Rail Delivery Group

Response to:

HM Treasury and Department for Environment, Food and Rural Affairs

Non-Road Mobile Machinery and Red Diesel: Call for Evidence

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Organisation: Rail Delivery Group
Address: 200 Aldersgate Street, London EC1A 4HD
Type: Business representative organisation

The Rail Delivery Group (RDG) brings together passenger train operators, freight train operators, Network Rail and HS2 together with the rail supply industry. The rail industry – a partnership of the public and private sectors – is working in partnership for Britain's prosperity[1] to secure prosperity in Britain now and in the future. The RDG provides services to enable its members to succeed in transforming and delivering a successful railway to the benefit of customers, the taxpayer and the UK's economy. In addition, the RDG provides support and gives a voice to passenger and freight operators, as well as delivering important national ticketing, information and reservation services for passengers and staff.

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[1] *In Partnership for Britain's Prosperity,* RDG (October 2017): http://www.britainrunsonrail.co.uk/files/docs/one-plan.pdf

1. Overview

RDG welcomes the opportunity to respond to the Treasury's and the Department for Environment, Food and Rural Affairs (Defra) call for evidence on Non-Road Mobile Machinery (NRMM) and Red Diesel. Our response has been developed in consultation with our members and therefore reflects the views of the industry. Our responses to the questions in the consultation document are provided in section 2.

However, we would like to stress our deep concern about the premise of the call for evidence in respect of its inclusion of rail, particularly of rail freight. The red diesel rebate for rail offers real value and is vital in helping to reduce emissions. If a red diesel rebate reduction is applied to rail, it will have an adverse effect on emissions: significant increases in rail freight costs would seriously undermine the sustainability of the sector and lead to a shift in traffic from rail to road. This would increase air pollution from HGVs as well as increasing carbon emissions and road congestion.

We therefore wish to make some broader comments here that HM Treasury and Defra should take into account:

- **Railway Patronage** – Our railway is an increasingly popular mode of transport. Since 1997-98, passenger numbers have more than doubled and rail freight volumes have risen by 80%.[2] Britain has seen some of the most significant freight growth in Europe and, together with the Czech Republic, Britain has experienced the largest modal shift in favour of passenger rail in Europe since 2009.[3] RDG research shows that network utilisation in Britain is roughly 80% higher than the EU average.

- **Railway Funding** – Data from the Office of Rail and Road (ORR) shows that 65% (£9.7 billion) of rail funding came from passenger fares, while 35% (£3.4 billion) came from government funding in 2016-17.[4] Britain has responded to the growth in passenger and freight demand by investing more than any other EU Member State in rail including in major capacity enhancement projects to help reduce crowding and to make modal shift more attractive[5]. Rail freight operators have invested almost £3 billion since 1997 to enhance capacity and improve performance and reliability which has delivered benefits for rail freight customers and the economy.[6] In the next decade the rail industry will invest more than £50bn into the sector and at least £11.6bn of this will be from the private sector.[7]

- **Covering costs** – Although rail freight pays less fuel tax, it pays Track Access Charges to Network Rail for every tonne-km moved which the road freight sector does not incur. According to research by Freight on Rail, fuel duty has been frozen since 2011 whereas access charges have increased by more than 20% above RPI over the same period. These charges are expected to increase by another 30% in real terms over the next 10 years. Therefore, rail freight is not gaining an advantage over road freight overall from red diesel use.

- **Economic Benefit of the Railway** – The link between a stronger railway and a stronger economy is clear. The railway delivers economic benefits of up to £31bn per year[8]. In 2016 rail freight delivered £1.7bn of economic benefits, comprising £1.2bn of productivity benefits and a further £0.5bn of externality benefits by reducing road congestion, improving air quality and lowering carbon emissions.[9]

- **Environmental Benefits of Rail** – Rail has strong environmental credentials, helping to improve air quality and reduce carbon missions. According to the International Union of Railways Handbook (UIC IEA), globally, the transport sector was responsible for 22.7% of the total energy-related CO_2 emissions, of which 3.3% was due to rail activity. Railways therefore generated less than 1% of total energy-related CO_2 emissions. At the same time, railways transported more than 9% of the world's passengers and freight. In Britain, the railway helps to reduce CO_2 emissions by 7.7m

