IV.6 Heavy metals

IV.6.1 Air pollution by heavy metals in 2020

Arsenic

The annual pollution limit level for arsenic (6 ng.m^{-3}) was not exceeded at any of 62 stations with valid annual average values in 2020 (Fig. IV.6.1). The highest annual average (2.7 ng.m^{-3}) was observed at the Kladno-Švermov and Kladno-Vrapice urban background stations. Compared to the value at the Kladno-Švermov station in 2019 (3.3 ng.m^{-3}), this is a decrease of 18%, and at the Kladno-Vrapice station (2.6 ng.m^{-3}), an increase of 4%.

In 2020, the annual average arsenic concentrations in the Czech Republic were low and below the lower assessment threshold (2.4 ng.m^{-3}). Concentrations above the lower assessment threshold occurred only in the Kladno district, but even there the upper assessment threshold (3.6 ng.m^{-3}) was not reached (Fig. IV.6.2).

Arsenic concentrations have long been below the limit value over most of the Czech Republic, except for the Kladno and Prague areas (Fig. IV.6.3). In non-polluted areas, concentrations are below the lower assessment threshold, though polluted areas have concentration above the limit value. Of the total 46 stations that measured arsenic concentrations both in 2019 and 2020, the annual average concentration increased at only 5 stations (11%), and decreased at 36 stations (78%). Concentrations remained unchanged at 5 stations (11%).

Cadmium

The annual pollution limit level for cadmium (5 ng.m^{-3}) was not exceeded at any of 63 stations with valid annual average value in 2020 (Fig. IV.6.4). The highest annual average was observed at the Tanvald-školka urban background station (2.9 ng.m^{-3}). Compared to 2019 with 4 ng.m^{-3}, this is a decrease of 28%.

In 2020, the annual average cadmium concentrations in the Czech Republic were low and below the lower assessment limit (2 ng.m^{-3}). Concentrations above the lower assessment threshold occurred only in the Jablonec nad Nisou district, but even there the upper assessment threshold (3 ng.m^{-3}) was not reached (Fig. IV.6.5).

In the long term, cadmium concentrations are below the lower assessment threshold throughout the territory of the Czech Republic, except for the Jablonec nad Nisou vicinity (Fig. IV.6.6). Of the total 46 stations measuring cadmium concentrations both in 2019 and 2020, the annual average concentration increased at 14 stations (30%), and decreased at 26 stations (57%). Concentrations remained unchanged at 6 stations (13%).

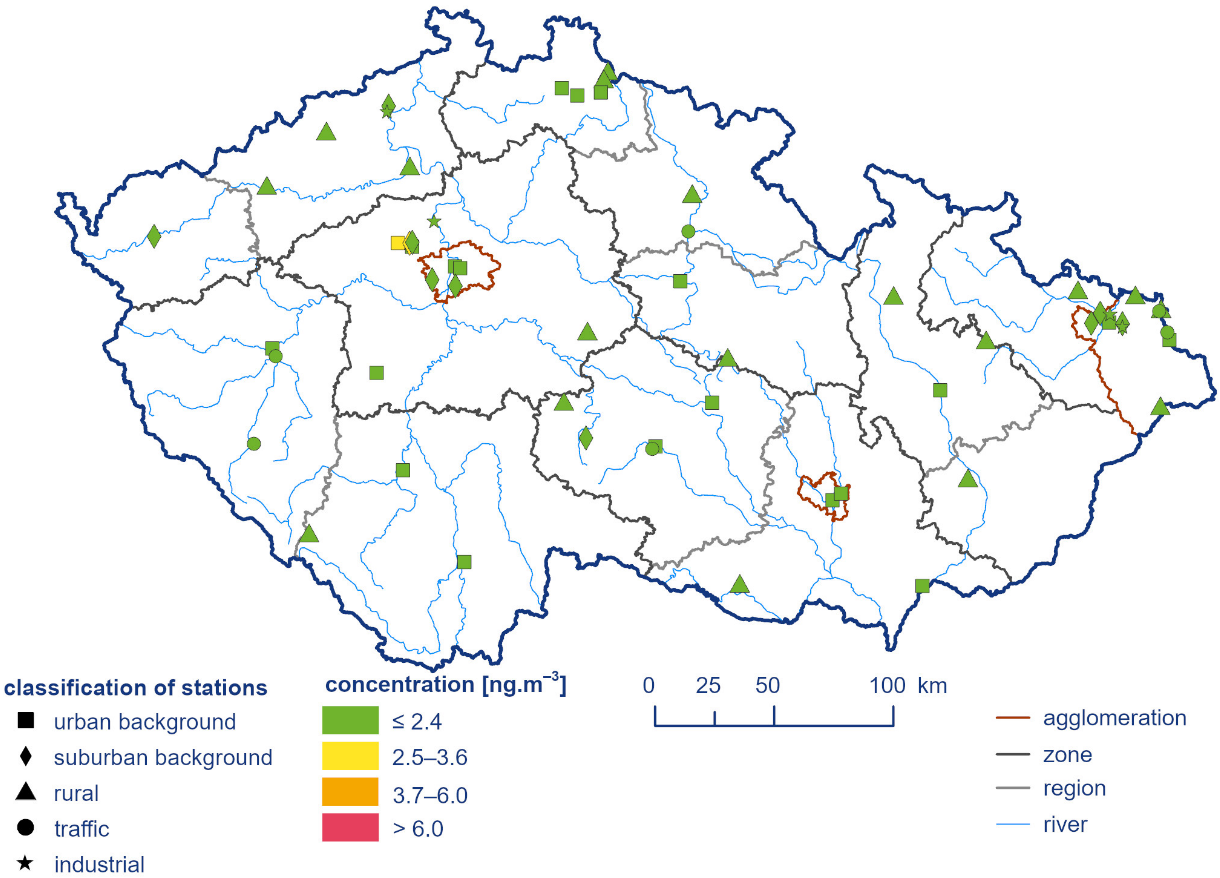

Fig. IV.6.1 Annual average concentrations of arsenic at air quality monitoring stations, 2020

