European Research Group on Mobile Emission Sources
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Information Paper

Diesel light duty vehicle NO_x emission factors

Recent news on emission control failures of diesel cars in the US and the EU have raised concerns on the representativity of diesel light duty vehicles emission factors, used for official reporting by parties to the LRTAP convention.

The ERMES group comprises lead independent institutes in the EU who are responsible for the development of road vehicles emission factors, used in the most widespread emission models, including COPERT, HBEFA, and VERSIT+.

ERMES partners would therefore like to share the following information with national experts and users of these emission factors and emission models.

How are passenger diesel car Euro 5 emission factors being affected by recent developments?

Emission factors up to Euro 5 diesel passenger cars (M1) have been mostly based on in-laboratory chassis measurements over non-regulatory driving patterns and with road load which, in most cases, has been determined with actual coast-down tests on the road. These conditions cover a much wider engine operation range than regulatory tests and should rather reflect a realistic driving operation. As a result, Euro 5 diesel car emission factors used in the models already have been 4-5 times higher than the emission limit value (0,18 g/km), actually closer to 0,8 g/km.

Reports on real-world testing of Euro 5 cars from TNO[1] and JRC[2] and unpublished measurements from LAT and TUG using PEMS, do not show substantially higher levels on the road than those already used in the emission models. Certainly, this first impression will have to be confirmed by dedicated tests. For the moment though, we do not have indications calling for urgent and substantial changes in the Euro 5 diesel passenger car emission factors used.

What about Euro 5 light commercial vehicles?

Recent measurements from EMPA and TNO[3] on Euro 5 light commercial vehicles (N1) showed that their emission levels can actually be much higher than for passenger cars, on average close to 1,2 g/km. The reasons for this deviation could include different engine calibration, the impact of vehicle loading on emissions, or different driving schedules than passenger cars.

These different levels for Dutch conditions are being reflected in the latest version of the Versit+ model. To generate versatile emission factors for the EU, the information collected will have to be further processed with the model PHEM from TUG and then be fed to HBEFA and COPERT as soon as possible.

What is to be expected for Euro 6 diesel vehicles?

As has been presented in previous ERMES reports[4,5], emission factors for Euro 6 cars were based on a rather small sample of early Euro 6 vehicles and are in the order of 0,3 g/km. Actual Euro 6 vehicle models on the road are equipped with different NO_x emission control technologies which exhibit significant variance in their emission performance. Moreover, recent reports from TNO[6] and ICCT[7] showed that current Euro 6 cars may actually on average emit higher, especially in urban conditions, than current emission factors show. In each member state, the average NO_x emission level will also depend on the mix of the different emission control technologies used.

There are two more things that one has to consider. First, the Real Drive Emissions (RDE) regulation in preparation at an EU level is expected to improve the effectiveness of emissions control in the real world. Therefore, it is expected that real-world emission factors will significantly improve when RDE is in place. Second, in anticipation of the RDE framework, one may expect that new Euro 6 models are gradually improving, employing more robust emissions control.

As a summary, current real-world Euro 6 emission levels seem to be higher than the average level of the emission factors used, but these levels should be decreasing with time. Delivering robust Euro 6 emission factors for different conditions requires actual testing and analysis of emissions of more vehicle models than available today.

Why don't we urgently revise emission factors?

Given current indications, one might be tempted to urgently correct emission factors. However, it would not be wise to make a patchy revision now and change emission factors again, as soon as new measurements become available. However, this document provides some indications on where we expect most of the changes will occur. National experts may use these indications when consulting with the national and international authorities.

What would it take to revise emission factors?

In order to develop new emission factors we obviously need to execute on-road tests of new (Euro 6) vehicle models to capture actual emission levels. For such tests, vehicle models need to be carefully selected to reflect main emission control technology penetration in the fleet and include indications of compromised emission control algorithms. In addition, ambient conditions for on-road tests have to be systematically selected to cover the variety of temperature conditions. The test data then have to be implemented in simulation tools to calculate the emission levels for the same representative driving conditions as already employed for EURO 0 through EURO 4 vehicle technologies.

Second, we need to perform on-road and chassis dynamometer tests in the lab, particularly for Euro 5 vehicles, in order to capture the magnitude of a possible systematic difference between in-lab and on-road emission levels, in order to possibly correct existing emission factors.

We may also need to consider the possibility that Euro 6 cars of different technologies show distinctly different real-world emissions performance, including also variability in the performance under different climatic conditions. In such a case, accounting for national environmental conditions and the share of these different technologies in national fleets will be required.

Are diesel NO_x the only problem?

We cannot say this for sure. We have limited information, *e.g.* on how aged emission control systems of both gasoline and diesel vehicles perform. Although the share of pre-Euro 4 vehicles is decreasing with time, these may disproportionally be contributing to total emissions.

Moreover, there is a continuous trend in South and Eastern EU to convert petrol vehicles to LPG. Earlier measurements[8] on a small sample of retrofitted LPG vehicles showed significantly elevated emission levels after conversion. However, the actual magnitude of this problem is not known while the number of retrofitted vehicles is increasing around Europe to a few million already.

In addition, more information on non-regulated pollutants is required. For passenger cars and light commercial vehicles there are no NH_3 emission limits, despite urea injection in the exhaust, while it is known that aged three way catalysts can be significant sources of on-road NH_3.

Issues are also known in the area of greenhouse gas control, including an increasing deviation between real-world and type-approval CO_2 emissions[9,10], our very limited knowledge of N_2O emissions, and others. Key priorities for future research studies is provided in a relevant JRC report[11].

How can these problems be addressed?

ERMES produces an annual report[12] on road traffic emissions areas that require attention and provides a list of actions that are required to improve emission factors. ERMES uses this document to guide national and international research for these activities. The objective has always been to deliver coordinated actions at the EU level on what is required to provide reliable emission factors for national inventorying and air quality modelling.

However, road transport emissions are often considered to be well understood and funding for actual testing and monitoring real-world emissions has significantly been reduced over the last years. Current, unfortunate, developments have shown that independent monitoring of vehicle emission levels continues to be absolutely necessary.

Therefore, ERMES urges national authorities and the European Commission to support the activity of real world emission testing and emission factor production. The institutes

constituting ERMES have the capacity, the experience, and the independence required to generate those emission factors.

It should not be forgotten that all investment that goes into the development of emission factors pays off by improved air quality, decreased environmental and health impacts and therefore substantial reductions in the external costs of transport.

References

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