AIR QUALITY

Introduction

In recent times air quality has moved up the agenda of environmental impacts of road traffic and is now demanding urgent attention by policy-makers and planners. Current levels of air pollution – specifically nitrogen oxides and NO_2 in particular – in our larger cities and along some major roads are well above the statutory limits and increasingly known to be injurious to health. Although there are other sources of NO_x emissions, (industry, commercial and residential properties), these are more diffuse than those from road transport, and it is emissions from the latter - specifically from diesel engines - that cause these high levels of concentration.

This Supporting Document sets out a brief overview of the issues, with particular reference to the Major Road Network, to support the statements in chapter 5 (section 5.4) of the main Study Report[1].

Transport and air pollution

The UK continues to fail to comply with European air quality limits[2] in respect of nitrogen dioxide concentration levels across most urban areas, and in particular at roadside locations. Although transport contributes only some 30% of total nitrogen oxide emissions, it is the concentration around the road network that causes the breaches of the NO_2 limit levels.

The screen shot below (Fig SD5.1) from the DEFRA website (also reproduced as Figure 5.1 in the main Study Report) shows the 2014 geographical pattern across much of England of the annual mean levels of nitrogen oxides concentration (as NO_2) in $\mu g\ m^{-3}$. The breach level is 40 $\mu g\ m^{-3}$ and areas of breach are colour-coded on the map in rising levels of non-compliance - yellow, orange and red. Most large towns and a few motorway corridors show the yellow (lowest) levels of breach, with parts of larger cities showing higher levels of non-compliance. Central London and certain other parts of Greater London, particularly Heathrow Airport, are among the worst.

Limits also apply to short periods of excessive concentration, such that an *hourly* NO_2 limit of 200 $\mu g\ m^{-3}$ is not to be exceeded 18 times in a calendar year. The Guardian website reported that Oxford Street had exceeded this limit for 2016 by 8 January[3]; inner London and parts of west London do experience very high levels of air pollution,

[1] In preparing this Supporting Document we have drawn heavily on the RAC Foundation's report *Air Quality and Transport: Impacts and Solutions,* June 2014. We are grateful for their permission to do so.

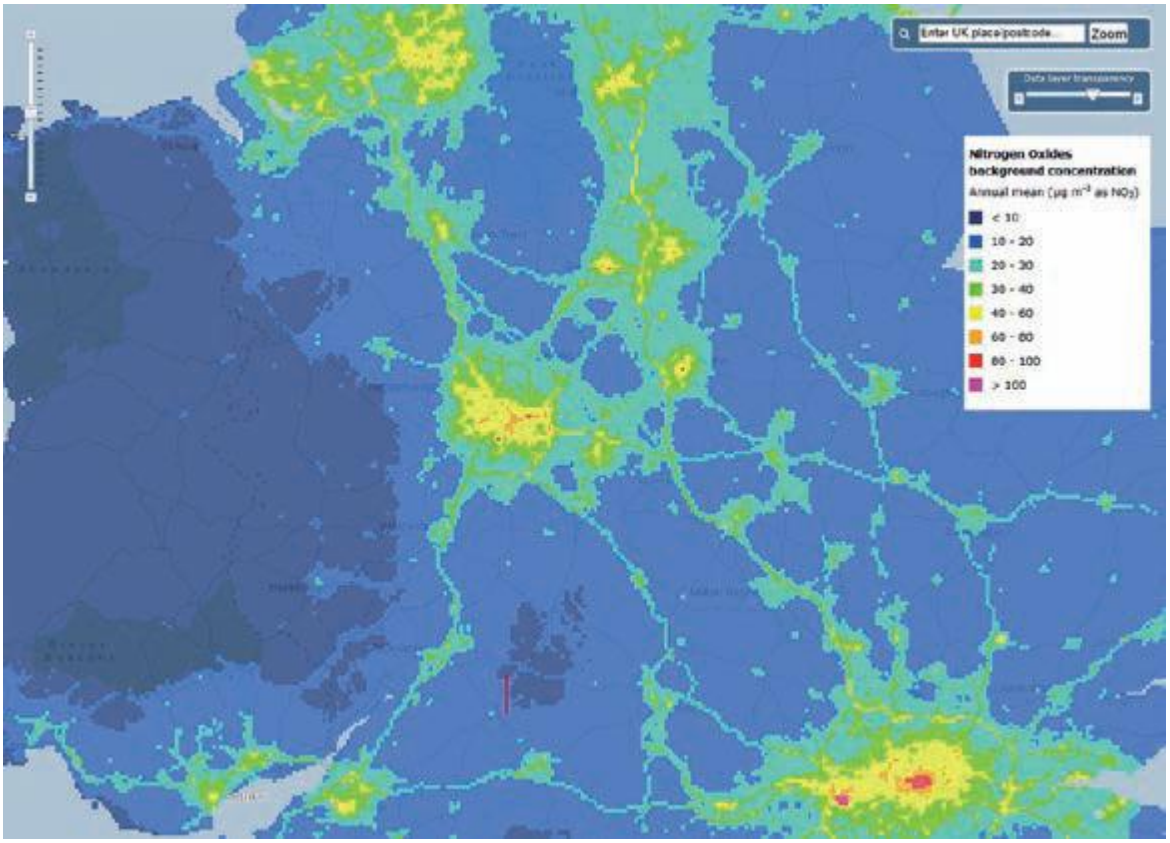
[2] set by the European Commission (Ambient Air Quality Directive 2008/50) and enshrined in UK legislation as the Air Quality Standards Regulations 2010.