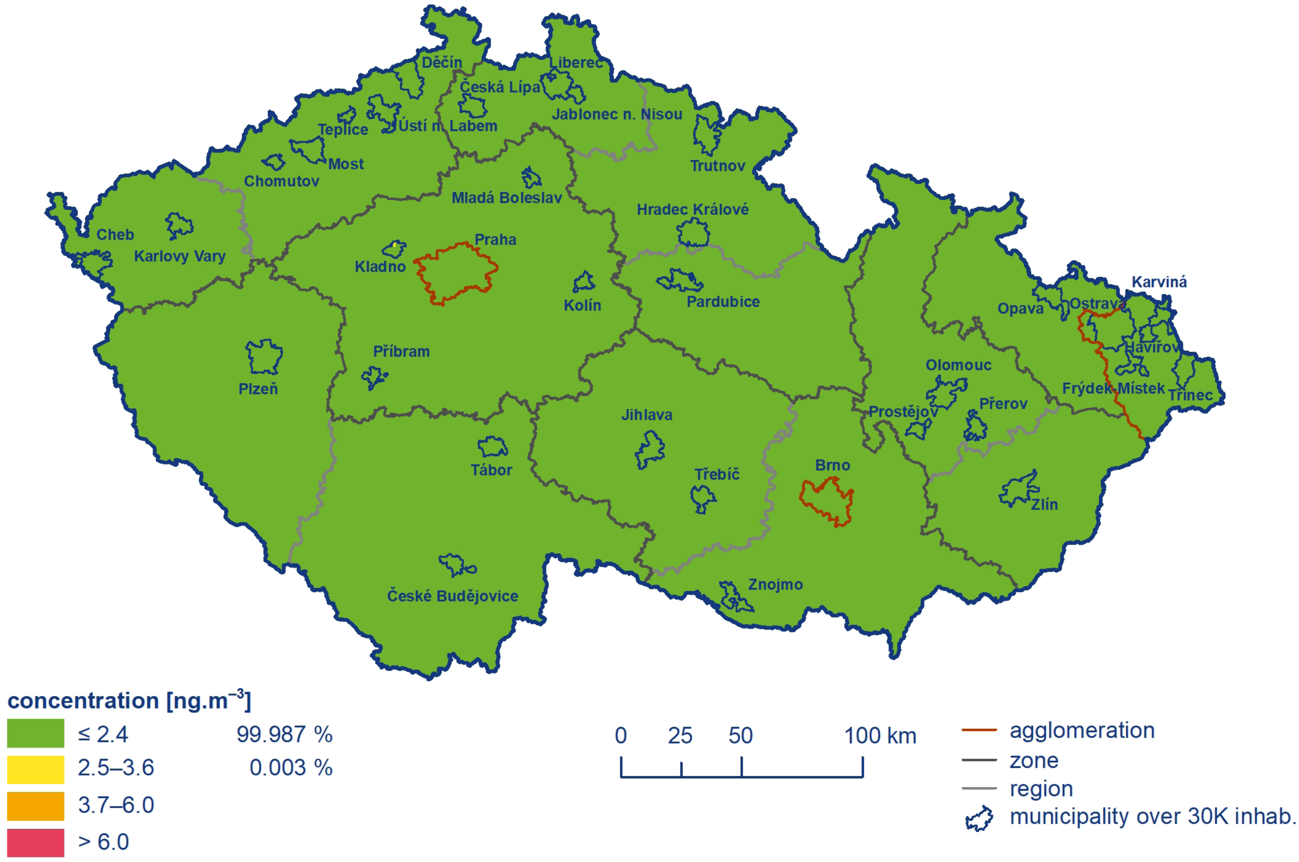

Fig. IV.6.2 Field of annual average concentration of arsenic, 2020

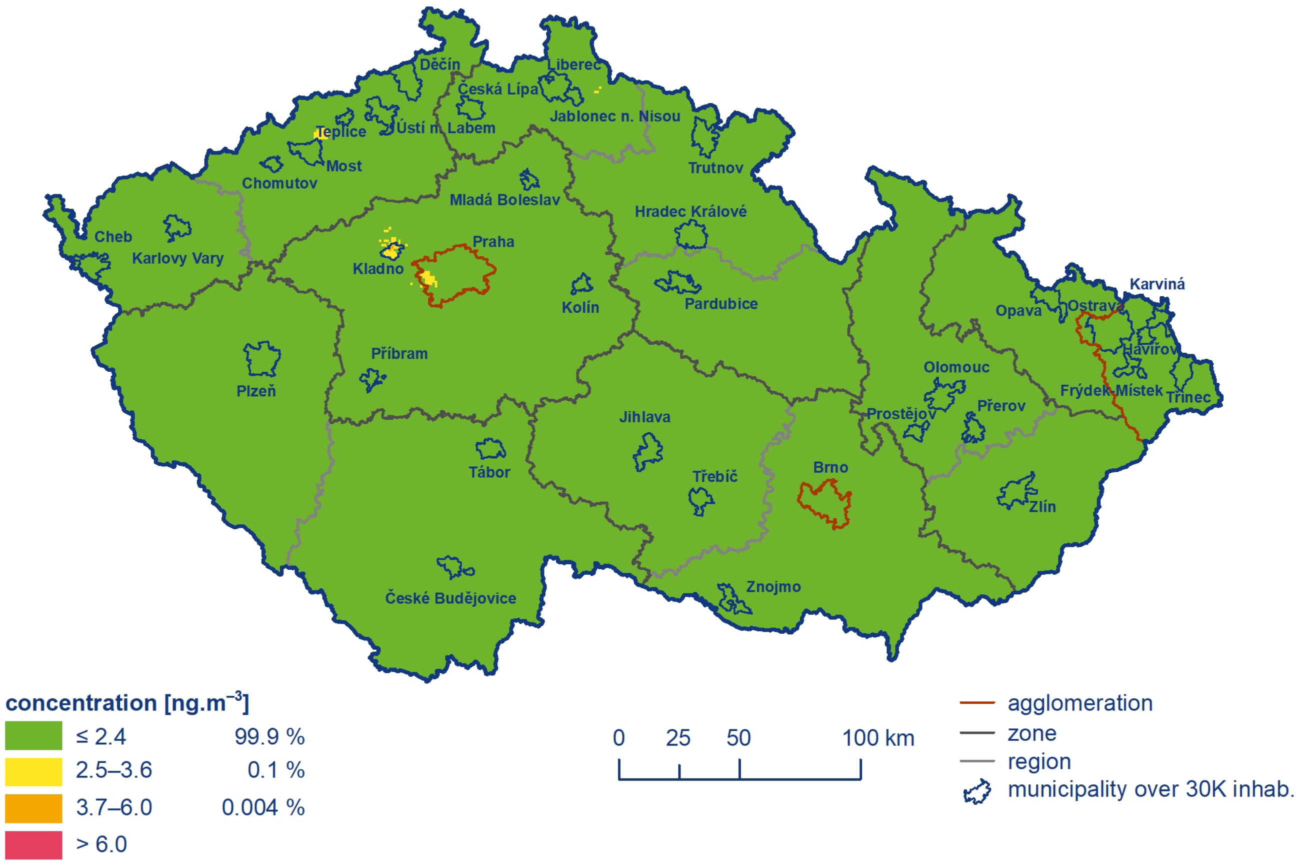

Fig. IV.6.3 Five-year average of annual average concentrations of arsenic, 2016–2020

Nickel

The annual pollution limit level for nickel (20 ng.m^{-3}) was not exceeded at any of 62 stations with valid annual average value in 2020. The highest annual average value (4.5 ng.m^{-3}) was observed at the Ostrava-Hošťálkovice suburban background station being in operation since January 2020. The highest concentration at a station operating in previous years was measured at the Ostrava-Přívoz industrial station (3.1 ng.m^{-3}). Compared to 3.6 ng.m^{-3} in 2019, this is a decrease of 14%.

Nickel concentrations have long been very low throughout the territory of the Czech Republic. The highest concentrations are repeatedly measured in the O/K/F-M agglomeration, but even there values do not reach the lower assessment threshold (10 ng.m^{-3}). Of the total 38 stations measuring nickel concentrations both in 2019 and 2020, the annual average concentration increased at 7 stations (18%), and decreased at 22 stations (58%). Concentrations remained unchanged at 9 stations (24%).

