03.11.2
Traffic-Related Air Pollution Along Streets 2020 and 2025 (Edition 2018)

Abstract

Berlin's motor vehicle traffic has for years now been the cause not only of considerable noise immissions in significant problem areas, but also of air pollution, especially since other categories that originally contributed to air pollution in Berlin have been substantially reduced.

In the proximity of high pollution immission, such as at busy urban canyons, high concentrations of immission occur. Unlike in most industrial areas, there are many people on traffic filled streets, be they residents, customers or workers, who face increased exposure to pollution. In order to meet EU Directive 2008/50 and especially also the 39th BImSchV, ordinance on air quality standards and emissions limits, to comply with emission limits at the locations of the highest concentrations, quantification of harmful pollutants must be as complete as possible.

For this purpose, in Berlin, air quality measurements have been supplemented by model calculations for all high-traffic streets in which limits could potentially be exceeded.

However, even at high-traffic urban canyons, the existing pollution produced by other sources in the city, and introduced by the long-distance transportation of pollution, is an important factor. Therefore, for the planning of measures to improve air quality in Berlin, a system of models was used, which can calculate the wide-ranging influence of distant sources, as well as the effect of all emitters within the city, even at high-traffic urban canyons. The model uses the levels:

- urban canyon
- city-wide background pollution, and
- regional background pollution

The results of the measurements of recent years and the comprehensive model calculations carried out for 2015 lead, among other things, to the following conclusions:

- The NO_2 pollution measured both in the Berlin suburbs and in residential areas and along primary roads has decreased only slightly, and in urban canyons it almost always exceeds the limit of 40 µg/m³ for protecting human health. Annual mean values of between 41 and 73 µg/m³ along primary roads, 27 µg/m³ in inner-city residential areas and 14 µg/m³ on the outskirts were measured in 2015. In 2017, too, the annual mean values along primary roads exceeded the 40 µg/m³ limit consistently, ranging between 41 and 63 µg/m³. Very similar values had already been observed in 2001. Despite improvements in exhaust gas technology and despite a slight reduction in motor vehicle traffic in Berlin between 2010 and 2015, the expected substantial reduction in NO_2 emissions has not yet occurred. The largest decrease is expected at Hardenbergplatz. The BVG (Berlin Transport Services) buses that mainly operate there have been gradually retrofitted with nitrogen filters or have been replaced by new clean buses in recent years. While an annual NO_2 mean of 62 µg/m³ was measured here in 2014, this number dropped to 53 µg/m³ in 2015 and to 45 µg/m³ in 2017.
- One of the reasons for the generally negligible decrease in NO_2 is the strong increase in the number of diesel vehicles in Berlin. Whereas in 2002 approx. 14 % of all cars and light commercial vehicles had diesel engines, this proportion increased to approx. 35 % in 2015. Diesel vehicles emit significantly more nitrogen oxides than petrol-fuelled vehicles. The share of NO_2 in the exhaust has also increased in the last 10 years from less than 10 % to more than 40 %. Thus, diesel vehicles contribute disproportionately to the NO_2 pollution along primary roads. It has also turned out that diesel vehicles with the newer exhaust emissions standard Euro 5 sometimes produce higher NO_x emissions than diesel vehicles with the older Euro 4 standard.

Prognosis for 2020 and 2025:

- To calculate the emissions forecast for 2020 and 2025, the Emissions Register was updated factoring in that the city is growing. Furthermore, improved heating technologies, the switch from coal to other energy sources and the efficiency increase of large combustion plants as well as the regular renewal of the motor vehicle fleet were taken into account. All measures the traffic sector had adopted by 2017, including the planned expansion of bus services, completion of tram lines, completion of new road sections and the promotion of bicycle traffic, were also considered.
- To calculate traffic-related emissions, the traffic model was adapted for the years 2020 and 2025. Congestion plays an important role in determining traffic-related emissions accurately. A new method was hence devised, which deduces congestion volumes to be expected in the future based on the current situation and the forecast driving volume. The traffic indicators for 2020 and 2025 thus determined were subsequently used to calculate traffic-related emissions. The effectiveness of the Euro 5 and Euro 6 diesel vehicle "software updates" were considered here in addition.
- As a result of fleet renewal, traffic-related NO_x emissions will see an average drop of about 26 % by 2020, with a similar or slightly higher driving volume and slightly poorer traffic conditions.
- The highest traffic-related reductions of NO_x emissions have been predicted for public buses with 56 %, heavy trucks with 31 %, coaches with 26 %, passenger cars with 20 % and light commercial vehicles with 11 %. Bus fleet renewals and retrofitting of the Berlin Transport Services (BVG) bus fleet were taken into account here, which led to substantial reductions in emissions.
- The immission forecast for 2020 revealed that NO_2 concentrations above 40 µg/m³ are still predicted for approx. 3.5 km of roads with about 4,000 residents. A possible deviation of roughly 4 µg/m³ is assumed, as, for example, the calculation model rather underestimates emissions as compared to measured values and as emission properties of the vehicles tend to be estimated too optimistically. **In 2020, road sections of approx. 15 km and about 16,000 residents will still be affected by exceeded levels**. Measures, including the following, have not yet been taken into account: 30 km/h speed limits that are being planned or in progress, fleet improvements through increased purchases of electric vehicles, hardware retrofitting for diesel passenger cars and light trucks, and other non-infrastructural measures, such as the promotion of ecomobility.
- The most severely polluted road sections in 2020 are located along Leipziger Straße between Wilhemstraße and the Bundesrat (Leipziger Str. 3-4) with a forecast level of 61 µg/m³, between Charlottenstraße and Friedrichstraße with a level of 56 µg/m³ and between Friedrichstraße and Leipziger Straße 21 with a forecast level of 51 µg/m³. Similarly high values are also simulated for the city motorway between Neue Kantstraße and Spandauer Damm. The simple calculation model used here, which is intended for simulations for the entire primary road network, cannot accurately reflect the complex road space situation there, with the city motorway positioned in a trough and any adjacent buildings located 5 m above that level.
- Brückenstraße, located between Köpenicker Straße and Rungestraße, is also expected to measure above 50 µg/m³. The remaining road sections affected by limit value exceedances are between 40 and 50 µg/m³.
- Causes for the high NO_2 pollution on Leipziger Straße:
- Berlin's entire road traffic accounts for 81 % of the pollution, 92 % of which is caused by diesel vehicles and only 8 % by petrol vehicles;
- slightly more than half of the NO_2 pollution emanating from motor vehicle traffic is caused by diesel vehicles, which rises to more than 70 % if combined with light commercial vehicles;
- public buses on Leipziger Straße only account for about 11 % of the additional NO_2 pollution. The contribution of public buses to NO_2 pollution has thus dropped substantially, which is already evident from measurements taken at Hardenbergplatz and is thereby confirmed.
- In a further step, additional non-infrastructural measures, including the increased promotion of ecomobility as specified in the Mobility Act and the new public transportation tariff structure, will be evaluated together as to their impact on motor vehicle traffic and air pollution through 2020.
- For 2025, it is predicted that all limits regarding air pollutants will be observed.

Index-based assessment

The map derived from the model calculations shows the spatial distribution of traffic induced air pollution for NO_2 and PM_{10}, as a prognosis for the year 2020. A summary assessment was conducted for both substances. The index developed weighs the calculated concentrations according to their limit values throughout the primary road network, which was expanded to some 12,000 road sections for this purpose, and then adds up the quotients. For example, if both components reach 50 % of the limit, an index of 1.00 will result. All sections that show a reading in excess of 1.8 (90 % or more of the limit value) will require special attention in future.

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