Zpráva o životním prostředí České republiky v roce 2021

Česká informační agentura životního prostředí (CENIA)
2022

Report on the Environment of the Czech Republic

2021

cenia

Ministry of the Environment of the Czech Republic

Drawn up by
Czech Environmental Information Agency

Overall editorial staff
L. Hejná and E. Koblížková

Authors
E. Čermáková: chapter Climate change in Czechia, 1.1, 1.3, 1.6, 3.1; P. Grešlová: chapter 3.1, 3.2; M. Havránek: Assessment methodology for trends and state; T. Kochová: chapter Planetary boundaries, Opinions and attitudes of the Czech public; P. Lepičová: chapter 1.2, chapter 1.3, 1.4, Assessment methodology for trends and state; J. Mertl: chapter Climate change in Czechia, 1.2, 1.4, 1.5, 1.6, 2.1, 2.2; J. Pokorný: chapter 1.5, 1.6, 2.2, Financing of environmental protection; J. Přech: Planetary boundaries, chapter 3.1; M. Rollerová: chapter 1.2, 1.5, 2.1, 3.1; V. Vlčková: chapter 1.3, 1.6, 2.2

The assessment has been prepared using data provided by the listed cooperating organizations.

Map outputs
V. Dastychová: chapter Manifestations of climate change in Czechia – Figure 5, 6, chap. 3.2 – Figure 11, 12;
K. Horáková: chapter Manifestations of climate change in Czechia – Figure 4, chapter 1.2 – Figure 8

Map created using data from ArcČR 500 v. 3.0. Thematic content created from data provided by the institutions listed as the data source for each map.

Authorised version

ISBN 978-80-7674-060-0 (print version)
ISBN 978-80-7674-061-7 (online pdf version)

Published by
Czech Environmental Information Agency
Moskevská 1523/63, 101 00 Prague 10, info@cenia.cz, http://www.cenia.cz
Prague, 2022

Recommended citation
CENIA (2022). *Report on the Environment of the Czech Republic 2021*. Czech Environmental Information Agency. Available from: https://www.cenia.cz/publikace/zpravy-o-zp/

Typesetting
Daniela Řeháková

List of cooperating organisations

Central Institute for Supervising and Testing in Agriculture
Czech Astronomical Society
Czech Geological Survey
Czech Hydrometeorological Institute
Czech Office for Surveying, Mapping and Cadastre
Czech Society for Ornithology
Czech Statistical Office
CzechInvest
Energy Regulatory Office
Evernia, Ltd.
Forest Management Institute
Forest Stewardship Council Czech Republic
Forestry and Game Management Research Institute
Charles University Environment Centre
Institute of Agricultural Economics and Information
Institute of Sociology of the Czech Academy of Sciences, Public Opinion Research Centre
Masaryk University, Faculty of Social Studies, Department of Environmental Studies
Ministry of Agriculture of the Czech Republic
Ministry of Finance of the Czech Republic
Ministry of Industry and Trade of the Czech Republic
Ministry of the Environment of the Czech Republic
Ministry of Transport of the Czech Republic
National Institute of Public Health
National Reference Laboratory for Environmental Noise
Nature Conservation Agency of the Czech Republic
Povodí Labe, state enterprise
Povodí Moravy, state enterprise
Povodí Odry, state enterprise
Povodí Ohře, state enterprise
Povodí Vltavy, state enterprise
Programme for the Endorsement of Forest Certification Czech Republic
Research Institute for Soil and Water Conservation
Road and Motorway Directorate of the Czech Republic
Správa železnic, state enterprise
State Environmental Fund of the Czech Republic
T. G. Masaryk Water Research Institute, public research institution
Transport Research Centre

Table of contents

Introduction

The Report on the Environment of the Czech Republic (the "Report") is drawn up every year on the basis of Act No. 123/1998 Coll., on the right to information on the environment, as amended, Government Resolution No. 446 of 17 August 1994, and Government Resolution No. 934 of 12 November 2014. It is submitted to the Government of the Czech Republic for approval and subsequently to the Chamber of Deputies and the Senate of the Parliament of the Czech Republic for debate.

It is a comprehensive document assessing the state and development of the environment in Czechia from all aspects based on the data available for the year under assessment.

The Czech Environmental Information Agency has been responsible for drawing up the Report on the Environment of the Czech Republic since the 2005 Report. The Report concept was revised in 2018. As a result, a detailed version of the Report is now prepared every two years, and in the intervening period the most important information on the state and development of the environment is published in concise form. The 2021 Report is one of those concise versions. Starting with the 2020 Report, the content concept and structure of the Report, based on the State Environmental Policy of the Czech Republic 2030 with a view to 2050, has been changed to enable the continuous assessment of its indicators and meet the set goals and priorities. The main areas are based on the State Environmental Policy 2030 (1. Environment and health, 2. Climate-neutral and circular economy, 3. Nature and landscape) and are framed by other topics central to the state and development of the environment (Planetary boundaries, Climate change in Czechia, Financing of environmental protection, Opinions and attitudes of the Czech public).

The 2021 Report was discussed and approved by the Government on 14 December 2022 and then submitted to both parliamentary chambers for debate. Due to the reporting and processing methodology used, at the time the Report was being drawn up some data sets for 2021 were not available or the data were only provisional. Information on data sets (the reasons for their unavailability and future updates) for which 2021 data were unavailable at the time of publication is provided in the relevant chapters.

The 2021 Report is simultaneously published electronically (https://cenia.cz, https://www.mzp.cz) together with the Statistical Environmental Yearbook of the Czech Republic 2021 and Reports on the Environment in the Regions of the Czech Republic 2021. Detailed data sources are available on the Envirometr portal (https://www.envirometr.cz).

Key messages of the Report

The state of the environment is still not optimal with regard to air and water quality, and the unsustainable use of natural resources is reflected in the poor state of ecosystems and loss of biodiversity. In 2021, despite the ongoing COVID-19 pandemic, the economy grew after a significant contraction in the preceding year, causing year-on-year increases in environmental pressures from production processes, higher population mobility and household consumption.

In terms of temperature and precipitation, 2021 was a normal year without significant extremes, however the long-term increase in the average annual temperature in Czechia is accelerating. The course of the temperature and precipitation conditions was reflected in the normal development of the moisture balance, runoff conditions and groundwater conditions. Unlike in previous years, soil drought was not widespread and only the South Moravia Region was significantly affected. Fluctuations from normal values in temperature and precipitation are part of climate change, which is also manifested through increasing extremes in hydrometeorological phenomena. In June 2021, the most powerful tornado in the history of Czechia affected the South Moravia Region, causing fatalities and billions in property damage.

The course of the weather in 2021 had a favourable impact on the bark beetle calamity in the forests and led to a year-on-year reduction in the extraction of bark-beetle-infested timber. The state of forests damaged by the bark beetle calamity is undermining their ability to sequester carbon dioxide and poses a serious challenge to progress towards climate neutrality. According to the latest emissions inventory as of 2020, Czechia had the worst balance of emissions and removals in the land use, land use change and forestry (LULUCF) sector in the EU27.

The area with exceeded human-health air limits is slowly decreasing for most of the monitored substances, with slight year-on-year fluctuations due to meteorological conditions and the development of the national economy. The high proportion of emissions from household heating remains a persistent problem. This is mainly due to local heating using solid fuels, accounting for more than a third of household heating. The burning of not only coal, but also wood, wood waste and other materials not intended for heating is problematic in terms of emissions from household heating systems.

Surface water quality has improved since 2000. During the 2000–2021 period, the most significant reductions in ammonia nitrogen and total phosphorus in watercourses were achieved thanks to technological improvements in the treatment of wastewater discharged from point sources. Nevertheless, some stretches of watercourses continue to be assessed as heavily or very heavily polluted.

There was confirmation of the continuing trend of shrinking natural habitats associated with a decline in bird populations, which are the main indicator of biodiversity in forest and agricultural landscapes. The agricultural (mainly arable) land area is decreasing every year while that of built-up areas is increasing. Agricultural production is intensive and a high amount of mineral fertilisers is still applied. This, together with the persistence of large soil blocks and a high degree of ploughing, makes the soil vulnerable to erosion.

The material and energy intensity of Czechia is decreasing. The 2020 target for primary energy consumption was not exceeded and the more stringent 2030 target was not even exceeded. The structure of the energy mix remains different from the target structure, but is gradually changing in the desired direction. The export character of foreign trade in electricity persists. Although the use of renewable sources for electricity and heat production is growing, Czechia remains largely dependent on imports of energy raw materials from abroad, especially oil and natural gas.

Waste generation has not been reduced, yet overall waste treatment remains dominated by material recovery, the share of which is increasing in accordance with circular economy principles and the current waste treatment hierarchy. In the case of municipal waste, however, landfilling continues to prevail despite significant efforts.

Transport in Czechia remains carbon-intensive, with most of the energy consumed in transport coming from the burning of fossil fuels. Air pollution from transport is gradually decreasing as technology is modernised and legislative requirements are met. By contrast, greenhouse gas emissions in transport have evolved along with transport intensity and fuel consumption and, with the exception of 2020, have been rising. The registration of new vehicles powered by alternative fuels is growing dynamically, with their share exceeding one tenth of new passenger car registrations in 2021.

