

V.2 The Brno agglomeration

The Brno agglomeration lies in the centre of the Southern Moravian region and is identical with the administrative territory of the City of Brno. There are several important sources affecting air quality in the city. The impact of these sources varies significantly in particular parts of Brno, depending on, for example, the type of heating or traffic load in a given locality.

Like other large cities, Brno, as the second largest city in the Czech Republic, faces a significant share of traffic affecting air quality, especially in nitrogen oxides. There is still no main city traffic circuit and this fact greatly reduces traffic flow in some parts of the city and in the city centre. Local heating is the most important source of particulate matter.

In 2019, construction activities were also intensively carried out in several places which may lead to a very high share of air pollution temporarily and locally, especially near the Brno-Zvonařka station and temporarily also Brno-Úvoz (hot spot). In addition to pollution from the building activity itself (building material heaps, demolitions, loading and unloading or moving material, movement of construction machinery, etc.), construction work often also leads to disruptions in traffic flow and traffic jams. Subsequent resuspension is also important.

The effect of long-distance pollution transport cannot be neglected either. Especially in the north-east flow, pollution from the Moravian-Silesia region or even across the border from Poland can reach the Brno area via the Zlín region through the Moravská brána territorial area. Particularly, if such a situation occurs during temperature inversion, high concentrations of pollutants appear and, possibly, a smog situation can be announced. However, in 2019 no smog situation was announced in the territory of Brno agglomeration, similar to the previous year. However, this is primarily related to the meteorological conditions which were relatively good in both years.

Tab. V.2.1 The territory of the Brno agglomeration with the exceeded limit values of the individual pollutants

Year	PM ₁₀ annual average	PM ₁₀ 24h	PM _{2.5} annual average	NO ₂ annual average	Benzo[a]pyrene annual average	O ₃
2012	–	27.7 %	3.04 %	2.45 %	45.03 %	4.02 %
2013	–	2.49 %	–	2.02 %	28.89 %	46.94 %
2014	–	0.54 %	0.43 %	–	0.43 %	–
2015	–	–	–	–	–	12.2 %
2016	–	–	–	0.87 %	1.85 %	0.01 %
2017	–	15.05 %	–	–	0.57 %	9.16 %
2018	–	13.17 %	–	–	13.64 %	37.17 %
2019	–	–	–	–	0.68 %	72.26 %

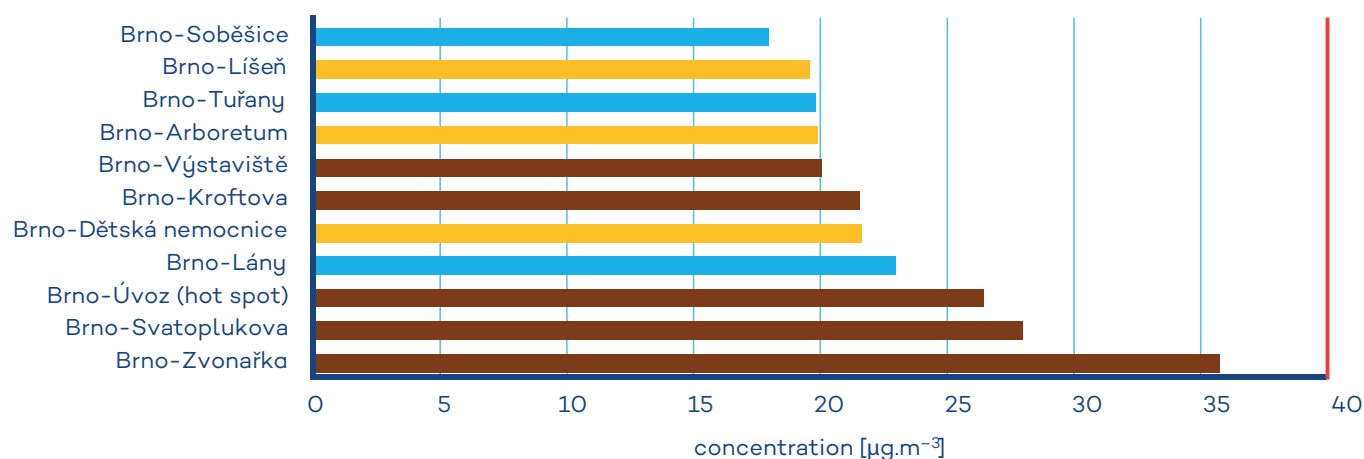


Fig V.2.1 Annual average PM₁₀ concentrations in 2019, Brno agglomeration

At the Brno-Zvonařka station, verified data for the period from January to March 2019 were not delivered in time, therefore it was not possible to calculate the appropriate averages and number of exceedances of the limit for this station. At the time of creating this part of the yearbook, only preliminary data were available and individual averages were calculated; however, it still represents operational data that may not completely reflect the final value and at the same time this station is not included in the tabular part which is created earlier. In the comparison the values 2010–2019, the data from the Brno-Zvonařka station were combined from two series for this station (traffic station until 31 August 2018 and industrial station from 1 September 2018).

