



CREATING VALUE FOR LIGHT DENSITY URBAN FREIGHT LINES



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RAILROAD DEVELOPMENT CORPORATION



- Pittsburgh-based, privately held railway investment and management company
- Focus: Emerging Corridors in Emerging Markets
- Financial structure based on **Joint Ventures**



BACKGROUND ON VIVARAIL

- UK rail equipment manufacturer led by **Adrian Shooter**, a 50-year veteran of the UK rail industry
- Recipient of the Innovate UK **Accelerating Innovation in Rail** grant for continued development of the ground-breaking battery train
- **Vivarail** has filed for patent protection of its new technologies



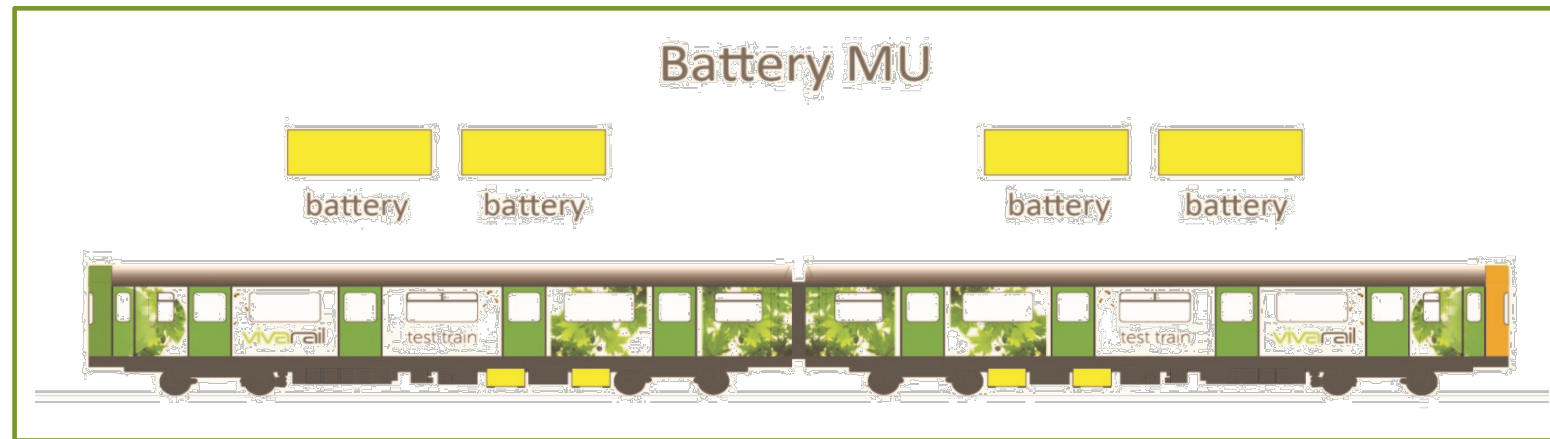
CLASS 230

- Built from the aluminum body shell and bogies from former London Underground equipment
- Modular design options:
 - DMU
 - EMU
 - Battery
 - Hybrid
 - Fuel Cell
- Power source be upgraded or changed with minimal effort
- Minimal maintenance requirements
- 3 diesel trainsets in service on the West Midlands franchise as of April 2019
- 5 diesel – battery hybrid trainsets in coming into service on the Wales and Borders franchise in late 2019



FUTURE-PROOF TRANSPORTATION

- **Modular design** allows easy reconfiguration for various power sources (diesel, electric, battery, hybrid, fuel cell)
- Electronic control and power equipment housed beneath the train
- 2-car battery train equipped with 4 battery rafts (each with a capacity of 100kWh)
- Range: 50 - 60 miles with an 8-10 minute charge at the end of each journey



FULLY CUSTOMIZED DESIGN



- Passenger friendly, flexible interior layouts
- Storage for bicycles, luggage, and strollers
- WIFI and USB charging ports available

ENVIRONMENTAL BENEFITS

- Up-cycled aluminum car bodies and bogies reduce the amount of raw materials and energy needed to produce new railcars
- Zero emission battery train
- Trackside maintenance reduces empty mileage and fuel costs
- Interior design allows room for bicycles, encouraging door-to-door transit
- Fuel savings of 25% as compared to a diesel unit with braking energy recovered into the batteries



