APPENDIX 12.3

FUTURE YEAR EMISSION CALCULATIONS

Introduction

Atmospheric dispersion modelling is used to determine the effect of future development traffic on local air quality. The modelling utilises predictions of the composition and emissions profile of the vehicle fleet which are produced by Defra in the emissions factor toolkit (EFT). The composition and emissions profiles are provided on a year by year basis from 2013 to 2030, with the database being periodically updated.

The main issue with regard to the modelling of future traffic impacts is the choice of emission factors to use given that there is a degree of uncertainty as to the accuracy of the emission factors, as well as uncertainty introduced by the modelling process and the traffic data on which the predictions are based. This has become more important in recent years as it has been realised that previous versions of the EFT were likely to have significantly underestimated the real world emissions of the vehicle fleet, as well as the more recent revelations concerning the use of ‘defeat devices’ on VW group vehicles.

This note therefore sets out PBAs approach to the choice of vehicle emission factors for future year assessments. The note has been revised following updating of the Defra Emissions Factor Toolkit in November 2017.

Modelling Methodology

As a prelude to the discussion of emission factors, it is useful to recap on the general methodology that is used for dispersion modelling of road traffic emissions:

- Traffic data is entered into the dispersion model to represent the baseline situation and the model is used to predict how NOx emissions are dispersed in the environment.
- The dispersion modelling predictions are compared to monitoring data to obtain a verification factor; the factor by which the predicted road traffic concentration must be multiplied by to agree with the monitored concentration.
- The modelling is repeated for the future year situation; with traffic data representing the situation without the development in place (the ‘without’ scheme scenario) and with the development in place (‘with’ scheme). In both cases, the verification factor obtained from the baseline modelling is used to multiply the model results by, in essence assuming that the model is equally as accurate in the future as it was for the baseline scenario.

The verification factor is one of the key elements in the discussion regarding vehicle emission factors. One element of uncertainty in the modelling is the degree to which the emission factors in the EFT are different to actual emissions of the vehicle fleet on the local road network. The use of the verification factor for the future year predictions essentially assumes that the difference between the EFT emission factors and real world emissions is the same in the future as it was in the baseline year. In other words, unless there is some reason to believe that the future year emission factors are less accurate than the baseline year emission factors, the degree to which the EFT emission factors and real world emission factors differ is taken into account in the modelling by the use of the verification factor. This is discussed further in the following sections.

Emissions Factor Toolkit

The EFT contains estimates of the future composition of the vehicle fleet in terms of the age and type of vehicles. The composition of the vehicle fleet is primarily related to the age of the vehicles (in terms of their emissions class) and the fuel that they use (i.e. petrol or diesel). In general terms, the majority of new vehicles replace much older vehicles, and as the emissions performance of vehicles is generally taken to improve over time, both current and historical versions of the EFT predict very large reductions in NOx emissions in the future. It is also obvious that the further one looks into the future, the more uncertain the predictions become as they depend on the rate of vehicle renewal and the size and fuel mix of the vehicles bought; which are all estimates.

The emissions performance of the vehicles is classified in terms of Euro type approval testing; Euro 1 to 6 concerning light duty vehicles and Euro I to VI heavy duty vehicles. Whilst the introduction of each Euro class has generally seen a tightening of emission standards, the standards up until now have been based on laboratory testing of vehicles. The emissions performance of the vehicles in real world driving conditions has been higher than the laboratory testing results, especially for diesel vehicles. This factor was not recognised in earlier versions of the EFT, and combined with the fact that diesel vehicles have much higher NOx emissions than petrol vehicles and there has been a very large increase in the number of diesel vehicles on the road, has meant that the NOx emissions and NO2 concentrations have not reduced as previously predicted.

The trends in NOx emissions in the vehicle fleet, especially diesel vehicles and the accuracy of the current version of the EFT, is therefore critical in terms of the choice of emission factors in modelling.

Trends in NO_x Emission

For light duty vehicles, the latest Euro standard is Euro 6, which was introduced from September 2015 (with a derogation in the UK for the registration of new vehicles until September 2016).

The emissions standards currently relate to a laboratory test whereby the average emission rate is calculated over an idealised drive cycle. The cycle used is the New European Drive Cycle (NEDC) and there has been extensive criticism that the drive cycle does not represent real world driving conditions. It has therefore been agreed that a new drive cycle will be introduced, the World Light-duty Test Cycle (WLDTC), as well as an on-road test termed Real Driving Emissions (RDE).