V.2.1 Air quality in the Brno agglomeration

Suspended particulate matter PM₁₀ and PM_{2.5}

At two stations (Brno-Arboretum and Brno-Výstaviště), the monitoring equipment was renewed during April 2019 and replaced with a new one. Due to this change, complete data were not available at the time of closing the tabular section, and therefore annual averages are not included in this section. For the purposes of the yearbook, these averages were calculated (these numbers may differ in the final form), both stations met the condition of 90% data availability.

In 2019, as in the previous year, the pollution limit value for the annual average concentration of PM₁₀ fraction of suspended particles (40 µg.m⁻³) was not exceeded at any station in the Brno agglomeration (Fig. V.2.1). Of the stations that met the condition of

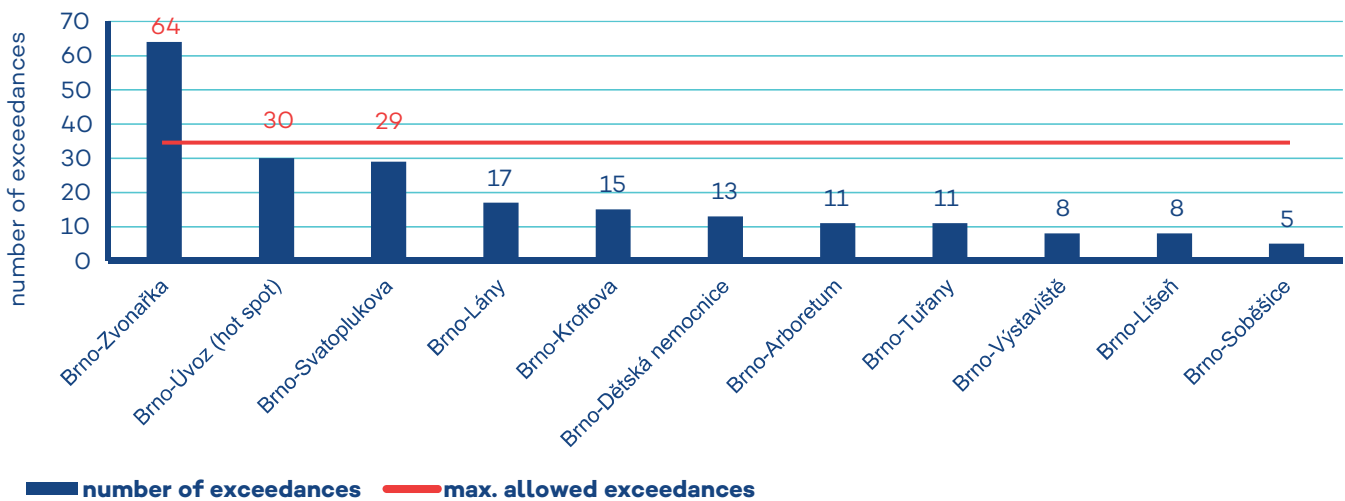


Fig V.2.2 Number of days with PM₁₀ concentration >50 µg.m⁻³ in the individual years, Brno agglomeration, 2019

