NSW GOVERNMENT

Advisory Committee
on Tunnel Air Quality

TP07:
Options for Reducing In-Service Vehicle Emissions

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Summary

This paper examines the potential for a Smoky Vehicle Enforcement Program or a Low-Emission Zone to address tunnel-related air quality issues by reducing emissions from the in-service vehicle fleet.

A Smoky Vehicle Enforcement Program:

- could provide an in-tunnel benefit by reducing or eliminating gross polluting vehicles from a tunnel, leading to improved visibility and air quality in the tunnel.
- could provide a regional air quality benefit if it results in an overall reduction in smoky vehicles.
- can be implemented using existing legislation, and be based on the existing M5 East tunnel model.

A Low Emission Zone:

- could provide an in-tunnel benefit by reducing or eliminating gross polluting vehicles from a tunnel, leading to improved visibility and air quality in the tunnel. Newer vehicles are less likely to be smoky vehicles.
- could provide a regional air quality benefit if it results in an overall reduction in fleet emissions.
- would require new legislation to implement.

Smoky Vehicle Enforcement Program

Under NSW environmental legislation, it is an offence for a vehicle to emit visible air impurities for more than 10 seconds[1].

A smoky vehicle camera system was installed in the M5 East tunnel in June 2006 at a cost of $3 million, and received a $250,000 upgrade as part of the M5 East Air Quality Improvement Program announced in October 2012. The upgrade allows a broader range of smoky vehicles to be detected as part of a new Smoky Vehicle Enforcement Program. The smoky vehicle camera system is designed to detect, identify and record smoky vehicles using smoke detectors, video and still cameras, and optical character recognition software to capture the registration number of smoky vehicles.

The Smoky Vehicle Enforcement Project started on 1 March 2013, and includes increased fines for the operators of smoky vehicles. Vehicle operators will now face fines of $2,000 for the first two offences. A third offence will attract a $2,000 fine as well as an automatic three-month suspension of vehicle registration.

Operators of heavy vehicles that are detected emitting excessive smoke inside the M5 East tunnel are also invited to participate in the Diesel Retrofit and Repair Initiative. This has air quality benefits for not only the M5 East tunnel but also across the wider Sydney network.

1 Protection of the Environment Operations (Clean Air) Regulation 2010

Low Emission Zone

Low-Emission Zones are areas that restrict access to allow only cleaner vehicles that meet specified emissions standards or related criteria. For example, access to an area could be restricted only to vehicles manufactured after 2008. Although Low-Emission Zones could apply to all vehicles in principle, they have generally been applied to heavy vehicles due to their relatively large contribution to air pollution compared with their representation in the vehicle fleet[2]. Low-Emission Zones operate in many European cities, including London, as well as Tokyo and the ports of Long Beach and Los Angeles.

Low-Emission Zones tend to be focussed on city and town centres, where land-use is dense, traffic is heavy and population exposure is high. They are also used in areas where there is a high concentration of diesel emissions, such as ports (which often combine ships, rail transport and road transport in close proximity to residential areas). Due to the high population exposure, it is these locations that provide the largest potential health benefits of improved air quality[2,3]. The case study outlined in Appendix A examines the benefits of the London Low-Emission Zone in reducing the concentrations of nitrogen dioxide (NO_2) alongside busy roads.

Potential Benefits of a Source Control Program

There are three potential benefits of reducing emissions from in-service vehicles using a motorway tunnel:

1. **Improved in-tunnel air quality**

   One of the key issues for tunnel users – particularly in the M5 East tunnel – is in-tunnel haze due to emissions of particulate matter (PM) from diesel vehicles. The impacts are particularly noticeable if a driver is following a smoky vehicle. Due to the longitudinal tunnel ventilation system in the tunnel, a smoky vehicle creates a 'slug' of smoke that has to travel along the length of the tunnel until it is removed at the ventilation extraction point.

2. **Improved air quality within 200 metres of portals**

   As noted in Technical Paper 6 – Road Tunnel Portal Emissions, the detectable impact of portal emissions on local air quality is highly localised to an area within 100–200m of the portal.

   For tunnels where portal emissions are permitted, any reduction in in-tunnel pollutant concentrations would result in a corresponding improvement in air quality within 200 metres the portals.

   As tunnel ventilation stacks have no measureable impact on local air quality, there is no significant local benefit in reducing the mass of emissions from the tunnel stacks.

