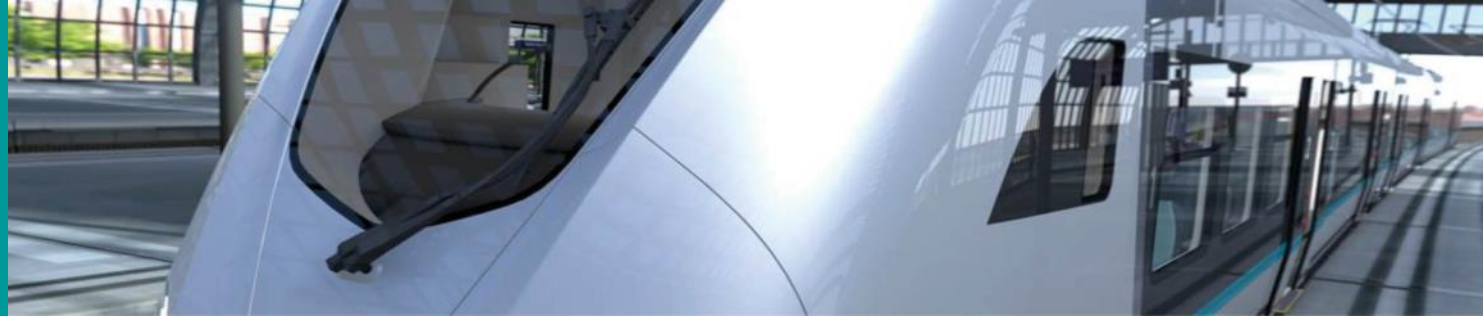
siemens.com/mireo

Gefördert durch:

Bundesministerium für Verkehr und digitale Infrastruktur

Koordiniert durch:

SIEMENS

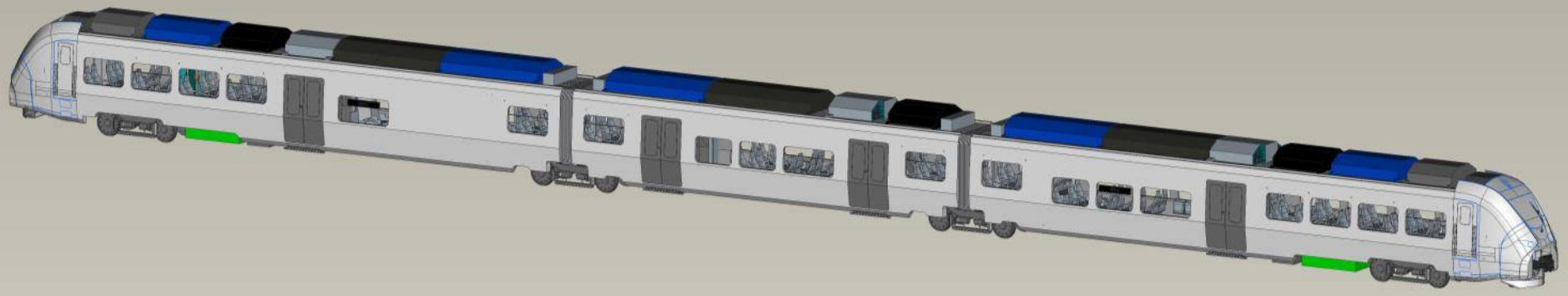


Mireo Plus – Value added for our customers

The focus of our innovation roadmap is the improvement of Life Cycle Cost

SIEMENS

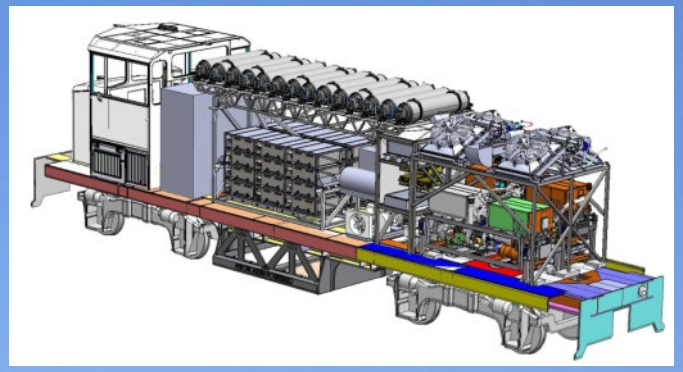
Mireo Plus The future becomes hybrid



Mireo Plus H (Hydrogen train by Siemens Mobility)

Powered by BALLARD®

BALLARD®



Prototype fuel cell powered shunt locomotive.

- Moves railroad cars over short distances in yard
- 300-500kW gross power with 60kg H2
- Refueled at hydrogen station within railyard
- Public-private project partnership with Vehicle Projects, BNSF Railway, US Army Corps of Engineers & Ballard

BALLARD®

Fuel cell and hydrogen provide and attractive solution for zero-emission rail.

BALLARD®

Power to change the World®

- Committed to sustainable mobility and clean air for everyone
- Developed technology over 30+ years
- We have leading talent with >600 people passionate about our mission
- HQ in Vancouver (Canada) with offices in China, Denmark and USA.

Power to Change the Word®

Alan Mace
541 678 8086
alan.mace@ballard.com
WWW.BALLARD.COM