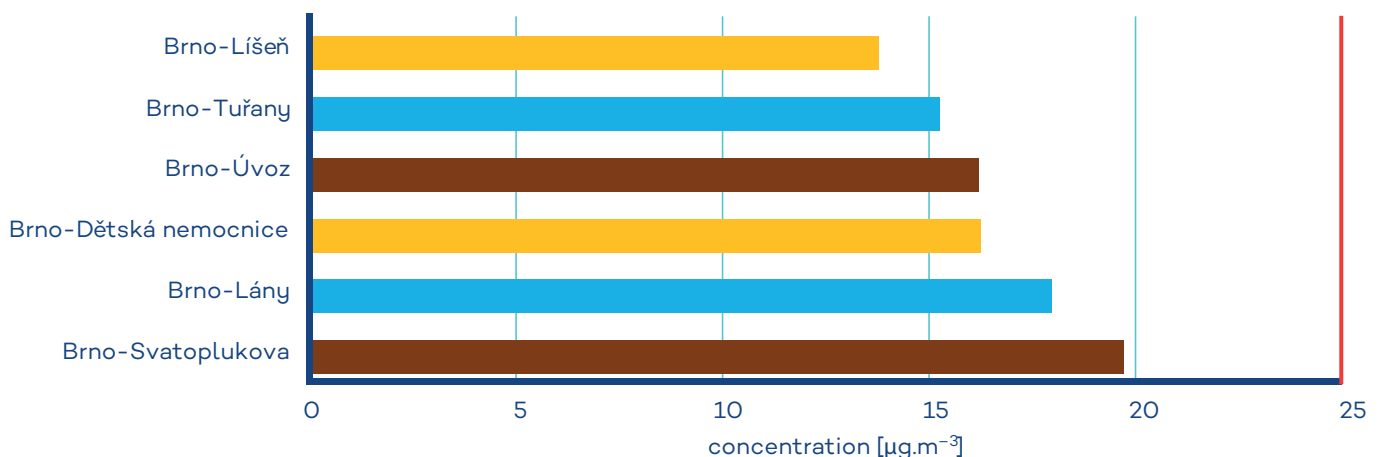


Fig V.2.3 Annual average PM_{2.5} concentrations in 2019, Brno agglomeration

data availability (11 stations), the highest annual concentration of PM_{10} was observed at the Brno-Zvonařka station ($35.8 \mu\text{g}\cdot\text{m}^{-3}$). This is a station that was significantly affected in 2019 by extensive construction work in the immediate vicinity of the station. For this reason, the station was temporarily reclassified as industrial in September 2018, and this situation lasted throughout 2019.

In 2019, the 24-hour PM_{10} pollution limit value ($50 \mu\text{g}\cdot\text{m}^{-3}$) was exceeded only at the above-mentioned Brno-Zvonařka station (64x) (Fig. V.2.2), where due to construction works, including demolition of buildings, a very high level of pollution occurs, especially by larger PM_{10} particles. This issue was also elaborated within the CHMI extensive study for the regional office of the South Moravian region, in which the impact of construction works was demonstrated, and measures were recommended to reduce the impact of construction works on air quality in general. At no other station the permitted number of 35 cases exceeding the limit value per year was exceeded.

The pollution limit value for the annual average concentration of $PM_{2.5}$ fraction ($25 \mu\text{g}\cdot\text{m}^{-3}$) was not exceeded at any station in the agglomeration in 2019 (Fig. V.2.3). Of the stations for which data for the annual average are available, the highest concentration was reached at the Brno-Svatoplukova urban traffic station ($19.7 \mu\text{g}\cdot\text{m}^{-3}$). Even according to the newly adopted air pollution limit valid from 2020 (reduction to $20 \mu\text{g}\cdot\text{m}^{-3}$), the annual air pollution limit for the annual concentration of $PM_{2.5}$ would not be exceeded at any station.

If we compare the course of average annual concentrations at the individual stations in recent years, we can say that the year 2019 was very good in terms of PM_{10} and $PM_{2.5}$ concentrations. The lowest annual average concentrations of PM_{10} since 2010 (or since the beginning of measurements at the given station, at the latest since 2016) were recorded at the vast majority of stations (Fig. V.2.4). For example, at the Brno-Arboretum station, for the first time since 2013, the annual average concentration was be-

low $20 \mu\text{g}\cdot\text{m}^{-3}$ ($19.9 \mu\text{g}\cdot\text{m}^{-3}$, the earlier minimum of 2017 was $24.0 \mu\text{g}\cdot\text{m}^{-3}$). The annual average was clearly the lowest since 2010 also at the stations Brno-Výstaviště, Brno-Lány, Brno-Svatoplukova, Brno-Tuřany, Brno-Soběšice and Brno-Kroftova. Data have been available at the Brno-Dětská nemocnice station only since 2014, and even here the value from 2019 was the lowest of all years. Exceptions are the Brno-Zvonařka station (for the above reasons) and the Brno-Úvoz station (hot spot) which were affected by construction activities in the immediate vicinity.

The situation is similar for smaller $PM_{2.5}$ particles. The lowest concentrations since 2010 were measured in 2019 at all stations with such a long time series (Brno-Lány, Brno-Svatoplukova – for the first time below $20 \mu\text{g}\cdot\text{m}^{-3}$, Brno-Tuřany), at two other stations with available data and shorter time series, there were also the lowest concentrations in the history of $PM_{2.5}$ measurements (Brno-Líšeň and Brno-Dětská nemocnice).

Such a good situation can be explained by several factors. The first, there was a very warm winter and a generally warm year of 2019, which reduces the need for heating which is the main source of PM_{10} emissions and especially $PM_{2.5}$. Another factor was the above-average dispersion conditions in the year. We can also expect a gradual replacement of boilers in households with new ones and a gradual renewal of vehicle fleet with new cars producing fewer air pollutants.

Nitrogen dioxide (NO_2)

The main source of NO_2 in the Czech Republic is traffic. The highest concentrations of this pollutant occur in large cities, one of them being the Brno agglomeration. Clearly, the highest concentrations of NO_2 have long been observed at the stations most affected by traffic, such as the Brno-Svatoplukova station or the Brno-Úvoz station (hot spot).