3. **Improved regional air quality**

   There is potential for an improvement in regional air quality if a program reduces emissions from a significant proportion of the in-service vehicle fleet, as motor vehicles are a major source of urban air pollution.

Table 1 provides a qualitative assessment of the potential benefits of source control options.

2 **http://archive.defra.gov.uk/environment/quality/air/airquality/local/guidance/documents/practice-guidance2.pdf,** Practice Guidance on low emission zones, DEFRA 2009

3 Medium-term effects of London's low emission zone, Ellison, Greaves, Hensher, Proceedings of Australasian Transport Research Forum 2012

Table 1: Qualitative Assessment of Potential Benefits of Source Control Options

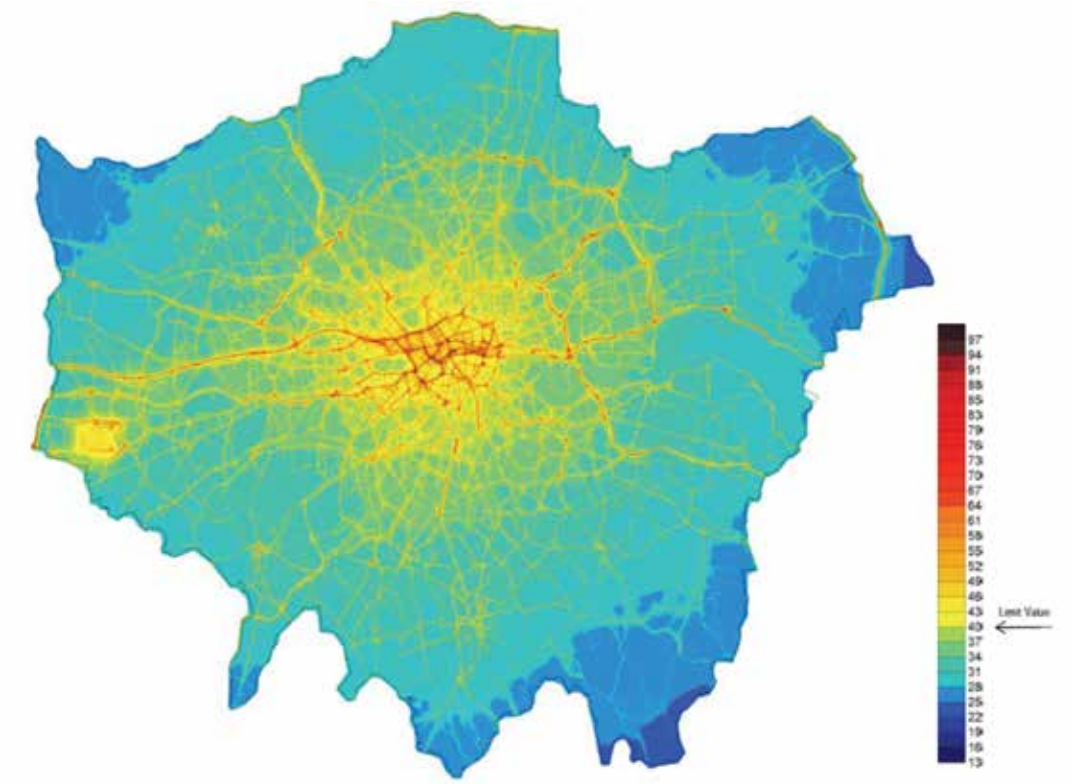
Scheme	In tunnel impacts	Comments	Regional air quality impacts	Comments
Smoky Vehicle Enforcement Program	Reduction	A reduction/elimination of gross polluting vehicles in the tunnel, would lead to improved visibility and air quality in the tunnel. Utilises existing legislation and agreements, and can be based on the existing M5 East model.	Negligible to small reduction in impacts	Reduction/elimination of gross polluting vehicles, provided vehicles do not avoid the tunnel.
Low-Emission Zone	Reduction	A significant proportion of the benefit would be from the elimination of gross polluting vehicles in the tunnel, leading to improved visibility in the tunnel. Newer vehicles are less likely to be smoky vehicles. Access to a Low-Emission Zone would likely be based on meeting specific vehicle emission standards. Treatment of good performing older vehicles requires consideration. While harder to enforce, access to a Low-Emission Zone could also be for vehicles retro-fitted with approved emission control devices. Would require new legislation to implement.	Negligible to small reduction in impacts	A Low-Emission Zone on specific sections of the motorway network is unlikely to significantly change the vehicle age distribution in the Sydney basin. Older vehicles are not likely to stop operating in Sydney – they would just avoid the Low-Emission Zone(s).