Up until September 2017, Euro 6 vehicles were only tested in the laboratory against the NEDC, and these vehicles are termed Euro 6ab. However, from September 2017, new models are tested against the WLDTC and will also have a RDE test. The initial introduction of the RDE test will allow vehicles to have average RDE test emissions of 2.1 times the WLDTC test standard (termed Euro 6c vehicles). The 2.1 factor is termed the conformity factor and will apply to new vehicle models from September 2017 and all new vehicles from September 2019. From January 2020, the conformity factor will reduce to 1.5 for new vehicle models (January 2021 for all new vehicles) and these are termed Euro 6d vehicles.

Air Quality Consultants undertook some research into the performance of diesel vehicles to support a methodology that they adopted for undertaking air quality assessments . As part of the analysis, they compared the real word test results of current Euro 6ab diesel vehicles and calculated an average conformity factor of 3.9 from the tests that were assessed. This work led to AQC publishing the CURED v2A calculator which attempted to take account of the real world emissions performance of diesel vehicles. The approach using CURED v2A was generally accepted to be conservative when considering developments a long time in the future.

Subsequently, the Department for Transport have undertaken testing of Euro 5 and 6ab diesel vehicles and found that the average NOx emissions were 1135 mg/km for Euro 5 vehicles and 500 mg/km for Euro 6ab vehicles . These work out to be a conformity factor of 6.30 and 6.25 for Euro 5 and Euro 6ab respectively. Adding in the DfTr results to the AQC results gives an overall average conformity factor for Euro 6ab vehicles tested of 4.1.

A paper presented by Dr Marc Stettler at the recent Westminster Energy, Environment & Transport Forum included results of RDE testing of existing Euro 6ab vehicles. Whilst there was wide range in the results, a number of the vehicles tested did already comply with the Euro 6c standard.

Similar results have been reported in a study led by Rosalind O'Drscoll of Imperial College . This showed that the average NOx emissions were 4.5 times higher than the Euro 6 limit, with an average NO2 percentage of 44%.

From the emissions testing work undertaken to date on Euro 6ab vehicles it is clear that the NOx emissions performance of Euro 6ab vehicles is significantly better than Euro 5 vehicles, although not in line with the laboratory standards. The introduction of Euro 6 should therefore see a significant reduction in NOx emissions in the future, as outlined in the following table.

Emission Standards	Real Driving Emissions NO_x mg/km
Euro 5, DfTr testing	1135
Euro 6ab, DfTr testing	500
Euro 6c, September 2017 models	168
Euro 6d, January 2020 models	120

Further testing of vehicles is ongoing, with Emissions Analytics regularly publishing the results of real world emissions testing on vehicles . Also, in the November 2017 budget, the government announced a one-off tax on new diesel cars not meeting Euro 6c standards. Both of these factors should help put pressure on vehicle manufacturers to meet the RDE standards. In the longer term, there is also the move to electric vehicles which will gather pace. Recent evidence in terms of vehicle procurement also suggests a decline in diesel vehicle sales due to negative publicity. These factors may mean that the vehicle fleet predictions in the EFT v8.0 are pessimistic with regard to vehicle NOx emissions.

