REAL DRIVING EMISSIONS OF EURO 6 DIESEL PASSENGER CARS AND THEIR IMPACT ON URBAN AIR QUALITY

Introduction

Emission reduction measures have resulted in significant improvements in overall air quality in Europe. However, air quality remains a challenge in many urban areas and non-compliance with Air Quality Limit Values (AQLVs) remains an issue especially for nitrogen dioxide (NO_2) and particulate matter (PM).

In many cities, road transport has been the primary focus for emission reduction measures and diesel passenger cars in particular are often assumed to be one of the main causes of non-compliance with AQLVs. However, diesel vehicle technology has made significant advancements in recent years to reduce emissions. To ensure that the emission reduction measures result is similar real driving improvements, a new real-driving emissions (RDE) test procedure that measures vehicle emissions under more realistic real-world conditions and therefore provides more accurate information on the emissions generated in urban environments has been introduced.

Concawe commissioned two studies in 2017 to determine the expected emissions from the latest Euro 6 diesel passenger cars (including Euro 6d certified since September 2017) under the new testing methodology and to understand how the emissions from these new diesel cars would impact ambient air quality compliance when compared with zero emission vehicles (ZEV). The first study, completed by Ricardo, summarized RDE emission test data for Euro 6 passenger cars. The second project, completed by AERIS Europe, incorporated the data from the Ricardo study and modelled the impact of the diesel passenger cars on NO_2 and PM compliance, and population exposure under different scenarios including a scenario where all new passenger cars are replaced with zero tailpipe emission vehicles. A summary of both studies is provided in the following sections.

Expected Light Duty Vehicle Emissions from Final Stages of Euro 6

This study focussed on determining the actual and expected real driving emissions for multiple classes of Euro 6 vehicles (Euro 6b, Euro 6c, Euro 6d temp, Euro 6d). The study evaluated the test data for a number of diesel passenger cars run using the newly developed on-road RDE test procedure and other real world driving cycles and provided a prediction for how different Euro 6 vehicles, including the most advanced (Euro 6d) would perform. The data included literature values as well as those based on the test data generated from Ricardo's testing. The results (Figure 1) show that from existing data, real world NO_x emissions from diesel passenger cars are significantly reduced by successive improvements in Euro 6 legislation. In addition, the evidence suggests that the technical solutions currently being introduced when applied to Euro 6d cars will meet the 80 mg/km EU NO_x emission standard under RDE test conditions.

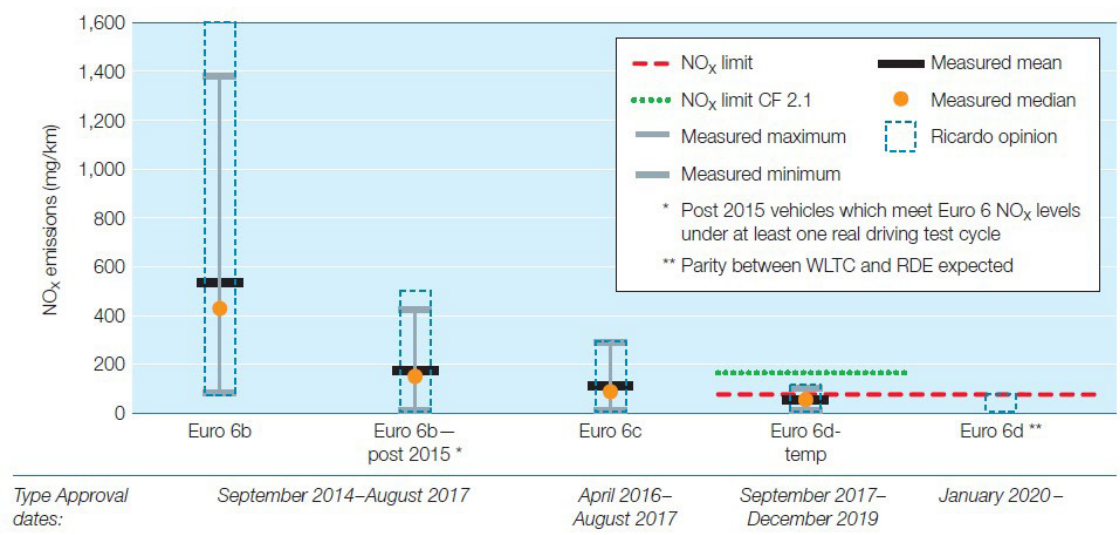

Figure 1. Measured NO_x emissions from Euro 6 diesel passenger cars under real driving emissions-test conditions (0°C to 30°C, 0 to 700 m altitude).