Lead

The annual pollution limit level for lead (500 ng.m^{-3}) was not exceeded at any of 63 stations with valid annual average values in 2020. The highest annual average (52 ng.m^{-3}) was observed at the Ostrava-Radvanice ZÚ station. The same value was measured in 2019.

In the long term, lead concentrations are very low throughout the territory of the Czech Republic. The highest concentrations are repeatedly measured in the O/K/F-M agglomeration, but even there values do not reach the lower assessment threshold (250 ng.m^{-3}). Of the total 46 stations measuring lead concentrations both in 2019 and 2020, the annual average concentration increased at 9 stations (20%), and decreased at 34 stations (74%). Concentrations remained unchanged at 3 stations (7%).

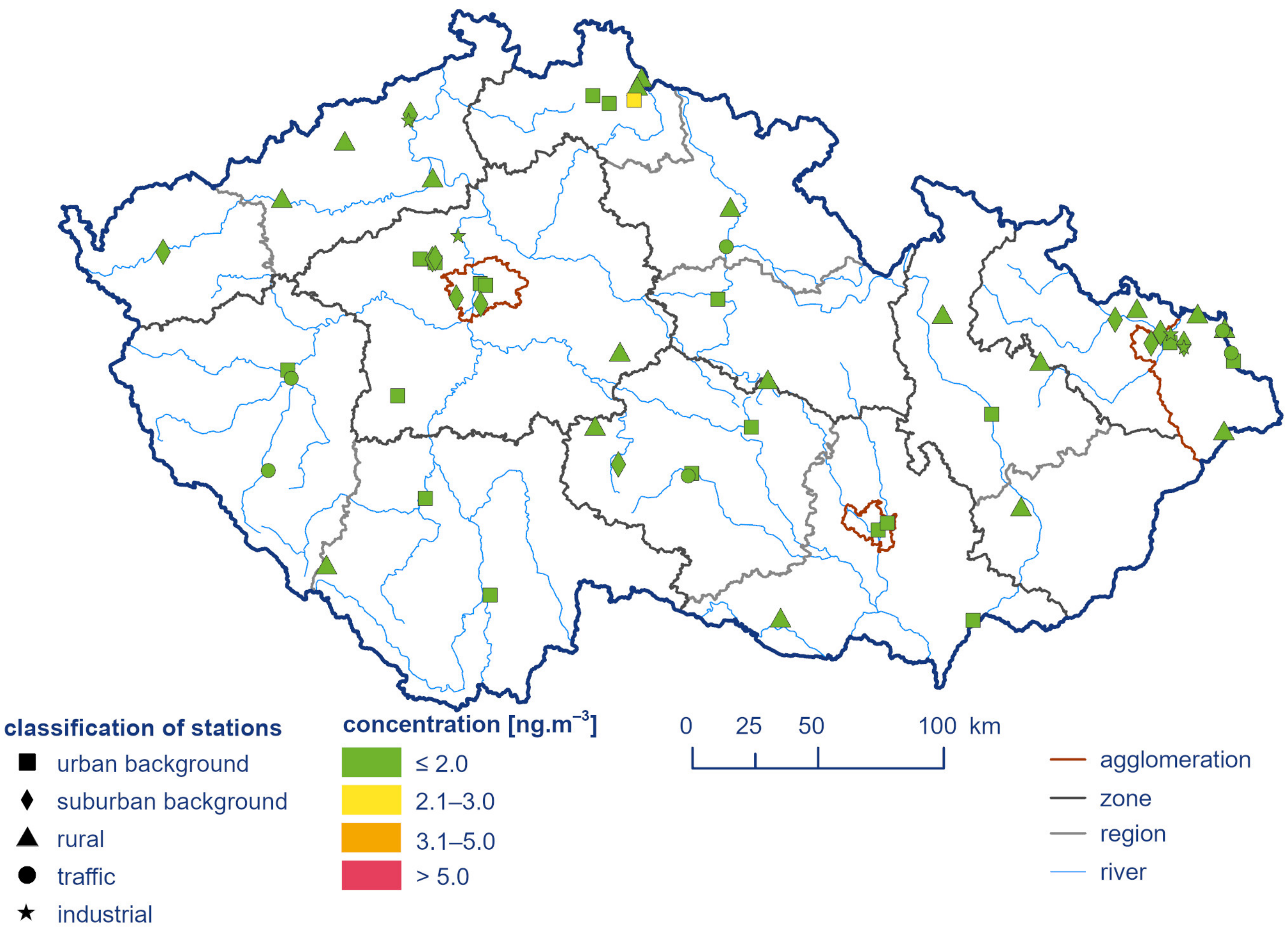

Fig. IV.6.4 Annual average concentrations of cadmium at air quality monitoring stations, 2020