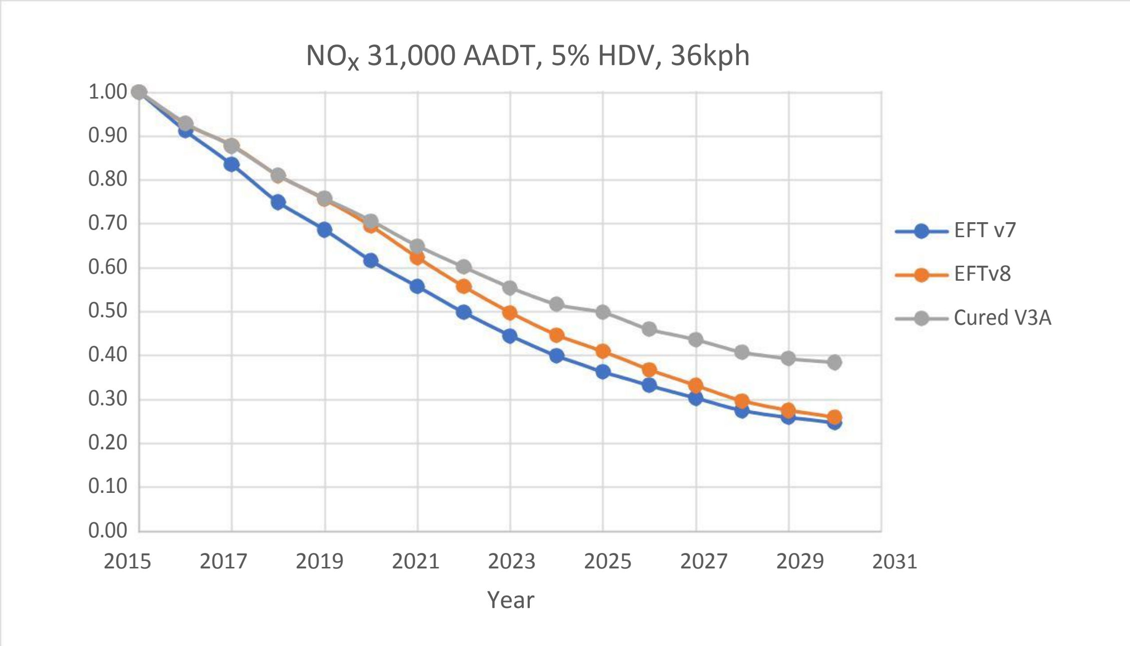
Emissions in the EFT

As noted in Section 3, the EFT contains estimates of vehicle emissions by Euro Class. The database was updated in November 2017 from v7.0 to v8.0. It now uses NOx emissions factors for the vehicles taken from the European Environment Agency's COPERT 5 database, compared to the previous COPERT 4 version v11.

The EFT now takes account of the real world performance of Euro 6ab diesel cars, applying a high conformity factor to these vehicles. For Euro 6c and Euro 6d vehicles, it assumes that the RDE will be effective in bringing down vehicle emissions, but does not assume that vehicle emissions will be as low as the conformity factors in the RDE testing. The EFT therefore incorporates an assumption that diesel car NOx emissions will be higher in real world driving conditions than the testing standards allow.

AQC have reviewed their approach to vehicle emissions following publication of EFT v8.0. CURED v3A has been formulated assuming that light duty vehicle emissions are as per EFT v8.0 up until Euro 6c. Euro 6d vehicles are assumed to have the same emissions as Euro 6c. Emissions from HDVs are assumed to be as per the EFT v8.0. Vehicle emissions using CURED v3A can be considered to be a worst-case sensitivity test post 2020.

The following graph shows the relative decline in vehicle NOx emissions predicted for a road in outer London with 5% Heavy Duty Vehicle traffic travelling at 36kph. As air quality models are verified against historic data, the relative decline in emissions is shown.



For emission years prior to 2021, the CURED v3A methodology is likely to give similar results to using the EFT v8.0 data. Post 2021, when the introduction of Euro 6d begins to take effect, then CURED v3A and the EFT v8.0 begin to diverge. By 2030, CURED v3A emissions are approximately equivalent to EFT v8.0 for 2025.

Future Year Assessment Methodology

The selection of emission factors for a future year assessment depends partly on the situation regarding the assessment to be undertaken. Where pollutant concentrations are low and are unlikely to exceed threshold levels, then one may take a conservative approach and keep emission factors at current levels. This will produce a conservative result, but as the result will be 'acceptable' in terms of leading to no exceedances of National Air Quality Strategy Objectives, then it is a reasonable approach to adopt as it avoids uncertainty as to whether there will be exceedances in the future.

In contrast, where pollutant concentrations are high, then a different approach to uncertainty is required. In addition, for a formal Environmental Impact Assessment the legal requirement is to assess 'likely significant effects'. This is not 'worst case' significant effects, but 'likely' significant effects and therefore must allow for a degree of uncertainty in the predictions.

As discussed in Section 2, the use of the verification factor in the modelling takes account, amongst other things, of the difference in the real world emissions performance of vehicles in the fleet. For developments up until 2021, the current EFT should be reasonably accurate as to NOx emissions as the problem with the performance of diesel vehicles has been recognised. As such, one is justified in using the emission factors for the year of the assessment as the uncertainty in the emission factors is taken account of by using the verification factor.

Developments post 2021 will increasingly be influenced by the assumption that the RDE testing of diesel vehicles is effective, which may or may not turn out to be the case. In essence, the result is likely to lie between the green and red curves of the previous graph. This is likely to become less important as the actual levels of emissions is significantly reduced in the future. If a conservative approach is warranted, one could follow the green curve, the effect of which is outlined in the table below.

Traffic Data Year	EFT v8 year
2015	2015
2016	2016
2017	2017
2018	2018
2019	2019
2020	2020
2021	2021
2022	2021
2023	2022
2024	2022
2025	2023
2026	2023
2027	2024
2028	2024
2029	2025
2030	2025
Beyond 2030	2025

In the case of a large development with a completion year a long time into the future, then if only completion year traffic data is available, it is likely to be appropriate to assume that the completed year traffic data occurs at the opening year of the development. As appropriate, a change in emission year in accordance with the above table may be considered; however, one must be careful not to be too conservative in that scenario.