[2] *Partnership Railway in numbers, RDG* (October 2017), *Freight Britain*, RDG (2015).
[3] Rail Market Monitoring (RMMS), European Commission, 2016.
4 *UK rail industry financial information 2016-17*, ORR (18 January 2018).
[5] Rail Market Monitoring (RMMS), European Commission, 2016.
[6] *Rail Freight: Working for Britain*, RDG (June 2018).
[7] *In Partnership for Britain's Prosperity*, RDG (October 2017).
[8] https://www.raildeliverygroup.com/about-us/publications.html?task=file.download&id=469773423
[9] *Rail Freight: Working for Britain*, RDG (June 2018).

tonnes a year. Rail freight in Britain reduces CO_2 emissions by 76% compared to HGVs per tonne of freight hauled and each freight train removes up to 76 lorries from our roads, improving air quality. Moreover, being far more energy efficient, rail freight remains a key part of the solution to reducing air pollution. A tonne of goods can travel 246 miles by rail as opposed to 88 miles by road on a gallon of fuel. This contribution by rail is also recognised by Government. As the Department for Transport's Rail Freight Strategy states: *"[We] recognise the positive benefits of rail freight for the UK – including its environmental and air quality benefits relative to road freight and its impact on reducing road congestion"*.[10]

- **Reducing rail emissions further** – while electrification remains the long-term solution to decarbonising the railway and improving air quality, operators have taken, and continue to take measures which are helping to reduce emissions. These include investing in bi-mode trains that use a combination of diesel and electricity to power trains and implementing start-stop technology on diesel locomotives to reduce fuel usage. The industry has also developed the Rail Technical Strategy which provides a long-term technology map to guide research, development and innovation across the industry. Reducing carbon and using energy efficiently are core themes within the strategy resulting in industry trials of a battery powered train, the monitoring of the development of fuel cell trains and the development of lower-cost electrification systems. The rail industry has also established a task force to explore options for decarbonising the railway by 2040 in response to the Rail Minister Jo Johnson's decarbonisation challenge.

We recognise the need for the rail sector to play its part in reducing carbon emissions and air pollution and we are exploring opportunities to develop, trial and introduce new, low carbon technologies. There are, however, some specific reasons why diesel will remain of critical importance for the continued success of the rail sector for some time to come:

- **Passenger duty cycle**: diesel passenger trains typically run 500 miles a day and refuel just once. They need significant levels of installed power (around 500kW per vehicle for a modern diesel multiple unit) to provide the acceleration required to meet timetable requirements and to power onboard systems (e.g. heating, air conditioning etc). The intensity of this service pattern is likely to prove challenging for new technologies to deliver reliably day-in, day-out.

- **Freight duty cycle**: freight operators need locomotives that can operate anywhere in the country. These locomotives require very high levels of installed power (between 2 - 3MW) and the ability to operate for long distances without refuelling. Currently there are no viable alternative traction technologies (other than electrification) that can deliver this duty cycle.

- **Asset life**: rolling stock typically lasts for 35 years (much longer than road vehicles) which can limit the rate of introduction of new technologies. This does not mean that rolling stock cannot be upgraded during its life. Diesel trains will generally be retrofitted with new or refurbished engines during their life which provides an opportunity to install more efficient and cleaner technologies.

- **Modal shift**: any significant increase in rail freight fuel costs (compared with road diesel) will lead to a significant modal shift from rail to road. With freight operators having faced significant losses in recent years following the decline of the traditional coal market, increases in fuel costs could seriously undermine the sustainability of the sector. The consequential increase in HGV traffic will lead to higher levels of road congestion, higher carbon emissions and poorer air quality, which would ultimately be counterproductive to the aim of the measure. This would also run counter to the Government's policy of supporting modal shift by road to rail, as evidenced by the DfT and Transport Scotland Rail Freight Strategies.

Any increase in the taxation of red diesel would ultimately increase costs to government through the passenger franchising process as train operators would pass these costs back to government as franchises come up for renewal.