[3] https://www.theguardian.com/environment/2016/jan/08/london-takes-just-one-week-to-breach-annual-air-pollution-limits. Retrieved 30 September 2016. Source King's College London, https://www.londonair.org.uk/LondonAir/Default.aspx Retrieved 30 September 2016

among the highest in Europe, which are not replicated anywhere else either generally or on the Major Road Network.

Nitrogen oxides from road transport sources are almost entirely due to diesel engine emissions. Heavy duty trucks and buses have been the main sources, but in absolute terms this has been reducing. Aggregate NO_x emissions from diesel cars have been growing fast as climate change policy has supported diesel over petrol due to lower fuel consumption and CO_2 emissions – the proportion of the UK car population accounted

Fig SD5.1 Background Concentrations of NO_x: London – Midlands – North corridor



Source: Annual mean NOx (as NO2) concentrations (background) 2014 England, Defra.
Screen shot taken from https://uk-air.defra.gov.uk/data/gis-mapping. Breach level is 40 µg m-3

for by diesels has risen from 7% in 1994 to 38% by the end of 2015[4].

Alongside nitrogen oxides, levels of particulate matter (PM_{10} and $PM_{2.5}$) are largely within European limit values. However, the EU limit value is higher than the more stringent World Health Organisation (WHO) guidelines; as a result, particulate matter is potentially a more significant public health matter than the compliance data might suggest.

[4] *Vehicle Licensing Statistics Quarter 4 2015,* Department for Transport, April 2016

Particulate matter is produced by tyres and brakes, as well as the diesel engine, so it can be an issue for petrol-engine vehicles as well, and will require solutions that address non-combustion pollution sources as well. While road vehicle sources of PM account for only 15-18% of the total mass of PM generated in a year, as with NO_x it is the transport components that generate the high concentrations in urban areas and on major corridors.

Air Pollution and Public Health

There is clear evidence of a causal relationship between exposure to traffic-related air pollution of NO_x and PM and health impacts, such as exacerbation of asthma, non-asthma respiratory symptoms, impaired lung function and cardiovascular mortality and morbidity.