APPLICATIONS IN THE UK

- **Main line applications:** regional and urban services such as West Midlands and Wales and Borders franchises
- “Crowd-busting” features:
 - Low floor entry
 - Four doors per side
 - “City” design 3-car train can handle 400 passengers at full capacity
- Superior acceleration and efficient loading/unloading maximizes Network Rail line capacity

APPLICATIONS IN THE UK: WEST MIDLANDS FRANCHISE

- 3, 2-car diesel trainsets serving the Marston Vale line between Bedford and Bletchley
- Passenger service launching in April, 2019



APPLICATIONS IN THE UK:

WALES AND BORDERS FRANCHISE

- 5, 3-car diesel-battery hybrid trainsets serving the Wrexham-Bidston, Conwy Valley, and Chester – Crewe lines
- Flagship fleet for the Wales and Borders franchise, operated by KeolisAmey
- Trains will be in service in late 2019



APPLICATIONS IN THE USA: “POP-UP METRO”

- Maximize utility of existing light-density freight lines
- For less than the cost of a consultant study...
- Test and evaluate the operation and market...
- Jump-start the development of commuter rail corridors



APPLICATIONS IN THE USA: “POP-UP METRO”



Pop-Up Metro Starter Kit:

1. Trains and Charging Infrastructure
2. Temporary Modular Platforms
3. Temporal Separation

POP-UP METRO STARTER KIT: TRAINS



- Proof of concept: Vivarail Class 230 completing test runs at Bletchley prior to service launching in April 2019

POP-UP METRO STARTER KIT: CHARGING INFRASTRUCTURE



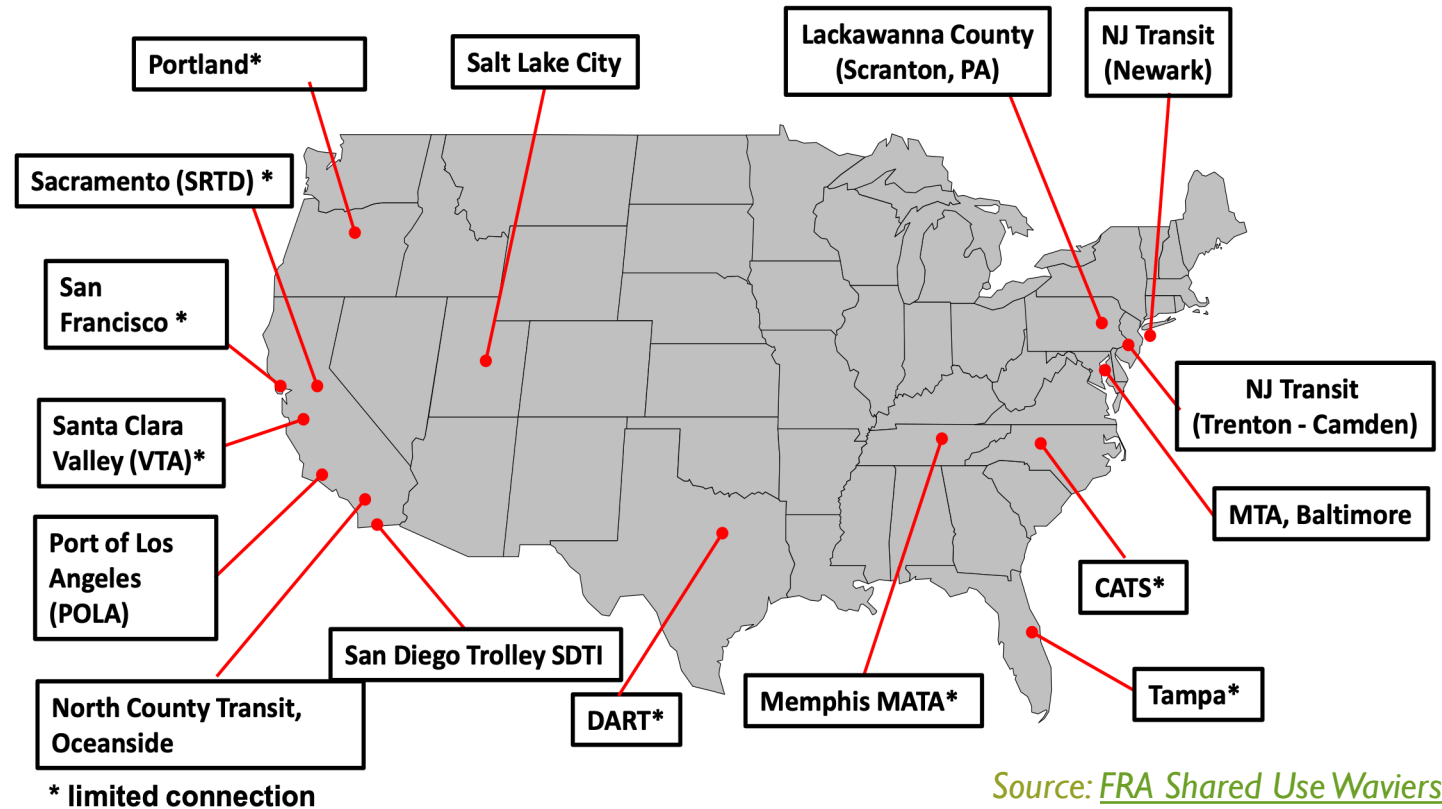
- Automatic Charging Point enables easy installation of battery trains
- Trackside electronic control unit to power the batteries even on non-electrified tracks