We are aware that a major concern for HM Revenue & Customs (HMRC) with red diesel is tax fraud. Rail is a secure industry because most of our installations use bulk fuel fillers to transfer diesel to a vehicle. Train operators also measure and account accurately for diesel consumption and theft is a disciplinary offence taken seriously. Because of our good practices and from past discussions with

[10] *Rail Freight Strategy*, DfT (2016).

HMRC we do not believe that rail is a major risk for fuel fraud.

2. Response to Questions

Q1. What NRMM do you use/hire currently?

The primary use of NRMM is for passenger and freight transport which operates mostly on non-electrified lines. Network Rail also use NRMM for the maintenance and renewal of the railway. The current freight fleet of NRMM is circa 650 locomotives which are owned outright or financed. A breakdown of passenger rolling stock is provided in the spreadsheet included with this response.

For each type of machinery identified in question 1 please can you provide the answers to the following questions:

Q2. What is the power source of the machinery (specify fuel type or if electric or hybrid)?

In terms of NRMM, 72% of our passenger vehicles are electric powered and ultimately derive their energy from the national grid, either directly from the national grid itself or via the regional electricity companies. The remainder of our passenger vehicles (28%) are currently diesel powered. None of our vehicles are currently a hybrid of diesel and battery storage but some are being developed for use in Wales and the West Midlands. Some NRMM are bi-modal in the sense that they can operate electrically where lines are electrified and switch to diesel engines on non-electrified stretches of track.

For rail freight, there are around 88 electric locomotives, 34 bi-mode locomotives and 528 diesel-only locomotives. This reflects the need for freight locomotives to have the flexibility to go anywhere on the rail network rather than be constrained to electrified lines and to operate during electrical outages. The same applies for track plant NRMM used by Network Rail to maintain the railway infrastructure.

Q3. Where do you use it? For what purpose is it typically used, and is it used primarily in urban or rural areas?

NRMM is used across the whole of the railway network in both urban and rural areas to transport people and goods. Red diesel is used to power rail vehicles all over the UK. Virtually every passenger train operator has some proportion of diesel vehicles, the exceptions being Southeastern, C2C, Heathrow Connect, TfL Rail and Merseyrail. Diesel locomotives powering freight track plant trains, which are used for rail maintenance and renewal activities, can go anywhere on the UK network.

Using the Long-Term Passenger Rolling Stock Strategy the total number of new vehicles committed for delivery in the five-year period that commenced April 2014 (Control Period 5 or CP5) and in the early years of Control Period 6 (2019-2024) is now more than 6,000. The number of vehicles in service will grow by 15% by 2019. 29% of the fleet are self-powered by diesel engines. The delayed delivery of the committed electrification programmes has resulted in increased purchases of bi-mode vehicles. 1,054 such vehicles are now on order from three suppliers for six train operators. It is clear therefore, that the use of diesel powered NRMM for rail will continue for the foreseeable future.

Q4. In a typical year, how many litres of red diesel do you use?

Official data from the ORR indicates that operators used circa 705 million litres of red diesel in 2016-17. The breakdown for this was 501 million litres of diesel used by passenger train operators and 204 million litres of diesel used by rail freight operators. Energy accounts for circa 5-10% of train operator costs. The differential between red and white diesel (used in road vehicles) is currently around 62 – 67 pence per litre. The resulting increase in fuel costs of a rebate reduction would be between £437 million – £472 million annually and these costs would be borne by passenger and freight operators which would have material impacts.

For example, one franchise owning group has estimated that the change from red to white diesel would cost them £52m per annum across their three franchises. They indicated this was higher than their operating margins and would put into question the feasibility of continuing to operate one or more of their franchises.

This is of greater concern for rail freight. The value of the red diesel rebate is estimated to be around £93 million. As freight operators have reported annual operating losses of around £80 million recently, which they have absorbed, any reduction in the red diesel rebate could seriously undermine the sustainability of the rail freight sector. The associated mode shift to road freight of this would significantly increase rather than reduce emissions – therefore such a measure applied to rail would be counterproductive to its ambition.