Appendix A

Case Study: City of London and Nitrogen Dioxide

Nitrogen dioxide (NO_2) impacts in London provide an example of the benefits of Low-Emissions Zones in locations with high population density and heavy traffic. Figure A1 shows that the highest annual average NO_2 concentrations in 2008 occurred along busy roads[4].

Figure A1: Predicted annual average NO_2 concentration ($\mu g/m^3$) in 2008

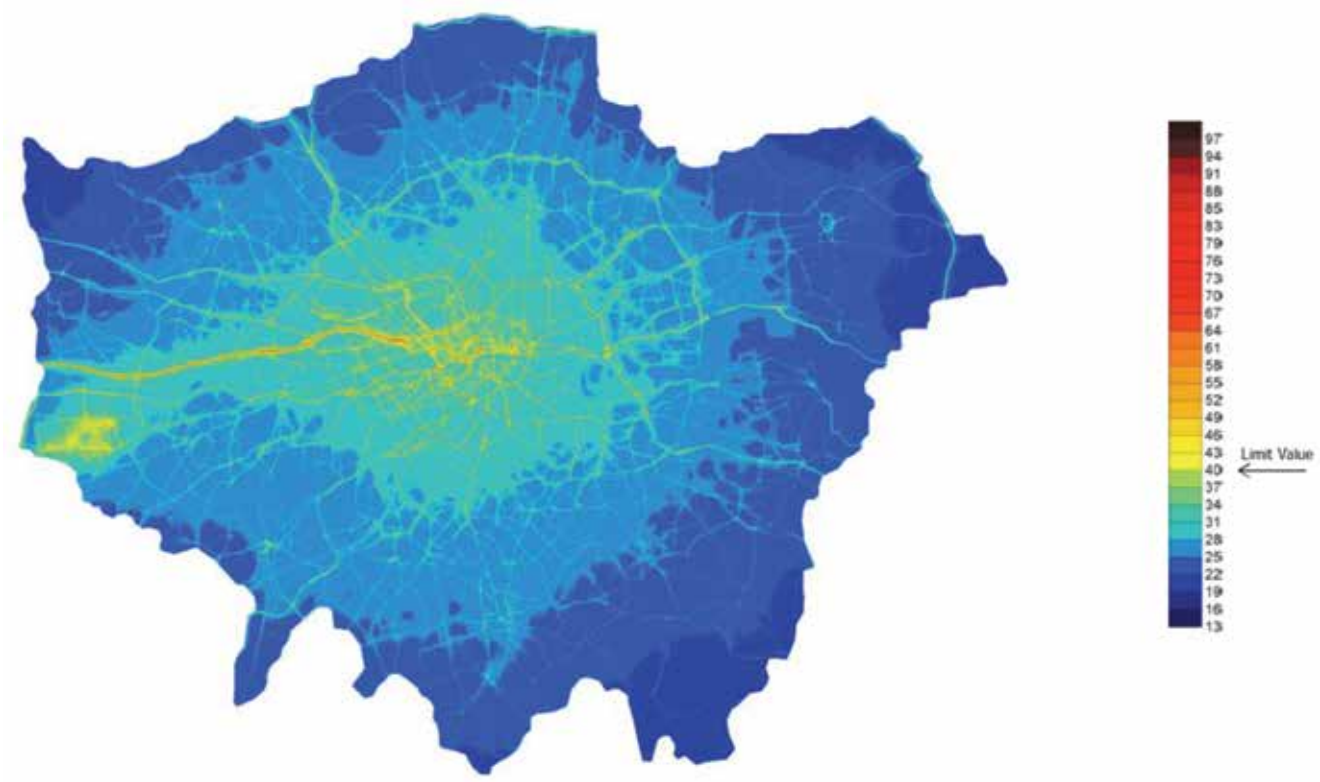


The Low-Emission Zone started operating in the area above on 4 February 2008, with phased introduction of an increasingly stricter regime until 3 January 2012. Applicable vehicles (larger vans and heavy-duty vehicles) registered after October 2001 were generally compliant with the first stages of the Zone (when Euro 3 was the mandatory emission standard). Since January 2012 the mandatory emission standard has been Euro 4 (for PM) for vehicles over 3.5 tonnes in weight, and Euro 3 (for PM) for larger vans and minibuses.