POP-UP METRO STARTER KIT: TEMPORARY PLATFORMS



- Proof of concept: **connecting to main line services** at UK “Rail Live” infrastructure show July 2017

TEMPORAL SEPARATION: SAMPLE OPERATIONS



TEMPORAL SEPARATION: TECHNICAL AND REGULATORY BACKGROUND

- Where FRA regulations govern, passenger service may be permitted to operate on limited and selected portions of the general railway system using rail cars which are “near compliant” with FRA standards.
- Service is permitted according to an operation-specific waiver, the core of which is temporal separation.
- Under temporal separation, FRA-compliant and non-compliant modes (freight and passenger) are kept absolutely separate by assignment of specific blocks of time to each mode.

POP-UP METRO: PILOT PROJECTS UNDER CONSIDERATION

- Location A
 - Commuter service between future commuter rail line and urban center.
 - Seasonal tourist shuttle service from remote parking areas to urban center.
 - **Public infrastructure**, facing existential threat
- Location B
 - Commuter service between suburb and urban center
 - Potential for expansion at regional level in conjunction with evolving commuter rail network
 - **Private infrastructure**, passenger-oriented
- Proposed local **connections to intercity rail** corridors
- Additional opportunities as local interest evolves

POP-UP METRO: COMING IN 2019

Pop-Up Metro is launching the USA in Fall 2019 with a demonstration operation in Altoona, IA.

Following the launch, Pop-Up Metro has the potential to bring mobility solutions to communities that combine:

- **Mobility challenges** such as traffic congestion
- **Willing host railroads** interested in increasing the value of light-density freight lines
- **Local sponsors** in the public, non-profit, or private sectors

THANK YOU!

FEEDBACK
WELCOME!

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TECHNICAL DETAILS

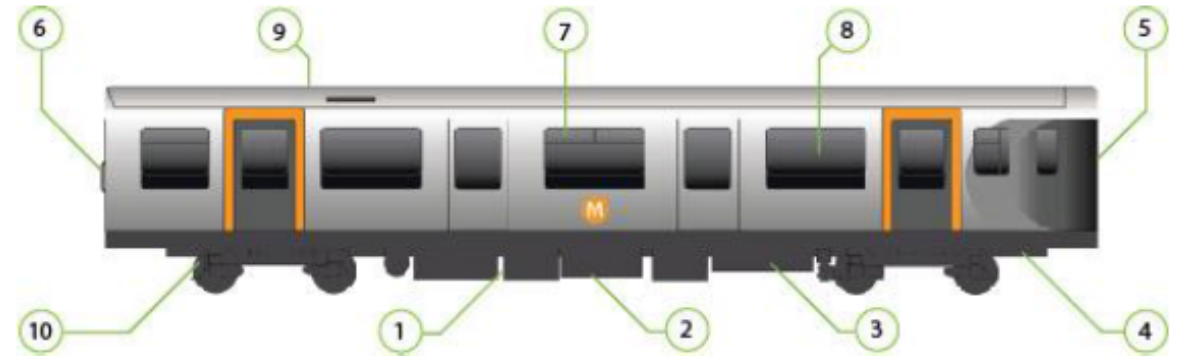
WHAT'S NEXT?