It is worth pointing out that the increases in the Renewable Transport Fuel Obligation (RTFO), current and proposed, are already having a material financial implication on cost of fuel for the rail industry.

Q5. How many hours do you use red diesel on average over the course of a typical year? Does this change as the machinery gets older?

We use red diesel for circa 20 hours a day for passenger rail and 24 hours a day for rail freight. Most train services operate seven days per week 52 weeks per year.

Q6. How old is your NRMM?

According to our Passenger Rolling Stock Strategy the average age of NRMM used for passenger services is around 20 years but it is expected to reduce to circa 15 years by 2021 because of the investment taking place in new trains. Most new vehicles are electric and the percentage will change from 72% to nearer 82% in this time. All new diesel trains will be compliant with the emissions standards set out in the NRMM directive and as previously mentioned will mostly be bi-mode.

For rail freight, the electric fleet is around 30-50 years old, the diesel/overhead electric bi-modes are 2-3 years old. The diesel fleet is mostly less than 20 years old.

Q7. At what age do you replace your NRMM?

The design life for most rolling stock is circa 35 years but can extend beyond this. However, the age at which rolling stock is replaced will be influenced by many reasons including the introduction of electrification, the rolling stock requirements set out by franchising authorities when they issue tenders for new franchises and the relative lease costs of new versus refurbished rolling stock. For rail freight, the design life is around 40 years.

Q8. Do you buy NRMM new, second-hand or lease? Do you have a policy for deciding to replace/upgrade machinery?

For passenger rail services, NRMM is usually leased from Rolling Stock Companies (RoSCos) who have introduced new trains as well as owning a legacy British Rail fleet. The Government has levers through the procurement process of rail franchises that cause passenger train operators to consider deploying newly-built or different traction and rolling stock options for a particular route. However, where possible, this market intrusion should be minimalised to allow the market place to innovate and provide the best value for money options for that context.

For rail freight, NRMM is purchased by individual operators, either new or second hand. The decision to replace or upgrade NRMM is for individual freight operating companies to take. As set out in response to questions 10, 12 and 13, there is limited scope to introduce market-ready alternatives at present.

Q9. What are the criteria you use to decide when to replace your machinery? For example, fuel costs, reliability, safety, maintenance costs.

For passenger rail services, lease costs and maintenance costs usually define replacement schedules. Franchising authorities, responsible for the procurement of passenger rail services, use the franchise competition process to drive innovation and quality in the provision of rolling stock which in turn could manifest itself in new or refurbished NRMM. This is also influenced by customer expectations: new vehicles are also good for passenger satisfaction because they can improve the travel environment with better features such as air conditioning and Wi-Fi and can also provide higher levels of performance and reliability.

In some instances, government undertakes the procurement of rolling stock itself where the requirements are such that economies of scale may be achieved, rather than this being led commercially by the market. The most recent example is the Intercity Express Programme (IEP) for the Great Western and East Coast franchises.

For rail freight, while the decision to replace NRMM is one for individual operators, fuel costs, reliability, safety and maintenance costs are all likely to influence operators' decision-making.

Q10. Have you considered alternatives and if so, why do you still use red diesel?

The rail sector has conducted significant research on this subject area via the RSSB research project S204[11]. The rail industry has established a task force to explore options for decarbonising the railway by 2040 in response to the Rail Minister Jo Johnson's decarbonisation challenge.

Electrification

The most viable alternative is electrification but there are cost implications associated with installing the overhead electrification. Most of the railway track is managed by Network Rail, which in 2016 had a network of 15,799 kilometres (9,817 miles) of standard-gauge lines, of which 5,331 kilometres (3,313 miles) were electrified. Further electrification is a viable alternative to diesel on busier routes. With just over 34% of our lines electrified we are one of the least electrified: according to the UIC, Network Rail ranks 32nd out of 44 European infrastructure managers, in terms of the proportion of electrified railways they possess[12].

Where we cannot fully electrify a route, partial electrification may be a solution if bi-mode trains could be deployed to operate over the gaps in electrification. Battery powered trains may be a solution for small gaps in electrified lines provided there is enough time to recharge the batteries between the gaps.

