2018

# Report on the Environment of the Czech Republic

cenia

Ministry of the Environment
of the Czech Republic

# 4 | Emissions of main air pollutants

## Key question

Have we succeeded in reducing air pollution that adversely affect human health and ecosystems?

## Key messages

The emissions of air pollutants significantly decreased in the period 1990–2000. Emission reduction continued also after 2000, in the period 2005–2018, the greatest decline was in $SO_2$ emissions by 53.0%, $NO_x$ by 42.1%, and VOC emissions by 21.0%.
In 2018, the decrease continued, the most markedly in the case of $SO_2$ emissions by 10.9%.
Total emissions of the individual pollutants are approximating the not-to-exceed limits of national emissions for 2020.

## Overall assessment of the trend

Change since 1990

Change since 2000

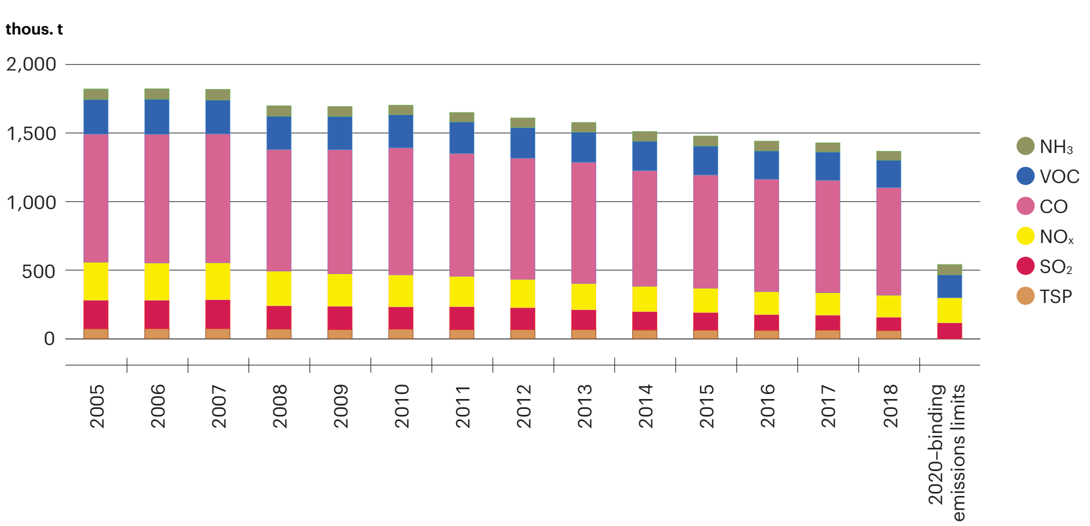
Change since 2010

Last year-on-year change

## Indicator assessment

**Chart 1**

**Trends in total emissions of selected pollutants in the Czech Republic and not-to-exceed limits of emissions from 2020 [thous. t], 2005–2018**