The Class 230
hydrogen train is in
development, providing
an emission-free
alternative hybrid unit



CLASS 230 DRIVING MOTOR CAR

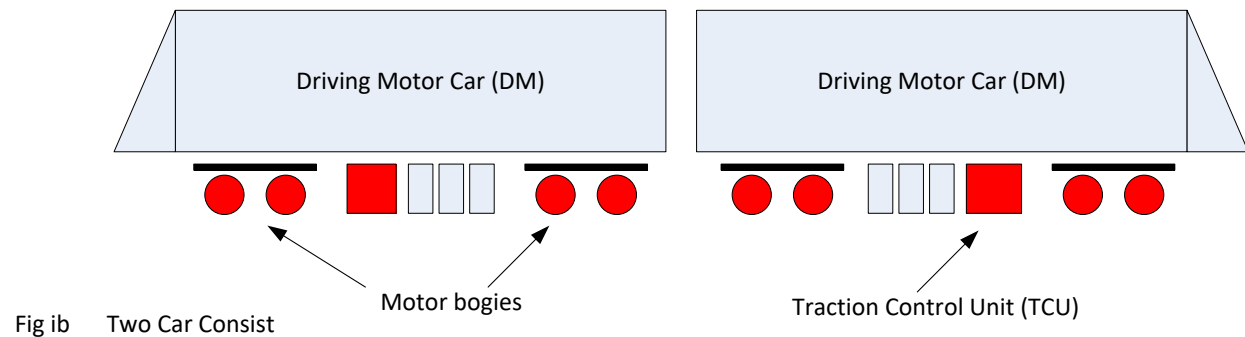
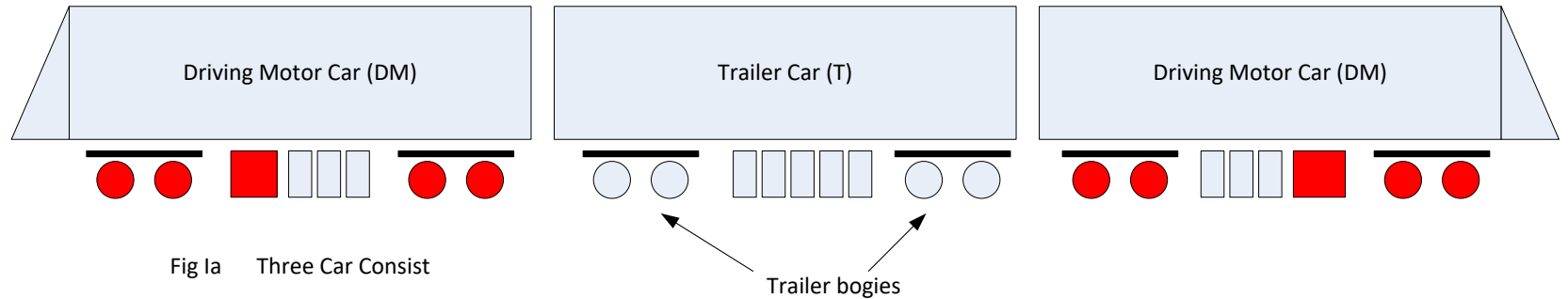
Diesel Generator Sets each produce around 125 kW and mount with special attachments to the vehicle underframe