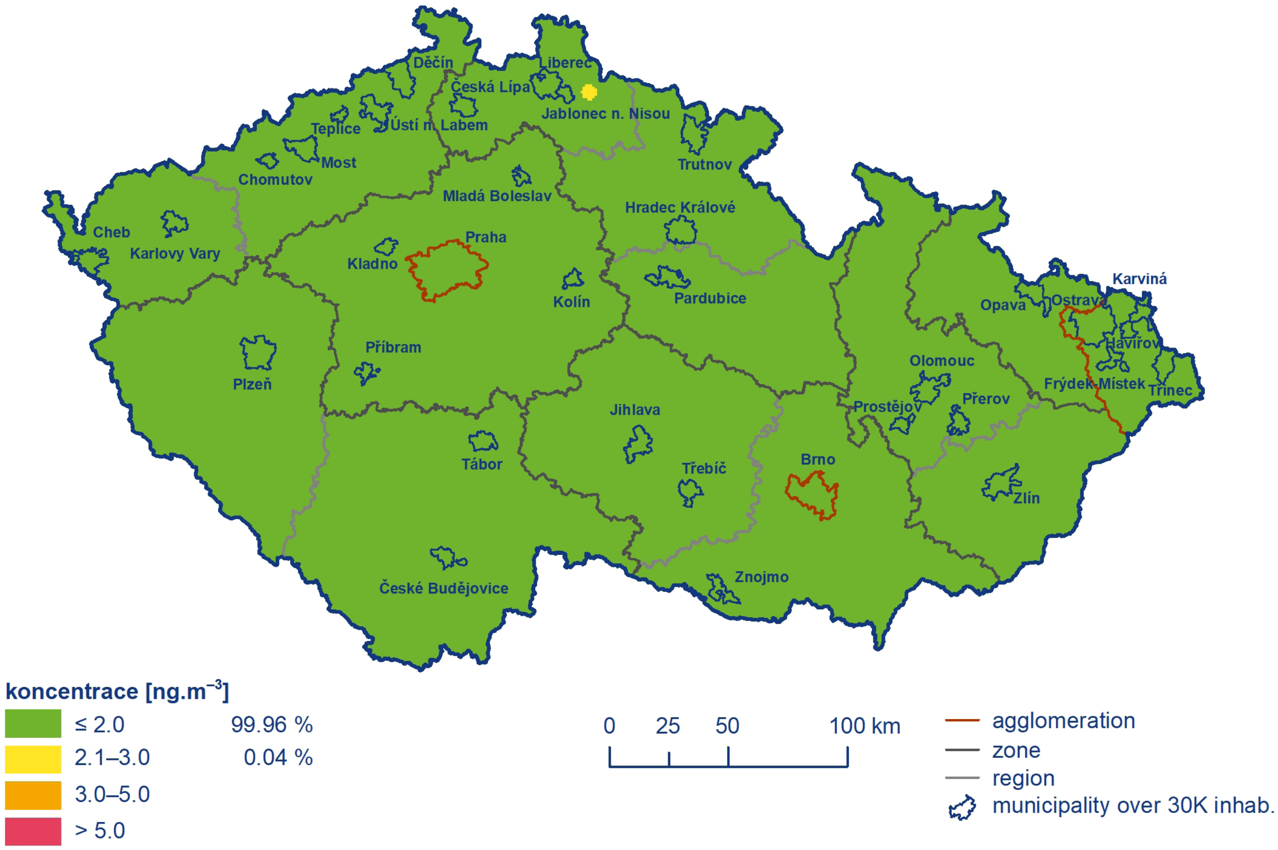

Fig. IV.6.5 Field of annual average concentration of cadmium, 2020

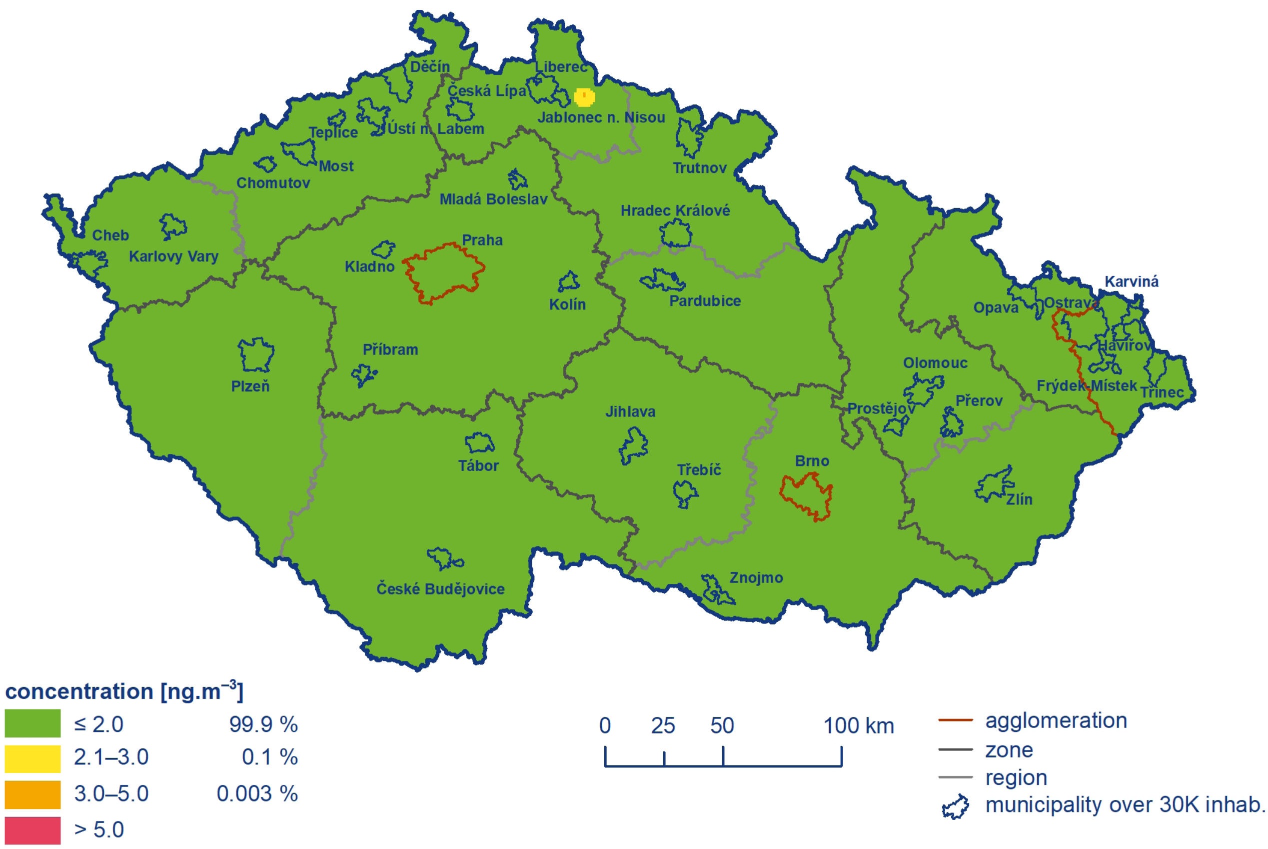

Fig. IV.6.6 Five-year average of annual average concentrations of cadmium, 2016–2020

IV.6.2 Trends in heavy metal concentrations

Arsenic concentrations have been slightly decreasing over the last 11 years (Fig. IV.6.7). In the most polluted area, the Kladno district, high to above-limit concentrations were observed until 2013 within the evaluated period 2010–2020. Since 2014, annual concentrations have been above the upper assessment threshold, however, in the last two years, this value has not been exceeded (Fig. IV.6.8). The Kladno district is one of the areas included in a campaign to measure heavy metal concentrations under the Technology Agency of the CR project (No. TITSMZP704). Preliminary results show that increased arsenic concentrations in this region are due to the use of specific type

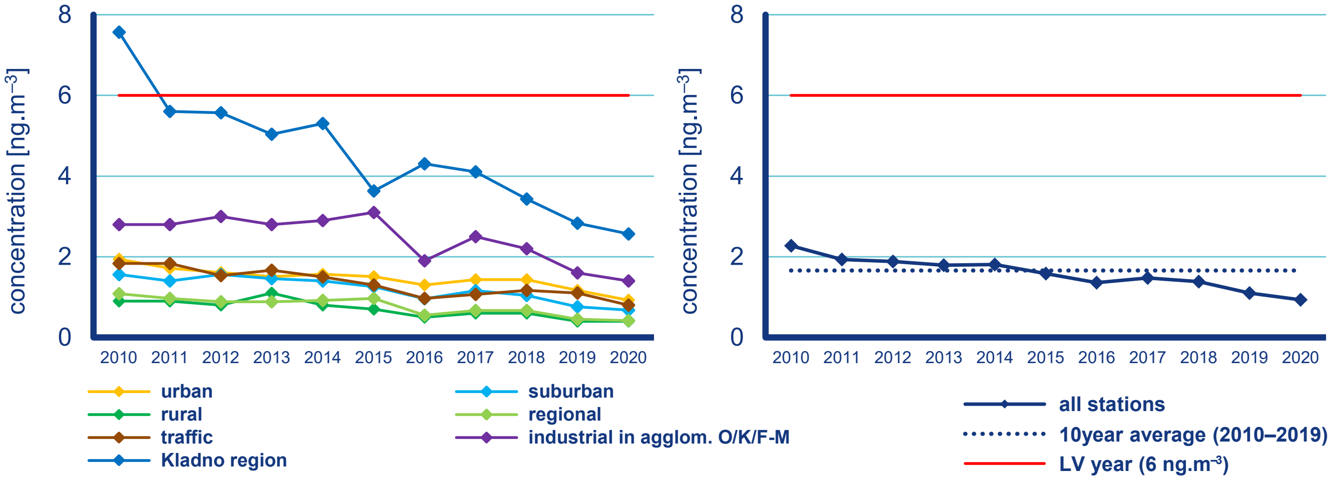

Fig. IV.6.7 Annual average concentrations of arsenic at particular types of stations, 2010–2020

Fig. IV.6.8 Annual average concentrations of arsenic at selected stations, 2010–2020

of coal for individual household heating. The issue is subject to further investigation.