Environmental protection, including addressing climate change, has long been financially ensured both from national sources and from European sources through operational programmes, in particular from the Operational Programme Environment and the Rural Development Programme. One example of the successful financing of environmental protection measures is the implementation of the New Green Savings and Rainwater programmes together with boiler subsidies. The share of environmental protection investment to GDP has been above average in the long term in an international comparison.

Climate change in Czechia

- 2021 was assessed as a normal-temperature year in Czechia, with the average annual air temperature (8.0°C) being 0.3°C lower than the 1991–2020 normal. According to the occurrence of summer and tropical days, the summer of 2021 was normal without significant temperature extremes.

- The air temperature in Czechia is rising by 0.4°C every ten years according to a comparison of the current and previous normal period.

- Precipitation was normal for Czechia in 2021, with average annual precipitation of 683 mm, or 100% of the 1991–2020 normal. Above-normal precipitation was recorded in May and August of 2021, while the autumn (September–November) was very dry and the second-driest since 1961.

- The moisture balance was relatively normal in 2021 compared to previous years in view of the temperature and precipitation conditions, with only small deviations from the long-term average. With the exception of South Moravia, the soil drought was not significant compared to previous years and had a smaller geographical extent; most of Czechia was not affected by soil drought.

- From a hydrological perspective, 2021 was a relatively average year overall, with fluctuations from normal occurring at the regional level, and with drought conditions occurring at a lower intensity than in previous years.

Water availability and quality

- Over the 2000–2021 period, the most significant reductions in pollution in Czech watercourses were achieved for $N\text{-}NH_4^+$ (a decrease in the average concentration of 75.8%) and P_{total} (a decrease in the average concentration of 51.2%).

- In groundwater, 27.6% of sites were found to have above-limit concentrations for the sum of pesticides indicator in 2021.

- The proportion of the population connected to the public water supply was 96.0% in 2021 (87.1% in 2000).

- The proportion of the population connected to a sewerage network has increased since 2000, reaching 87.4% in 2021, and the proportion of the population connected to a sewerage system with a waste water treatment plant also increased (to 84.7%).

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Water quality in watercourses	↗	→	→	~
Bathing water quality	~↗	~↗	~↗	✓
Groundwater quality	N/A	~↗	~↗	~
Population supplied with water from the public water supply	↗	↗	→	✓
Waste water treatment	↗	↗	↗	✓
Waste water discharge	N/A	↘	→	~
Groundwater and surface water abstraction by sector	↘	↘	↘	~
Water consumption from the public water supply and water losses in the water supply network	↘	→	→	~

Air quality

- Emissions of main air pollutants (NO_X, VOC, SO_2, NH_3 and $PM_{2,5}$) are showing a long-term fall. In the context of meeting commitments (emissions ceilings), it can be stated that unless there are significant changes in the current trend, the required emissions reductions by 2025 may not be achieved for all substances.

- Household heating emissions fell year-on-year in 2020[1] for all monitored substances, despite a colder heating season than the previous year, 2019.

- Emissions of NO_X, VOC, CO and suspended particulate matter (PM) from transport had a decreasing trend in the 2000–2021 period, most significantly in the case of VOC and CO emissions, which decreased by 78.5% and 83.1% respectively in this period. However, PAH emissions from transport are increasing.

- Some limit values are still being exceeded. In 2021, 6.1% of Czechia was defined as having at least one limit value exceeded without including ground-level ozone, while 19.7% of the population lived in this area. The limit value for ground-level ozone was exceeded over only a minimal area of the territory in 2021, a significant year-on-year change.

- One smog situation was declared in 2021 due to the exceeding of the threshold values for suspended PM_{10} particulate matter.

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Emissions of selected air pollutants	↘	↘	↘	~
Emissions from transport*				
Emissions of basic pollutants from transport	↘	↘	↘	✓
Emissions of greenhouse gases from transport	↗	↗	~↗	~
Emissions of PAH from transport	↗	↗	~↗	~
Emissions from household heating	~↗	↘	↘	✗
Compliance with limit values for selected pollutants	~↗	→	↗	~
Air quality in terms of human health protection	~↗	~↗	↗	~
Air quality in terms of ecosystem and vegetation protection	↗	→	↗	~

** Due to the heterogeneity of the topics underlying the construction of the indicator, an assessment of the sub (elementary) indicators is presented.*

[1] *Data for the year 2021 are not available at the time of publication. They will be published in February 2023 at the earliest.*

Exposure of the population and the environment to hazardous substances

- Air emissions of heavy metals (with the exception of copper) and POPs are decreasing in the long and medium terms. The main sources of emissions of heavy metals and POPs in Czechia in 2020[2] were household heating and the public energy and heat generation sector.

- Over the 2010–2021 period, the remediation of 2,172 contaminated sites was completed with compliance with the conditions of the remedial measures, while the remediation of 1,145 sites was completed in 2021.

- The incremental Evidence System of Contaminated Sites database contained 10,156 sites in 2021.

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Releases to water and soil and air emissions of selected hazardous chemicals	N/A	N/A	N/A	N/A
Air emissions of heavy metals and POPs	↘	↘	↘	✓
Contaminated sites (evidence and remediation)	N/A	N/A	N/A	~

Noise pollution and light pollution

- Urban agglomerations with a population of over 100 thous. are in particular exposed to noise pollution from road transport. In terms of all-day (24-hour) and night (from 22:00 to 06:00) noise pollution, the inhabitants of the Prague and Liberec agglomerations are exposed to the greatest noise pollution.

- Between the 2nd and 3rd round of the Strategic Noise Mapping (2012 and 2017), the total number of Czech inhabitants exposed to road traffic noise above the threshold for both day and night noise pollution fell.

- Investments in the implementation of noise protection measures on road infrastructure increased by 47.7% year-on-year to CZK 576.7 mil. in 2021. However, comparability with 2020 is limited due to the COVID-19 pandemic. The motorway network in Czechia was expanded by 43 km in 2021, and new sections of the D11 and D35 motorways were put into operation.

- The current level of light pollution is steadily worsening due to the increasing amount of illuminated areas. We can no longer find any area not affected by artificial illumination in Czechia.

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Noise pollution burden of the population	N/A	N/A	↘	~
Noise reduction measures in transport and development of transport infrastructure	N/A	N/A	↗	✓
Brightness of the night sky	N/A	N/A	N/A	~

[2] *Data for the year 2021 are not available at the time of publication. They will be published in February 2023 at the earliest.*

Society preparedness for and resilience to emergencies

- In 2021, a total of 202 alerts for hazardous hydrometeorological phenomena were issued under the Integrated Warning Service System, of which 148 were forecast alerts and 54 warned of the imminent occurrence of a hazardous phenomenon. The most frequent warnings issued were for thunderstorms and strong wind. 84.9% of alerts were successful or partially successful.

- In order to support preparedness for weather extremes or the impacts of climate change, almost 1,600 projects worth CZK 12.2 bil. were approved in the 2014–2021 period. At the Ministry of Agriculture of the Czech Republic, approximately CZK 18.6 bil. was spent on the Rural Development Programme and national programmes for the implementation of about 1,900 measures in the area of flood protection and water retention in the landscape.

- In 2021, insurers recorded 64 thous. claims from natural disasters with total damage of CZK 6.2 bil. Compared to 2020, the damage caused increased dramatically mainly due to storms and the devastating tornado in the Břeclav and Hodonín Regions.

- In 2021, there were five major industrial accidents involving spills of hazardous substances, an explosion and a fire.

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Public money spent on adaptation to climate change	N/A	N/A	N/A	N/A
Issuing Integrated Warning Service System alerts*	N/A	N/A	N/A	✓
Events and interventions arising from natural disasters	N/A	↗	~↗	✗
Amount of damage caused by natural disasters	~↗	~↗	↗	✗
Preventive and educational activities for population protection and crisis management	N/A	~↗	↘	✗
Number of major accidents reported	↗	↗	↘	~

** It is not possible or meaningful to set a trend for the operation of the alert system. The criterion for its success is not the number of alerts issued, but the quality, accurate and timely issuing of alerts.*

Adapted settlements

- In 2021, 39 municipalities and city districts in Czechia, one micro-region comprising another 13 municipalities and three regions, including Prague, had adaptation strategies or plans. Compared to the previous year, when 18 municipalities had these documents approved, this is a significant positive shift, yet overall the implementation of relevant adaptation measures at local and regional levels is progressing slowly.

- In total, 1,920 brownfield sites with a total area of 5,355.4 ha were newly registered in the 2014–2021 period. Brownfields in Czechia are being regenerated, with 157 sites deactivated from the National Brownfield Database in 2021 due to sale or successful regeneration.

- A total of 123 implementers, mainly from municipalities and small communities, were involved in the implementation of Local Agenda 21 at local and regional levels in 2021. However, the number of Local Agenda 21 implementers has been on a downward trend over the last five years.

- A total of 26 cities and urban agglomerations had Sustainable Urban Mobility Plans prepared and approved as of 2021, of which 18 have been verified as Sustainable Urban Mobility Plans and eight as Sustainable Urban Mobility Frameworks. All cities and urban agglomerations with over 100 thous. inhabitants have an approved Sustainable Urban Mobility Plan.

- In the area of rainwater or grey water management in settlements, 196 projects were approved in the 2014–2021 period worth a total of CZK 0.8 bil. total eligible expenditure, the implementation of which should mean the retention of more than 24 thous. m^3 of rainwater in municipalities. As part of the Rainwater programme, 8,689 projects were approved in 2017–2021 with a total support of CZK 335.1 mil., while the total volume of the storage tanks acquired with support from this programme amounted to more than 42 thous. m^3.

