railfuture

Airborne Pollution by Diesel Engines on Railways In Britain

1. Introduction and Summary

Railfuture is a major supporter of using our railways both for passengers and freight. Rail is widely viewed as a low atmospheric polluter compared with road and air. For most main routes, Railfuture supports electrification as being the cleanest motive power but the relatively high up-front cost of electrification has resulted in successive governments showing only varying levels of support and funding so that the UK has a much lower percentage of electrified lines compared to most industrial countries in Europe. With the exception of the West Coast Main Line, most freight is still operated by diesel locomotives. Despite a change of mind from 2010 onwards, the government has now curtailed new electrification projects. This is partly because Network Rail, the infrastructure owner, has lost many of the necessary engineering and project control skills, resulting in vastly more expensive electrification and delayed implementation.

The government has instead funded bi-mode trains with resulting higher levels of pollution, higher running costs and lower performance compared to electric trains.

The subject of airborne pollution has become a matter of serious concern internationally with increasing evidence of climate change resulting from CO_2 emissions. Pollution from NO_2 and particulate matter has also been recognised as causing early deaths from lung diseases and it has been shown that one of the main origins of this has been combustion of diesel fuel, particularly in cars.

In order to address this growing problem, the government plans to ban the sales of diesel and petrol cars by 2040. It has also recently stated that no more diesel-only trains and locomotives will be accepted on our rail system also from 2040. Road vehicles, both lorry and car, are moving more rapidly to adopt cleaner engines and electric cars and there is a serious risk that rail will lose much of its current green advantages.

The Rail Safety & Standards Board published a report in 2016 summarising the knowledge of the subject without carrying out further primary research. This latter report included a study funded by the London Boroughs of Ealing and Islington to measure atmospheric pollution adjacent to main lines a few miles outside Paddington and Kings Cross respectively. At the time, both these termini had substantial numbers of diesel trains operating a mixture of local and long-distance services. A UIC funded research project was also carried out by AEA Technology and this is also summarised in this report.

2. Main Types of Atmospheric Pollution by Diesel Engines

Since the turn of the century, atmospheric pollution from diesel particulates has been considered the primary cause of atmospheric pollution, particularly by road vehicles.

More recently nitrogen dioxide has been recognised as an even more serious pollutant leading to lung and heart diseases resulting in premature deaths. For rail in the UK, the high cost of mitigation measures might not be cost effective compared to other European countries with their more generous loading gauge.

3. 2016 RSSB Report

The HSE advised that there is a risk of lung cancer for those employees continually exposed for more than 20 years to diesel exhaust fumes as part of their job. Up to 2012, there was limited evidence, but further studies have confirmed the risks mainly for employees but, to a more limited extent, the general public.

It was not until 2014 that nitrogen dioxide was recognised as a different and potentially more dangerous pollutant arising from diesel exhausts and causing both heart and lung diseases with premature deaths. In the UK, evidence shows that this is at its most serious with high road traffic levels, particularly in London.

The International Union of Railways (UIC) commissioned a report on emissions from rail-based diesel engines. AEA Technology from the UK carried out the research and UIC published the findings in 2005. The research was carried out prior to the adoption of ultra-low-sulphur diesel following the EU's Fuel Quality Directive which was adopted in the UK in 2011. The UIC report therefore fails to reflect the reduction in pollution from using ultra-low-sulphur diesel.

Conclusions reached include:

- Diesel will have a continuing use for rail although more recent changes will reduce this.
- For diesels built post 1990 there are a range of technical options to reduce emissions.
- For the UK only, pollution will be at its worse in busy terminal stations. In some European countries, plus North America, pollution may also be substantial at busy shunting yards.
- Transport is the major atmospheric polluter, but rail is one of the lowest in the transport area with road being the worse contributor.

An RSSB research project published in 2007 came up with measures to reduce pollutants but these solutions all had substantial disadvantages such as cost, weight and size for the UK fleet. The project also promoted the idea of reducing idling time of diesel engines by connecting shore supplies at terminal stations.

The Ealing and Islington studies for the boroughs were carried out by King's College London. Despite the relatively high use of diesel engines, particularly out of Paddington it proved impossible to isolate rail-based pollution from road pollution. In any case, the volume of rail-based pollution will be reduced substantially as the High Speed Trains (HSTs) are withdrawn or transferred away from London and their replacement, Hitachi bi-mode IEP trains, will not generally operate in diesel mode near London.

A similar study at Edinburgh Waverley funded and published by a Scottish newspaper gave very misleading headline results with no substance.

Stop–start technology, as used by a number of car manufacturers, has also been adopted for some Class 66 diesel freight locomotives and this could have potential to reduce pollution, particularly for freight.

Finally, forced ventilation at some enclosed stations such as New Street, Birmingham should help to reduce atmospheric pollution and also provide an improved environment for passengers.

The general conclusion from this report is that rail created atmospheric pollution from diesel engines is low and cannot generally be identified separately from road transport. However, pollution is still reducing, despite government policy changes that have curtailed the volume of electrification, particularly on the Midland Main Line. Limited actions could improve things further so long as this was cost effective.