4 Mayor's Air Quality Strategy, Greater London Authority, December 2010
http://www.london.gov.uk/sites/default/files/MAQS%20Executive%20Summary%20FINAL.pdf

The Mayor's Air Quality Strategy predicts that annual average NO_2 concentrations in 2015 will reduce significantly with full implementation of the strategy – including the Low-Emission Zone. It can be seen in Figure A2 below that the most significant reductions in NO_2 concentrations occur along busy roads[4].

Figure A2: Predicted annual average NO_2 concentration (µg/m^3) with full implementation of the strategy in 2015

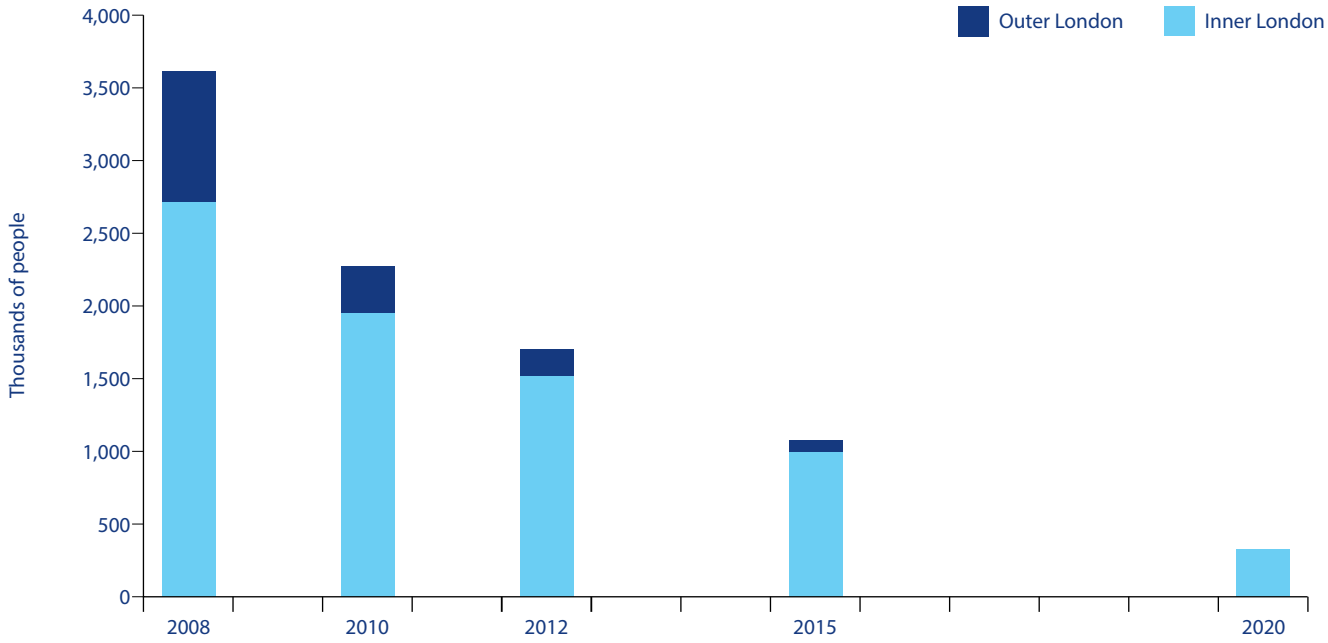


4 Mayor's Air Quality Strategy, Greater London Authority, December 2010
http://www.london.gov.uk/sites/default/files/MAQS%20Executive%20Summary%20FINAL.pdf

Appendix A

Research by Aether on behalf of the Greater London Authority[5] found that the number of Londoners living in areas exceeding the EU annual limit value for NO_2 (40 µg/m³) more than halved between 2008 and 2012. As shown in Figure 3, in 2008 the figure stood at around 3.6 million, but by 2012 this had been reduced to 1.7 million (about 20% of the population of London). This was due in part to the tighter Low-Emission Zone standards, retiring the oldest and most polluting taxis, and cleaning up the bus fleet. By 2016 this figure is expected to reduce further to around 1 million people, and by 2020 to be approximately 300,000 people, most of whom live in central London.

