

## Written evidence submitted by G-volution Ltd

### AN ALTERNATIVE WAY TO REDUCE CARBON, REDUCE COSTS - AND CLEAN THE AIR ON EXISTING RAIL ASSETS TODAY:

G-volution Ltd:

#### G-volution Technology Summary:

- Reduces carbon, reduces operating costs, delivers cleaner air
- Retrofittable. Available NOW
- Fuel flexible: bio Methane, Hydrogen, Hydrogen and Methane, bio LPG, Ammonia are all possible – again, immediately
- BUT bio-fuels give a better payback in the short to medium term, hydrogen can follow (when cheaper). Methane and Propane contain a lot of hydrogen.
- TWO live Demonstrators on UK Network December 2020 and January 2021 – together with UK Rail operator Grand Central Rail (part of Arriva Group), and Network Rail/COLAS.
- BOTH are WORLD FIRSTS and have never been deployed anywhere before
- Delivers infrastructure within current context (including bio-gas, bio-LPG, hydrogen, and many other carbon neutral fuels) – focus on de-carbonisation, not de-fossilisation. This means we give support for future hydrogen use right now (it will be some time – 5-10-15 years - before green, affordable hydrogen (and trains to run on it) can be deployed widely in the UK rail infrastructure).

**The concept:** diesel engines are extremely efficient and prevalent. They do not need to run on diesel fuel. They need to be cleaner, greener and cheaper to operate. G-volution has pioneered the concept of dual fuelling (CO-COMBUSTION) which enables diesel engines to run on two or more fuels at the same time replacing a large proportion of diesel with a cleaner and cheaper alternative fuel (see [www.g-volution.com](http://www.g-volution.com)). This enables existing (or new) diesel engines to run on cheaper and cleaner fuels, whilst retaining the flexibility to run on diesel if required. This concept allows the possibility of introducing clean fuels cost effectively (3-5 year payback, including infrastructure) and delivering infrastructure in a range of fuels (depending on price and availability) including bio LPG (liquefied petroleum gas), bio-Methane (LNG, Liquefied Natural Gas), hydrogen, and potentially methanol (used in marine) and hydrous ethanol.

**G-volution has pioneered this approach in the US Rail market, and the UK HGV market since 2008. Both LPG and Natural Gas (LNG) – which have bio-gas equivalents – work in this context. The technology is thus proven and therefore represents low technology risk. The opportunity to decarbonise the UK rail sector is set out below.**

**The Issue:** In the UK Rail sector there is a need to:

- de-carbonise rail operations now and cost effectively as the rail industry requires a positive payback model on all investments
- deliver a new infrastructure for sustainable de-carbonised energy

#### 1. The Facts:

- 25% of all UK passenger trains are diesel powered
- 90% if all UK freight trains are diesel powered
- Diesel engines are efficient (and being so numerous will be difficult and prohibitively expensive to replace in the near and medium term);

- Diesel engines exist in myriad sectors, they will not be replaced for some time. They represent 'sunk' carbon now.
- **BUT** they do not need to run on 100% diesel fuel, cleaner fuels are available (e.g. 'eFuels' which are renewable non fossil synthetic fuels).  
[see Institute of Mechanical Engineers Road Transport bio fuels Analysis @ [www.imeche.com](http://www.imeche.com); and Prof Doug Greenhalgh report @ <https://www.g-volution.co.uk/site/sites/default/files/Decarbonising-Heavy-Transport-Today-April-2019.pdf> (DGR)]

- Electricity is not necessarily:
  - available
  - green or
  - affordable

There are some parts of the network where electrification can never be economically justified, or is simply impracticable (i.e. freight). Freight operations (in the main) require vehicles that can 'go anywhere' which due to the aforementioned issues with economically electrifying the entire network means that freight traction will need to be self-powered for the foreseeable future.

- Electricity infrastructure is expensive (sometimes prohibitively so) and is slow and disruptive to deliver in terms of infrastructure and rolling stock.
- Renewable fuels such as bio Methane, and bio LPG have a far higher energy content than batteries or hydrogen [see DGR, where these are referred to as eFuels].
- Cleaner eFuels are available and can be delivered **NOW** in within the existing fuelling infrastructure utilising existing assets allowing for future new refuelling infrastructure for zero emission fuels such as hydrogen to be established [see DGR]. By this we mean that Natural Gas, LPG or bio equivalents (as well as Hydrogen) and be added to fuel depots as a fuel available for rail use in parallel with the current diesel infrastructure. Thus new eFuels can come into practical, cost effective use immediately. See also: <https://www.g-volution.co.uk/site/sites/default/files/Technology-Route-Map-for-Dual-Fuel-April-2019.pdf>

**2. The Proposal, illustrated and demonstrated:** as stated above, the proven concept of dual fuelling is to enable diesel power trains to run on two fuels at the same time [see co-combustion as above]. This ensures use of cleaner eFuels in a gradually expanded fuelling infrastructure [in each fuel, natural gas, bio gas, bio LPG as required/available]. The train can run on diesel only when required. Thus there are no range or power issues unlike, say, batteries.