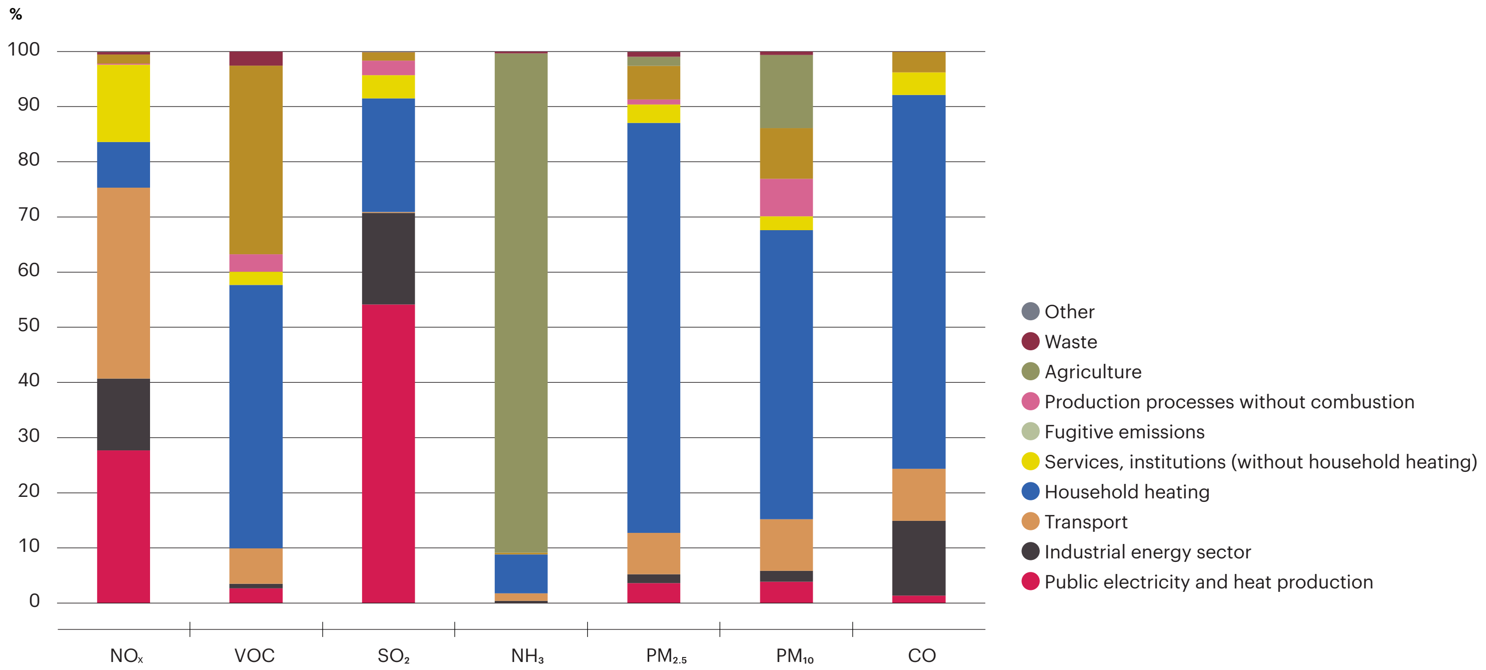



*The not-to-exceed limits for the emissions of TSP and CO have not been established.*

*Data source: Czech Hydrometeorological Institute*

Chart 2

## Sources of selected emissions of pollutants in the Czech Republic [%], 2017




*The data for the year 2017 were reported on 9 May 2019.*
*Data for the year 2018 are not, due to the methodology of their reporting, available at the time of publication.*

*Data source: Czech Hydrometeorological Institute*

The **emissions of air pollutants** have been declining over the long term, year-on-year fluctuations are caused primarily by the weather conditions and economic activity including mainly transport performance and industrial production.

The largest decrease in pollutants was recorded in the period between 1990 and 2000, mainly at its beginning, as a result of structural changes in the national economy.

In the period **2005–2018**, the trend of declining emissions of air pollutants continued (Chart 1), the largest overall decreases were reported for $SO_2$ emissions by 53.0% to 97.9 thous. t, $NO_x$ emissions by 42.1% to 160.1 thous. t, and also for VOC emissions by 21.0% to a total of 199.4 thous. t. Less prominent decrease was reported for emissions of total suspended particles, which decreased by 17.6% to a total of 59.8 thous. t, CO emissions decreased by 16.1% to 784.3 thous. t and emissions of $NH_3$ decreased by 14.8% to 65.8 thous. t.

**In 2018**, overall positive developments continued. Significant year-on-year decreases were recorded especially for $SO_2$ emissions (by 10.9%), CO emissions (by 4.2%), and also for total suspended particles and VOC emissions (by 3.9% and 3.8% respectively). $NO_x$ emissions decreased by only 1.9% and $NH_3$ emissions by 1.8%.

$SO_2$ and $NO_x$ emissions are steadily decreasing as a result of the introduction of technologies and production processes in line with the requirements for applying best available techniques, changed fuels and reducing energy intensity of the economy. A significant role is currently played by the diversification of electricity production, i.e., the decrease in production of electricity in solid-fuel steam power plants and, on the contrary, its increase in nuclear power plants and also the production of electricity from renewable energy sources. A great influence is also the obligation to meet the legislative requirements arising from the transposition of Directive of the European Parliament and of the Council 2010/75/EU on industrial emissions into Czech legislation. However, the negative factor in the production of $SO_2$ and $NO_x$ emissions is the export character of the production of a part of electricity from solid fuels, together with the need to maintain the systemic and production adequacy of the electricity system. The long-term reduction of $NO_x$ emissions is also associated with a decrease in these emissions from the transport sector, in particular as a result of a gradual modernisation and replacement of the vehicle fleet, leading to a decline in transportation emissions.

The trend in the emissions of $NH_3$ is associated in particular with the set agricultural policy of the Czech Republic and with the implementation of the Common Agricultural Policy of the EU. However, the reduction of emissions of $NH_3$ in the long term is due to the diminishing numbers of livestock.

The development of VOC and CO emissions is associated with trends in industrial production, the most CO emissions from industrial sources come from iron and steel plants in Ostrava and Třinec and their development thus corresponds to the volume of production of those plants. Developments in $PM_{10}$, $PM_{2.5}$, VOC and CO emissions also reflect the development of the meteorological conditions in the heating season in that year and, moreover, are significantly influenced by the type of fuel used in household combustion heaters. The decrease in total suspended particles presented also as $PM_{10}$ and $PM_{2.5}$, was caused in the early 1990s by the application of end technology in solid-fuel steam power plants, in the last reporting period, the dust emission trend is influenced by growth of industrial production and construction.

The remaining reductions necessary to achieve the not-to-exceed emission values as of 2020, calculated on the basis of emission monitoring data, are 6.5% for $SO_2$ emissions, 3% for $NO_x$ emissions and 11.2% for $PM_{2.5}$ emissions (these emissions increased). In the case of VOC and $NH_3$ emissions, the emission ceiling is already met (Chart 1).

The main **sources** of emissions vary for each pollutant (Chart 2). As regards $NO_x$ emissions, the main source in 2017[1] was transport (32.3%) and also the public electricity and heat generation sector (25.7%). In the case of $SO_2$ emissions, the majority producer was the public electricity and heat generation sector (51.7%). VOC emissions came from both household heating (48.8%) and non-combustion production processes where solvent use predominates (33.2%). $NH_3$ emissions were mainly generated by the agriculture sector (90.5%). In the case of $PM_{2.5}$, total suspended particles and CO emissions, the main source is local household heating (74.9%, 59.7% and 53.0%, respectively).