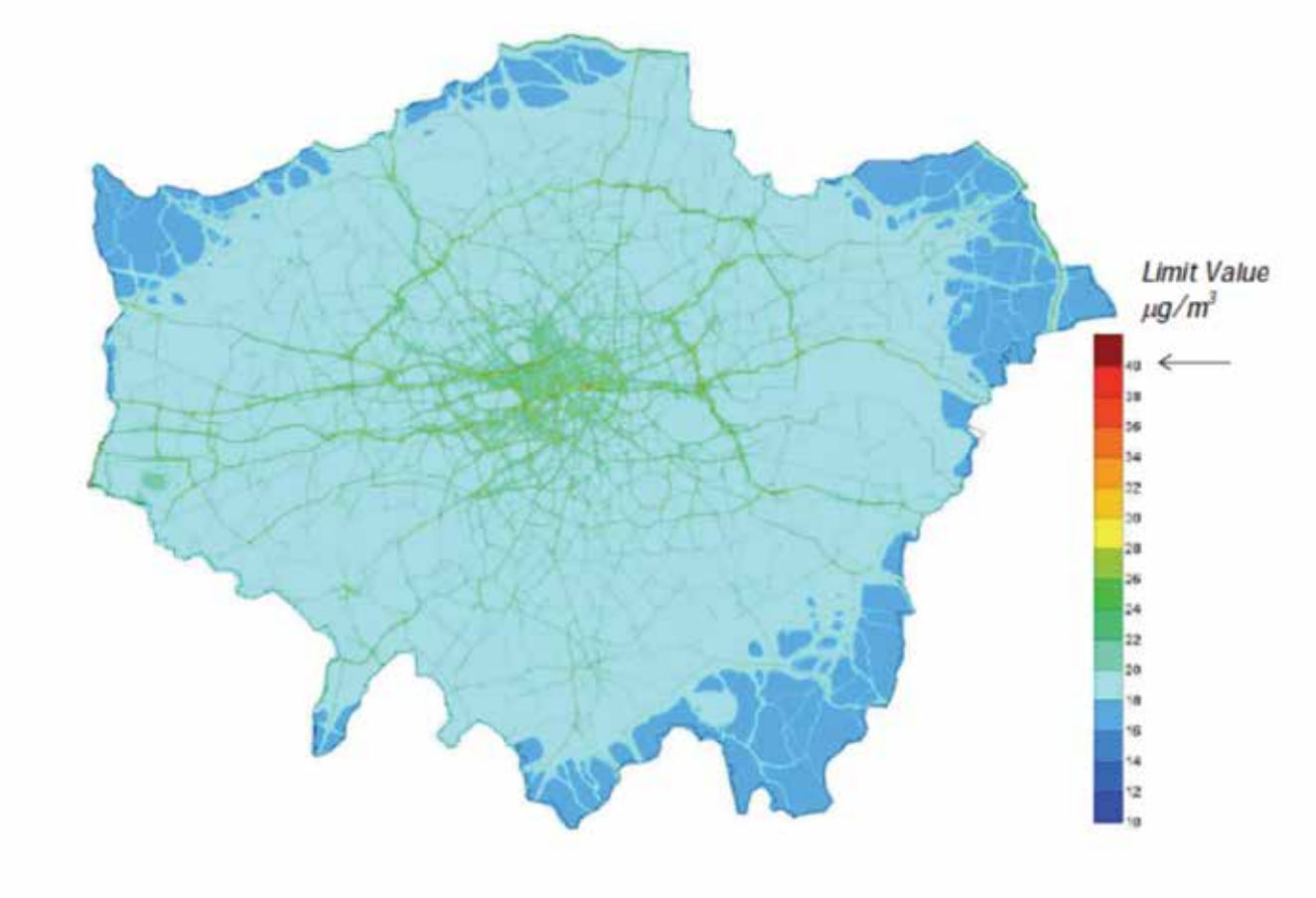
Figure A3: Estimated number of Londoners living in areas where annual average NO_2 concentrations exceed the EU limit value of 40µg/m³ (residential population only)



The benefits for PM_{10} are similar, but less dramatic than for NO_2, as illustrated in Figure A4 and A5.

5 **http://www.aether-uk.com/londonno2exposure/ posted 4 December 2013, viewed 16 December 2013.**

Figure A4: Predicted annual average PM_{10} concentration (µg/m^3) in 2008



Appendix A

Figure A5: Predicted annual average PM_{10} concentration (μg/m^3) with full implementation of the strategy in 2011