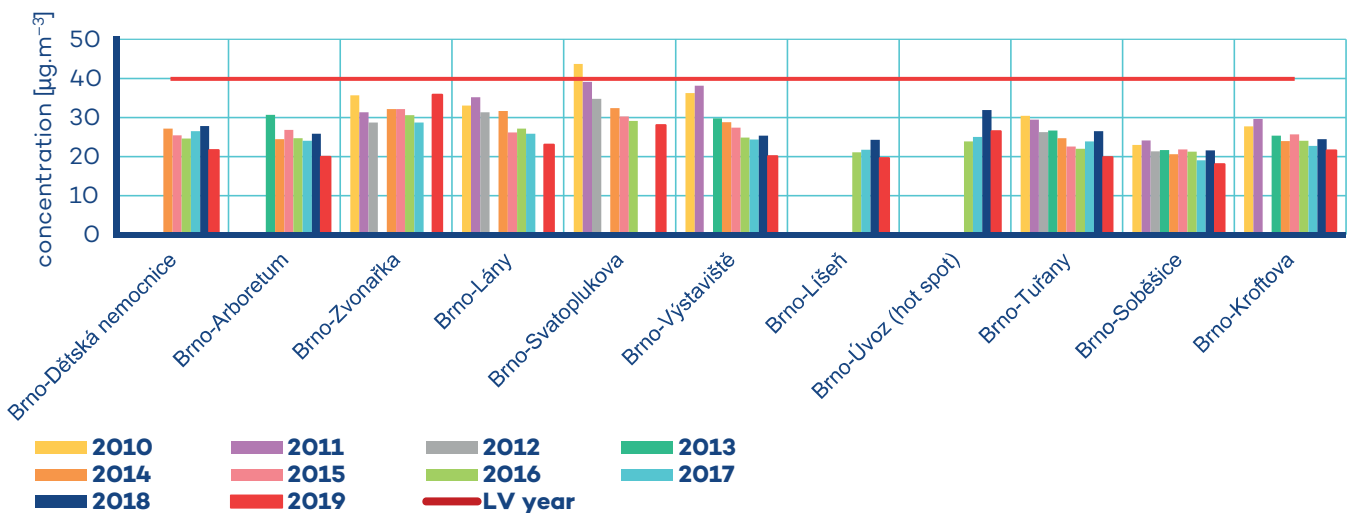


Fig V.2.4 Annual average PM_{10} concentrations between 2010 and 2019, Brno agglomeration

