Traffic-related Nitrogen dioxide – a risk to human health

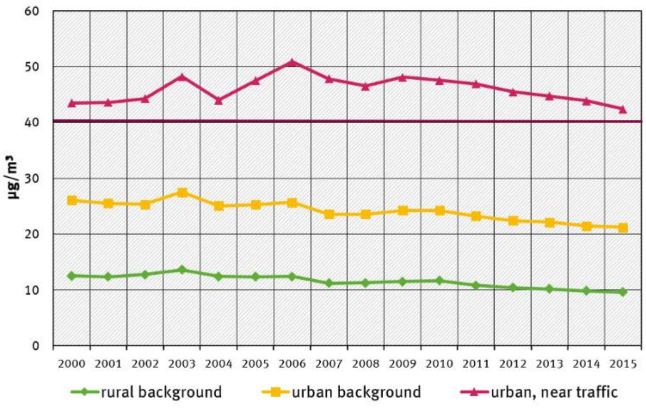

Figure 1: Annual average concentrations of NO_2, 2005–2015.
Source: UBA 2016.

As in previous years, the current EU limit value for nitrogen dioxide (NO_2) of 40 µg/m³ – as an annual average – was exceeded in 2015 at many measuring stations near roads (**Figure 1**). This limit value and the limit value for short-term exposure (200 µg/m³, hourly value) were introduced throughout Europe to protect human health, because inhaled NO_2 poses serious health risks. High short-term exposures to NO_2 may cause irritations of the respiratory tract. Long-term exposures, particularly when combined with exposure to other ambient air pollutants, may lead to reductions in lung function, chronic cardiovascular diseases, lung cancer, and as a result, to premature deaths. Children are particularly vulnerable to high NO_2 exposures. They are more likely to suffer from coughs, bronchitis and respiratory tract infections when exposed to levels higher than the short-term limit value, which are however, rarely observed in Germany. In their initial calculations on the burden of disease, the European Environment Agency has estimated that in Germany in 2012, 10,400 premature deaths, and thus, around 112,400 years of life lost, were attributable to NO_2 exposure.

Trend in NO_2 pollution

In Germany, emissions of nitrogen oxides (NOx) from all sources (industry, domestic heating, transport…) have been decreasing since 2000. Thanks to the introduction of EU exhaust emission standards, NOx emissions from the road traffic sector have even decreased by over 50%. Nevertheless, road traffic emissions are currently still the main source of overall NO_2 emissions, particularly in densely populated urban areas. The main source in these areas are diesel cars, which account for 67% of traffic-related NOx emissions.

Chassis dynamometer laboratory versus real-world driving conditions – the decisive difference

With the introduction of EU exhaust gases legislation, NOx emissions in the exhaust of petrol and diesel cars have been continuously reduced in tests in the chassis dynamometer laboratory. For petrol cars it has also been possible to largely achieve compliance with the Euro 5 and 6 standards in on-road operation. While the exhaust emission limit values for diesel cars should have led to an 85% reduction in their exhaust gas emissions from 2000 to today, real-world, on-road emissions from diesel cars show a decrease of only about 40%. The International Council on Clean Transportation (ICCT) has tested 15 diesel passenger cars using a portable emissions measurement system (PEMS). This demonstrated that the legal exhaust emission limits were not met during real-world operation: On average, real-world emissions were about seven times higher than the limits [3]. This discrepancy has led to the fact that the long-term NOx reduction targets are not reflected in the measured air quality data since 2005. In addition, a forecast of the development of car fleet composition (UBA, TREMOD 5.61) has predicted that the number of diesel passenger cars will grow by about 90% by 2030, compared to 2005, while the number of petrol cars will fall by 25% during the same time period (Figure 2). This increase in the number of diesel cars, and the emission problem in real-world operation are causing NO_2 levels in the air we breathe to rise.

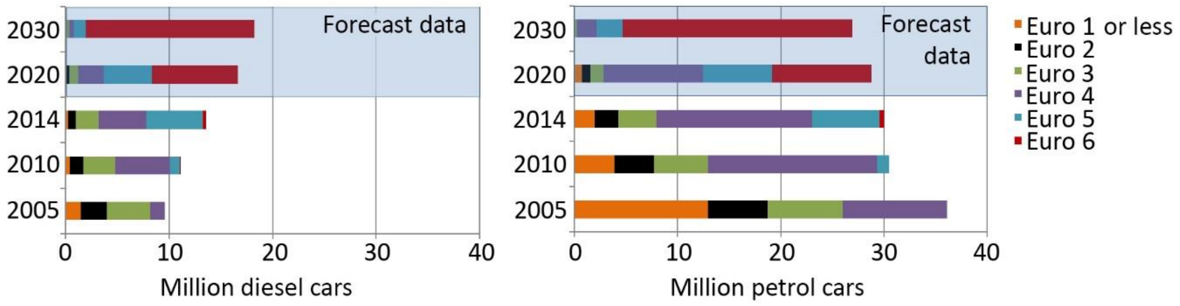

Figure 2: Number of diesel and petrol passenger cars, by EU exhaust emission standard.

Conclusion

Despite notable reductions in NOx emissions, health risks remain. Due to the gap between diesel vehicles' real-world emissions and the levels measured in chassis dynamometer laboratory tests, the EU limit values for NO_2 concentrations in ambient air often cannot be met. This poses a risk to human health, particularly because the studies conducted to date have not found a health-effects threshold for NO_2. This means that even concentrations below the EU limit values can harm human health. Measures necessary to reduce pollution by NO_2 from road traffic to protect human health and to meet the EU limit values in future include, for example, legally requiring emission measurements to be conducted in real-world, on-road operation. Reducing the diesel car fleet and further promoting electro-mobility might also lead to a reduction of NO_2 levels in ambient air in Germany.

Further research is needed to better assess the disease burden due to NO_2 in Germany. The German Environment Agency is therefore conducting a research project to estimate the burden of disease resulting from air pollution caused by NO_2 in Germany. The project will, in a first step, determine population exposure in terms of NO_2 background concentrations. By combining exposure and health data, it will then estimate the disease burden attributable to NO_2 exposure. First results are expected to be available by the end of year 2016.

References

[1] Umweltbundesamt (2016): Luftqualität 2015. Vorläufige Auswertung. [short link: http://bit.ly/1PWr5AV]

[2] EEA (2015): Report No 5/2015 Air quality in Europe. [short link: http://bit.ly/1PVQoC7]

[3] Franco V, Sánchez FP, German J et al. (2014): Real-world exhaust emissions from modern diesel cars. White Paper. The International Council on Clean Transportation. [short link: http://bit.ly/1EUVuXU]

Imprint

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