The business case for electrification is strongest on heavily used routes where the high capital installation costs can be offset by lower operational costs from powerful and reliable electric vehicles over the life of the infrastructure. Electrification on some parts of the network can only be done at significant cost.

Biodiesel, Battery Power and Hydrogen

The other options evaluated in addition to further electrification are: biodiesel (RSSB research project T697) battery power and hydrogen.

The industry has performed extensive testing of biodiesel and its traction can operate on blends up to 20%. Battery powered vehicles in passenger service were trialled on the Greater Anglia franchise, but this project proved the lack of feasibility of battery technology due to its continuing limitations (including range, energy density, recharge time and weight). The newly awarded Wales and Borders franchise plans to overcome these problems by combining battery power with diesel and electric to create a 'tri-mode' train they will operate on the route from 2023. The battery can be used to power the train and topped up/recharged via the diesel engine or where there are overhead wires via electricity from the national grid.

Trials in Germany demonstrate hydrogen fuel cell technology is feasible when combined with battery technology to form a hybrid. The UK rail sector is monitoring progress in Germany and considering a large-scale trial project but this is dependent on hydrogen infrastructure.

NRMM accounts for circa 1% of diesel engine manufacture and rail is 1% of NRMM so diesel rail traction is a niche market in the world. We therefore rely heavily on technology developments in other sectors that we can transfer to rail once they are suitably mature and reliable. For example, rail engines are often derived from marine and military applications. A key challenge is where we derive our alternative technologies from. As a niche market, it would be incredibly costly, risky and time consuming for the rail industry to develop alternative propulsion systems in-house. Rail will therefore need to collaborate with other sectors such as aviation and marine to develop alternatives.

Q11. Have you implemented any operating procedures to minimise the emissions and/or energy usage of your machinery?

Both passenger and freight operators have introduced several initiatives to minimise emissions from and energy usage of NRMM. Examples include:

[11] https://www.rssb.co.uk/horizonscanningcontent/s204-report-alternative-energy-sources-v11.pdf
[12] https://uic.org/IMG/pdf/diag_railwayeleclines.pdf

- Introducing idle management policies, such as stop-start technology, to switch off engines where possible when stationary like cars do;
- Introducing driver advisory systems that smooth out driving style and encourage driving techniques which keep the diesel engine at maximum torque and efficiency;
- Introducing modern gearboxes to optimise diesel engine performance;
- Reducing auxiliary loads through more efficient lighting
- Undertaking redesign work on some trains to isolate their engines when not required. For example, Class 185 trains isolate one diesel traction engine out of three when timetables enable running on less power;
- Freight operators have introduced fewer longer trains, enabling greater fuel efficiency and lower emissions per tonne of goods carried by rail rather than road.

Q12. What other types of equipment will be available to you next time you come to replace your machinery? What technologies are available? Are there any clean technologies e.g. electricity/alternative fuels?

RDG is of the view that electrification is the best option for reducing the need for diesel powered vehicles and the associated emissions. RDG would therefore encourage further consideration of the case for electrification following this call for evidence. The delayed delivery of the committed electrification programmes has resulted in increased purchases of bi-mode vehicles. 1054 such vehicles are now on order from three suppliers for six train operators. Bi-modes are being used in the interim but carry a weight penalty from carrying both a transformer and diesel engines but only using either the engines or the transformer at any one time.

Rail is undertaking research to develop solutions for the future that could reduce dependence on diesel for certain routes. For example, the Independently Powered Electric Multiple-Unit (IPEMU) project was a battery-powered train that was trialled in passenger service in January 2015 on a relatively short route between Manningtree and Harwich. The prototype rail project was UK's first modern battery-powered train and was established to demonstrate the potential of a battery-only EMU in passenger rail services. It was however for many reasons this was not feasible (see response to question 10).

However, hybrid technology that combines a diesel engine with battery storage may be more feasible than battery only operation and as a technology for rail it is available and is being planned for a fleet to be operated in Wales. It is proven in the automotive sector and provides a range of additional features for train operations such as silent pull out of stations and emissions-free running in tunnels or boost mode to recover time. However, although it is an option for some passenger services, it is not suitable for long-distance passenger services or freight operations, given the distance they typically travel and the weight of the load pulled.