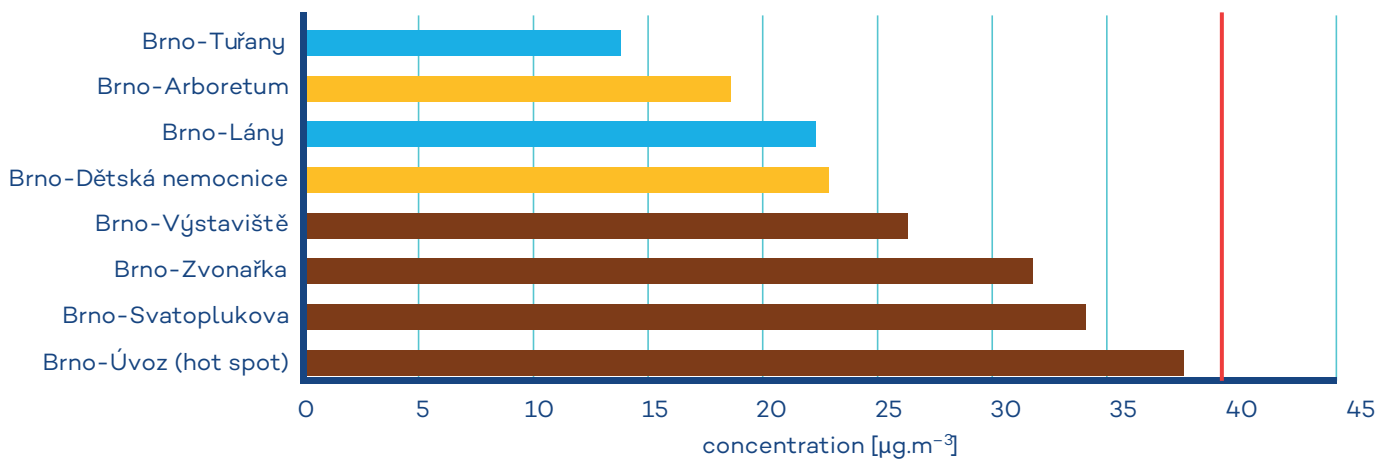


Fig V.2.5 Annual average NO₂ concentrations in 2019, Brno agglomeration

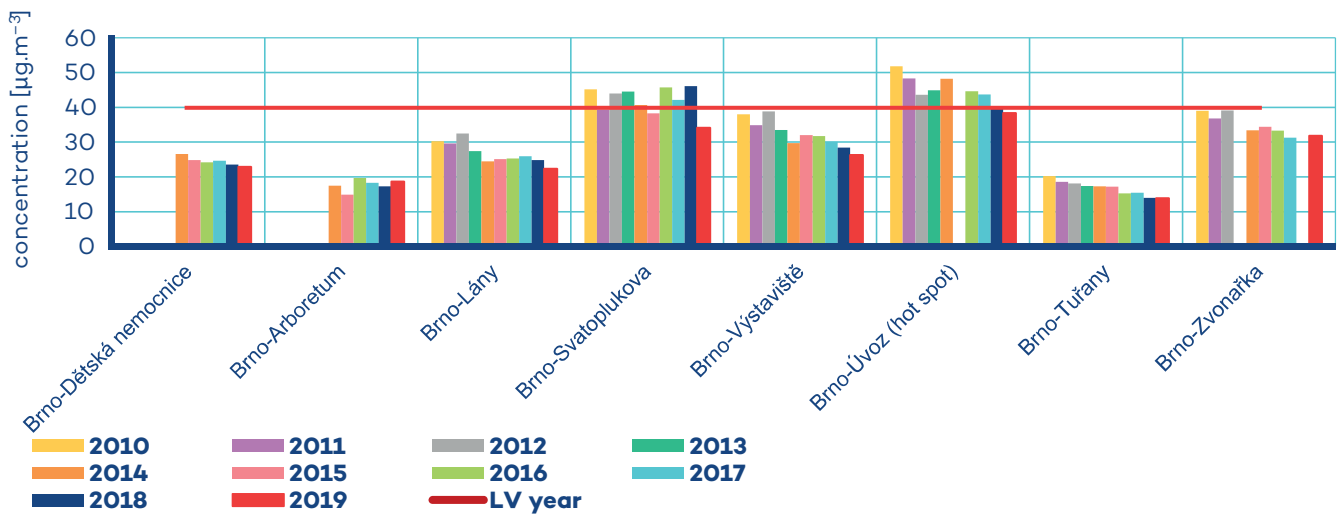


Fig V.2.6 Annual average NO₂ concentrations between 2010 and 2019, Brno agglomeration

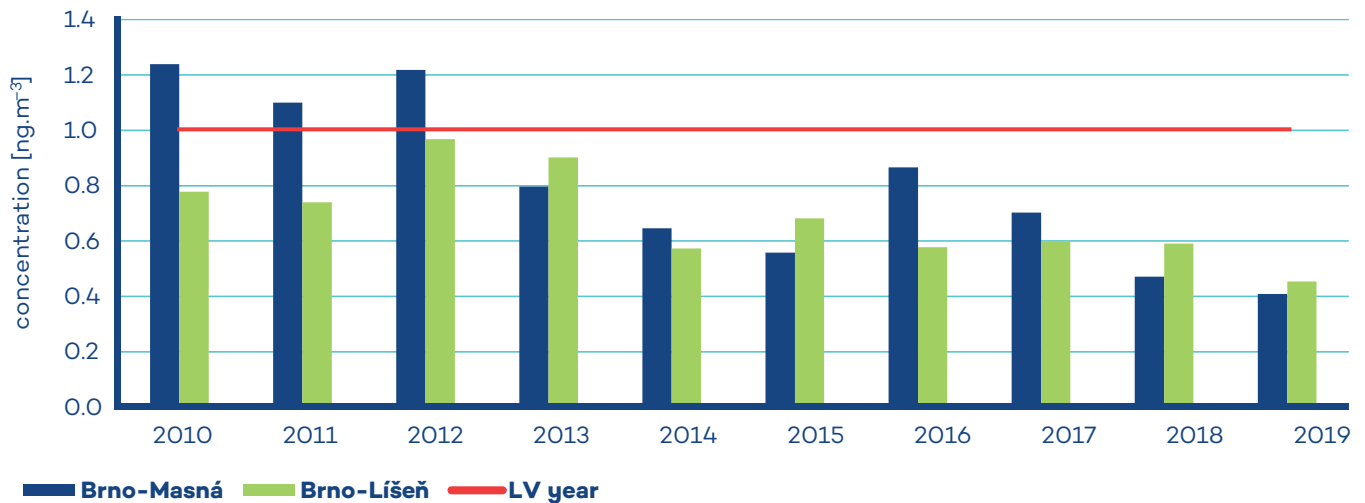


Fig V.2.7 Annual average benzo[a]pyrene concentrations between 2010 and 2019, Brno agglomeration