## Detailed data sources

**CENIA, Information System of Statistics and Reporting**

https://issar.cenia.cz

[1] *The data for the year 2017 were reported on 9 May 2019. Data for the year 2018 are not, due to the methodology of their reporting, available at the time of publication.*

# 7 | Air quality in terms of the protection of ecosystems and vegetation

## Key question

Are the limit values for the protection of ecosystems and vegetation exceeded?

## Key messages

The limit values for neither annual nor winter average $SO_2$ concentration were exceeded at any rural locality in 2018, and the annual limit value for annual average concentration of $NO_x$ for the protection of ecosystems and vegetation was not exceeded either.
The total atmospheric deposition of sulphur, nitrogen and hydrogen ions decreased year-on-year.

In 2018, the limit value for ozone for the protection of ecosystems and vegetation was exceeded at 23 stations classified as rural or suburban, and compared to 2017 the number of stations with an exceeded limit value increased.

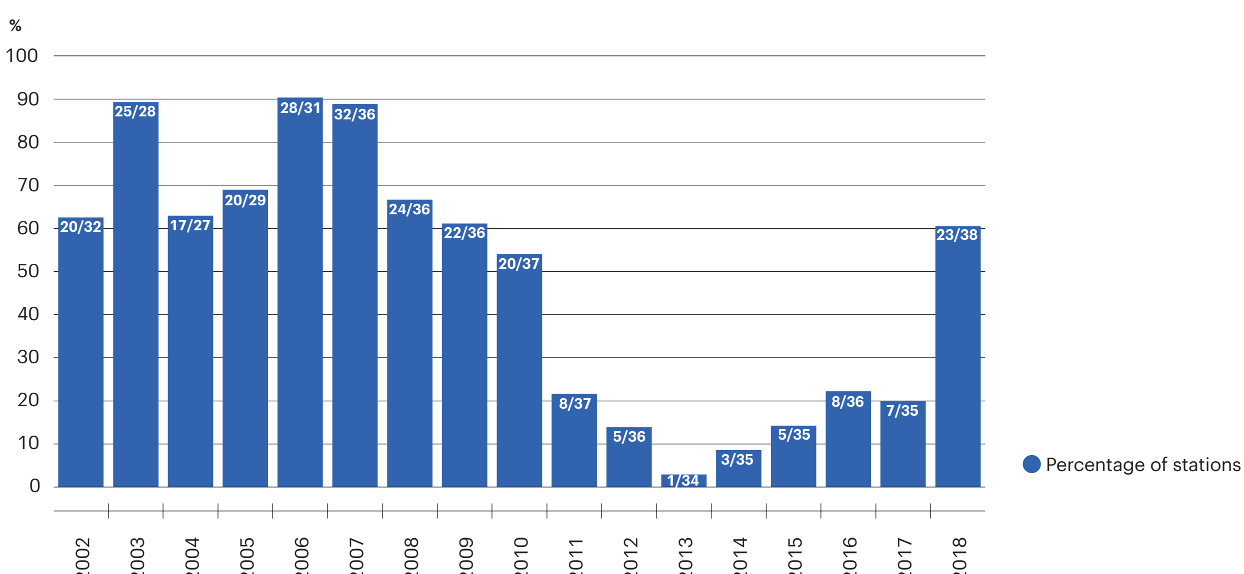
## Overall assessment of the trend

| Change since 1990 | Change since 2000 | Change since 2010 | Last year-on-year change |
|---|---|---|---|
| N/A | | | |

## Indicator assessment

**Chart 1**

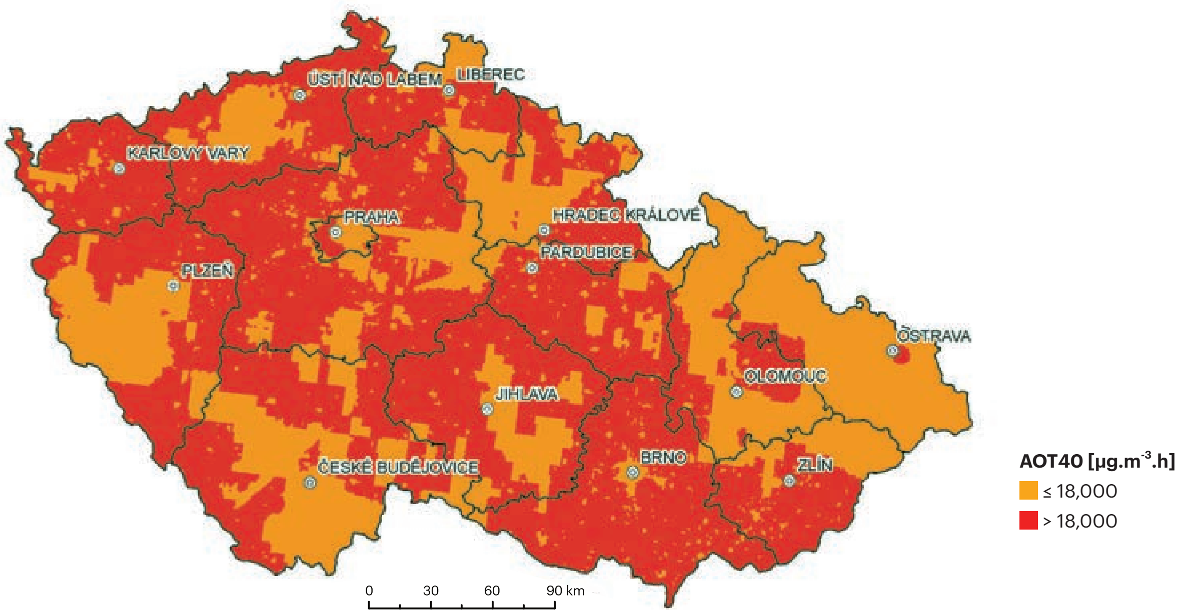
**Percentage of stations at which the limit values, expressed as AOT40 (5-year average) for the protection of vegetation, were exceeded [%], 2002–2018**