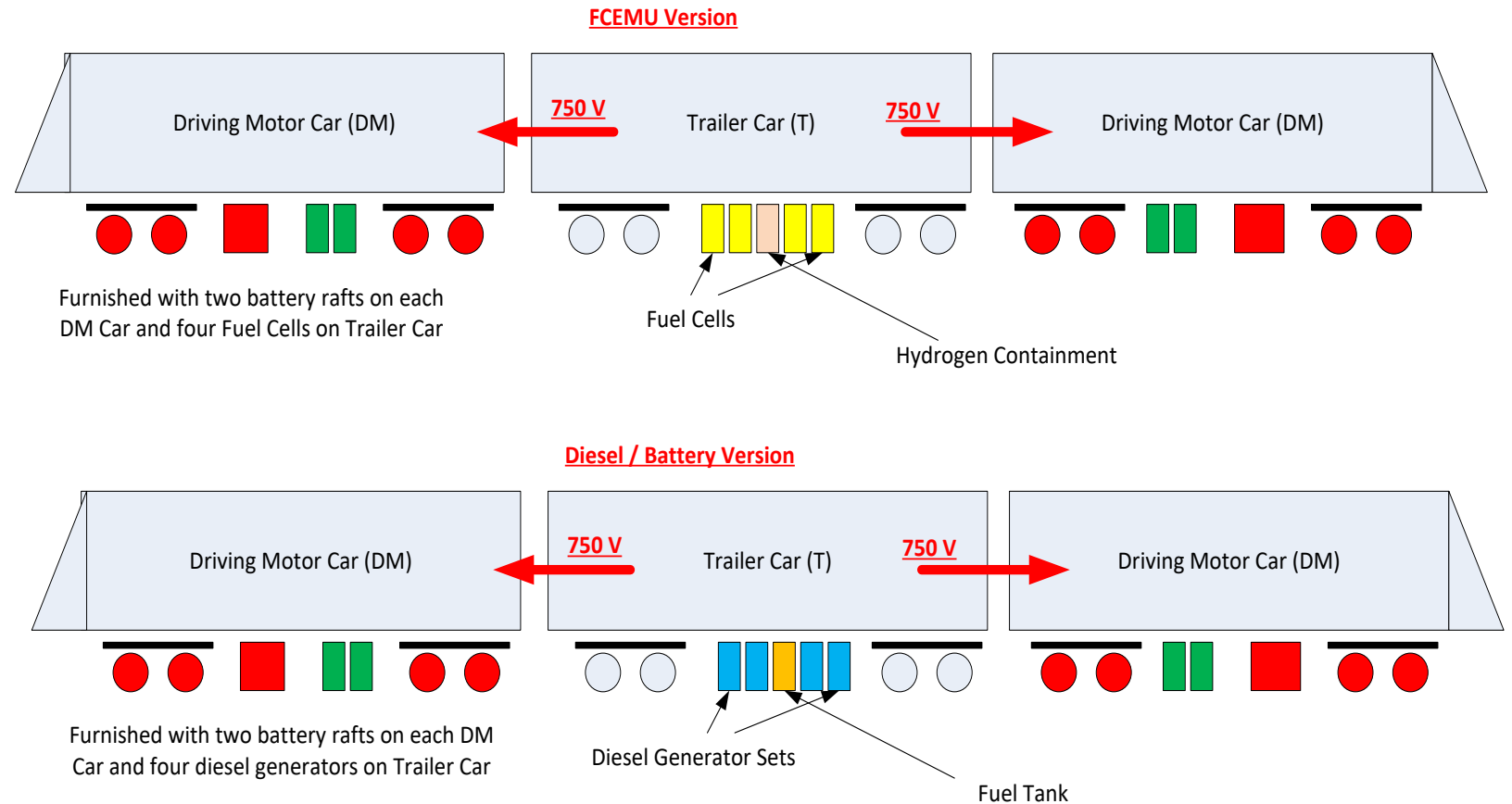
1. New Engines and Generators
2. New Auxiliary Equipment
3. New Traction control systems
4. New national rail safety systems
5. New cab structure
6. New gangways
7. New lighting
8. New or refurbished interior based on client requirements
9. Upcycled corrosion free aluminium bodyshell
10. Upcycled nearly-new bogies

ALTERNATIVE ARRANGEMENTS

- 3 Car carrying around 136 seated and 161 standing passengers
- 2 Car carrying around 88 seated and 106 standing passengers