Across Europe, an estimated 20-30% of the urban population are exposed to $PM_{2.5}$ levels above EU reference levels, and 91-96% above the more stringent WHO guidelines. In the UK, the burden of particulate air pollution in 2008 has been estimated to be equivalent to nearly 29,000 premature deaths (at typical ages of death), and to an associated loss of population life of 340,000 life-years. A study by the Institute of Occupational Medicine[5] has estimated that removing all fine particulate air pollution would have a bigger impact on life expectancy in England and Wales than eliminating passive smoking or all road traffic accidents.

There is an economic cost to the public health consequences of air pollution, last estimated by DEFRA in 2010. Half of this has been estimated as the transport contribution, worth £5bn to £11bn at 2009 prices[6].

Unsurprisingly, there is an increasing public awareness and concern about air pollution and its implications for health, particularly in London and other big cities where non-compliance with statutory limits continues to be high.

Diesel engine performance

Although the total mass of NO_2 and of particulate matter in the atmosphere has reduced significantly over the last 15 years, concentrations levels have remained steady in recent years. This is in spite of the progressive introduction by the EU of more stringent standards for diesel engine emissions, which would have been expected to reduce roadside pollutant concentration levels.

At the root of the problem is that the official tests by which new vehicles are certified do not yet reflect real world driving (new, more realistic, tests will not be introduced until

[5] Miller, B. G. & Hurley, J. F. (2006). *Comparing Estimated Risks for Air Pollution with Risks for Other Health Effects,* Institute for Occupational Medicine. Referenced in *Air Quality and Transport – impacts and solutions,* RAC Foundation, June 2014

[6] See *Air Quality and Transport – Impacts and Solutions,* RAC Foundation, *op.cit.*

2017): this applies both to fuel efficiency (and thus CO_2 emissions) and the emission of air pollutants – particularly operating on roads in towns and cities where speeds tend to be lower than in the tests.

In addition, it was revealed in 2015 that VW Group used 'defeat' software in many of their new car models to 'trick' the test regime by ensuring the vehicles exhibited less pollution than they would on the road – over and above the effect of the obvious difference in driving conditions. This has not been confidence-building for the reputation and commitment of one of the giants of the automotive industry.

Diesel engines in new cars ('light duty vehicles') have been required since September 2015 to meet Euro 6 emissions standards, which sets a limit of 80g of NO_x per 1,000 kms, compared with 180g for the previous Euro 5 standard. A recent report by *Transport & Environment*[7] showed that over four in five cars that meet the Euro 5 standard for NOx in the laboratory (180g/1,000km), and were sold in Europe between 2010-14, actually produce more than three times this level when driven on the road. Two-thirds of Euro 6 cars (most on sale since 2015) still produce more than three times the 80g/1,000km limit when driven on the road. A report by the Department for Transport[8] said they had found no evidence among other manufacturers of test cycle manipulation as used by the VW Group; however, tests did find higher levels of NO_x emissions in test track and real world driving conditions than in the laboratory for all manufacturers' vehicles, with highly varying results between makes and models.

However, the testing regime is on the brink of major reform. A Real Driving Emissions (RDE) test becomes part of the test regime from September 2017 (Euro 6c for light duty vehicles – cars and light vans). As part of this new regime a 'conformity factor' is applied which, when more than 1, allows the actual emissions in real world driving to exceed the limits by this factor. The factor is starting at 2.1 but by 2020 will be reduced to 1.5.

'In service conformity' tests for heavy duty vehicles (trucks and buses) become part of the Euro VI testing, with conformity factors set at 1.5. Transport for London has now tested examples of buses and heavy-duty goods vehicles at Euro VI[9]. In each case, the results have been impressive, with emissions of NOx significantly reduced from vehicles at Euro V, especially at lower speeds.