Q13. What barriers are there for you picking these cleaner technologies?

A barrier is market uptake of these technologies in other sectors. Trains account for circa 1% of NRMM and NRMM is 1% of the engine market. Rail is a niche market and so alternative power sources must be developed in collaboration with other sectors.

Another barrier is the infrastructure required to power our vehicles. More electrification requires connection points and potentially reinforcement of the national power grid. When battery density increases to the point it can be used in rail, we will also need to look at reinforcing the power grid to cope with charging loads or incorporating smart grid technology.

Red diesel is widely available and there is a fuel distribution network across the UK.

For hydrogen vehicles the business case is still to be proven for operation. A key factor is the availability of the fuel. A widely distributed, secure network of facilities would be needed to replace red diesel which will require investment from hydrogen fuel suppliers.

Diesel has a specific energy density of circa 48 MJ/kg. The best battery energy density by comparison is 0.875MJ/kg from Lithium-ion technology. On most routes we simply will not be able to move the volume of people or goods we do today with diesel and electric vehicles using current battery technology alone, as the mass of batteries needed to achieve the timetable would exceed axle loads and occupy valuable passenger space on trains. However, on some short routes that operate at low speed it may be possible to use battery and super capacitors to top up the energy reserves at stations. Currently the best way to use battery would be through a hybrid technology mentioned in the response to question 12 that combines diesel traction with energy storage.

Fire is a significant risk that train operators need to manage. Diesel is relatively safe fuel with a flash point exceeding 52^{O}C. Alternatives present a risk of fire or explosion such as Lithium-Ion batteries, Liquified Petroleum Gas (LPG) and hydrogen fuel. Moving from diesel to alternatives would require investment into railway infrastructure and safe working practices to ensure compliance with Dangerous Substances and Explosive Atmospheres Regulations 2002 that could be prohibitive.

Q14. What does the business case look like, on operating costs, between the alternatively fuelled equipment and the red diesel-powered ones?

According to the Network Route Utilisation Strategy, *"Compared to a diesel operation, an electric service will have lower rolling stock operating costs (for passenger vehicles fuel savings are currently estimated as between 19 and 26 pence per vehicle mile – a saving of around 50% – and maintenance cost savings as approximately 20 pence per vehicle mile – a saving of around 33%); have higher levels of vehicle reliability and availability; and lower leasing costs, but require investment in electrification infrastructure and increases in infrastructure maintenance costs. The superior performance of electric vehicles can provide journey time savings. Whilst these may be modest for high speed long distance services, they can be more significant in urban areas where frequent stops make acceleration savings more significant and, if the savings are significant on a route, rolling stock could be saved."*[13]

Battery technologies should offer similar savings to electrification but hydrogen is still to be tested in the UK. Biodiesel is more expensive than diesel and the Renewable Transport Fuel Obligation (RTFO) is already raising operating costs for red diesel.

The issue is capital expenditure and payback: there has already been significant investment into new vehicles and so a business case to make further changes will be hard for the industry to afford. For rail freight, there is currently no business case for operators, given the asset life of the current fleet and the absence of funding for capital expenditure following the operating losses sustained by the sector in recent years.

Q15. If you know your Standard Industrial Classification code, please also provide this. If you don't know your SIC code, please describe the sector in which your business primarily operates.

Passenger rail Standard Industrial Classification codes are 49.1 and 49.3. Rail freight Standard Industrial Classification codes are 49.2 and 52.21/1.

Other comments

The RDG would like to underline the industry's concern about any reduction in the red diesel rebate and to emphasise the serious material impact it would have on the rail industry and the resultant increase in air pollution that would follow. The RDG would welcome the opportunity to meet with the Treasury and Defra to discuss the options and implications of changes to fuel duty on the rail sector and to explain further the work and research the industry is undertaking to reduce emissions further. We would also encourage both the Treasury and Defra to ensure that the DfT has visibility of the proposals to enable the Department for Transport to input as they develop.

Response Ends

[13] Network RUS Electrification October 2009.