Institute of Air Quality Management

Dealing with Uncertainty in Vehicle NO_x Emissions within Air Quality Assessments

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The IAQM issues Position Statements on matters that could affect the way in which Members carry out their professional tasks and on air quality topics and issues where the IAQM can provide a unique perspective from which to give a professional opinion.

The issue

It has been known since around 2011 that nitrogen oxides (NO_x) emissions from diesel vehicles have not declined as expected despite the introduction of increasingly more stringent European Union (EU) emission limits since the early 1990s[1]. This, together with an increase in diesel cars and the use of emission control devices that increase the proportion of the nitrogen dioxide (NO_2) in the exhaust NO_x, has resulted in annual mean concentrations of NO_2 remaining high, particularly at roadside locations. Both the annual mean national air quality objective and the EU limit value are widely exceeded.

Defra's emission factor toolkit (EFT v7.0) for road transport provides forecasts of NO_x emissions up to 2030. This is widely used as input to dispersion models such as ADMS-Roads to estimate future NO_2 concentrations close to new developments. This and previous versions of the toolkit have, however, consistently over-estimated the benefits of the European diesel vehicle emission standards on NO_x emissions, and therefore the modelling has under-estimated future concentrations.

Background

Up to EFT version 4 the Department for Transport (DfT) consultants, TRL, developed road transport emission factors for use in emission estimates, based on the results of emission testing. These were combined with AEA/Ricardo's fleet turnover model to produce the emission forecasts. DfT's routine testing programme has now ceased and the current version of EFT (v7.0) uses emission factors from COPERT (v4.11)[2].

COPERT is the most commonly used European model for the calculation of emissions from road transport. It is updated every few years and version 4.11 is based on emission tests from a small number of early Euro 6[1] cars. A large number of emissions measurements are now available which were not included when developing the current COPERT functions. These suggest that COPERT v4.11 is likely to under-predict NO_x emissions from Euro 6 diesel cars. COPERT V5 is now under development, but the beta version does not address this issue.

COPERT emission factors are based on average vehicle speeds. Real world driving emissions data show that emissions increase during acceleration, which is not well represented by the COPERT speed-emission curves. There can be a large variation in emissions for the same average speed. These effects are observed across all ages of vehicle and since there is no indication that this will change in the future, this issue is not specific to future-year predictions.

There is uncertainty of the impact of the introduction of the World-harmonised Light-duty Test Procedure (WLTP) which will replace the current driving cycle and the real driving emissions (RDE) test procedure from 2017 for new vehicle types and 2019 for all new cars (the Euro 6c standard). The new test cycles should mean that future Euro 6c vehicles will have lower emissions than the current Euro 6 vehicles. However, cars satisfying this future legislation do not exist yet and therefore cannot be tested. In addition, the new complex emission control technology used in some current Euro-6 vehicles, and in future Euro-6 RDE compliant vehicles, have unknown deterioration and failure rates, which may lead to substantial increases in emissions over time.

Despite these issues, the evidence from real-world testing is that NO_x emissions from current Euro-6 diesel vehicles are substantially lower than from Euro-5 vehicles[3]. Although there are uncertainties over the WLTP, and how PEMS might be used to determine RDE, NO_x emissions from future Euro-6 RDE compliant vehicles are likely to be lower than from current Euro-6 vehicles. In addition, there is a general consensus that Euro-VI for Heavy Duty Vehicles is delivering substantial benefits over Euro-V.

IAQM's Position on this issue

It is important air quality practitioners acknowledge the uncertainty in the EFT emissions factors and that they are adequately accounted for when predicting future NO_2 concentrations. There are a number of approaches that could be taken, based on applying a sensitivity test that assumes NO_x emissions will not reduce as rapidly as shown by the EFT. The choice of approach will depend on the specific circumstances of the project being assessed.

If a sensitivity analysis is undertaken and shows a large difference in the predicted future NO_2 concentrations there needs to be careful consideration of the implications, particularly how this will affect the impact descriptors in Table 6.3 of EPUK/IAQM guidance on *Land-Use Planning & Development Control: Planning For Air Quality*[4]. If the sensitivity analysis shows that the objective is likely to be exceeded by only a small margin, and the assessment year is many years in the future, it may be

[1]The first two stages of the Euro 6 requirements are known as 6a and 6b respectively. Euro 6b introduced a particle number limit for the first time. In this Position Statement they have been referred to as Euro 6 to differentiate them from the later Euro 6c cars.

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concluded that it is likely that the objective will be achieved. On the other hand, if it is exceeded by a large margin and the assessment year is only a few years away, it would be prudent to assume that that there may be an exceedance. Whether it is likely to be 3% or 10% above the objective (the cut-offs in Table 6.3 of the guidance) will need to be determined on a specific project basis and requires expert judgement. IAQM Members should take a precautionary approach. Where it is likely that there will be an exceedance of the objective, taking into account the results of any sensitivity analysis, appropriate mitigation measures should be recommended.

References

[1] Carslaw, D.C., Beevers, S.D. Westmoreland, E. Williams, M.L. Tate, J.E., Murrells, T. Stedman, J. Li, Y., Grice, S., Kent, A. and I. Tsagatakis (2011). Trends in NO_x and NO_2 emissions and ambient measurements in the UK. Version: July 2011.
[2] This was the version used in the modelling for Defra's 2015 Air Quality Plan (Defra, 2015).
[3] Department for Transport, 2016. Vehicle Emissions Testing Programme.
[4] EPUK/IAQM, 2015. *Planning & Development Control: Planning For Air Quality*.

About the Institute of Air Quality Management (IAQM)

The IAQM aims to be the authoritative voice for air quality by maintaining, enhancing and promoting the highest standards of working practices in the field and for the professional development of those who undertake this work. Membership of the IAQM is mainly drawn from practising air quality professionals working within the fields of air quality science, air quality assessment and air quality management.

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