The national average cadmium concentrations have been slightly decreasing over the last 11 years with steady trend since 2016 (Fig. IV.6.9). In the most polluted area, in the Tanvald district, high to above-limit concentrations were observed between 2012 and 2015 (Fig. IV.6.10). The Tanvald area is characterized by a high concentration of glass industry (ASKPCR 2014) which is a significant source of cadmium emissions from the application of paints and fluxing agents (Beranová 2013). In 2015 and 2016, the production operation was adapted to be more ecologically favourable. leading to a decrease in annual average cadmium concentrations below the limit level. However, annual evaluations of measurements at the

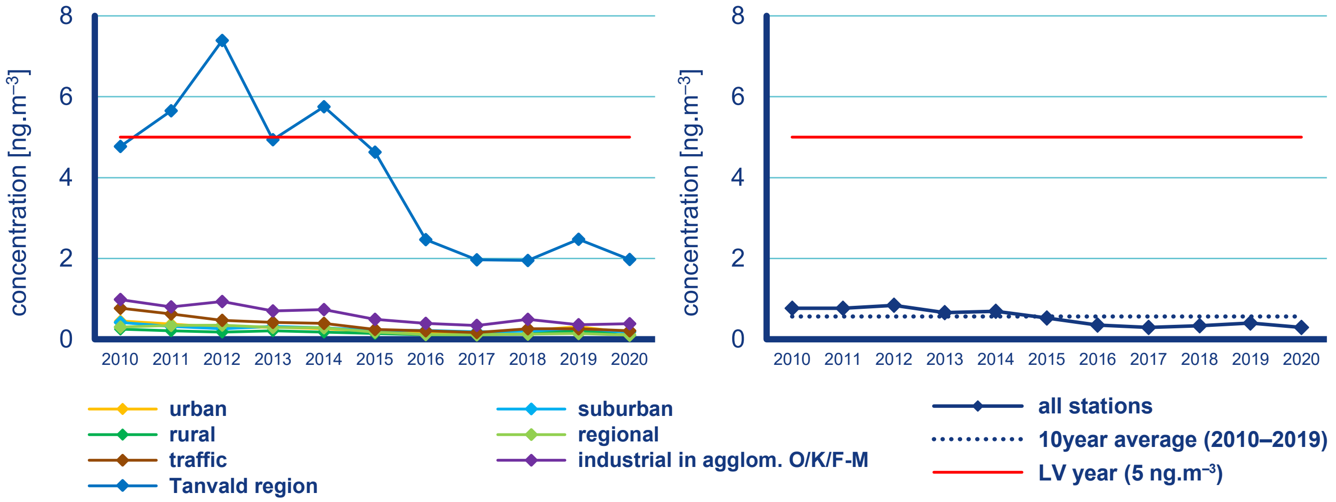

Fig. IV.6.9 Annual average concentrations of cadmium at particular types of stations, 2010–2020

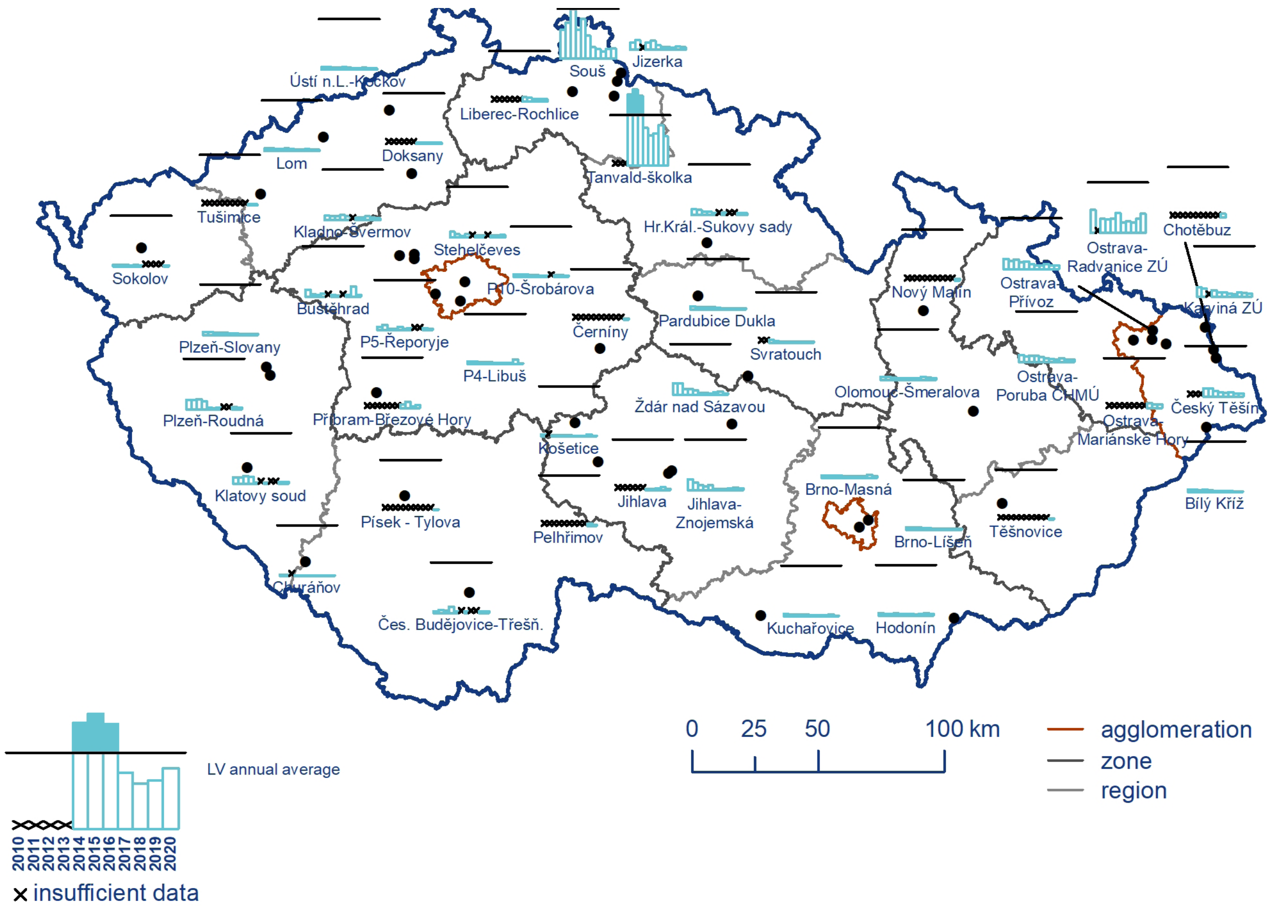

Fig. IV.6.10 Annual average concentrations of cadmium at selected stations, 2010–2020

Tanvald-školka station and monitoring of results are still needed to assess the effectiveness of specific measures.