A comparison of ambient air quality compliance for real driving emissions from the latest Euro 6 diesel passenger cars and zero emission vehicles

The AERIS Europe study used modelling to investigate the impact that fleet turnover to the latest Euro 6 diesel passenger cars would have on NO_2 and PM compliance during the period 2020-2030 through EU-28. Detailed analysis was also performed for 10 European cities. The study used the results of the Ricardo project on Euro 6 diesel passenger cars performance under RDE conditions. The impact on NO_2 compliance and population exposure was examined for two scenarios:

- **Ricardo Median Scenario:** All diesel passenger cars introduced in a specific year are assumed to conform to the median level of the Ricardo results. This scenario assumes that all new diesel passenger car registrations from 2020 onwards are Euro 6d.

- **ZEV Scenario:** All new diesel passenger car registrations from 2020 onwards are replaced by a zero emissions vehicle undertaking the same amount of kilometres driven.

[1] The Base Case scenario is based on the January 2015 TSAP16 WPE Current Legislation Baseline Scenario, associated with the EU Air Policy Review process as generated by the IIASA GAINS model.

For PM emissions, two scenarios were considered. The first is the Base Case[1] and the second models the elimination of all diesel exhaust emissions for new passenger cars registered from 2020 onwards.

The results (Figures 2 and 3) show that the progressive replacement of older diesel passenger cars by Euro 6d diesel cars will show a similar improvement in urban air quality compliance compared to a replacement with zero emission vehicles. In terms of air quality compliance at measuring stations, the ZEV scenario is unlikely to deliver any significant improvement compared to the Ricardo Median scenario. To effectively address the remaining areas of non-compliance, an analysis of local sources of pollutants is needed to identify the most effective mitigation measures.

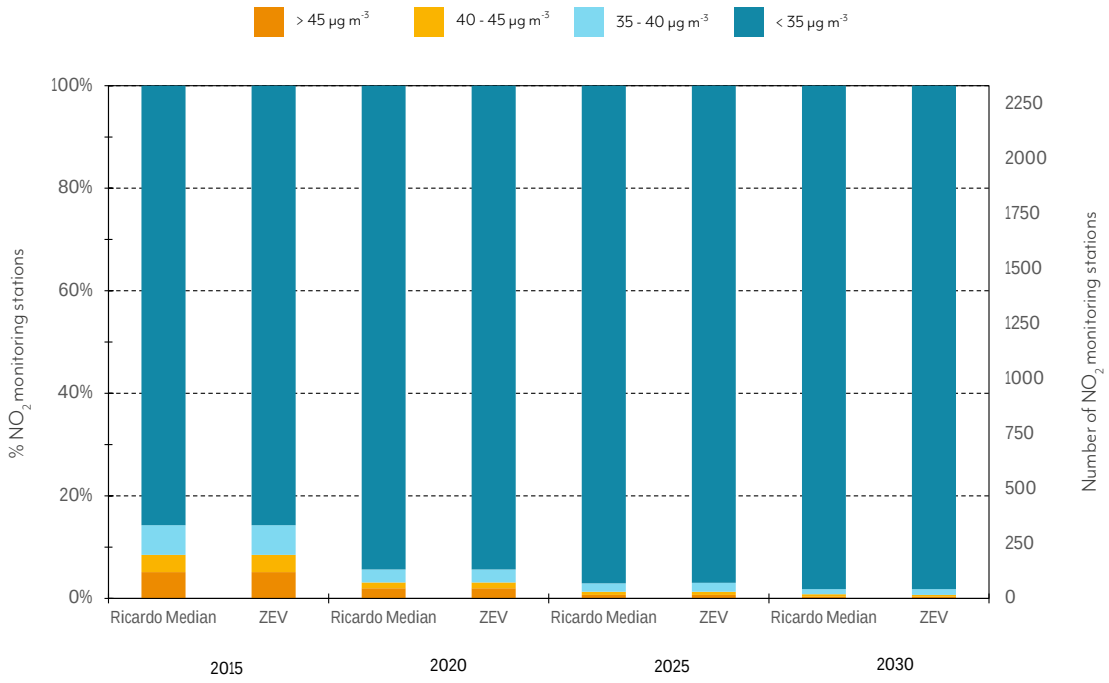

Figure 2. EU AirBase stations monitoring NO_2 annual mean concentrations (µg m^{-3}), above, and below the EU NO_2 annual limit value (40 µg m^{-3}): Ricardo Median and ZEV scenarios.