Fuel cell and diesel hybrid configurations all utilizing the same concept of interchangeable power pack modules

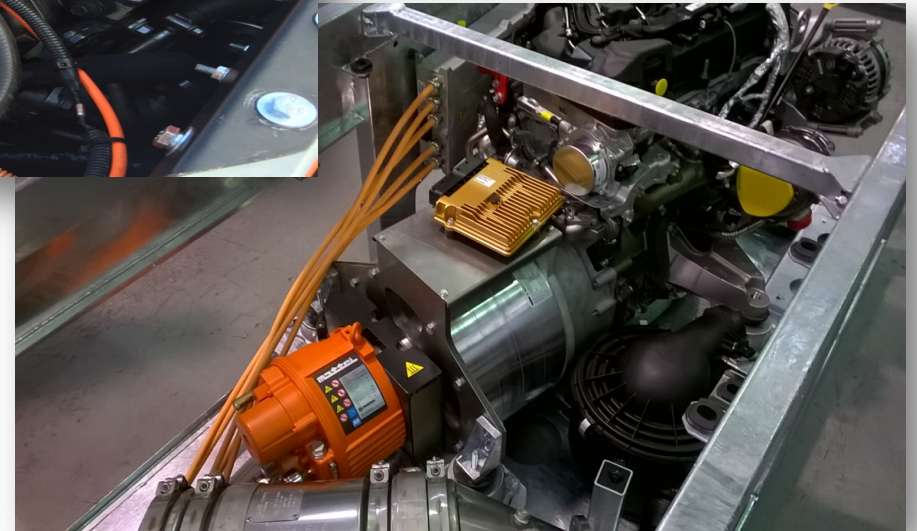
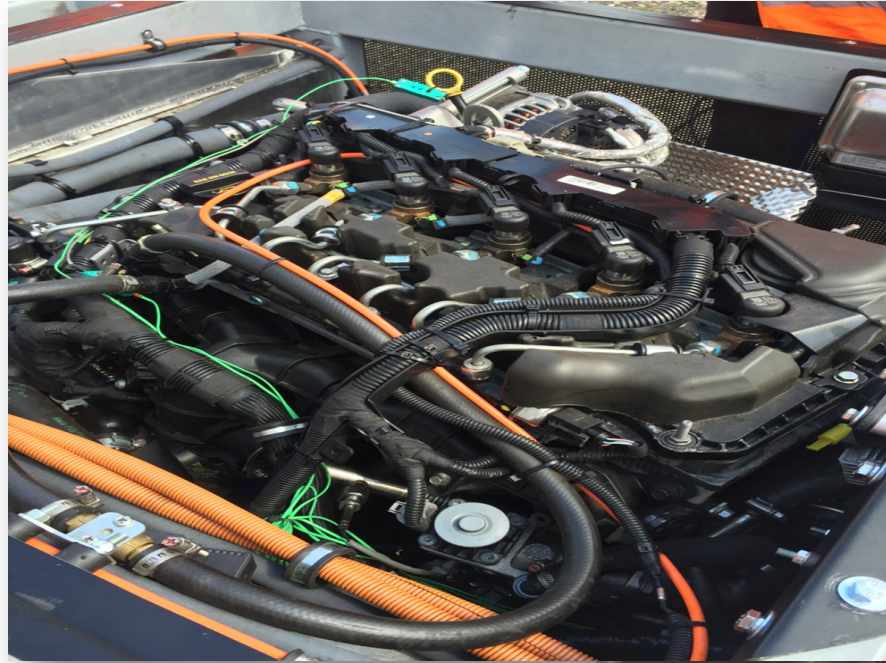


POWER UNIT INSTALLATION

- Can be changed in 10 minutes
- No need for return to depot
- Just needs a hard standing
- Available low cost parts
- Any available power source
- Innovative connection