*Data source: Czech Hydrometeorological Institute*

**Figure 1**

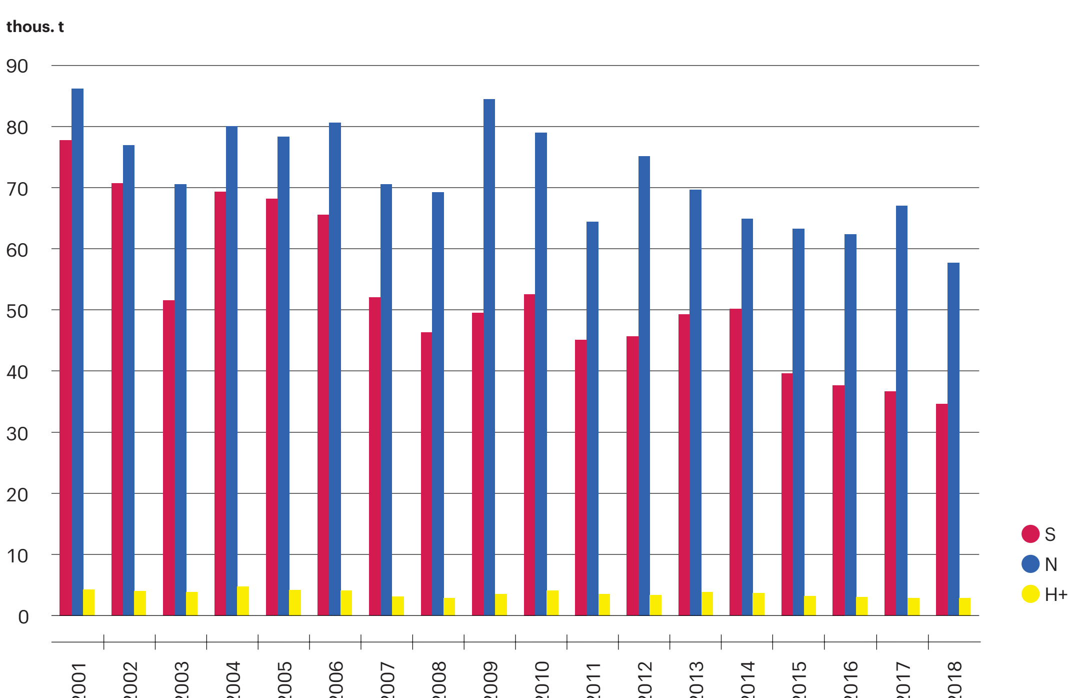
## Field of AOT40 index values, 5-year average [μg.m$^{-3}$.h], 2014–2018




*Data source: Czech Hydrometeorological Institute*

**Chart 2**

## Trends in the total atmospheric deposition of sulphur, nitrogen and hydrogen ions in the Czech Republic [thous. t], 2001–2018




*Data source: Czech Hydrometeorological Institute*

The **limit value for ozone for the protection of ecosystems and vegetation** (18,000 μg.m$^{-3}$.h) was exceeded in 2018 (2014–2018 average) at 23 stations out of a total of 38 rural and suburban stations (i.e. at 60.5% of stations). The highest values were measured at the station Kuchařovice (22,900.2 μg.m$^{-3}$.h). Compared to 2017 (2013–2017 average), the number of locations where exceedance was recorded grew, because in 2017 the ozone limit value for the protection of ecosystems and vegetation was exceeded at 20.0% of stations (i.e. at 7 out of a total of 35 stations monitored), Chart 1. At the same time, the area of the territory with the occurrence of above-the-limit AOT40 values increased (Figure 1).

Interannual changes in the values of the AOT40 exposure index are affected not only by ozone precursor emissions, but more particularly by the meteorological conditions (temperature, precipitation, solar radiation) in the period from May to July for which the indicator is calculated. Also for that reason, the highest concentrations of ozone and the most exceedances of the limit value were achieved in the years 2003, 2006, 2007 and 2018, which were characterised by favourable conditions for the formation of ground-level ozone.

The limit value for the **annual average concentration of $SO_2$** (20 μg.m$^{-3}$) for the protection of ecosystems and vegetation was not exceeded in 2018 at any one of the 18 stations classified as rural. Similarly, none of the 17 stations classified as rural reported exceeded limit values for the winter (i.e. the period October–March) average concentration of $SO_2$ (20 μg.m$^{-3}$) for the protection of ecosystems and vegetation in 2018. The highest annual average $SO_2$ concentration was measured in 2018 at the Věřňovice station (7.8 μg.m$^{-3}$), the highest winter average concentration of $SO_2$ was measured at the station of Krupka (10.4 μg.m$^{-3}$).