The annual NO₂ pollution limit value (40 µg.m⁻³) was not exceeded in 2019 at any station with available data (8 stations) (Fig. V.2.5). Compared to the previous year, we can see a decrease in the annual average at all stations except for the Brno-Arboretum station (Fig. V.2.6) where there was a slight increase in the annual average by approximately 1 µg.m⁻³. For example, at the Brno-Svatoplukova station, the most traffic affected station in the long-term with the highest annual NO₂ averages in Brno, the annual average decreased from 46.0 µg.m⁻³ (2018) to 34.1 µg.m⁻³ (2019). The highest average annual NO₂ concentration was measured at the Brno-Úvoz station (hot spot) (38.4 µg.m⁻³).

The hourly pollution limit value for NO₂ (200 µg.m⁻³) was not exceeded at any station in 2019.

As in the case of suspended particles, a significant contribution of good dispersion conditions in 2019 to the reduction of annual average concentrations can be assumed here as well. Gradually, however, the renewal of vehicle fleet in the Czech Republic is also evident, which contributes to the reduction of NO₂ and nitrogen oxide emissions in general.

Benzo[a]pyrene

Benzo[a]pyrene concentrations are monitored in Brno at two urban background stations – Brno-Masná and Brno-Líšeň. The pollution limit value for the annual average concentration of benzo[a]pyrene (1 ng.m⁻³) was not exceeded in 2019 at any of these two stations. At both stations, the annual average ranged between 0.4 and 0.5 ng.m⁻³ and in both cases it was the lowest value in the ten-year evaluation period 2010–2019 (Fig. V.2.7). However, it should be noted that benzo[a]pyrene monitoring is affected by the highest level of uncertainty countrywide. Its main source is local heating and, as some project measurements have shown, short-term concentrations of benzo[a]pyrene were measured to be much higher in small settlements around Brno. It is therefore possible that benzo[a]pyrene concentrations are higher in districts with a higher proportion of solid fuel heating. Nevertheless, a gradual decline has been observed in the last decade, which is probably related to the renewal of solid fuel boilers in households. The year-on-year decrease is rather due to meteorological conditions, espe-

cially duration of the heating season and the duration of periods with very low temperatures and thus a high extent of heating.

Ground-level ozone (O₃)

Data on ground-level ozone concentrations for 2019 are available for three Brno stations, namely Brno-Tuřany, Brno-Lány and Brno-Dětská nemocnice. In all cases, these are urban or, in the case of Brno-Tuřany, suburban background stations where the concentrations of O₃ are higher than at traffic stations.

In the 2017–2019 period, the allowed number of instances exceeding the pollution limit value was higher only at the Brno-Tuřany station (35.0 times), as in the last year. At the Brno-Dětská nemocnice station there were exactly 22 instances of exceeding the limit value and at the Brno-Lány station 24 instances (Fig. V.2.8). The cause of higher ground-level ozone concentrations at the Brno-Tuřany station is its location outside the city and also its location in a completely open space of the airport runway with direct sunlight.

The variation of ozone concentrations is very closely linked to air temperatures and the intensity of solar radiation in a given year. In recent years, which are characterised by above-average and sometimes even highly above-average temperatures in summer, the number of cases with concentrations of ground-level ozone exceeding the limit value increased.

Other substances

The concentrations of heavy metals (As, Pb, Ni, Cd) in the territory of the agglomeration have long been below the limit value, in some cases by two orders of magnitude (for example Pb at the Brno-Líšeň station, for which the annual limit value is set at 500 ng.m⁻³, reached only 3.3 ng.m⁻³ in the annual average of 2019).

Sulphur dioxide (SO₂) and benzene concentrations have long been below the limit values, same as concentrations of carbon monoxide (CO).

