

Air quality and rail freight

Scoping paper October 2017

Local air quality is now recognised as a major and pressing public health issue. As road emissions reduce and policy development gathers pace, rail must continue to be part of the solution. Rail freight has good environmental credentials but this reputation and advantage will be lost if action is not taken to understand and engage in proposals to reduce its local air quality impacts.

A range of EU, national and local policies and approaches are now being used to clean up toxic air. These include tighter emissions standards, investment in new technology and new Clean Air Zones.

The rail freight sector must act to better understand and respond to these developments. This should include:

- A research programme to examine the local impact Clean Air Zones and other initiatives will have on rail freight operations
- An update of comparative air quality data between HGVs and rail locomotives across a range of freight types and using comparable vehicles
- Campaigning to ensure Government investment in electric vehicles and alternative fuels directly engages the rail freight sector
- Research to examine how and where rail freight operations can be combined with low-emission first/last mile delivery operations
- Campaigning for targeted investment to improve emissions performance of the rail freight sector including retrofitting existing diesel freight engines
- Examination of opportunities for enlarging the electric freight network and the potential of bi-mode freight traction.

Introduction

As understanding of the public health impacts of poor air quality have grown, so the pressure on sectors responsible for the majority of diesel emissions has increased. Road freight, buses, taxis and private cars have all come under the spotlight.

Air quality is a complex topic. Standards are set internationally, policies and investments designed to improve performance come mainly from the national level, and implementation and monitoring is locally and regionally delivered. For rail freight operators and users, it can therefore be difficult to understand the risks and challenges, and to target their response accordingly.

To date, rail diesel and other non-road users including industrial equipment, have largely been excluded from the debate, as their relative contribution is small. However, as road emissions reduce, and as policy development gathers pace, rail must play its part.

The aim of the scoping paper is to provide a short overview and explanation of the current state of play, to provide clarity on the shape of public policy and to give a steer for identifying risks, opportunities and further areas of research.

Air pollution: types and sources

Air pollution is now recognised as a major public health issue. The World Health Organisation implicates outdoor air pollution in three million premature deaths each year¹, including 400,000 premature deaths a year in EU countries. In the UK, research by the Royal College of Physicians has estimated that outdoor air pollution is responsible for 40,000 premature deaths each year².

Such pollution is recognised as contributing to conditions including cardio-vascular illnesses, lung cancer, childhood asthma and Parkinson's disease³.

However, it is only relatively recently that poor air quality has become recognised as such a big issue. This is for three main reasons. First, the UK is in contravention of the EU Ambient Air Quality Directive⁴ leading to two successful legal challenges in the High Court and Supreme Court over the perceived tardiness of the Government's response⁵. Second, new research into the extent and impact of the problem has highlighted the large number who are seriously affected⁶. Third, there have been a series of exposés regarding widespread illegal practice in emissions testing by the motor industry⁷. Together, these have pushed air pollution into the headlines and led to demands for a comprehensive and speedy response.

Transport is a major cause of outdoor air pollution in the UK. Of the nine air pollutants that the UK monitors as part of the Ambient Air Quality Directive, transport is a significant factor in four, the sources and impacts of which are outlined below.

Nitrogen Oxides (NOx)

Nitrogen Oxide (NOx) is regarded by Government as the most pressing air pollution issue facing the country. Many urban areas suffer from NOx levels above the legal thresholds but the Government proposals to deal with the problem have been defeated twice in the Supreme Court due to their lack of appropriate urgency.

NOx refers jointly to nitrogen dioxide (NO₂) and nitric oxide (NO) which are formed during fuel combustion. NOx gases react to form smog and acid rain as well as being central to the formation of particulate matter and ground level ozone.

In areas of high motor vehicle traffic, such as in cities, the amount of nitrogen oxides emitted can be significant. In 2015, road transport accounted for 34 per cent of UK NOx emissions with diesel engines responsible for up to 80 per cent of NOx concentrations at the roadside⁸.

Particulate pollution

Road transport is a major source of particulate pollution, where particles are produced from burned fuel and from wear to tyres and brakes. Particulate pollution occurs in a number of size categories, although the most well-established health concerns involve PM10s which can cause respiratory and cardiovascular illness.

Adaptations for diesel engines have helped to reduce exposure to particulates, but new sources of transport emissions associated with brake and track and abrasion threaten to push levels of pollution from this source back up.

