

Accelerating the Adoption of Zero-Emission Rail Technologies with Battery Electric Multiple Units and Fast Charge





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- Pittsburgh-based, family-owned railway investment and management company
- Our Philosophy: Securing rail's role in advancing the future global economy and providing a prosperous livelihood for those moving the industry forward
- Financial structure based on Partnerships
- …including Vivarail





- UK designer and manufacturer of rail rolling stock, charging systems, and traction control technology
- Leader in battery train technology, including the UK's first battery and battery hybrid trains
- Vivarail has filed for patent protection of its new technologies



VIVARAIL CLASS 230 "D TRAIN"

- Built from the aluminum body shell and bogies from former London Underground equipment
- Modular design and power source: DMU, EMU, battery, hybrid, fuel cell
- Current UK operations:
 - West Midlands: 3 diesel trainsets
 - Wales and Borders: 5 diesel-battery hybrid trainsets
 - Isle of Wight: 5 third rail trainsets



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 I00kWh)
- Range: 50 60 miles with an 8- to 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







VIVARAIL AT COP 26

- First battery-electric train to cross the iconic Firth of Forth bridge
- Ran daily trips to and from Glasgow Central Station as part of the official Network Rail Green Trains@COP26 event
- Honored guests included
 HRH Prince Charles and
 Prime Minister Boris Johnson



APPLICATIONS IN THE UK: WEST MIDLANDS, WALES & BORDERS FRANCHISES

- 3, 2-car diesel trainsets serving the Marston Vale line between Bedford and Bletchley
 - Passenger service launched in April 2019
- 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 Transport for Wales
 - Trains in service as of 2021





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:

- Trains
- Charging infrastructure
- Temporary modular platforms

Additional services provided as needed:

- Guidance on temporal separation protocols under FRA guidelines
- Driver training, train maintenance

POP-UP METRO: TRAINS





Proof of concept: Vivarail Class 230 battery train demonstrations at Rockhill Furnace, PA from August 2, 2021

POP-UP METRO: PLATFORMS



- Proof of concept: connecting to main line services at UK "Rail Live" infrastructure show July 2017
- Proof of concept: in Rockhill Furnace, PA commenced August 2, 2021

POP-UP METRO: CHARGING INFRASTRUCTURE





- Fast Charge: Automatic Charging Point enables easy installation of battery trains
 - Trackside electronic control unit to power the batteries even on non-electrified tracks
- Standard Charge: in operation as part of the Rockhill demonstration

FAST CHARGE

- Trackside energy storage (battery bank)
- Proximity sensors detect train and run safety checks
- Audio tone-based interlock system (no WiFi or Bluetooth needed, decreasing risk of interference)
- Charge transfer via ceramic shoe
- Trackside equipment is basic on board Traction Control Unit controls the current

FAST CHARGE



https://www.youtube.com/watch?v=C-r_zANq8jU&t=1s

TEMPORAL SEPARATION

- 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.



Source: FRA Shared Use Waviers

POP-UP METRO: DEMONSTRATIONS

- Pop-Up Metro commenced demonstration operations in Rockhill, PA in August 2021
- Pop-Up Metro can now demonstrate 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
 - Non-traditional opportunities such as linking mobility with real estate development





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

THANK YOU!

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