Adapting fuel cell technologies to rail applications

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Power to change the World®

• Committed to sustainable mobility and clean air for everyone
• Developed technology over past 39 years
• We have leading talent, with >600 people passionate about our mission
• Global public listed company with European operation in Denmark
Hydrogen powered rail (Hydrail) is zero-emission.

- Enable zero-emission trains over non-electrified rail networks.
- Reduces GHG emissions in urban centers and at railyards
- Meets emission reduction goals and new regulations
Fuel cells offer the benefits of electrification without significant infrastructure investment.
We have the experience in rail applications

- JR East commuter rail in Japan (pic)
- Light rail projects with CRRC in China
- BNSF Railway shunt locomotive in the USA
- Shunt locomotive in India
- New development program with Siemens for regional train (EMU)
Fuel cell tram demonstration project in Tangshan.

- World’s first Hydrogen-powered tram in commercial operation
- 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
Case Study: 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
Case Study: 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
Case Study: 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
Development program with Siemens for fuel cell engine to power the new Mireo regional train.
Fuel cell system design considerations for rail

- Component choice to reduce noise level and system weight
- Flexible system layout to meet train space requirements
- Protection against dust ingress (safety hazard)
- System frame design to meet shock and vibe requirements
Extensive 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
Lessons learned

- Define early the key requirements with train OEMs (power, packaging, interfaces)
- Improve access to rail-rated component supply chain
- Develop cohesive plans with 3rd party certification bodies for compliance of fuel cell systems to rail standards
FCveloCity® for rail applications

- 100kW building block fuel cell power modules
- Customizable packaging to meet architecture constraints
- Designed and tested to rail-specific standards
- Proven fuel cell stack durability (over 28,000hrs in service)
Power to Change the Word®