The national average nickel concentrations have been slightly decreasing over the last 11 years with steady trend since 2015 (Fig. IV.6.11). In 2013, there was a significant increase in nickel concentrations at traffic stations. The highest concentrations since 2009 were recorded at industrial stations in 2018 and 2019. The cause of these fluctuations has not yet been sufficiently clarified.

Lead concentrations show a declining trend over the last 11 years, except for 2018, when there was an increase in concentrations at all types of stations (Fig. IV.6.12).

IV.6.3 Emissions of heavy metals

Heavy metals include metals with a specific density greater than 4.5 g.cm^{-3} and their compounds. Heavy metals are a natural component of solid fuels, while their contents in fuels vary depending on the mining site. The amounts of heavy metal emissions from the combustion of solid fuels depends primarily on the kind of fuel, type of combustion equipment, and combustion temperature which affects the volatility of heavy metals. Heavy metal emissions are also formed in some technological processes because they are contained in the input raw materials (e.g. iron ore, scrap metal, glass batches, paints, glass shards). In addition to these processes, there are also a number of sources of fugitive emissions

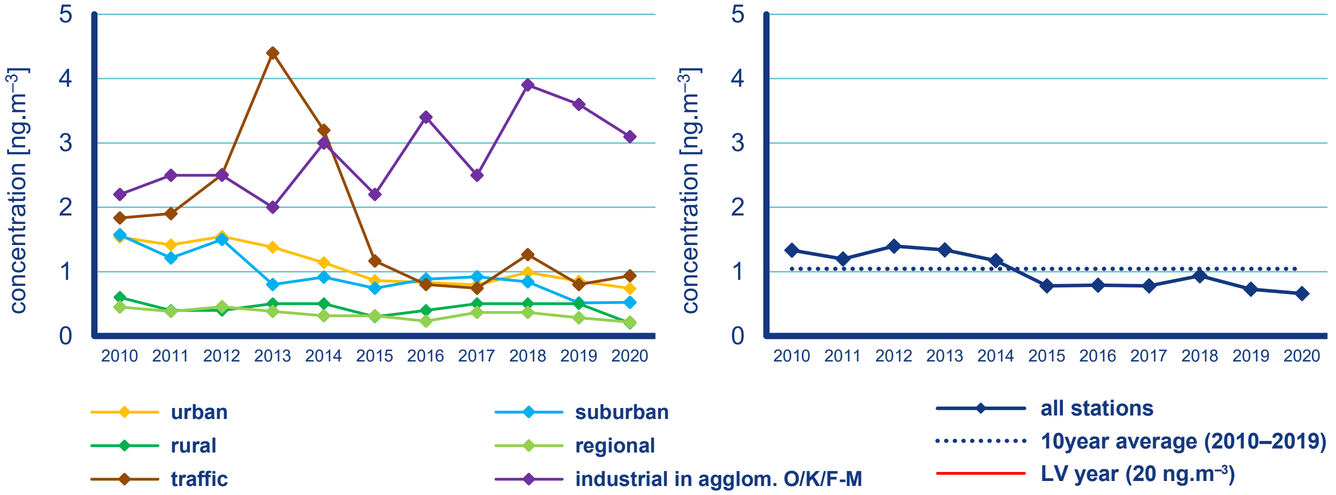

Fig. IV.6.11 Annual average concentrations of nickel at particular types of stations, 2010–2020

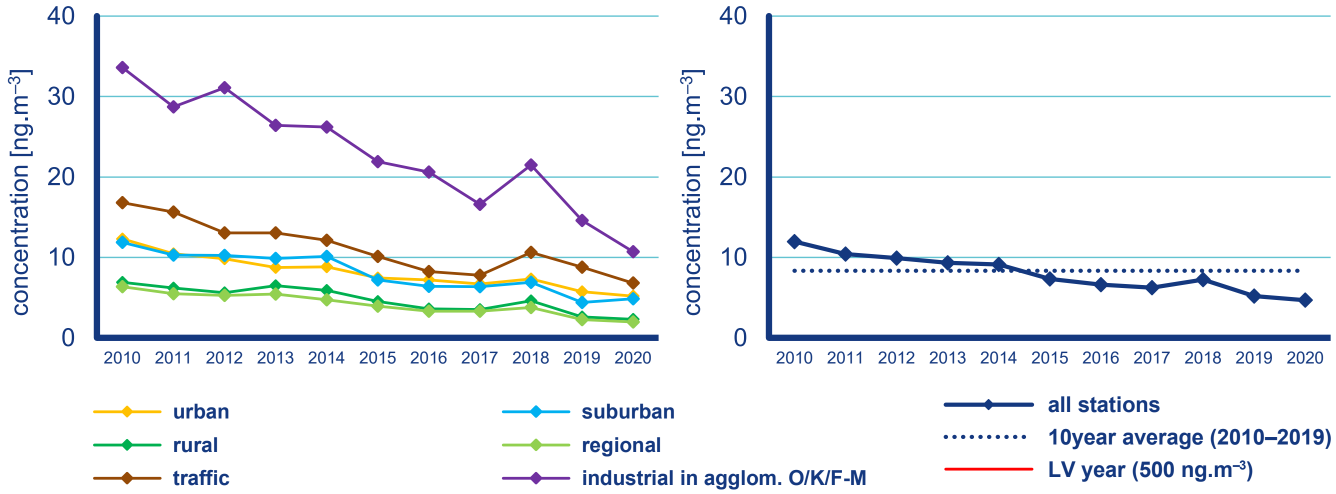

Fig. IV.6.12 Annual average concentrations of lead at particular types of stations, 2010–2020

containing heavy metals (for example, particles from the abrasion of brakes and tyres, or emissions related to old environmental burdens left by mining and metallurgical activities).

Combustion processes are of predominant importance primarily for the emissions of arsenic and nickel. The most significant sectors at a national scale include 1A1a — Public electricity and heat production which contributed 24.3% to arsenic emissions and 36.8% to nickel emissions in 2019 (Fig. IV.6.13 and Fig. IV.6.17). In 2019, there were significant contributions from the sectors of iron and steel production (1A2a and 2C1) related primarily to lead emissions (21.6%; Fig. IV.6.19). The impact of sector 1A4bi — Residential: Stationary predominated in cadmium emissions, with a share of 49.7% (Fig. IV.6.15), and also significantly contributed to arsenic emissions (31.9%; Fig. IV.6.13). A significant share of total lead emissions is formed by emissions from the triggering of fireworks and pyrotechnics (31.7%; Fig. IV.6.19), which belong to sector 2G – Other sources. The cadmium emissions from the 2G sector accounted for 9.2%, with the main source of emissions being tobacco smoke (Fig. IV.6.15). The decreasing trend in emissions of heavy metals in the 2010–2019 period is associated with the rate of emissions of suspended particles (Chap. IV.1.3) to which these substances are bound (Figs. IV.6.14, IV.6.16, IV.6.18, and IV.6.20). Measures in the sector of iron and steel production made a substantial contribution to the decrease in heavy metal emissions, especially improvements in the dust-removal system for iron ore agglomeration sintering strands. Technical measures have also succeeded in reducing heavy metal emissions from glass production. In recent years, there has been an increase in the volume of the secondary production of non-ferrous metals, especially aluminium and lead. Emissions of heavy metals from these sources are very variable, and depend on the quality of the processed scrap metal.