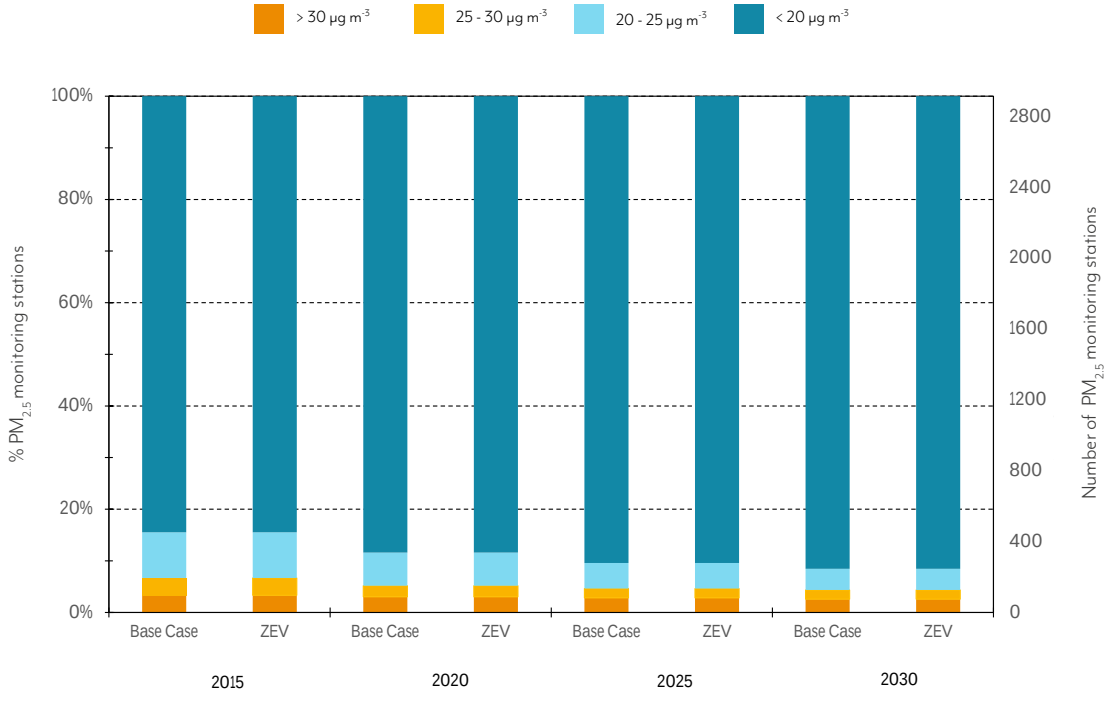

Figure 3. EU AirBase stations monitoring $PM_{2.5}$ annual mean concentrations (µg m^{-3}), above, and below the EU $PM_{2.5}$ annual limit value (25 µg m^{-3}): Base Case and ZEV scenarios.

In addition, the modelling at city level shows that there is almost no difference in population exposure between the ZEV scenario and the Ricardo Median scenario between 2020 and 2030, which is when the Euro 6d RDE compliant vehicles will start to enter the vehicle fleet (Figure 4, using Munich as an example).