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Number of municipalities with adaptation plans	N/A	N/A	↗	✗
Brownfields	N/A	N/A	N/A	~
Local Agenda 21	↗	~↗	↘	✗
Sustainable Urban Mobility Plans	N/A	N/A	↗	✓
Supported projects for the use of rainwater and grey water	N/A	N/A	↗	✓
Green areas in cities	N/A	N/A	→	~

Transition to climate neutrality

- Greenhouse gas emissions excluding the LULUCF sector decreased by 43.0% in the 1990–2020 period[3] and by 8.3% in 2020. Due to continued high calamity logging, the positive balance of emissions and removals in LULUCF is unfavourable, and in 2020 was the highest in Czechia among all EU27 states.
- EU-ETS greenhouse gas emissions fell by 29.8% between 2005 and 2021 and, if the current trend continues, it is realistic to anticipate the 2030 target will be met. The situation is worse outside the EU-ETS (within the scope of the ESR), where emissions have stagnated except in 2020, and development is not yet on track to reach the 2030 target.
- Gross electricity generation, after the slump caused by the COVID-19 pandemic, increased by 4.3% year-on-year to 84,907.3 GWh in 2021.
- Foreign trade in electricity continues to be export-oriented, with the share of the balance in consumption reaching 15.0% in 2021.
- 37.7% of heat for household heating came from solid fuels (28.8% from biomass and 8.9% from fossil fuels).
- Energy consumption in transport increased by 61.3% in the 2000–2021 period, with more than two-thirds of transport energy consumption coming from diesel combustion in 2021.
- Registrations of new alternative-fuel powered vehicles are growing, reaching 13.9% of the total number of new passenger cars registered in 2021.
- The energy intensity of the economy declined by 0.1% year-on-year in 2020[4] due to measures taken in response to the COVID-19 pandemic, a result of a reduction in consumption of primary energy sources but also a decline in GDP.
- Primary energy consumption in 2020[5] fell to 1,677.6 PJ, meaning both the 2020 (not exceeding 1,855 PJ) and 2030 (1,735 PJ) targets were met. However, the structure of the primary energy sources differs significantly from the targets set for 2040.
- Czechia's energy import dependence was 39.0% in 2020[6], with the largest share of energy resources imported from Russia.
- Electricity generation from renewable sources in 2021 increased by 2.5% year-on-year to 10,547.3 GWh.
- The share of RES in gross final energy consumption in 2020[7] was 17.3%. The target for 2030 is 22%.
- The share of RES in final energy consumption in transport in 2020[8] reached 9.4%, thus the target of 10% energy from RES in transport by 2020 was not met.

---

[3] *Data for the year 2021 are not available due to the preparation schedule of the emissions inventory.*

[4–7] *Data for the year 2021 are not available at the time of publication. They will be published in January 2023 at the earliest.*

[8] *Data for the year 2021 are not available at the time of publication.*

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Greenhouse gas emissions (without LULUCF)	↘	↝	↝	~
Electricity and heat generation*				
Gross electricity generation	○	○	○	✗
Gross heat generation	N/A	○	○	N/A
Share of the balance of foreign trade in electricity in domestic consumption	↝	↘	↘	~
Household heating by fuel	↗	→	→	✗
Energy and fuel consumption in transport	↗	↗	↝	✗
Energy intensity of the economy*				
Development of the energy intensity of the economy	N/A	↘	↘	~
Structure of primary energy sources	N/A	○	○	~
Energy efficiency	N/A	↝	↝	✓
Energy import dependence	N/A	↗	↗	✓
Use of renewable energy sources	↗	↗	↗	✓
RES consumption in transport	↗	↗	↗	~

** Due to the different time series trends underlying the construction of the indicator, an assessment of the sub (elementary) indicators is presented.*

Transition to a circular economy

- The material intensity of the Czech economy has been steadily decreasing, with a 45.2% decrease in the 2000–2020 period[9]. This reduces the environmental burden per unit of GDP generated.

- In 2018[10], the share of secondary raw material production volume in direct material input was 8.3%.

- Total waste generation has a significantly increasing trend in the medium and short term, as does the generation of non-hazardous waste. Municipal waste generation is increasing in the medium term.

- In the medium term, there has been a slight reduction in the generation of mixed municipal waste.

- A sustainable approach to waste or packaging generation is one of the principles guaranteed by the ecolabelling of products and services. In terms of long-term development, we note a significant downward trend in the number of licences for the Czech Environmentally Friendly Product and Environmentally Friendly Service ecolabel, while the number of EU Ecolabel licences is increasing. In 2021, there were a total of 34 valid licenses to use the Czech Environmentally Friendly Product/Environmentally Friendly Service ecolabel in Czechia, which corresponds to 48 certified products; in the case of the EU Ecolabel, there were 22 licenses for 5,201 certified products.

- A positive aspect of the transition to a circular economy is that the overall waste treatment is dominated by waste recovery, especially material recovery, the share of which is increasing in the medium and short term.

- The main objective in the field of municipal waste treatment is to significantly reduce landfilling in favour of material recovery, yet almost half of municipal waste is still landfilled.

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Material intensity of the economy	↘	↘	↘	✓
Share of secondary raw material production volume in direct material input	N/A	~↗	↗	~
Waste generation	N/A	↗	↗	✗
Ecolabelling*				
Total number of valid Environmentally Friendly Product and Environmentally Friendly Service ecolabel licences	↘	↘	↘	✗
Total number of valid EU Ecolabel licences	↗	~↗	~↗	✓
Waste treatment structure	N/A	○	○	✓
Municipal waste treatment	N/A	○	○	~

** Due to the different time series trends underlying the construction of the indicator, an assessment of the sub (elementary) indicators is presented.*

[9] *Data for the year 2021 are not available at the time of publication.*

[10] *Data for the years 2019–2021 are not available at the time of publication.*

Ecological stability of the landscape and sustainable landscape management

- Year-on-year, mineral fertiliser consumption increased by 2.5% to 104.2 kg of net nutrients per ha in 2021.

- In 2021, the consumption of active substances amounted to 3,797.5 thous. kg of active substances, a slight year-on-year increase (of 0.3%).

- The area affected by mineral extraction is decreasing, while the size of the area with completed reclamation is increasing.

- Extensive soil loss through erosion occurs every year. 51.7% of agricultural land is potentially threatened by water erosion, of which 15.6% by extreme erosion. 36.6% of agricultural land is threatened by wind erosion. The number of recorded erosion events (271) was lower in 2021 than in previous years, reflecting the balance between temperature and precipitation over the course of the year.

- The area of agricultural land is in long-term decline, with a total of 1,500 ha of land lost in 2021. The area of built-up areas has been growing over the long term, and increased by 621 ha between 2020 and 2021.

- Damage to forest stands expressed as a defoliation percentage remains high and trends are negative in the long term. In 2021, 79.3% of conifers and 40.1% of deciduous trees were classified in defoliation classes 2 to 4 for older stands (60 years and older), and 29.5% of conifers and 28.1% of deciduous trees for younger stands (up to 59 years).

- Large-scale logging continued after the bark beetle calamity in 2021. However, for the first time since its inception in 2015, the volume of logging carried out decreased year-on-year to 30.3 mil. m^3 of wood without bark. The share of incidental (calamity) logging in total logging decreased from 94.8% in 2020 to 86.9% in 2021.

- In the areas affected by the bark-beetle calamity, forests are being restored and, thanks to an increase in the proportion of deciduous trees being restored, there is a gradual approach to the recommended tree composition. In 2021, a record 21,2 thous. ha was reforested with deciduous trees and 19,5 thous. ha with conifers, although spruce was still the most frequently planted tree species (12,1 thous. ha).

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Infiltration capacity of soils	N/A	N/A	N/A	N/A
Land use	↗ (red)	↗ (red)	↗ (red)	✕ (red)
Quality of agricultural and forest soil*				
Quality of agricultural soil	N/A	N/A	N/A	N/A
Quality of forest soil	N/A	N/A	N/A	✕ (red)
Erosion and compaction of agricultural soil	N/A	↗ (red)	~↗ (yellow)	✕ (red)
Consumption of fertilisers and plant protection products	~↗ (yellow)	~↗ (yellow)	↘ (green)	~ (yellow)
Land take	~↗ (yellow)	↗ (red)	↗ (red)	✕ (red)
Mineral extraction and reclamation*				
Mineral extraction	↘ (green)	~↗ (yellow)	↘ (green)	N/A
Reclamation after mineral extraction	↗ (green)	↗ (green)	↗ (green)	N/A
Organic farming	↗ (green)	↗ (green)	↗ (green)	~ (yellow)
Average size of fields	N/A	↘ (green)	↘ (green)	✕ (red)
Forest health condition	↘ (red)	↘ (red)	↘ (red)	✕ (red)
Sustainable forest management	~↗ (yellow)	~↗ (yellow)	~↗ (yellow)	~ (yellow)
Tree species composition of forests	↗ (green)	↗ (green)	↗ (green)	✕ (red)

** Due to the different time series trends underlying the construction of the indicator, an assessment of the sub (elementary) indicators is presented.*

Biodiversity

- Between 2000 and 2016[11], the area of unfragmented landscape decreased by 11.7% from 54.1 thous. km^2 in 2000 (68.6% of the territory) to 47.8 thous. km^2 (60.6% of the territory) in 2016.