The limit value for the **annual average concentration of $NO_x$** (30 μg.m$^{-3}$) for the protection of ecosystems and vegetation was not exceeded in 2017 as well as in 2018 at any one of the 19 stations classified as rural. The highest annual average concentrations of $NO_x$ were achieved at the Sivice locality (27.9 μg.m$^{-3}$).

The **total atmospheric deposition (**Chart 2) consists of wet and dry components and represents a direct input of pollutants into other environmental compartments. Despite the long-term decline of pollutants there remains a high burden of ecosystems caused by the atmospheric deposition in many areas of the Czech Republic. It is mainly caused by transport emissions ($NO_x$) and emissions from industrial and energy sources ($NO_x$ and $SO_2$). A significant proportion is also represented by the long-range transport of pollution from neighbouring countries of Central Europe.

In 2018, the total atmospheric deposition of **sulphur** amounted to a total of 34.6 thous. t of sulphur for the total area of the Czech Republic and thus reached the lowest value since 2001. The total deposition of sulphur is the highest in the Ore Mountains (Krušné hory) where the maximum values of the throughfall deposition of sulphur are also achieved. The value of total **nitrogen** deposition (oxidized + reduced forms) has remained high in the last decade, i.e. above 60 thous. t per year, due to the production of $NO_x$ emissions. In 2018, total deposition of nitrogen amounted to 57.7 thous. t.year$^{-1}$ in the Czech Republic, which represents a significant year-on-year decrease. In the case of total **hydrogen ion** deposition, the value reported in 2018 was 2.9 thous. t.year$^{-1}$ for the area of the Czech Republic, which is the lowest since 2001.

## Detailed data sources

**CENIA, Information System of Statistics and Reporting**

https://issar.cenia.cz

# Air quality in the global context

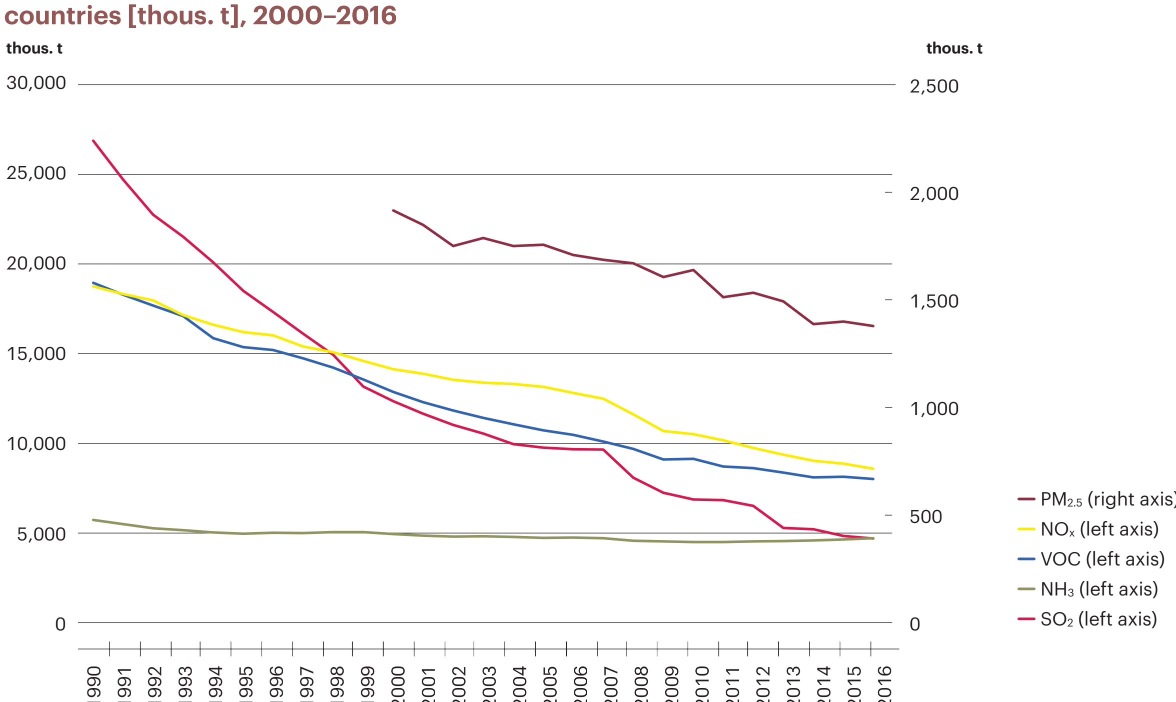
## Key messages[4]

- Emissions of air pollutants in the EEA33 countries have been decreasing since 1990, in the period 1990–2016 $SO_2$ emissions decreased by 82.5%, VOC emissions decreased by 57.7%, $NO_x$ emissions by 54.2%, $NH_3$ emissions by 17.6% and emissions of $PM_{2.5}$ decreased by 28.0% since 2000.
- Lead emissions decreased between 1990 and 2016 by 93.9%, mercury emissions by 71.5% and cadmium emissions by 64.6%.
- Air quality is improving slightly in Europe.
- The limit value for the protection of ecosystems and vegetation for ground-level ozone in 2015 was exceeded in approximately 30% of the territory of European countries, especially in southern Europe.