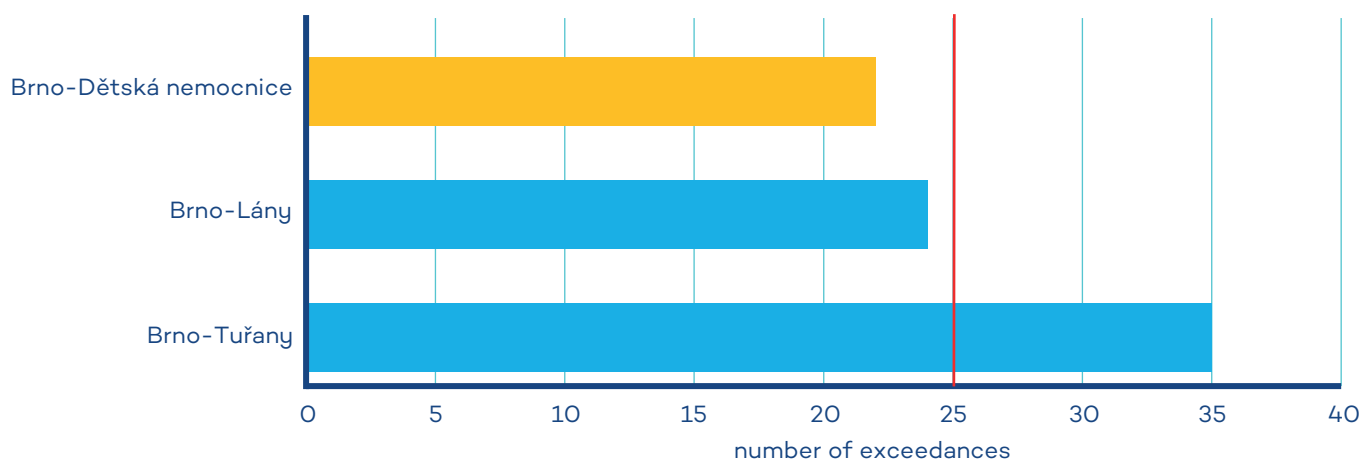
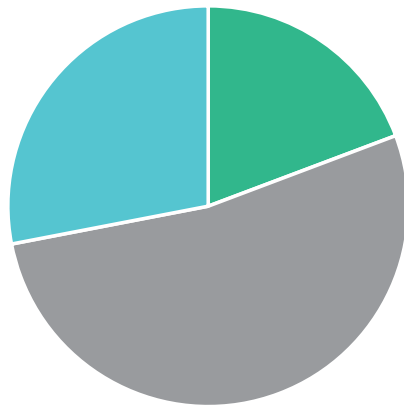
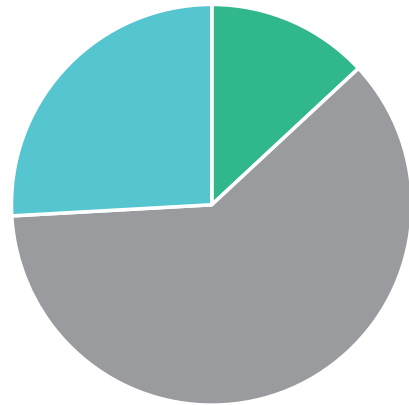


Fig V.2.8 Numbers of exceedances of the limit value of O₃ in the average for three years in 2017–2019

TZL

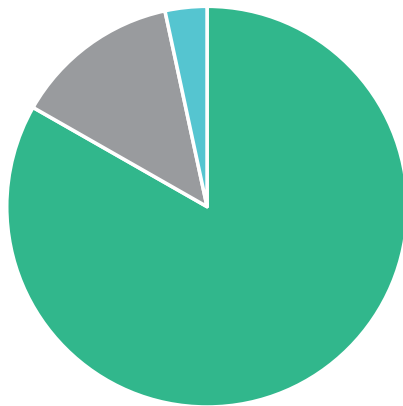


■ REZZO 1+2 ■ REZZO 3 ■ REZZO 4

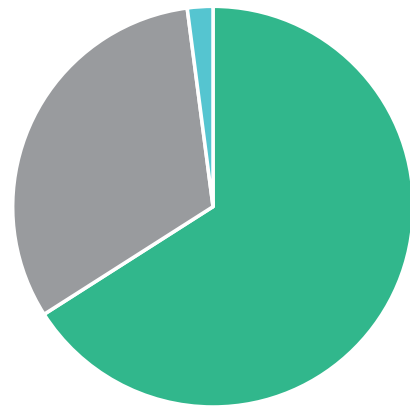


■ REZZO 1+2 ■ REZZO 3 ■ REZZO 4

SO₂

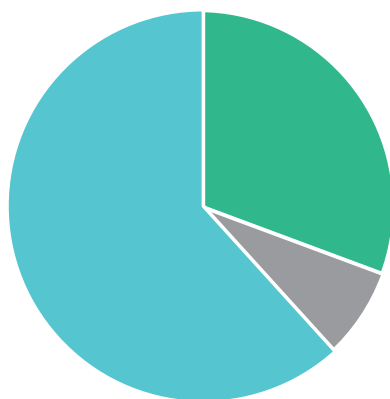


■ REZZO 1+2 ■ REZZO 3 ■ REZZO 4

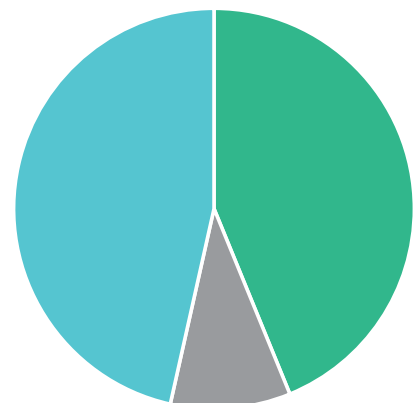


■ REZZO 1+2 ■ REZZO 3 ■ REZZO 4

NO_x



■ REZZO 1+2 ■ REZZO 3 ■ REZZO 4



■ REZZO 1+2 ■ REZZO 3 ■ REZZO 4

2008

2018

Fig. V.2.9 Emissions of selected pollutants listed according to REZZO, agglomeration of Brno, 2008 and 2018