- The average share of natural habitat area to cadastral land area was 12.9% nationally in 2021, and has decreased by 0.1 percentage points each year since 2016.

- Based on the results for the 2013–2018 period[12], 59.8% of animal species, 75.4% of plants and 79.6% of habitats are in an unfavourable or bad conservation status.

- Since 1982, the abundance of all common bird species in Czechia has declined by 5.6%. The abundance of farmland birds has declined by 31.8% since 1982. The abundance of forest bird species was 17.7% lower in 2021 than in 1982.

- Climate change is having an increasing impact on populations of common bird species in Czechia. This effect is manifested by an increase in the abundance of species that benefit from climate change and a decline in species for which conditions in Czechia are deteriorating. Since 2010, the impact of climate change on common bird species has increased by 17.4%.

- The total area of specially protected areas in Czechia, including both small-area and large-area specially protected areas, was 1,324.7 thous. ha in 2021, i.e. 16.8% of the national territory. This increased by 931.7 ha since 2020, while this increase was mainly due to the creation of new small-area specially protected areas.

- Populations of native plant and animal species and individual valuable communities in Czechia are threatened by the spread of geographically non-native species, especially invasive species. Out of the total of 1,454 non-native plant species that occur or have been recorded in Czechia, 61 are considered invasive. Of the 595 non-native species, 113 are considered invasive.

[11] *Data for the years 2017–2021 are not available at the time of publication.*

[12] *Data for the years 2019–2021 are not available at the time of publication due to the indicator being reported in six-year cycles.*

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Fragmentation of the landscape	↗	↗	↗	✕
Conservation status of species and habitats of Community importance	N/A	~↗	N/A	✕
Conservation status of bird species	↘	↘	↘	✕
Common bird species*				
Abundance of all common bird species, forest bird species and farmland bird species	↘	↘	↘	✕
Indicator of the impact of climate change on common bird species	↗	↗	↗	✕
State of plant, animal and fungi species according to the red lists	↘	↘	↘	✕
Share of species on red lists that are also protected species	N/A	N/A	N/A	N/A
Specially protected areas and Natura 2000 sites in the national territory	↗	↗	↗	~
Share of habitats and species in local Natura 2000 sites	N/A	N/A	N/A	N/A
Non-native species in Czechia	N/A	N/A	N/A	✕
International trade in endangered species protected under CITES	N/A	N/A	N/A	N/A
Breeding of endangered species in zoos	N/A	N/A	N/A	~

** Due to the different time series trends underlying the construction of the indicator, an assessment of the sub (elementary) indicators is presented.*

Financing environmental protection

- The volume of expenditure from central sources stagnated at CZK 60.1 bil. in 2021, and the volume of expenditure from territorial budgets increased by 5.8% to CZK 47.5 bil. Priority areas of support included water protection, biodiversity and landscape protection, waste management and, last but not least, air and climate protection. In this area, the implementation of programmes aimed at promoting insulation, energy savings and changes in heating technologies (e.g. the New Green Savings programme and the boiler subsidies) continued.

- In the individual calls of the New Green Savings programme, a total of CZK 13.5 bil. was provided during the 2014–2021 programming period to almost 59 thous. beneficiaries.

- Under the Operational Programme Environment for the 2014–2020 programming period, four new calls for proposals were announced in 2021, amounting to EUR 31.2 mil. (CZK 0.8 bil.) of total eligible expenditure. Since the beginning of the programming period, the granting of subsidies for 9,470 applications worth a total of EUR 3.5 bil. (CZK 91 bil.) of total eligible expenditure have been approved by legal act.

- The Operational Programme Environment also finances boiler subsidies; 107 thous. replacements of boilers using solid fuels were approved in three calls by the end of 2021, with a total volume of EUR 463.7 mil. (CZK 11.9 bil.).

- The share of investment in environmental protection to GDP has been above average in the long term in an international comparison, and together with non-investment costs for environmental protection in 2021 amount to 1.9% of GDP.

Opinions and attitudes of the Czech public

- 65% of respondents were interested in environmental information in 2021. When assessing the sufficiency or lack of information about the environment in Czechia, the opinion of the Czech public is not unequivocal.

- Satisfaction with the state of the environment in the place of residence was expressed by 76% of respondents, and satisfaction with the state of the environment in the whole of Czechia by 69%.

- The most pressing global phenomena in 2021 were the accumulation of waste (92% of respondents) and the pollution of drinking water (92% of respondents).

- The awareness of the Czech public about climate issues, both in terms of understanding climate change and the production of greenhouse gas emissions and the energy sector in Czechia, is very low.

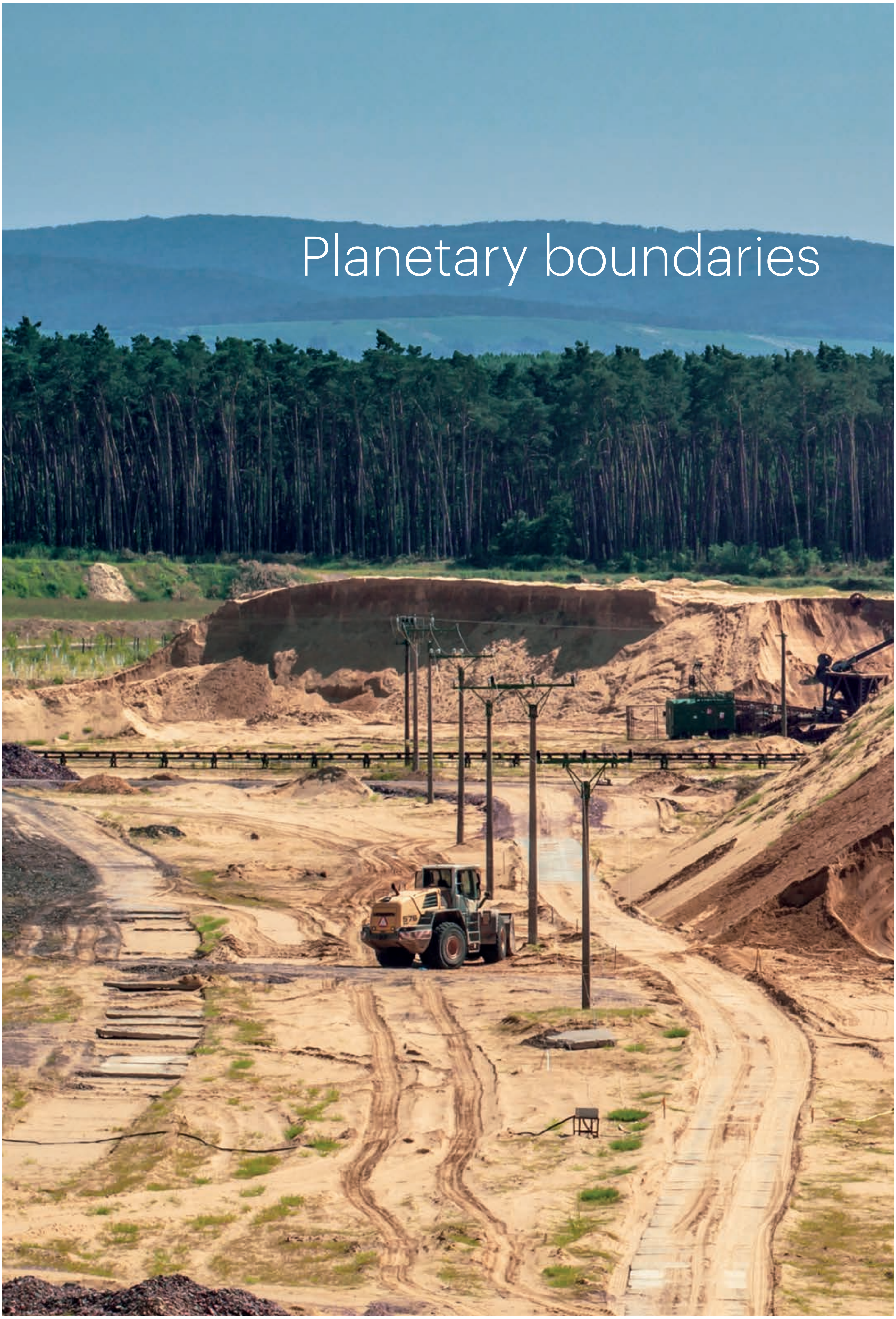
- More than two-thirds (70%) of respondents in Czechia believe that national governments are responsible for tackling climate change, and only one-fifth believe that the government is doing enough to tackle climate change.

Graphical representation of the aggregate trend		
Positive upward trend	Stagnation	Negative upward trend
Positive downward trend	Fluctuating trend	Negative downward trend
N/A The trend cannot be determined		

Graphical representation of the trend in the structure indicator		
Positive trend	Neutral trend	Negative trend

Graphical representation of the state		
Good state	Neutral state	Bad state
N/A The state cannot be determined		

Planetary boundaries



© Jiří Přech/CENIA

Planetary boundaries

Global population and economic growth, particularly in the second half of the 20th century, has been accompanied by a sharp increase in the use of natural resources. There has been a significant increase not only in population but also in GDP, energy consumption, fertiliser use and water consumption. The global use of natural resources (biomass, ore and non-ore metals, fossil fuels) has more than tripled since the 1970s and continues to increase. Moreover, the consumption of natural resources to meet the needs of the Earth's current population of 7.7 bil. is well beyond sustainable levels. However, human activities in recent years have reached such a scale and intensity that the burden on the environment is deflecting conditions on Earth from the stable state reached in the past. Such deflection or exceeding of limits (Box 1) may cause irreversible or sudden changes in environmental conditions leading to a state less favourable to human development.