4. Main Hot Spots for Pollution on the UK Railway Network

The Busiest Routes and the Busiest Stations are in London

All of the routes and stations into London see occasional diesel operated (or steam hauled) charter trains and removing them would not significantly reduce pollution levels on the routes nor at termini. Similarly, infrastructure trains involved with materials and plant and used for maintenance and renewals are all generally diesel hauled. The earlier generations of diesel engines still operate to a limited extent and they include Class 47s, Class 37s Class 50s and Class 20s.

Freight sees quite substantial use by diesel locomotives to yards a few miles out of the termini and on cross-London routes. Much of this is operated by second generation diesel locomotives.

London Bridge and Victoria are diesel free with the exception of the Uckfield services. These latter services are fairly limited in numbers, are worked by fairly modern diesel multiple units (DMU) and are less polluting than earlier generations of DMU.

Cannon Street, Blackfriars and Charing Cross are totally diesel free.

Waterloo still has one long distance diesel operated service to Salisbury and Exeter and this is operated by Class 159 DMUs, some of the oldest units on the network and therefore a cause of higher pollution levels.

Paddington, currently probably the most polluted station in London, will be diesel free within 12 months or so except for the diesel hauled West Country sleepers and their associated empty stock moves.

Marylebone is totally diesel operated but most of the DMUs and diesel locomotives operating there are of fairly modern design with reduced pollution levels.

Euston is mostly diesel free apart from the Voyagers used by Virgin West Coast and the empty stock sleeper working, as will Kings Cross be within the next two years.

St Pancras will retain the HSTs or other DMUs in the short term for working the Midland Main Line long-distance services. Replacement with bi-modes seems the obvious route forward. The existing Meridians are more modern and less polluting.

Liverpool Street and Fenchurch Street are totally diesel free.

So, within two years, we should see London termini mainly free of diesels except for Marylebone and St Pancras.

The Rest of the Country

New Street Birmingham is probably the station suffering most pollution from diesels with CrossCountry HSTs and Voyagers plus DMUs on some suburban lines. Some WCML services are also operated by Voyagers. Arriva also operates Class 158 DMUs to Shrewsbury and mid Wales.

Manchester has recently benefitted from further electrification although still sees many DMUs. The oldest are due for withdrawal before 2020.

Leeds and York both see substantial numbers of DMUs, including Voyagers and older BR-built DMUs.

Cardiff and the Welsh Valleys are totally served by DMUs. Any further reductions in pollution await the next franchise.

Glasgow Queen Street and Edinburgh Waverley both see substantial numbers of DMUs but this will be substantially reduced once the route between the two cities via Falkirk is electrically operated. Technical problems with the new Class 385 trains are delaying this.

5. Further Action

Pollution by Diesel Engines on our Rail Network

Our UK railways have 40% of electrified lines and compares poorly with other European countries such as Germany, Holland, Denmark and Italy that all have more than 50% electrified lines.

As a result, our network has been heavily dependent on diesel haulage since the 1960s, although progressively reduced until privatisation in 1993.

Further substantial electrification was proposed from 2010 and this included two important Inter-City routes the GWR from Paddington to Bristol, Cardiff and Swansea and the Midland main line from Bedford to Sheffield, Leeds and Nottingham. Due to late delivery and vastly increased costs on the GWR project, it has been dramatically decreased in scope and the all new IEP electric trains will be supplied as bi-modes with a diesel engine for the non-electrified parts such as Cardiff-Swansea, Didcot-Oxford and Chippenham to Bristol. Electrification of the Midland Main Line north of Bedford will be curtailed at Kettering (plus the branch to Corby) leaving Kettering to Nottingham, Derby and Sheffield without wires.

There may well be a reduction in pollution as the IEP trains will presumably will be fitted with engines compliant with stricter reductions on emissions set by the EU and will generally replace more polluting HSTs that were built in the 1970s. This reduction will not

be as great as originally expected as many of the redundant HST trains are being moved to other parts of the country for reuse.

The HSTs used on the East Coast mainline will also be replaced with IEP trains and the latter will run as far as Edinburgh on the existing electrified lines and only revert to diesel onwards to Inverness and Aberdeen.

Scotland has progressively electrified routes in the central belt but elsewhere continues to operate DMUs.

Wales is shortly to let a new franchise and there are reasonable expectations that the Welsh Valleys at least will see electrification in some form or bi-mode trains will be procured.

A limited number of new diesel multiple units are being supplied around other parts of the UK and these will replace much older units, again reducing pollution but not eliminating it.

6. The Future for Rail

Rail is a relatively minor cause of atmospheric pollution and compares well with road. Switching to electric road vehicles or even more revolutionary sources of energy such as hydrogen is likely to reduce road based pollution, even if it takes a further ten years or so before mass production is achieved.

Rail needs to monitor changes and to take reasonable steps to reduce pollution further. Perhaps, more importantly, the overall rail industry needs to exploit its advantages and to advise and advertise those advantages. In the longer term, electrification of more routes is essential if larger numbers of passengers and larger volumes of freight are to be carried. Rail has an innate disadvantage compared to road as its trains and locomotives have a much longer life cycle compared to road vehicles.

Whilst road is trying to exploit the idea of driverless electric cars, this ignores the congestion caused by capacity constraints and rail should be pointing this out and explain that rail is the best surface mode for mass transport, regardless of pollution.