V.2.2 Emissions in the Brno agglomeration

At the present time, approx. 590 sites of operation of sources of air pollution included in the REZZO 1 and REZZO 2 databases are individually registered in the territory of the Brno agglomeration. Only several dozen of them have a substantial effect on the overall emissions. These are primarily heating sources (Teplárný Brno, a. s.), communal waste incinerators (SAKO Brno, a. s.) and a few sites of operation of the processing industry (Eligo, a. s., Slévárna REMET foundry, s.r.o., or Brněnská obalovna, s.r.o. – Chrlice). The sources of SPM include also recycling lines of construction waste being operated both at a given location (e.g. Setra Brno-Černovice) and at other places where the activities are undergoing, for example, demolitions. According to the outputs of SLDB 2011, central heating sources predominate in heating households (54% of flats), followed by gas boilers and local gas boilers (together 37% of flats). Coal, wood or coke is used as a fuel in only a small part of the households, primarily at the periphery of the city. Similarly, a large portion of the buildings of the communal sphere are connected to central heating sources or have their own gas boilers.

There was a decrease in monitored emissions at the individually registered sources in the 2018–2019 period. For reported SPM emissions, there was a slight increase, especially in Eligo food production (by approx. 3 t to a total of 34.3 t) and also due to the general validity of the obligation to report emissions from category 5.11 sources. (production of building materials, recycling lines, etc.) for the first time in 2019. In reality, however, these emissions were being produced throughout the operation of the sources. Another significant source of SPM emissions are foundry operations (e.g. Slévárna HEUNISCH Brno) for which, in addition to reported SPM emissions, a certain fraction of difficult-to-identify fugitive emissions can also be expected. A decisive share of SO₂ emissions originates from the SAKO Brno, a.s., municipal waste incinerator, which, in addition to district heating sources, also plays a significant role in the production of NO_x emissions.

Countrywide, the emission load of Brno is rather specific. The point sources operating at its territory are minor, with some exceptions, and significant amount of the emissions originates from traffic or local household heating (Fig. V.2.9). According to a detailed evaluation of the variation of emissions between 2008 and 2016 prepared for the update of the Air Quality Improvement Program in 2018, transport accounts for more than 45% of NO_x emissions.

V.2.3 Summary

The main problem of the air quality in the territory of the Brno agglomeration is the high concentration of suspended particulates PM₁₀ and nitrogen dioxide (NO₂) at some stations in the city. Compared to previous years, 2019 was a very good year in terms of air pollution.

For suspended particles, a decrease in the annual average concentration by tens of percent was observed at most stations compared to 2018. The only exception is the Brno-Zvonařka station, which, in 2019, was significantly locally affected by the surrounding extensive construction work (reconstruction of the Plotní/Dorných crossroads, demolition of buildings and their replacement by office complexes). The annual limit of PM₁₀ was not exceeded at any station, neither the annual limit of PM_{2.5}. The total of 35 permitted cases exceeding the 24-hour limit value in a year was not met only at the Brno-Zvonařka station, where, according to so far operational data, 64 cases occurred. This is indeed a very high number, but it must be considered in the overall context. At the nearby Brno-Výstaviště station, which is also located at a busy crossroads of four-lane roads, there were only 8 cases. This indicates a very local increase in concentrations at Zvonařka due to temporary effects.

In 2019, no station in Brno exceeded the annual or hourly limit value for NO₂, which is also an improvement compared to 2018.

In both cases, the overall improvement of the situation in 2019 was due to good dispersion conditions and above-average temperatures, however, the gradual renewal of solid fuel boilers in households and the renewal of the vehicle fleet probably also have a certain effect.

The pollution limit value for benzo[a]pyrene was not exceeded either in 2019 at any of the two measuring stations; the annual average concentration at both of them was even the lowest in the evaluated ten-year period 2010–2019. Again, good dispersion conditions and above-average temperatures in the winter months of 2019 have their effect, and to some extent the renewal of solid fuel boilers may also play a role, as local household heating is almost the only source of benzo[a]pyrene emissions in the Czech Republic.

For the whole of 2019, no smog situation was announced in the territory of the Brno agglomeration, same as in the previous year.