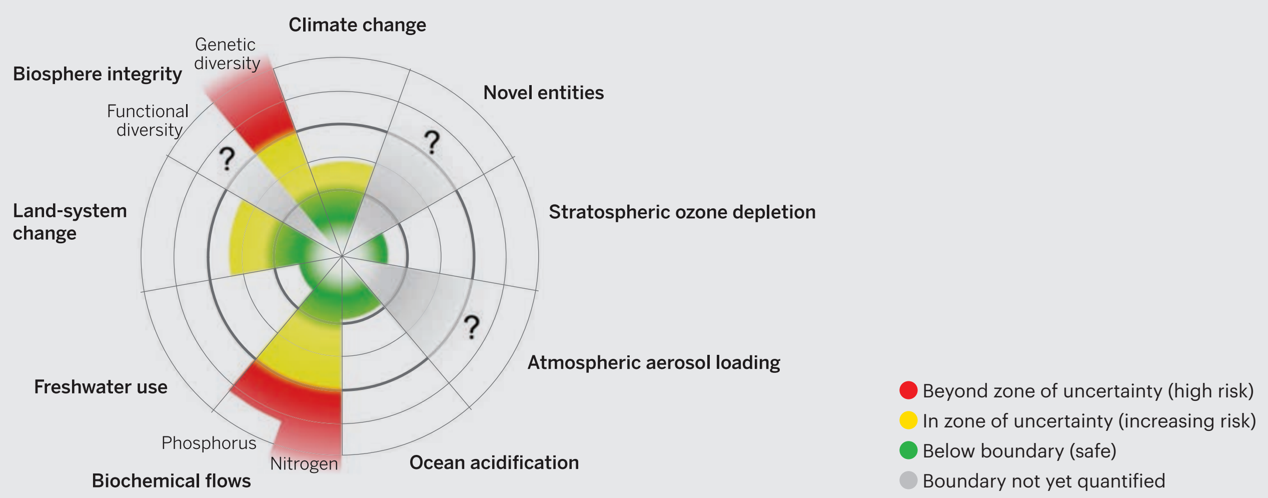
Box 1

The concept of planetary boundaries

Steffen et al., 2015[13] identified nine processes, called planetary boundaries, that regulate the stability and resilience of the system on Earth. Within these limits, humanity can continue to develop and thrive, however exceeding these boundaries increases the risk of generating sudden and irreversible large-scale environmental changes that could affect the system of the entire Earth and could be catastrophic for human development.

These are the nine planetary boundaries: climate change; change in biosphere integrity (previously loss of biodiversity); stratospheric ozone depletion; ocean acidification; biochemical flows – the phosphorus-nitrogen cycle; land-system change; freshwater use; atmospheric aerosol loading; novel entities. Two of these boundaries, namely climate change and change in biosphere integrity, are identified as crucial because they have the potential to affect the Earth's planetary system if they are fundamentally or permanently exceeded.

It is currently estimated that humanity has already exceeded four planetary boundaries, namely the change in biosphere integrity; climate change; land-system change; and biochemical flows.



Data source: Steffen et al., 2015

[13] *Steffen, W. et al., 2015: Planetary boundaries: Guiding human development on a changing planet. Science, Vol. 347, Issue 6223, doi: 10.1126/science.1259855.*

As a result of globalisation, Czechia is putting pressure on planetary systems in almost every country in the world through imports of commodities and products. Czechia is a net importer of materials and energy, so the impacts associated with materials extraction, greenhouse gas emissions and land use occur mostly abroad. To reduce society's pressure on climate change, it is necessary to reduce greenhouse gas emissions while still achieving socio-economic development. In addition to the emissions produced in the state in question (domestic greenhouse gas emissions), it is necessary to include the sum of greenhouse gas emissions produced in the supply chains of the goods and services consumed in that state (carbon footprint). The carbon footprint of Czechia shrunk by 33.1% from 1990 to 2018[14] and in 2018 it amounted to 123.7 mil. t CO_2 eq. The carbon footprint per capita (11.6 t CO_2 eq.) in Czechia is thus approximately double the global average (6.2 t CO_2 eq.). Czechia's material footprint increased by 25.7% from 1990 to 2018. In 2018, it was 228.4 mil. t, or 21.5 t per capita (the global average is 12.5 t per capita). The largest contributors to the material footprint in 2018 were non-metallic minerals (107.4 mil. t), fossil fuels (49.6 mil. t) and metal ores (19.1 mil. t). Through its international trade relations, Czechia is also responsible for land use in almost every country in the world. Society uses land in many ways, including for agricultural production, forestry, and urban and industrial areas. However, soil sealing, and intensive agriculture are limiting the ability of the land to function as part of an ecosystem, with serious impacts such as loss of biodiversity. The sum of land use caused by final consumption in Czechia is called the land footprint. This footprint increased by 4.8% from 1990 to 2018 and amounted to 10.5 mil. ha, which in per capita terms (1.0 ha) is comparable to the global average (1.1 ha per capita). The disproportion between the ecological footprint (consumption of natural resources) of Czechia and its biological capacity (the ability of ecosystems to regenerate resources) is resulting in a national ecological deficit of 145%.

The long-term outlook of Czechia, and Europe as a whole, in terms of the environment and sustainable development is influenced by factors of various scales. These factors include global megatrends (Box 2), weak signals and emerging trends (Box 3), or wild-card developments (Box 4). Czechia's ability to influence the development of these factors is limited, yet their impact on its future development is significant.

Box 2

Global megatrend clusters

Global megatrends are large-scale social, economic, political, environmental, or technological changes that are slow to take shape but which, once established, have profound and lasting effects on many, if not most, human activities, processes, and perceptions.

Increasing rates of urbanisation and migration: Demography, urbanisation and migration are significantly linked, as population growth is very often linked to the expansion of urban areas and migration, often contingent on better employment opportunities and living standards in cities. Under long-term scenarios, the world's population is expected to increase from 7.7 bil. today to 8.5 bil. in 2030, 9.7 bil. in 2050 and 10.9 bil. in 2100. The largest increase is expected in urban areas of developing countries. A significant part of this increase is related to socio-economic development, improving health care, better levels of education, and an increase in wealth, which lead to a decrease in mortality rates and an increase in life expectancy. As the birth rate declines over the long term while life expectancy increases, there is an overall ageing of the population. For the first time in the entire history of mankind, the share of the population aged over 65 will outweigh children aged under five. Population growth is not evenly distributed – it is most pronounced in sub-Saharan and North Africa and Central and Southeast Asia, while East Asia and Europe are facing population decline. Population development is closely linked to population migration which, however, affects only about 3% of the world's population and is mainly dominated by intracontinental migration. While Europe is a key destination for refugees, Asia is becoming an increasingly attractive destination for migrants[15]. The most important drivers of migration are environmental degradation and climate change. At the same time, it is greatly influenced by the geopolitical situation and armed conflicts. Urbanisation rates are expected to rise globally, particularly in Africa and Asia, to reach an estimated 68% of the population living in urban areas. Moreover, cities are the areas where the biggest differences in living standards – economic activities and social changes – can be observed.

[14] *Data for the years 2019–2021 are not available at the time of publication.*

[15] *Refugee: According to the Refugee Convention (Geneva Convention) from 1951, a refugee is a person who, owing to well-founded fear of persecution for reasons of race, religion, nationality, membership of a particular social group or political opinion, is outside the country of his nationality and is unable or, owing to such fear, is unwilling to avail himself of the protection of that country.*
Migrant: A person who leaves his or her country of origin voluntarily, or was born in another country or lived in one for a long time.

Climate change and global environmental degradation: Human activity has caused a 1°C increase in global temperature compared to the pre-industrial period. The rising global temperature is changing fundamental patterns and affecting the environment, economy, society, resources and the energy security of the population. There has been a change in the representation of native and invasive species and an increased frequency of occurrence of extreme events such as droughts, flooding, vegetation fires, heat waves and more. The Earth is facing biodiversity loss, with the sixth mass species extinction currently being observed, and overall 75% of the terrestrial and 40% of the marine environment has been significantly altered. Environmental degradation has social and economic impacts, and is contributing to an increase in inequality. Air pollution results in 6 to 7 mil. premature deaths, and water quality is deteriorating in almost all regions of the world due to significant water pollution. Plastics and e-waste are a growing problem.

Increasing scarcity of and global competition for resources: Economic growth, increasing wealth, and increasing levels of well-being have long increased the demand for resources. Overall, energy consumption has increased 25-fold since 1800, and has long been based mainly on fossil resources; moreover, there has been no significant change in the global energy mix in the last 20 years. Although the share of energy supplied from renewable sources is growing, these sources and related technologies face challenges related to technological, infrastructure and security transformation. The extraction of materials has a significant impact on ecosystems, reduces biodiversity, exacerbates climate change, and contributes to the deepening of social inequalities within regions. Lifestyle changes that increase the demand for high-protein and fat-high foods and the increasing demand for biofuels are contributing to increasing demand for agricultural land. However, land-use change (deforestation) and intensification of farming can exacerbate the impacts of climate change and degrade ecosystems.