## Indicator assessment

**Chart 1**

**Emissions of the main air pollutants $SO_2$, $NO_x$, VOCs, $NH_3$ in the EEA33 countries [thous. t], 1990–2016, and $PM_{2.5}$ in the EEA countries [thous. t], 2000–2016**




*Current data are not, due to the methodology of their reporting, available at the time of publication.*

*Data source: European Environment Agency*

[4] *Current data are not, due to the methodology of their reporting, available at the time of publication.*

# 18 | Defoliation of forest stands

## Key question

Is the health condition of forest stands in the Czech Republic improving?

## Key messages

The unsatisfactory and worsening health condition of forest stands in the Czech Republic is currently caused mainly by long-lasting drought and subsequent spread of insect pests, but also by historical exposure of forest ecosystems to air pollution. Unsuitable species composition of forest stands and the compartment felling method create a prerequisite for high defoliation. In the context of drought, the pressure of climate change is also increasing.

Damage to forest stands in the Czech Republic expressed as a percentage of defoliation[2] remains high. In the category of older stands (60 years and over), the sum of defoliation classes 2–4 in conifers was 76.6% and in deciduous trees 42.8%. In younger stands (up to 59 years), the situation is more favourable, in the case of conifers, classes 2–4 covered 29.4% of stands and for the deciduous trees 34.0%. After the improvement in the second half of the 1990s, a deterioration can be observed after 2000 in all categories.

## Overall assessment of the trend

Change since 1990

Change since 2000

Change since 2010

Last year-on-year change

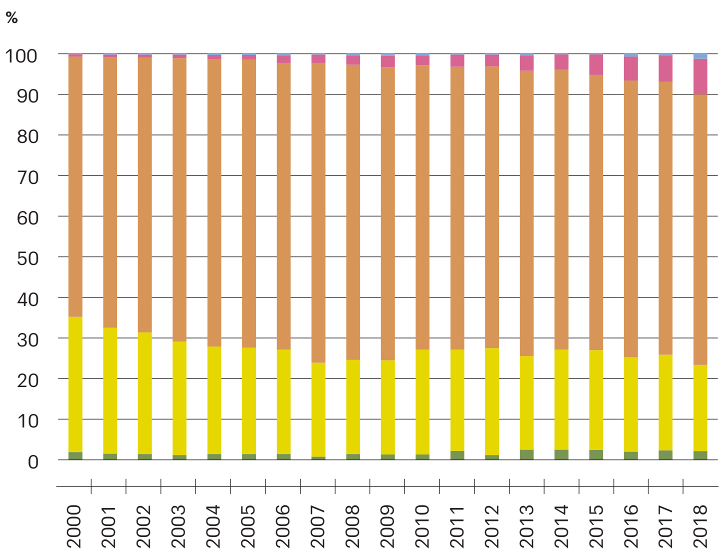
[2] *Defoliation values are divided into five basic classes, the last three of which the last three characterize significantly damaged trees: 0 – none (0–10%); 1 – moderate (> 10–25%); 2 – medium (> 25–60%); 3 – strong (> 60–< 100%); 4 – dead trees (100%).*

## Indicator assessment

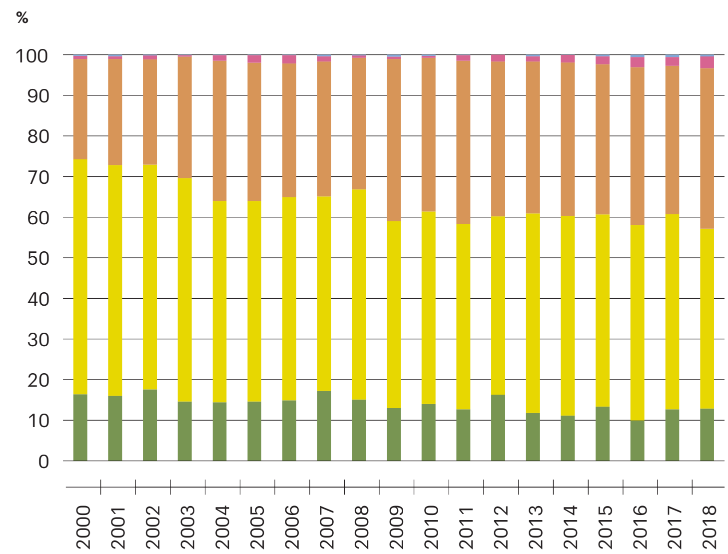
**Chart 1**

**Defoliation of older conifers and deciduous trees (60 years of age and older) in the Czech Republic by classes [%], 2000–2018**