The development of policy

[7] *Dieselgate – Who? What? How?* , Transport and Environment, September 2016 https://www.transportenvironment.org/sites/te/files/publications/2016_09_Dieselgate_report_who_what_how_FINAL_0.pdf Retrieved 30 September 2016

[8] *Vehicle Emissions Testing Programme*, Department for Transport, April 2016

[9] *In-service emissions performance of Euro 6/VI vehicle,* Transport for London, 2015

EU and UK[10] policy has for some time sought to reduce emissions concentration levels. It has long been recognised that these need to include measures such as the substitution of lower emission vehicles and technologies (for commercial as well as personal transport), behavioural change with travellers switching to zero- or lower-emission modes such as walking, cycling or public transport[11] , and low emission or exclusion zones to address particular emissions hotspots - in addition to the expectation of improved emissions performance of the 'parc' as a whole.

Such measures are more appropriate for urban areas, where journey lengths are short. Substantial margins of breach of NO_2 limit levels appear not to occur on interurban sections of the Major Road Network; it is probable that where persistent breaches are observed, effective measures will combine smoothing of traffic flow, reducing congestion and minimising stop-start, with traffic management strategies to prevent excessive traffic volumes occurring in particular locations, and the adoption of speed limits below the standard 70 mph. Such measures are not without cost – either the cost of network improvements and management, or in costs to the user.

In the longer term, as traffic levels on the MRN are forecast to grow, it will be necessary to rely on the progressive improvement of diesel vehicle emissions – including trucks which have a disproportionate presence on the MRN, particularly on the Strategic Road Network.

The effectiveness of such policies, and the institutional capability to implement them was called into question over the last few years with the legal challenge to the UK government brought by the NGO *Client Earth.* Their contention was that the UK's policy in response to the EU requirement to produce plans to bring about compliance with the limit values on air pollution was taking far too long, especially given the consequences for public health and cost to the economy. This led eventually to a hearing by the Supreme Court, and a decision in April 2015. This decision required the UK government (in practice DEFRA and the three devolved administrations) to produce by December 2015 new Air Quality plans to accelerate the achievement of compliance.

The new plans[12] – which are focused on addressing the Air Quality issues in towns and cities – recognise existing policies and programmes to improve the emissions performance of buses and certain classes of commercial vehicles, alongside other sustainable transport initiatives. Specifically the plans involve the introduction of Clean Air Zones in five cities in England which will exclude or charge non-compliant vehicles (buses, coaches, taxis and lorries, but not cars), with Birmingham and Leeds also excluding or discouraging non-compliant vans, alongside behavioural measures. London already has a comprehensive Air Quality Strategy, which among other things will involve a new Ultra Low Emission Zone and tightening the existing Low Emission

[10] For example *Air Quality Plans for the achievement of EU air quality limit values for nitrogen dioxide in the UK*, DEFRA and the devolved administrations, September 2011.

[11] There may be challenges in ensuring emission levels per passenger mile carried are sufficiently lower

[12] *Improving Air Quality in the UK: tackling nitrogen dioxide in our towns and cities,* Department for Environment, Food and Rural Affairs, December 2015

Zone; the new Mayor is already planning further initiatives to address the air pollution challenge in London.

Some doubts have been expressed about the deliverability of these plans and the likelihood of achieving the targets; *ClientEarth* has brought a new legal challenge to the adequacy of these plans which is due to be heard in the High Court in late October 2016.

Depending on the success of the new test regime and results achieved, it should become easier over the next few years for policy makers to make reliable forecasts of the likely level of actual emissions of a future 'parc' of vehicles at a particular time, and to have more confidence that over time actual roadside emissions will reduce significantly. However, any policy to reduce concentration levels below the statutory limits in areas of severe breach – particularly in London - will need to be draw on a wider range of measures as well, and that is reflected in the government's latest plans. The expressed objective is to achieve compliance outside London by 2020, and within London by 2025; the London Mayor is committed to achieving that target earlier.

Overall, the expected improvement in air quality expected to be achieved during the 2020s means that in our view it is unlikely to be an issue in the evolution of the Major Road Network MRN over the longer term, to 2040. Meanwhile, we are in no doubt that much change – in vehicle emissions performance and in successfully addressing the known pollution hotspots - has to be delivered over the next few years.

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