Acceleration of technological change: Technological progress promotes the prosperity of society and develops alongside social needs, lifestyle and economic development. Technological innovation is currently accelerating, mainly due to large-scale digitalisation. However, issues of ethics, personal data security and media manipulation are closely related to technological progress. Digitalisation can also put more pressure on resources, while new technologies and digitalisation are changing the nature of jobs and thus affecting the social system.

Power shifts in the global economy and geopolitical landscape: Global economic output has increased roughly 12-fold since 1950, leading to both improved welfare and increased environmental stress. Key factors in the global economy are trade liberalization, technological progress, supply chain globalization, respectively international trade, and cheap labour. Economic growth in developing countries has alleviated poverty and enabled investment in social infrastructure and services to develop. In the long term, the power of the world's corporations to influence and shape social and environmental standards and influence social discourse and policymaking is increasing, thereby limiting the ability of governments to respond to current issues. Future geopolitical challenges are expected to concern trade agreements, access to raw materials and international markets.

Diverse values, lifestyles and governance approaches: The perception of values has changed significantly in recent years. On the one hand, there has been an increase in consumerism and thus an increase in demand for resources, while on the other, various forms of sharing, a community way of life and an overall sustainable lifestyle are developing, motivated in particular by concern for the climate and the environment. New work patterns and lifestyles are developing as a result of technological change, economic growth and digitalisation. Lifelong learning also plays an important role. However, social and health inequalities persist and, in Europe in particular, pressure on public spending is increasing as a result of an ageing population.

Data source: EEA, 2020[16]

[16] *EEA, 2020: Drivers of change of relevance for Europe's environment and sustainability, 138 p., doi:10.2800/129404.*

Box 3

Weak signals and emerging trends

Weak signals and emerging trends are phenomena that proceed at a rapid pace but are not yet clearly observable in the medium to long term and therefore usually allow an alternative interpretation of their potential impact on future developments.

Blockchain is a decentralized database recording transactions with an ever-expanding number of records. It is an illustration of the new opportunities resulting from digitalisation. Environmental protection could benefit, for example, from increased traceability and accountability in supply chain management for waste, emissions or the origin of agricultural products. However, its use may have a negative impact on the mitigation of climate change due to its high energy intensity.

Drones are increasingly used in the transport of goods in transport and industry, and this could contribute to reducing greenhouse gas emissions in transport. However, drone use uncertainties include their life cycle (including the use of batteries), as well as possible threats to wildlife and birds, increased noise pollution and visual impacts in urban environments.

Artificially produced meat, grown in vitro from the stem cells of live animals, may offer an alternative and new solution to the growing global demand for meat consumption (especially in Asia). Its inclusion could help reduce greenhouse gas emissions from livestock farming. Even if its production costs can be reduced, its expansion will remain largely dependent on social acceptance as well as on food safety protocols.

Synthetic biology, which involves the creation of completely new DNA and whole genome sequences, is already beginning to be used in the pharmaceutical, chemical, agricultural and energy sectors. In environmental protection, it could be used for the bio-remediation of polluted industrial sites, pollution detection, protection of endangered species, etc. However, synthetic biology can unexpectedly disrupt ecosystems and lead to biodiversity loss, for example through disease vector control (e.g. by using genetically modified mosquitoes to limit the spread of malaria).

Data source: EEA, 2020[17]

Box 4

Development wild cards

Development wild cards are events with a very low probability and low predictability of occurrence but which, if they do occur, will greatly influence future developments, in both the environment and in human society in all its aspects.

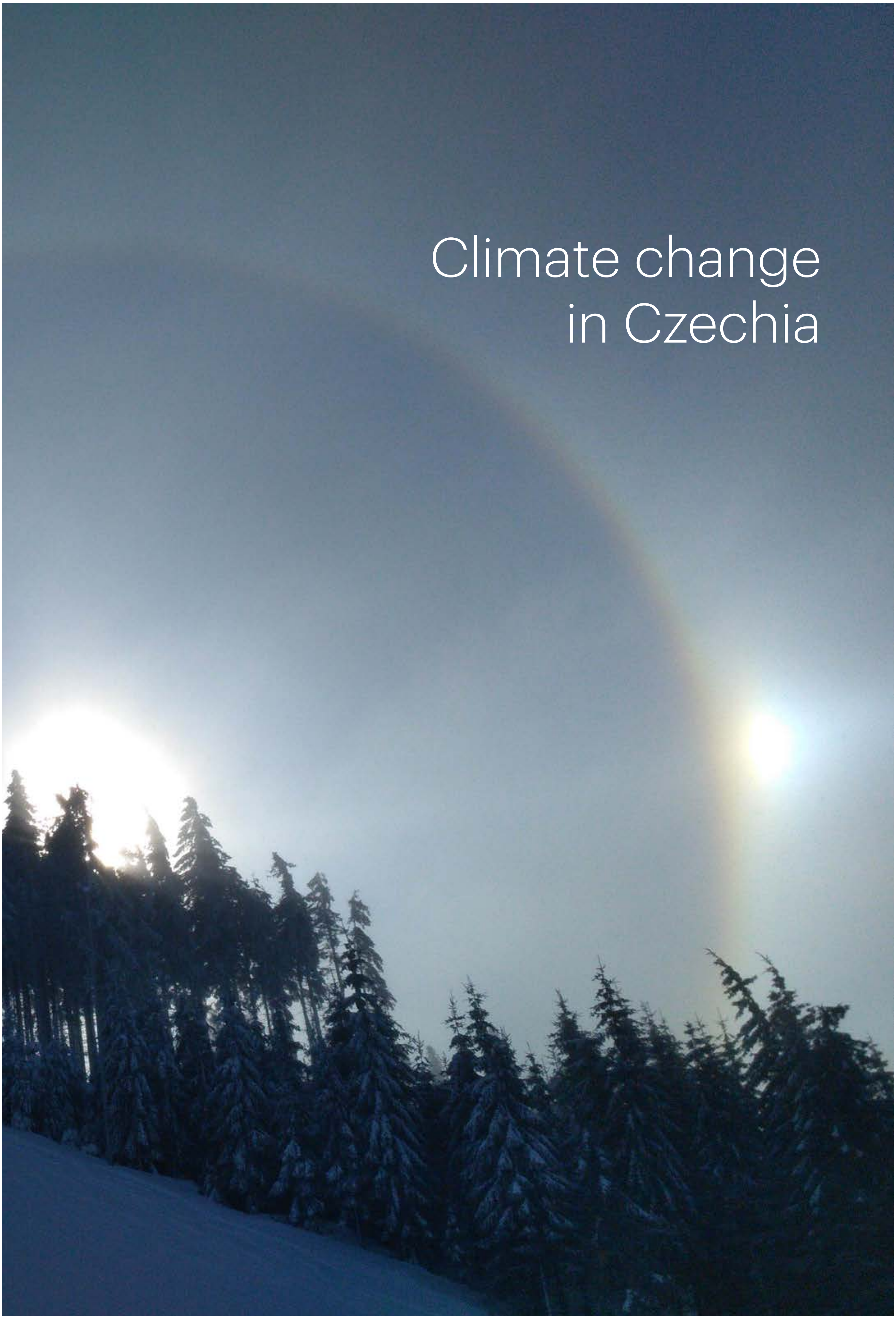
These could be, for example, **major technological changes, pollinator collapse** or **infectious disease outbreaks**.

Data source: EEA, 2020[18]

[17] *EEA, 2020: https://www.eea.europa.eu/highlights/emerging-trends-what-are-the*

[18] *EEA, 2020: https://www.eea.europa.eu/articles/forward-looking-assessments-for-better*