### Conifers




### Deciduous



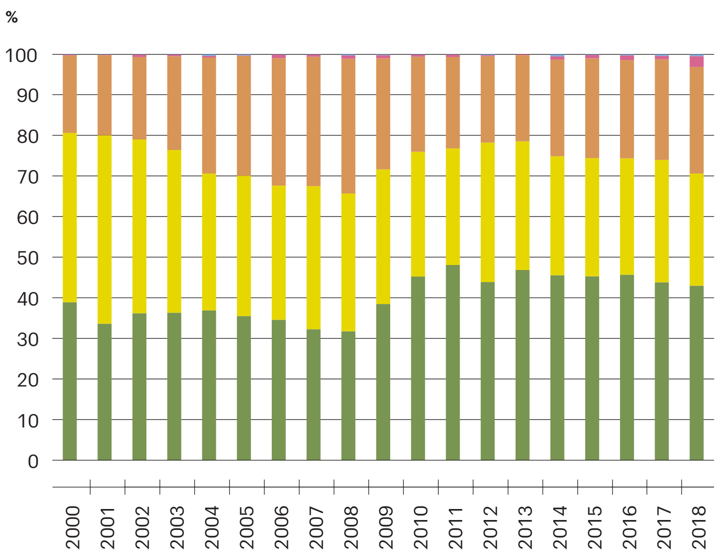

Class 0 (0–10%) Class 1 (> 10–25%) Class 2 (> 25–60%) Class 3 (> 60–< 100%) Class 4 (100%)

*Data source: Forestry and Game Management Research Institute, public research institution*

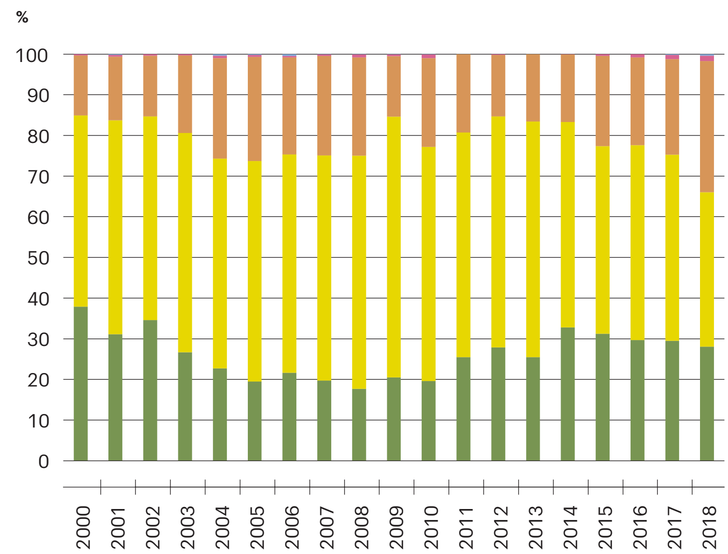
**Chart 2**

**Defoliation of younger conifers and deciduous trees (up to 59 years of age) in the Czech Republic by classes [%], 2000–2018**

### Conifers




### Deciduous

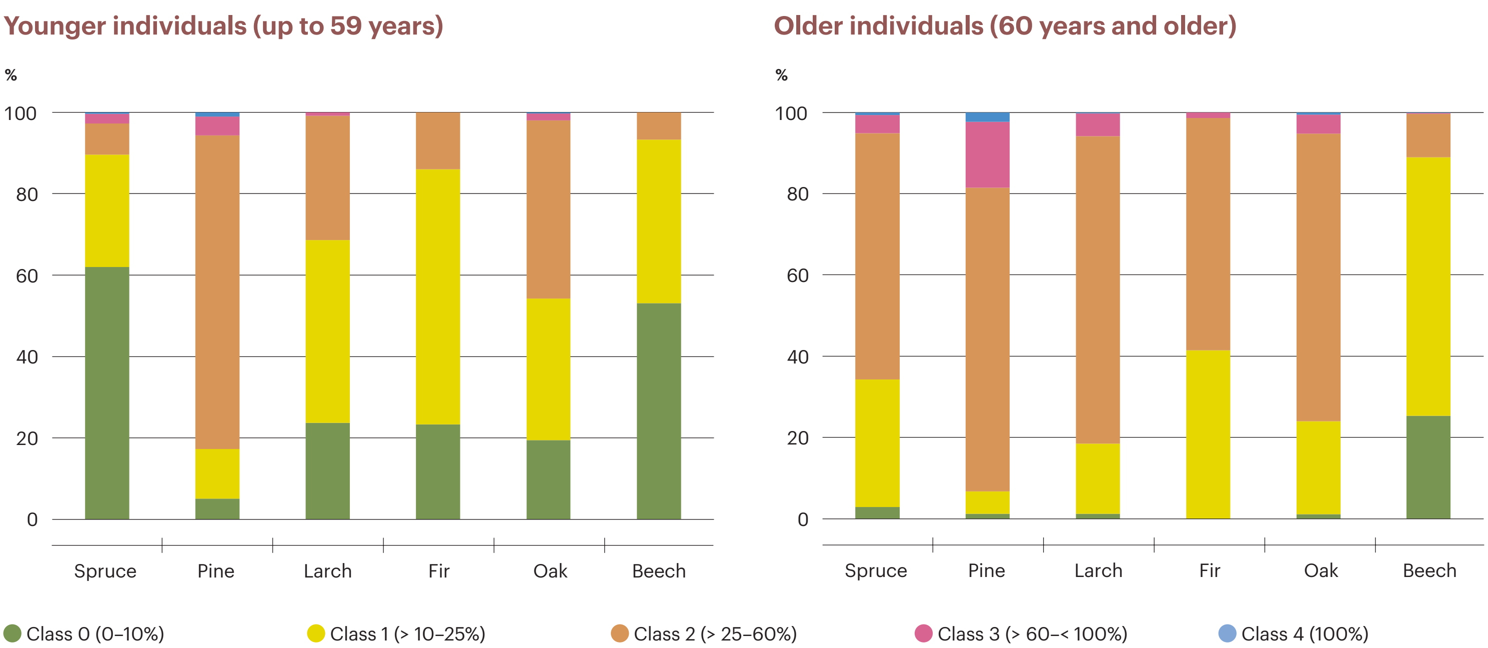



Class 0 (0–10%) Class 1 (> 10–25%) Class 2 (> 25–60%) Class 3 (> 60–< 100%) Class 4 (100%)