In comparing rail freight with road, it is important to consider emissions from all sources. HGVs cause serious particulate problems from tailpipe, tyre and brake wear (overall road transport PM10 emissions are 40 per cent tailpipe, 50 per cent brakes and 10 per cent tyres). Technologies such as regenerative braking systems, which are more commonly used in rail, cause relatively low levels of particulate pollution and give the sector an important comparative advantage.

Other pollutants

The effects of other pollutants, such as benzene and carbon monoxide have long been known about. Use of catalytic converters has significantly reduced emissions of these sources and they are not currently regarded as a widespread public health problem.

Policy responses

Strategies for tackling air pollution have three main sources:

- EU initiatives: Tighter enforcement of emissions, particularly from road vehicles
- National initiatives: Measures to encourage the development and take-up of cleaner technology
- Local initiatives: Measures to identify and address locations with the worst air quality.

EU initiatives

Emissions standards from road vehicle engines have been steadily tightened at EU level over the last 30 years. The latest Euro engine standard, Euro VI, was introduced at the end of 2013 replacing Euro V which has governed new vehicle engines since 2008.

For new trucks and buses, it represents a significant tightening of permissible emissions with particulate matter halved and NOx emissions reduced by more than three quarters compared with 2008's Euro V standard.

But while Euro VI has tight standards, the average HGV is seven and a half years old meaning only a quarter of lorries on the road meet this level. The majority fall into the Euro IV and V brackets, while 14 per cent of HGVs are over 13 years old. These older lorries are required to meet only Euro III standards or earlier which permit NOx emissions between 13 and 20 times higher than Euro VI and particulate emissions between 13 and 60 times higher.⁹

National initiatives

National Government's efforts to reduce NOx include:

- A new Air Quality Plan, published in 2017, with measures including banning sales of petrol and diesel vehicles by 2040
- £2 billion of support for ultra low emission vehicles since 2011
- Multi-million pound funds aimed at egregious performers such as buses and taxis
- Consultation on a targeted vehicle scrappage scheme aimed at some low income groups and the most polluted areas
- Highways England's designated air quality fund is worth £100 million over five years. It is aimed predominantly at reducing NOx emissions and includes initiatives outside of the Strategic Road Network, such as rail freight upgrades

Local initiatives

The impacts of poor air quality are experienced locally and the main focus for national Government has been on identifying areas suffering NOx problems and encouraging local authorities to tackle them. This includes:

- Mandatory establishment of Clean Air Zones (CAZs (see below)) in the worst affected areas - Birmingham, Derby, Leeds, Nottingham, Southampton and London
- Identifying 81 major roads in 17 towns and cities where urgent action is required
- A £255 million implementation fund for local authorities to tackle pollution hotspots with local authorities having until the end of 2018 to bid for measures including improved public transport, changes to road layouts and other initiatives
- A longer term Clean Air Fund to support improvements to local bus fleets, support for concessionary travel and more sustainable modes of transport or infrastructure changes.

Clean Air Zones (CAZ)

CAZ are the primary tool through which local air pollution is expected to be tackled. Any local authority can establish a CAZ, although the worst performing areas have a mandatory responsibility to implement them. Working within a framework set by national Government, objectives for the CAZ are to help decouple economic growth from pollution, support emissions reduction and improve air quality and health. As such, they aim to reduce not just air pollution, but to tackle carbon emissions too. CAZs fall into two categories; non-charging CAZ where the focus is on improving air quality, and charging CAZ which have additional powers to require vehicles to pay a charge to enter or move in the zone, including rail movements. Road freight movements within CAZ will be limited to those with Euro VI engines.

Air Quality Management Areas (AQMA)

In addition to CAZ, local authorities also have a responsibility to identify all areas that exceed statutory limits of air pollution. There are currently over 600 Air Quality Management Areas (AQMA) in the UK and their location can help identify where local authorities may look to establish CAZ in the future.¹⁰

Rail and air pollution

Overall, rail plays an important role in reducing the environmental impact of transport and is well placed to do more. While its carbon reduction credentials are excellent, its impact on local air quality is less positive even though it's per tonne air pollution figures are much better than HGVs.

Emissions from rail's diesel operations are covered by the Non Road Mobile Machinery legislation. Upgraded in January 2012, these focus on NOx and particulates. Despite the recent purchase of new traction, sections of the rail freight industry continue to be reliant on older diesel stock which

fall well short of modern requirements. Designs for new freight locomotives need to consider new technology. Of the 46 Class 66, 68 and 70 locomotives purchased in 2014 for use on UK railways, none was reportedly fully compliant with Stage IIIB emission limits which came into force on 1 January 2012.¹¹ Further upgrades in standards are due to be implemented from 2018-20, but the status of these changes for the UK is unclear in light of Brexit negotiations.

