NICE National Institute for Health and Care Excellence

Expert testimony to inform NICE guideline development

Section A: Developer to complete	
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Guideline title:	Air pollution – outdoor air quality and health
Guideline Committee:	Public Health Advisory Committee – PHAC E
Subject of expert testimony:	Review of the Euro Standards used to control vehicle emissions, and how future Standards may assist the efficacy of Low Emission Zones
Evidence gaps or uncertainties:	Limited “real-world” emissions tests for Euro 6 and Euro VI vehicles at present. How will the Portable Emissions Monitoring Systems tests be implemented at the European level? What is the potential for Euro 6 to significantly increase primary NO_2 emissions?

Section B: Expert to complete

Summary testimony:

Low Emission Zones (LEZs) can take many forms, both in terms of the types of vehicles that are controlled, and their geographic extent. To date, the majority of LEZs are founded on encouraging (or requiring) the use of newer vehicles within a defined geographic area. The measure is thus predicated on an assumption that emissions from new vehicles will be lower than from older vehicles. If this is not the case, then the policy is potentially undermined by a failure in technology, or inadequate regulation.

Emissions from road vehicles are regulated under a series of European Directives. These set type-approval emission categories (commonly referred to as the "Euro standards) for both Light Duty Vehicles (cars and vans) and Heavy Duty Vehicles (HGVs, buses and coaches). The standards currently extend from Euro 1 to Euro 6 for LDVs, and from Euro I to Euro VI for HDVs. The Euro 1/I standards came into force in 1992. The Euro VI standard has been mandatory for HDVs since January 2014; the Euro 6 standard for LDVs will be fully implemented in the UK by September 2016.

The Euro standards have introduced progressively tighter emissions limits for a range of pollutants. However, with regard to NOx, these tighter standards have failed to deliver a corresponding reduction in measured pollutant concentrations; indeed, over the period from about 2000 onwards, there has been little, if any reduction in measured concentrations of NOx or NO_2 at many sites. Where reductions have been measured, the fall-off in concentrations is well below that expected.

The issue is related to the actual "real-world" driving performance of diesel LDVs and HDVs. This has been exacerbated by the "dieselisation" of the fleet via fiscal incentives to support the climate change agenda – such that 50% of new cars registered in the UK in 2012 were diesel. The problem appears to be solely related to NOx emissions. The evidence to date suggests that emissions of Particulate Matter have reduced in line with expectations, and that the performance of petrol-driven LDVs is as expected.

Type-approval for LDVs is currently carried out on a chassis dynamometer, using a drive cycle (NEDC) that does not accurately represent "stop-start" driving in urban conditions. In addition, test laboratories "exploit the flexibilities" in the current regulations to optimise the outcomes for fuel performance and pollutant emissions.

Type approval for HDVs is carried out using a "bench test" for the engine. The type-approved engine may then be used in vehicles that operate on very different duty cycles. In addition, some NOx reduction technologies (Selective Catalytic Reduction) do not operate efficiently (if at all) at low exhaust temperatures, typical of urban stop-start driving.

As a result, the expected reduction in vehicle NOx emissions over the transition from Euro 1/I to Euro 5/V has not materialised, and will have significantly affected the ability of LEZs to deliver any reduction in NO_2 concentrations.

The introduction of Euro 6/VI brings a number of important changes.

LDVs will be tested using the World Harmonised Light-duty Test Cycle (WHTC) which is more transient in nature and better reflects urban driving conditions. In addition, the type-approval emissions performance has to be verified for "Real Driving Emissions" (RDE) using a Portable Emissions Monitoring System (PEMS) which is attached to the vehicle exhaust whilst it on the road. A "Conformity Factor" (CF) is applied to RDE to allow for different parts of the duty cycle and the measurement tolerance of PEMS. Euro 6 will be phased in over the period 2016 to 2020 (Euro 6a/b, Euro 6c and Euro 6d) with each phase becoming more stringent in terms of the CF allowed. An analysis of recent test results for Euro 6a/b vehicles suggests an average CF of about 4. This suggests that, on average, NOx emissions from Euro 6a/b vehicles are 50-70% lower than from Euro 5. This should improve further as the CF is tightened to 1.5 by 2020.

HDVs are tested using the World Harmonised Stationary Cycle (WHSC) and World Harmonised Transient Cycle (WHTC). This includes a "Not to Exceed" approach for "Off-Cycle" testing, such that tests are applied at random points (speed and load) on the fuel map. HDVs are also subject to PEMS tests, conducted over a mixture of urban, rural and motorway conditions.

Ana analysis of recent tests suggests that NOx emissions from Euro VI vehicles are some 75-95% lower than from Euro V.

In conclusion, whilst there is the possibility that NOx emissions from Euro 6/VI vehicles may be higher than the type-approval standard, there is convincing evidence that they will be substantially lower than Euro 5/V, and will support the introduction of a LEZ.

A further issue to be considered is the emissions of "primary NO_2" (f-NO_2). Emissions from combustion processes are primarily as nitric oxide (NO) which is converted to NO_2 by reaction with ozone. At roadside locations, the reaction is "ozone-limited" as the atmosphere is "saturated" with NOx – this limits NO_2 concentrations at roadside sites. If f-NO_2 increases, this may increase roadside NO_2 concentrations. There is currently no European regulation on f-NO_2 emissions.

The f-NO2 emissions from diesel cars have increased from about 10-15% (Euro 3) to ~30% for Euro 4/5.

There is considerable uncertainty over f-NO_2 for Euro 6 diesel cars, and it is dependent on the exhaust gas after-treatment that is applied.

Any substantial increase to f-NO_2 could be detrimental to the efficacy of LEZs.

References to other work or publications to support your testimony' (if applicable):

Marner, B., Moorcroft, S. and Laxen D. (2016) Emissions of Nitrogen Oxides from Modern Diesel Vehicles. Air Quality Consultants – available to download at www.aqconsultants.co.uk

Carslaw, D., Beevers, S., Westmoreland, E. and Williams, M. (2011) Trends in NOx and NO2 emissions and ambient measurements in the UK, [Online], Available: uk-air.defra.gov.uk/reports/cat05/1108251149_110718_AQ0724_Final_report.pdf.

Carslaw, D. and Rhys-Tyler, G. (2013) Remote sensing of NO2 exhaust emissions from road vehicles, July, [Online], Available: http://uk-air.defra.gov.uk/assets/documents/reports/cat05/1307161149_130715_DefraRemoteSensingReport_Final.pdf.

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