*Data source: Forestry and Game Management Research Institute, public research institution*

**Chart 3**

### Defoliation of basic tree species in the Czech Republic by classes [%], 2018




*Data source: Forestry and Game Management Research Institute, public research institution*

The **percentage of defoliation**, which is defined as a relative loss of the assimilation apparatus in the tree crown compared to an undamaged tree growing under the same stand and habitat conditions, can be used to express the health condition of forest stands. Defoliation is influenced by many biotic (insects, fungi) and abiotic (drought, frost, wind) factors, in terms of human activity it is primarily caused by the exposure of forest ecosystems to immissions of sulphur ($SO_2$) and nitrogen ($NO_x$). The effects of anthropogenic immissions are divided into primary, caused by direct damage to the surface of assimilation organs, and secondary, caused by leaching of alkaline nutrients due to soil acidification. In addition to habitat conditions and the amount of acid deposition, the acidification and overall nutrient balance of forest ecosystems is also influenced by the method of forest management, including tree species composition and logging intensity.

Assessment of the health of coniferous and deciduous stands using the defoliation level is divided according to age into two categories – older (60 and more years) and younger (up to 59 years). The defoliation values are divided into five basic classes (0–4), of which classes 2–4 characterise significantly damaged trees.

In the case of **older stands**, a significant increase in defoliation in response to air pollution was observed during the 1970s and 1980s. The subsequent stabilization was attributed to the reaction of forest stands to the reduced immission load. However, since the beginning of the 21st century, the condition of both coniferous and deciduous trees has deteriorated again (Chart 1). For conifers, class 2–4 defoliation increased from 64.8% in 2000 to 76.6% in 2018 (74.1% in 2017). The largest increase (by 8.2 p.p.) since 2000 was in the category of 60–100% damage (class 3) and the proportion of already dead trees in class 4 increased (from 0.1% to 1.2%). In the case of deciduous trees, the trend of an increasing share of classes 2–4 also prevails. In 2000, a total of 25.8% of the stands belonged to these classes and between 2017 and 2018 this share increased from 39.3% to 42.8%. Coniferous stands are more vulnerable to acidification due to the slow decomposition of their litterfall, which is associated with the production of low molecular weight organic acids, and due to higher concentrations of immissions in throughfall precipitation due to dry deposition on needles.

In the **assessment of individual wood species** aged 60 years and over, the value of defoliation in the sum of classes 2 to 4 is the highest for pine from among conifers – in 2018 it was 93.3%, for larch (81.5%) and spruce (65.8%). Among deciduous trees, a significant degree of defoliation in classes 2–4 is shown for oak – on 76.0% of the evaluated trees in 2018 (Chart 3).

In **younger stands (up to 59 years)**, the level of defoliation is lower (Chart 2) because younger forests have better vitality and ability to withstand adverse environmental conditions. A significant reason is also the lower immission load in the past. After

2000, however, the progress of defoliation of the younger stands can be characterised by an increasing proportion of trees in class 2 to 4 at the expense of classes 0 and 1 (conifers in the period 2000–2008 from 19.4% to 34.3%, deciduous trees from 15.1% to 25.0%). The change in trend can be observed after 2008, when in both categories of tree species, the proportion of class 2 to 4 decreases. Between 2013 and 2018, however, a re-increase from 21.5% to 29.4% for conifers and from 16.6% to 34.0% for deciduous trees is observed.

In the **evaluation of individual tree species** up to 59 years, in the case of conifers, the least favourable situation is repeatedly for pine, which is sensitive to drought, temperature extremes and sudden weather changes. In 2018, in the sum of classes 2–4, the total defoliation was 82.7%. A more favourable situation, compared to older stands, is observed in the case of spruce (only 10.4% in classes 2 to 4). In the deciduous stands of the younger age category, the higher degree of defoliation applies mainly to oak, with 45.8% (Chart 3).

The **poor health of forest stands** is a consequence of the intensive immission load on forest ecosystems in recent decades, when older stands were significantly influenced by deteriorated air quality since their early growth stage. Since 1989, the immission situation has improved significantly thanks to the installation of devices, the change of the fuel base and the application of emission limits on air pollution sources. Forest stands, however, respond to changes with a considerable delay, moreover, the immission load continues, even though its intensity is demonstrably lower. At present, the health condition of forest stands is negatively influenced by the spruce bark beetle gradation and by individual manifestations of climate change such as drought, strong wind and subsequent prolonged vegetation period. In addition, many of the forest stands are characterized by an unsuitable species composition, with the prevailing use of compartment felling, which do not create the prerequisites for improving forest health. Therefore, the state of forest health remains unsatisfactory.

## Detailed data sources

**CENIA, Information System of Statistics and Reporting**

https://issar.cenia.cz