Diesel engines are also responsible for particulate pollution including trace metals such as copper and zinc and organic compounds caused by combustion. These are caused by braking and abrasion of train and track. Factors such as increasing axle load and train speed, as well as an increasing train frequency, increase emissions from this source. PM10s and smaller PM2.5s are at the root of the main harmful effects from particulate matter and cause respiratory and cardiovascular illness.¹²

There is limited research available to help understand what the air pollution impacts of rail are and none focusing specifically on rail freight. Yet rail freight clearly has the potential to help reduce emissions in targeted areas.

What research does suggest is that transferring more freight from road to rail could bring major reductions in pollution. For example, the current 33 freight train movements in and out of Felixstowe already translates to around 2,500 fewer lorries per day from the A14 corridor.¹³ The decision to increase this to 47 movements a day¹⁴ shows how investing in the rail freight network on key corridors can ameliorate road congestion and reduce pollution. Better integrating rail and road planning with measures to reduce pollution has great potential to reduce road congestion and pollution.

Possible effects on the rail freight sector

Despite representing only a small percentage of overall air pollution, in some locations rail freight and its associated operations will be significantly impacted by measures to improve air quality.

Relatively high environmental requirements from the Euro VI engine standards, expected widespread electrification of road vehicles including HGVs and other initiatives, such as scrappage could leave rail freight exposed in terms of its contribution to air pollution and carbon.

Rail freight operations in urban Clean Air Zones are likely to become targets for local authorities. If the need to reduce emissions cannot be mitigated, local authorities may levy charges against rail freight movements. Construction and industrial freight operations could be doubly affected by the increased focus on air pollution, with heavy plant machinery also often relying on older diesel engines which will be increasingly fingered as part of the problem. As well as jeopardising the viability of some rail freight operations, this could shift freight from rail to road with potential impacts on carbon emissions as well as safety and congestion.

It is expected that Control Period 6 (CP6) will see a retrenchment of rail investment and a focus on repairs and renewals. Ambition for further electrification of the rail freight network beyond schemes held over from CP5 will require detailed engagement with the new pipeline approach envisaged for enhancement projects.

Despite these effects, there are also opportunities for rail freight if it can prove, and develop, its credentials in helping to reduce air quality impacts. For example, some local authorities will be focused on reducing the number of HGVs on

sensitive sections of their road network. This could open the way to considering alternative freight movement strategies in both local government as well as the private sector.

Recommendations for further work

Burgeoning interest in air pollution has generated a policy environment focused on local authorities. In contrast to road transport, little research has so far been undertaken on the contribution rail freight makes to air pollution in specific local areas. A research programme aimed at better understanding these impacts is needed, beginning with operations within planned CAZs.

Research should update comparative air quality figures for HGVs and rail locomotives. This should be based on average core routes for road and rail across a range of freight types and using comparable vehicles (for example Class 66 equivalent to Euro I and class 70 equivalent to EuroV1, Class 88 for electric locomotives).

Much of central Government's response to air pollution has been to encourage a move to electric and hybrid engines. Rail (passenger and freight) urgently needs to be included in this work and to have a much clearer and more supportive relationship with the Office for Low Emissions Vehicles. The sector should approach Government to establish the best way of achieving this end with the aim of attracting government funding for research into alternative fuels for freight locomotives.

Combining rail freight with low emission first/last mile delivery options raises three opportunities:

- Rail-based transport to edge-of-town trans-shipment centres
- New freight rail services running into cities
- Introduction of freight to passenger trains.

There is a strong case for targeted investment to improve emissions performance of the rail freight sector. This should include:

- Examining the potential for retrofitting existing diesel freight engines
- Opportunities for enlarging the electric freight network
- Exploring the potential of bi-mode freight traction. In particular, passenger rail may move to bi-mode trains, which run electric through urban areas, and it needs to be established whether rail freight has any comparable options in this area. DRS has purchased ten dual mode locomotives class 88, which are designed for predominantly electric mode but with the ability to use diesel to go into depots.

It is important Government does not pursue these objectives solely through the regulatory regime, but supports solutions put forward by the rail freight sector.

The sector must respond positively to the pressures it faces, both to ensure operations can be maintained and enhanced, and to secure and develop the major environmental benefits that come from a strong rail freight sector.

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