

The NO₂-Problem in (European) Cities: What is the impact of Diesel vehicle emissions?“

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Fine particulate matter and nitrogen dioxide (NO₂) are the key problems for increasing air quality in Europe. Whereas particulate matter and the exceedance of PM limiting values have attracted considerable public attention during the last couple of years, the NO₂ problem is a relatively new one, which became mature through the introduction of new European limiting values in January 2010.

The reduction of nitrogen oxide (NO_x=NO+NO₂) emissions has been historically one of the key objectives for improving air quality in Europe. NO_x emissions have started to decrease considerably since the mid eighties of the last century in many European areas. In Germany the decreasing NO_x concentrations at urban measurement stations are in agreement with the reduction of NO_x emissions from vehicular traffic. However, the measured NO₂ concentrations are stagnating nationwide. In 2015, at more than the half of the urban measurement stations in Germany, annual mean values for NO₂ exceeded the new Europe-wide limit value of 40 µg/m³ (20 ppbv) NO₂. Similar findings are reported from many other member states of the European Union.

The observed trend of the airborne NO₂ concentrations has different reasons. Firstly, the NO₂/NO_x emission ratio has increased significantly during the last two decades, mainly because of the introduction of novel diesel engines. Furthermore, secondary NO₂, caused by the titration reactions of NO with ozone (O₃) and peroxy radicals (RO₂), is responsible for the major fraction (approximately 70%) of the measured NO₂. However, secondary NO₂ shows a highly nonlinear dependency on NO_x and thus, is decreasing much more slowly than expected from the decreasing NO_x levels.

Based on the results from the present study, the increased NO₂/NO_x emission ratio can only explain a minor fraction of the observed high airborne NO₂ concentration in city centres.

A significant reduction of primary NO₂ emissions, due to improved exhaust gas treatment, will not have a strong influence on urban NO₂ levels, and a further significant reduction of the NO_x emissions, in particular from diesel vehicles, is necessary in order to meet the annual mean limit value for NO₂ of about 20 ppb in the future.