Climate change in Czechia



© Jan Kolář/CENIA

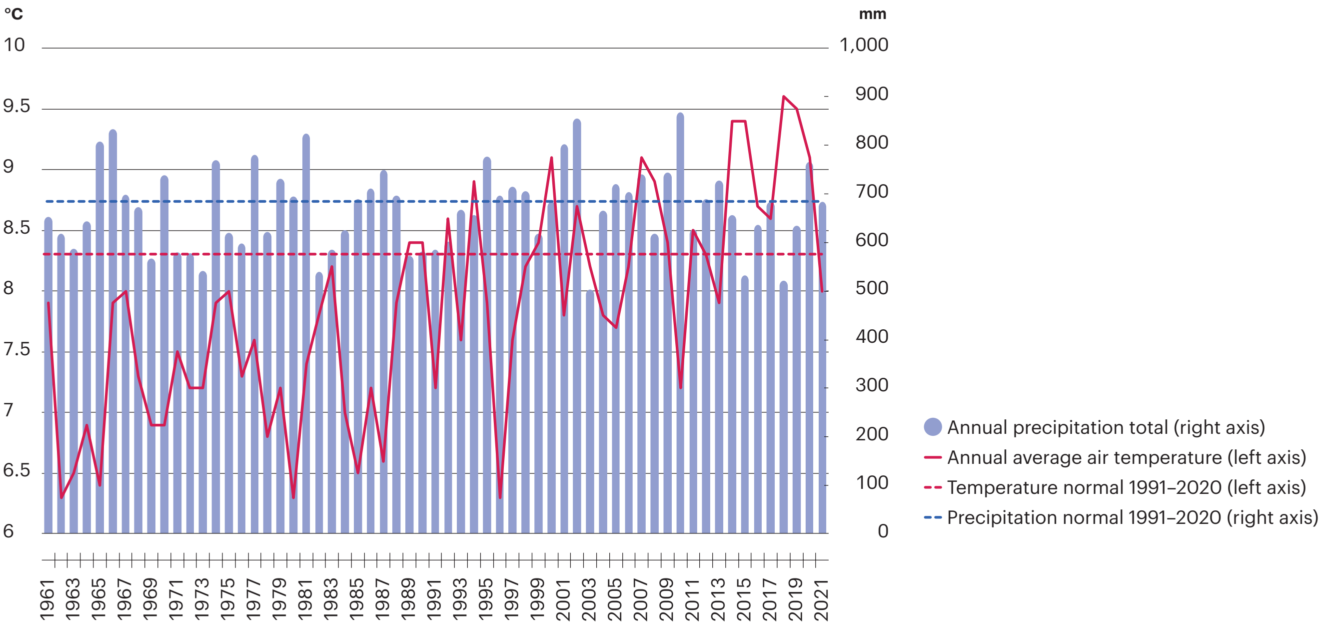
Climate change in Czechia

Temperature and precipitation conditions

The year 2021 has been assessed as a **normal in terms of temperature** in Czechia, with an average annual air temperature (8.0°C) 0.3°C below the 1991–2020 normal (Chart 1). Thus, 2021 became the first temperature-normal year after a continuous seven-year streak of above-normal-temperature years with varying degrees of extremity (2018 and 2019 were the warmest above-normal-temperature years), and the second-coldest year in the last 10 years. The deviation of the mean annual temperature in 2021 relative to the previous 1981–2010 normal period was +0.1°C, and relative to the 1961–1990 normal was +0.5°C. A comparison of the temperature deviations from the individual normal periods shows that the increase in annual average temperature is accelerating in Czechia.

Chart 1

Average annual air temperature and annual precipitation in Czechia compared to the 1991–2020 normal [°C, mm], 1961–2021



Data source: Czech Hydrometeorological Institute

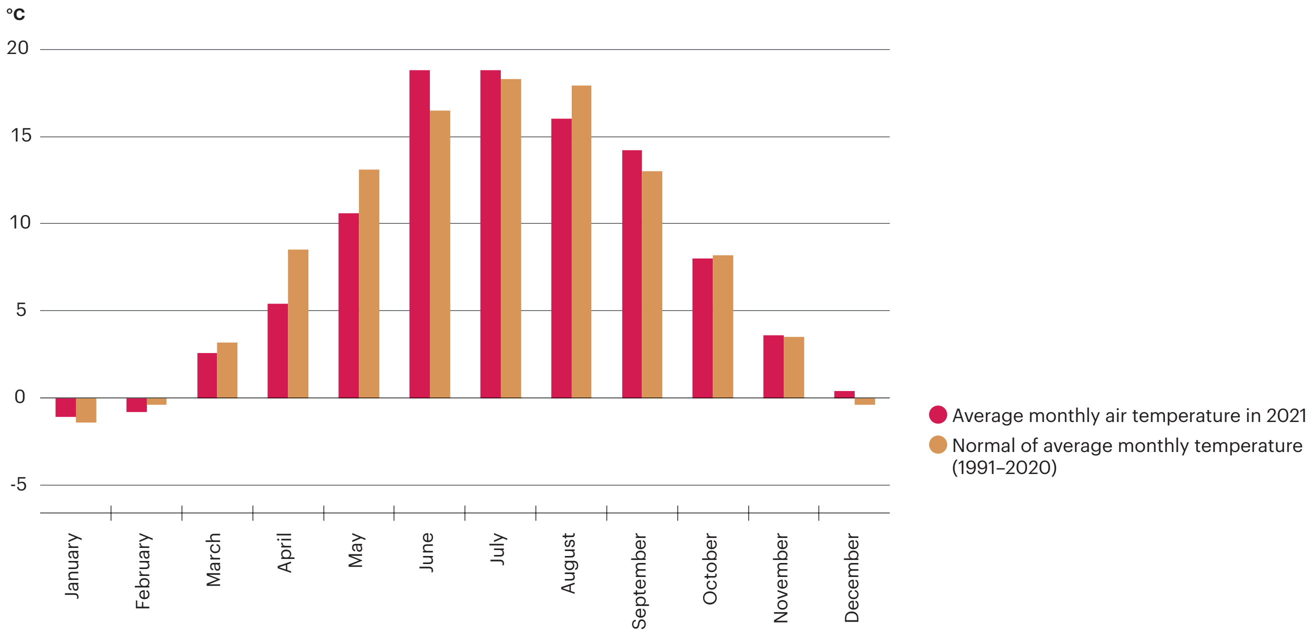
The majority of **months in 2021** were rated as normal in terms of temperature relative to the 1991–2020 normal (Chart 2). June was a strongly above-normal month in terms of temperature (deviation +2.3°C), while September was above-normal (+1.2°C). On the other hand, August was a below-normal month in terms of temperature (deviation -1.9°C), while April and May, with monthly average temperature deviations from normal of -3.1°C and -2.5°C, were assessed as strongly below-normal months according to the temperature extremity classification. **Seasonal mean temperatures** were also within normal limits in 2021, except for spring (March, April and May), which was very cold with a deviation from normal of -2.1°C.

In terms of **characteristic days**, 2021 was a normal year with no significant temperature extremity. In terms of the aerial average, there were 42 summer days (90.8% of the 1991–2020 normal) and only six tropical days (55.7% of the normal), the fewest since 2011. The most summer and tropical days were recorded by stations in South Moravia, with 87 summer days and 28 tropical days at the Strážnice station. This station also recorded the highest maximum daily temperature in 2021, on 8 July 2021, when the temperature rose to 36.5°C.

In total 126 frosty days per year (110.8% of normal) and 31 icy days (94.1% of normal) were recorded in the aerial average. Compared to the previous winter season, the incidence of frosty and icy days was higher in 2021, and more than double in the case of icy days.

Chart 2

Average monthly air temperature in Czechia compared to the 1991–2020 normal [°C], 2021



Data source: Czech Hydrometeorological Institute

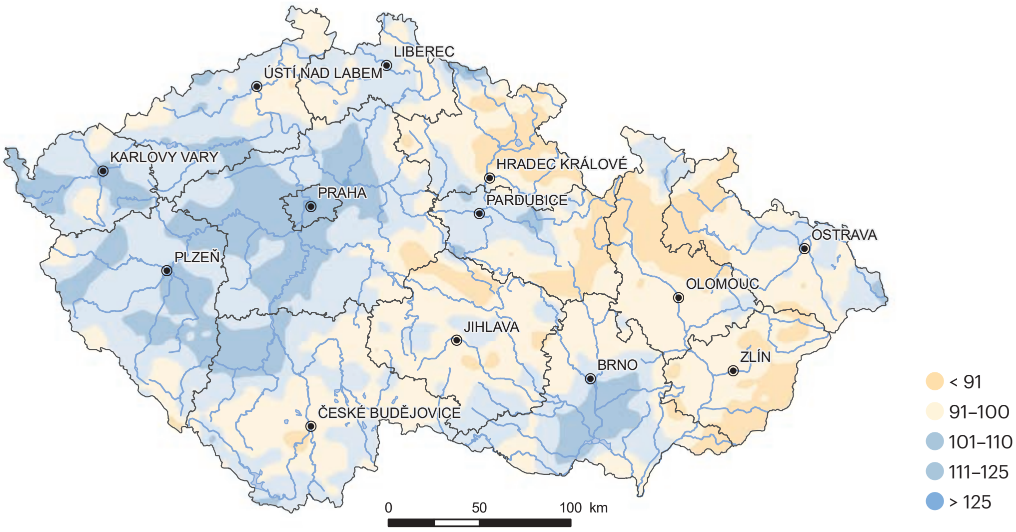
Precipitation was normal for Czechia in 2021, with average annual precipitation of 683 mm, or 100% of the 1991–2020 normal. Even though precipitation in Czechia is very variable spatially and temporally, there is no clear trend in annual precipitation over the whole territory.

Above-normal precipitation was recorded in May and August 2021, when 141% and 136% of normal precipitation fell on average in Czechia. On the other hand, September and October were very dry, with only 38% and 39% of normal precipitation on average. The remaining months of 2021 were rated as normal in terms of precipitation. In terms of seasonal precipitation, 2021 was characterised by an above-average wet summer and a very dry autumn. Throughout the autumn (September to November) only 88 mm of precipitation fell in Czechia (57% of normal), making it the second-driest autumn since 1961.

Annual precipitation compared to normal was higher in Bohemia in 2021, where 694 mm of precipitation fell on average (102% of normal), than in Moravia and Silesia (661 mm, i.e. 96% of normal, Figure 1).

Figure 1

Annual precipitation in Czechia expressed as a percentage of normal precipitation 1991–2020 [%], 2021



Data source: Czech Hydrometeorological Institute

Occurrence of drought and flooding, run-off conditions and groundwater state

Climatic drought represents meteorological conditions (especially precipitation, air temperature and air humidity) that are unusual for the territory and lead to a lack of water in the territory, which can subsequently cause other forms of drought (hydrological, soil).