In view of the predominant contribution of the sector of public electricity and heat production and the sector of iron and steel production, the territorial distribution of heavy metal emissions (excluding emissions from the sector 2G – Other sources) is determined mainly by the location of production facilities in these sectors. Emissions of arsenic and nickel are concentrated in areas in which thermal power plants and heating plants burning coal are located. These are primarily enterprises in the Ústí nad Labem, Central Bohemian and Pardubice regions. Emissions of cadmium and lead are predominantly produced in the O/K/F-M agglomeration due to concentration of enterprises producing iron and steel. A significant amount of lead emissions in the Central Bohemian region originates from secondary lead production at Kovohutě Příbram.

- **1A4bi – Residential: Stationary**
- **1A1a – Public electricity and heat production**
- **1A2a – Stationary combustion in manufacturing industries and construction: Iron and steel**
- **1A2c – Stationary combustion in manufacturing industries and construction: Chemicals**
- **1A2f – Stationary combustion in manufacturing industries and construction: Non-metallic minerals**
- **1A3bi – Road transport: Passenger cars**
- **1A3bvi – Road transport: Automobile tyre and brake wear**
- **1A4ai – Commercial/institutional: Stationary**
- **1B2aiv – Fugitive emissions oil: Refining / storage**
- **2A3 – Glass production**
- **2C1 – Iron and steel production**
- **2C3 – Aluminium production**
- **2C5 – Lead production**
- **2G – Other product use**
- **Other**