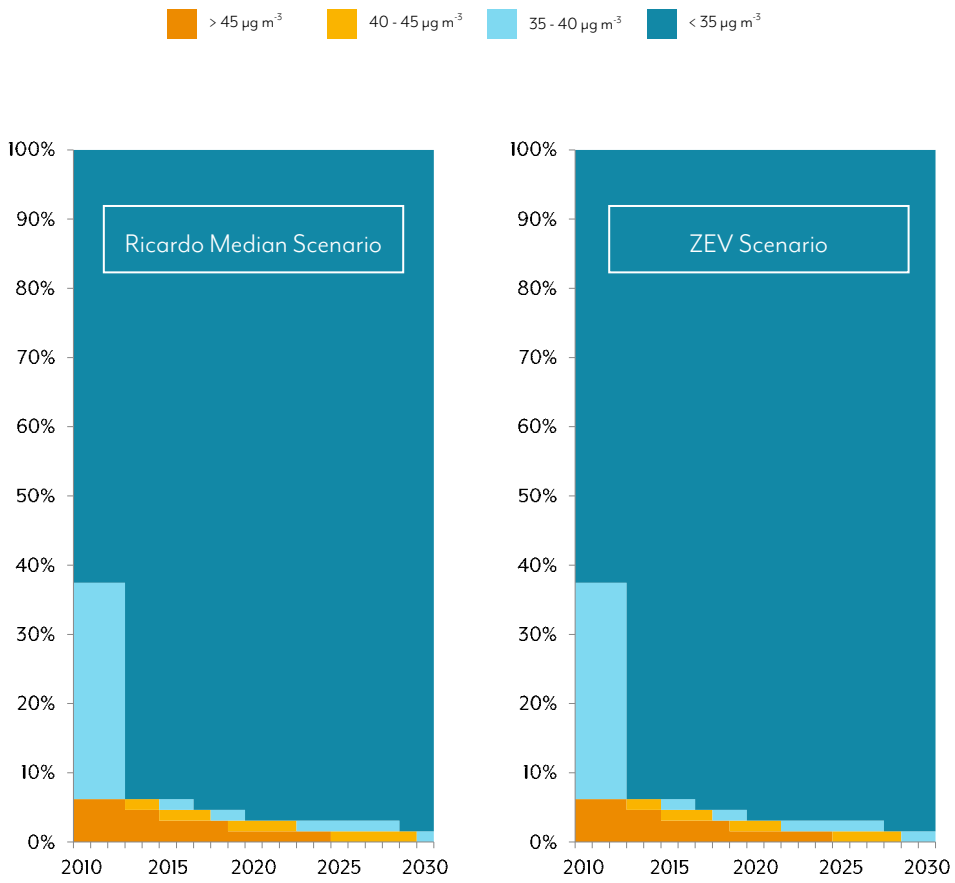

Figure 4. Population exposure to NO_2 in Munich - Ricardo Median and ZEV scenarios.

Conclusions

- The evidence suggests that the technical solutions currently being introduced when applied to Euro 6d will achieve the 80 mg/km EU NO_x emission standard for Euro 6 passenger cars, or better, under real world driving conditions.
- In the turnover of the vehicle fleet from older vehicles to new vehicles, the latest Euro 6d diesel vehicles will be as effective as zero emission vehicles in helping cities become compliant with air quality limit values.
- The modelling shows almost no difference in population exposure is expected between the Ricardo Median and ZEV scenarios. This is also true if the Ricardo maximum values are considered.
- Further developments on new vehicle emission standards or measures that exclude new diesel cars from cities are unlikely to deliver earlier compliance or a reduction in population exposure.

Study Links

- Expectations for Actual Euro 6 Vehicle Emissions. Ricardo. March, 2018. Available at: https://www.concawe.eu/wp-content/uploads/2018/04/RD18-000697-2-CONCAWE_Expectations_for_Actual_Euro_6_Vehicle_Emissions.pdf

- A comparison of real driving emissions from Euro 6 diesel passenger cars with zero emission vehicles and their impact on urban air quality compliance. Aeris Europe. April 2018. Available at: https://www.concawe.eu/wp-content/uploads/2018/04/Rpt_18_8.pdf

For more information visit **www.concawe.eu**

About Concawe

The scope of Concawe's activities has gradually expanded in line with the development of societal concerns over environmental, health and safety issues. These now cover areas such as fuels quality and emissions, air quality, water quality, soil contamination, waste, occupational health and safety, petroleum product stewardship and cross-country pipeline performance.

Our mission is to conduct research programmes to provide impartial scientific information in order to:

- Improve scientific understanding of the environmental health, safety and economic performance aspects of both petroleum refining and the distribution and sustainable use of refined products;

- Assist the development of cost-effective policies and legislation by EU institutions and Member States;

- Allow informed decision making and cost-effective legislative compliance by Association members.

Concawe endeavours to conduct its activities with objectivity and scientific integrity. In the complex world of environmental and health science, Concawe seeks to uphold three key principles: sound science, transparency and cost-effectiveness.