- The results of this concept in the UK rail framework have been developed into the two demonstrators described. These demonstrate the potential to:
  - **Immediately reduce carbon** by 16-44% (depending on which fuel is used, and the replacement ratio)
  - **Immediately Reduce fuel costs** by 20-40% (again, dependant on fuel chosen)
  - **Immediately Reduce particulate matter** by up to 90%
  - **The Technology is now a reality.** A Class 180 Grand Central DMU is now converted to run on diesel and LNG. This will run on a diagram within the Grand Central operations. The work being done demonstrates the fuel cost savings, the carbon and clean air benefits. Above all, this can demonstrate that such a technology can actually be practically deployed into the UK rail network quickly to make a significant and immediate carbon reduction across the network. Turning the feasibility into reality can take up to 741,000 tonnes of carbon out of the UK's air every year, 27% of the amount currently accounted for by rail transport. This can help create new emissions standards for rail to encourage further decarbonisation initiatives.

- G-volution has also demonstrated dual fuel in the context of rail freight sector, a Class 73 with bio-LPG, see [www.g-volution.com](http://www.g-volution.com) supported by Innovate UK. And, pending funding, the marine sector.
3. **Barriers to entry:** as with all rail projects there are significant barriers to entry. These are all overcome by the two projects, Grand Central Class 180 and Network Rail Class 73, during 2020, and include:
- Emissions: while lower costs and lower carbon are good, clean air is also key. Clarity of emissions standards for retrofit is ongoing.
  - Technical: there are significant network approval hurdles to overcome to ensure that the new fuels can be carried safely on the network. This is part of the RSSB sponsored project [see P41 of draft Rail Decarbonisation report <https://www.g-volution.co.uk/site/sites/default/files/Rail-Industry-Decarbonisation-Task-Force-Initial-Report-to-the-Rail-Minister-January-2019-Page-41.pdf>]
  - Fuel infrastructure: requires the input of Network Rail
  - Financing: G-volution has pioneered a financing model that can deliver these benefits with very limited capital expense by the operator or leasing company. Followed by 3-5 year payback.
  - Ownership model: requires the approval of the TOC, and the ROSCO, which takes time to deliver. However, the benefits of the technology can add life to existing rolling stock, reduce emissions and assist in franchise bidding (as innovation, a route to de-carbonisation).
  - Warranty/Repair and Maintenance: requires partnership, something G-volution has pioneered.
4. Compliance matrix: the Committee is calling for written evidence on the following: ***what G-volution can deliver see italics:***
- what role rail decarbonisation can make to the Government's wider commitments on air quality to 2040;
    - ***cleaner fuels can mean cleaner air [up to 90% less particulates]***
  - whether there is adequate financial and other support from the Government for the development of alternatively fuelled rolling stock;
    - ***lower costs of fuel enables a better payback on investment;***
    - ***delivery of a demonstrator unit will enable faster change***
    - ***funding may be available through fuel suppliers, or 'green leasing' opportunity – payback from lower operating costs***
  - how the industry is responding to the challenge of a carbon-free transport future by 2040 and developing technologies to achieve that;
    - ***so far, in freight, little has been done. This can change.***
    - ***there are few initiatives that can operate with zero carbon in heavy duty***
    - ***focus on what fuels can be delivered, and by what mechanism***
    - ***If Hydrogen, infrastructure and roll out will have to be considered carefully***
  - what challenges there are to deploying alternatively fuelled rolling stock on the GB rail network, particularly given issues with standards and loading gauge:
    - ***infrastructure delivery takes time, but we have shown it is possible and now ;***
    - ***safety standards can be met by all new fuels [see Network Rail Approval process for GV demonstrator***
  - what passenger benefits alternatively fuelled rolling stock could provide;
    - ***cleaner air, quieter, greener, cheaper and a lower carbon journey***

- whether alternatively fuelled rolling stock would be cost effective compared to EMUs over a 25-40 year life-cycle:
    - ***this is inevitable in certain areas – it certainly will be***
    - ***there are approximately 3,500 DMUs and 650 freight vehicles which exist today – they are sunk carbon. Using them in a cleaner, greener and cheaper way must be more cost and carbon effective***
  - what the train interior of the future needs to have to ensure continued growth in rail travel, particularly amongst young people and future generations and to be fully accessible to all.
    - ***N/A***
5. **NOTE:** THE ROLE OF NATURAL GAS, AND OTHER FUELS LIKE BIO-LPG, ARE PART OF RAIL DECARBONISATION STRATEGIES IN SCOTLAND, SPAIN, CALIFORNIA AND ITALY. BIO-METHANE IS A KEY ELEMENT IN HGV DE-CARBONISATION IN EUROPE AND USA. DUAL FUELLING HAS BECOME THE PROCESS OF EVOLUTION IN THE MARINE INDUSTRY ALSO.
6. **Conclusion:** in conclusion, given the practical and time constraints on the rail industry, G-volution proposes dual fuelling as a quick, sustainable, low cost and low carbon alternative which immediately ameliorates the reality that a large part of the rail fleet will be powered by diesel engines for many years to come. These can be established by demonstrating [on an engine test cell] the routes and duty cycles in question, the cost and environmental savings, and then implementing them. The solution is both applicable to existing assets and new build. It is fully compatible with other solutions [such as hybrid and bi-mode] , will encourage the development of new infrastructures, especially hydrogen, and importantly, G-volution’s proposal allows for the use of zero net emission fuels in the future as and when infrastructure, fuel cost and availability allow.

We cannot allow ‘the perfect to be the enemy of the good’– G-volution’s proposal can make an immediate, substantial, sustainable and highly cost effective impact on decarbonisation to the benefit of train operators (lower carbon, lower fuel costs), and to train staff, to passengers and to the wider public (cleaner air)

**G-volution Ltd**

*October 2020*