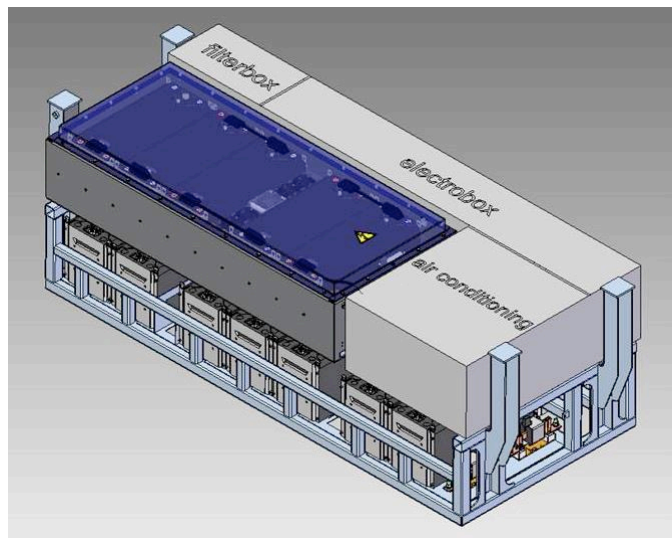
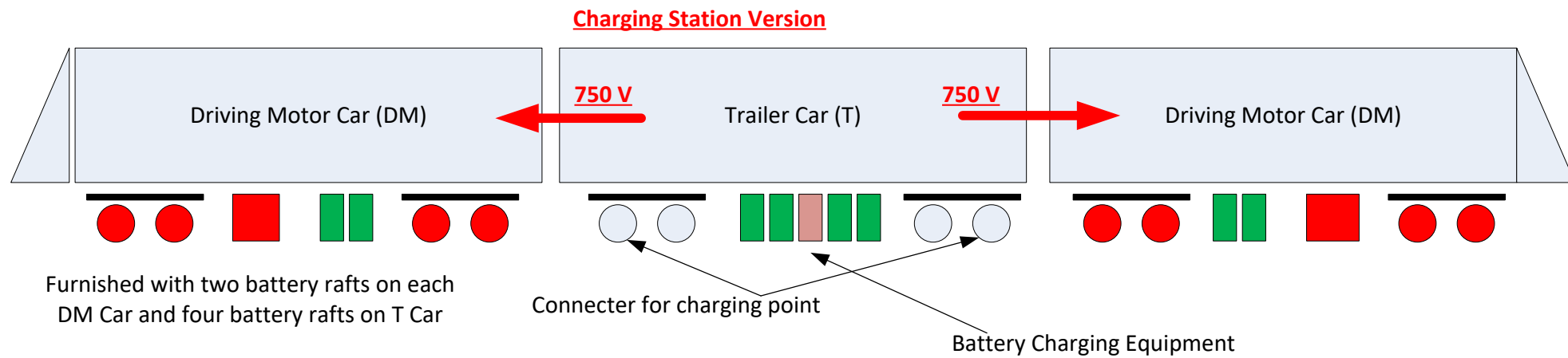
- Diesel engine unit (750v)
- Ford 3.2l diesel unit
- Latest alternator
- Latest AC motors
- New fire protection
- Patented technology



BATTERY OPTIMIZATION CHARGING BATTERY PACK (750V)

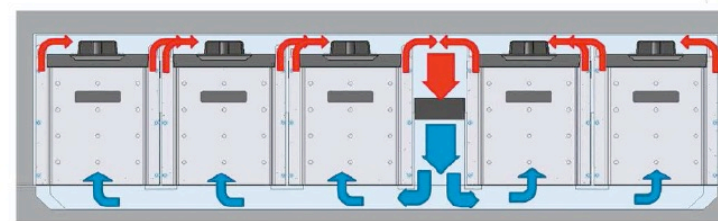
- Capacity around 100 kWh each raft, giving 200 kWh on the vehicle
- Planned to operate with 30% - 40% reserve capacity, so around 130 kWh useful energy
- Consumes around 2kWh per vehicle mile depending on route and duty profile, so useful range is in the region of 20 to 30 miles





Batteries - Cooling system

- ▶ Innovative cooling concept
- ▶ Air - cooling inside container
- ▶ Water cooling / heating on system level
- ▶ Highest power and energy density



Modern pouch style battery used
in the Class 230s, built by market-
leader Hoppecke