Legend to Figs IV.6.13 and IV.6.20

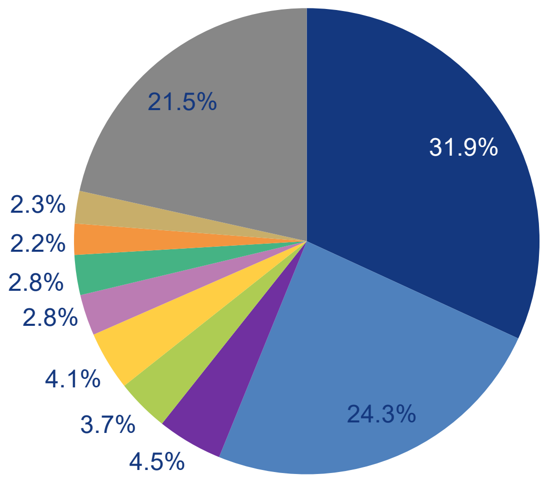

Fig. IV.6.13 Share of NFR sectors in total emissions of arsenic, 2019

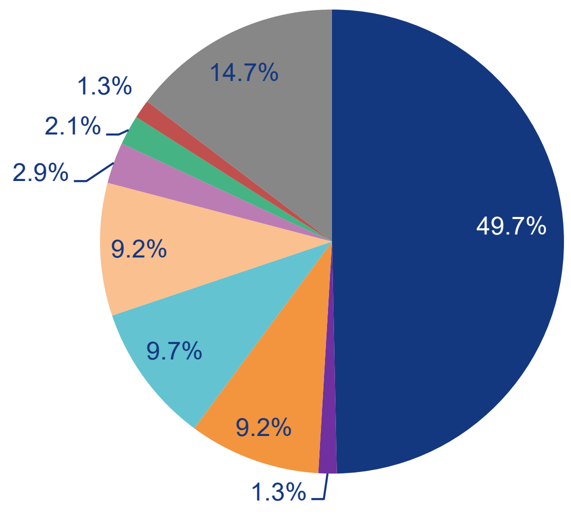

Fig. IV.6.15 Share of NFR sectors in total emissions of nickel, 2019

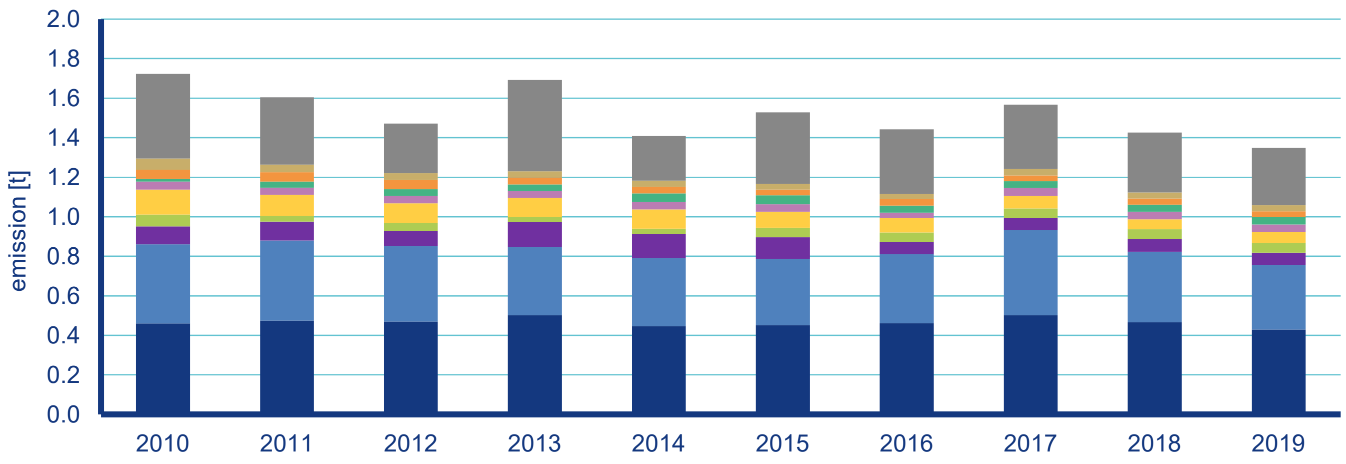

Fig. IV.6.14 Total arsenic emissions of arsenic, 2010–2019

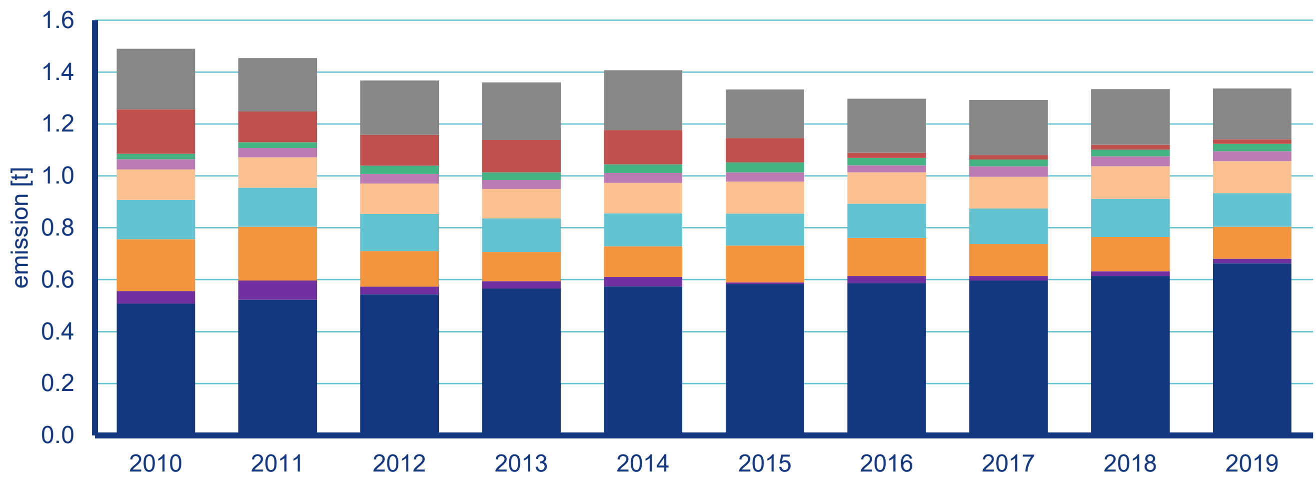

Fig. IV.6.16 Total emissions of nickel, 2010–2019

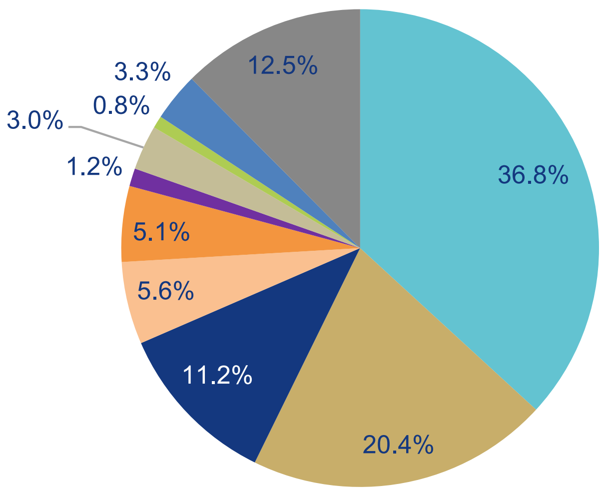

Fig. IV.6.17 Share of NFR sectors in total emissions of cadmium, 2019

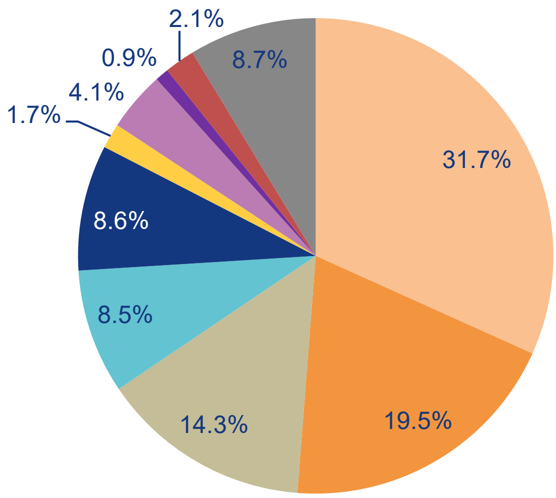

Fig. IV.6.19 Share of NFR sectors in total emissions of lead, 2019

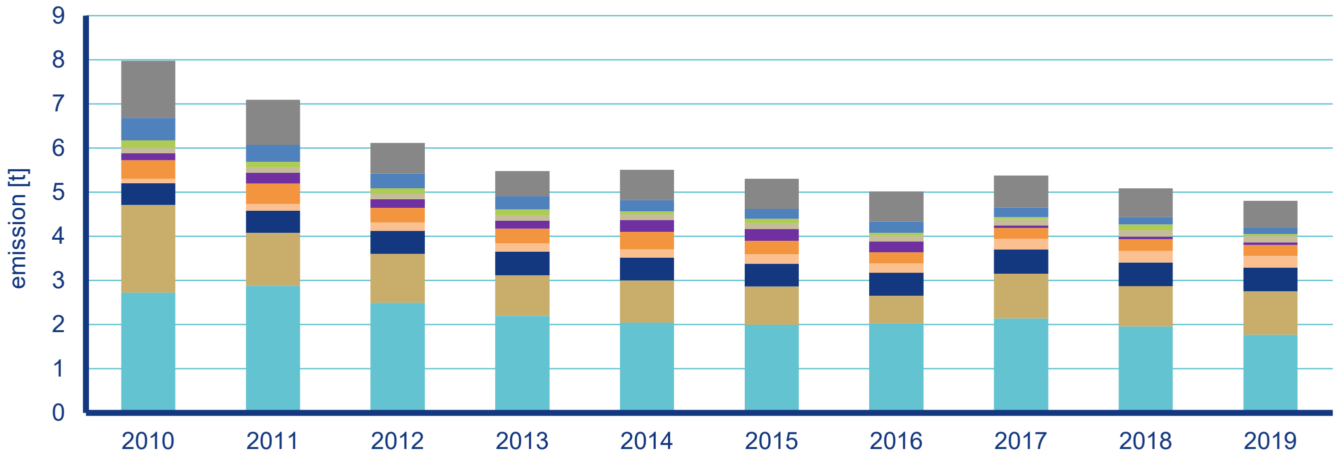

Fig. IV.6.18 Total emissions of cadmium, 2010–2019

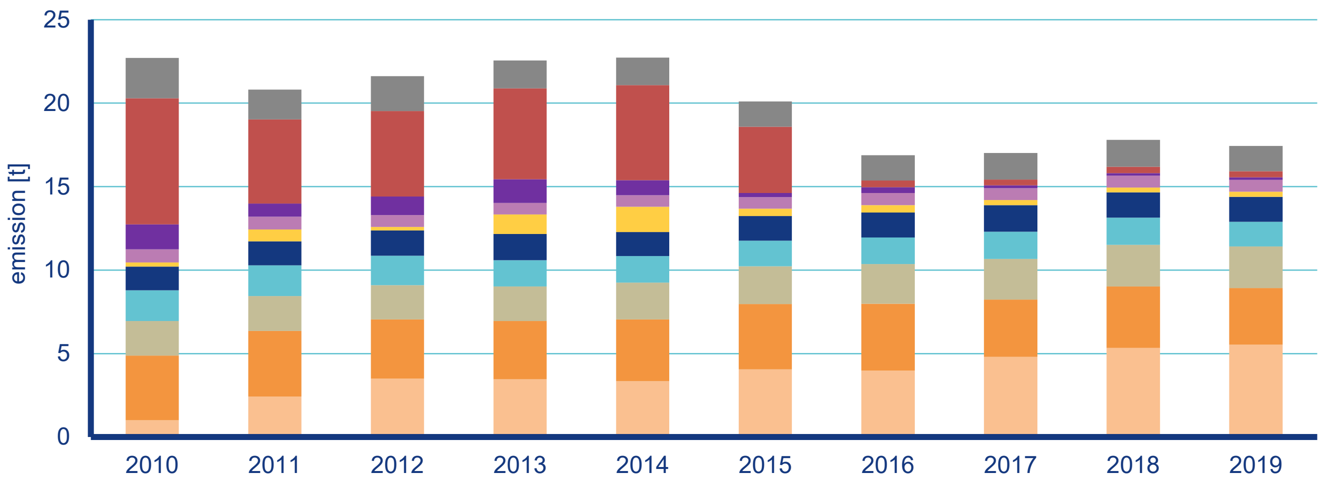

Fig. IV.6.20 Total emissions of lead, 2010–2019