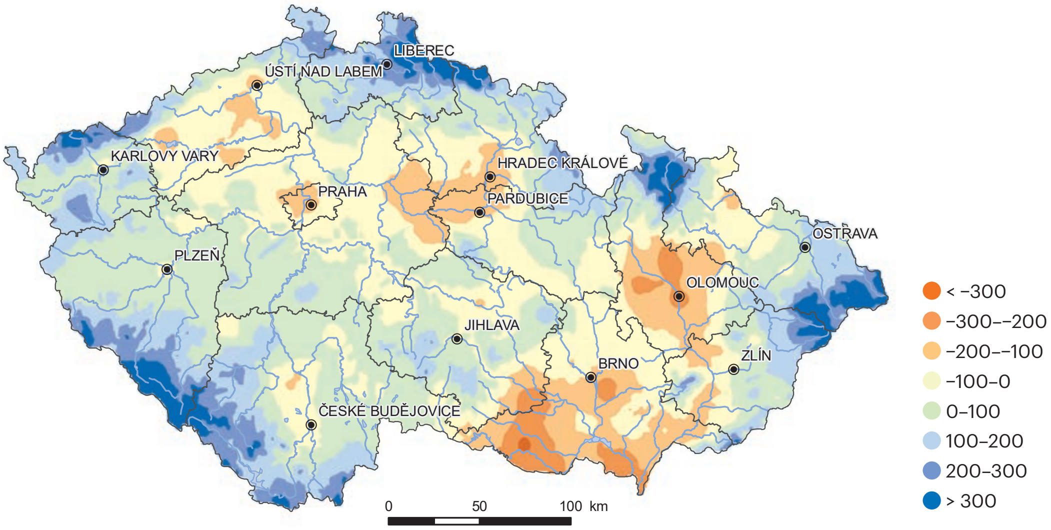
Drought according to the SPEI-6 index[19] occurred at the beginning of the growing season (April) in Czechia in 2021, mainly affecting southern, western and northern Bohemia, South Moravia and Vysočina. Due to above-average precipitation in May and summer (mainly August), the drought eased and by the end of the growing season (September), drought according to SPEI-6 was not present in most of the area. The SPEI-6 index for the growing season (April–September) was positive (+0.65) on average for the whole of Czechia, i.e. without the occurrence of drought. According to the monthly SPEI-1 index, drought in the growing season occurred only in June (mild drought) and September (moderate drought).

The **development of the basic moisture balance of grassland** in 2021 was relatively normal compared to previous years in terms of temperature and precipitation, with only small deviations from the long-term average. The slight decrease in the balance of precipitation and potential evapotranspiration was due to lower precipitation and a subsequent increase in temperatures from March to early May. After a temporary improvement, moisture balance values started to decrease again and in mid-June they were negative, except for Vysočina Region and the higher areas of the border mountains. During the summer, the moisture balance fluctuated and depended on regionally highly varied precipitation; in early August, the moisture balance deficit was greater than -100 mm in most lowland areas of Moravia, and up to -200 mm in South Moravia. Precipitation in August improved the situation, especially in Moravia, but in September the moisture balance values slowly decreased again and in the beginning of October a moisture balance deficit was observed over about half of Czechia. In aggregate for the whole growing season (April–September, Figure 2), the greatest moisture-balance deficit was observed in South Moravia and Haná, and to a lesser extent in the Polabí and Poohří regions. In most of Czechia, however, the moisture balance was positive, significantly so in the case of the border mountains.

[19] *The Standardized Precipitation Evapotranspiration Index (SPEI) is a climate drought index that assesses drought as the difference between precipitation and potential evapotranspiration relative to normal. The index is most commonly calculated on a moving basis with steps of one to six months; here we present variants with steps of one (SPEI-1) and six months (SPEI-6).*

Figure 2

Basic moisture balance of precipitation and potential evapotranspiration of grassland in mm for the growing season 1 April to 30 September 2021 in Czechia [mm]



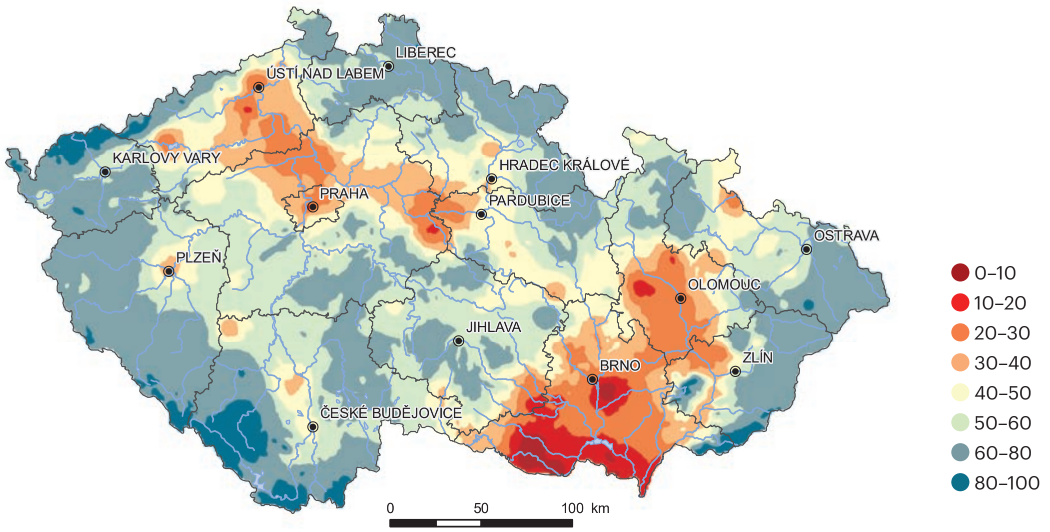
Data source: Czech Hydrometeorological Institute

The development of moisture balance conditions was also reflected in the values of available water capacity, with decreasing values of water reserves in the soil during March to early May. The most significant moisture decreases were observed in South Moravia, where the values fell below 50% of available water capacity. Water reserves in the soil subsequently increased due to significant precipitation, but then decreased again, and in mid-June water reserves in the soil were below 50% of the available water capacity over more than half of Czechia, and below 20% of the available water capacity in the Podyjí Region (Figure 3). Low values were also reached in the Polabí, Ústí nad Labem and Olomouc Regions. However, even in this period the soil drought was not significant compared to previous years, except in South Moravia, and was smaller in area than in previous years; with most of Czechia not being affected by soil drought.

Thanks to the significant precipitation mainly in the western half of Czechia in July, water reserves in the soil increased, while in South Moravia and Haná the situation improved only at the beginning of August, and available water capacity values in most of Czechia were relatively favourable. A slight continuous decrease in the water reserves in the soil occurred from the end of August to the end of October.

Figure 3

Available water capacity in the soil in Czechia (available water capacity = 170 mm/m) – current state of modelled values as of 20 June 2021 [% of available water capacity]

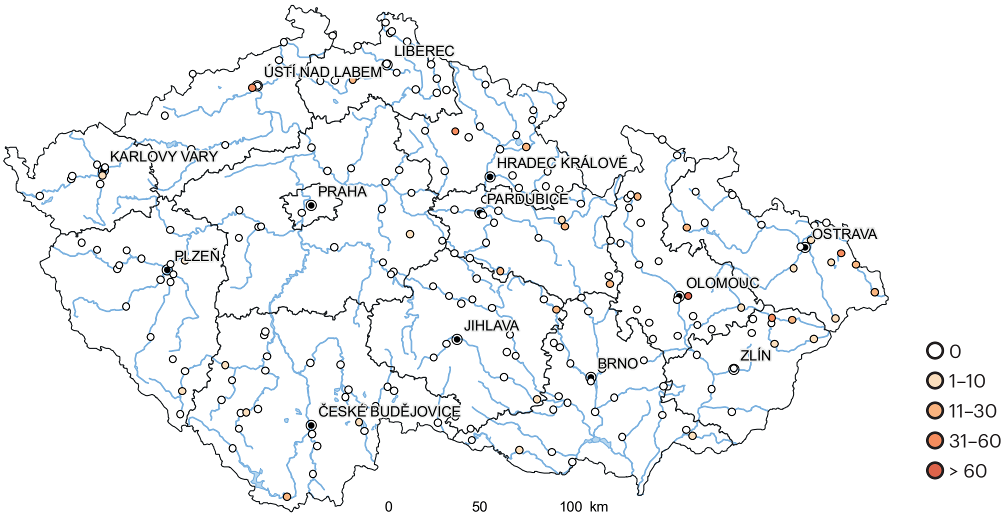


Data source: Czech Hydrometeorological Institute

From a hydrological perspective, 2021 was a relatively average year overall in most of the monitored catchment areas. The **average annual flow** on the selected profiles in 2021 ranged from 79% to 125% of the long-term average for 1991–2020, with the lowest flow on the River Jizera in the Tuřice-Předměřice profile and the highest in the River Jihlava in the Ivančice profile. In 2021, unlike in 2020, none of the profiles recorded a **hydrological drought** duration of 100 days or more (of a total of 217 monitored). The highest number of days of hydrological drought was recorded on the Velká Bystřice stream (Bystřice profile), with 70 days (Figure 4). The highest number of profiles with indicated Q_{355} hydrological drought in the context of the whole year was recorded in the last week of October, when their share was 23%, especially in the Morava and Odra basins. A hydrological drought occurs when flows are less than Q_{355}. This is the flow rate reached or exceeded on average 355 days a year, and which is important for maintaining the basic water management and ecological functions of the flow.

Figure 4

Flow rate under the long-term 355-day flow rate in Czechia for the 1981–2010 period [number of days], 2021



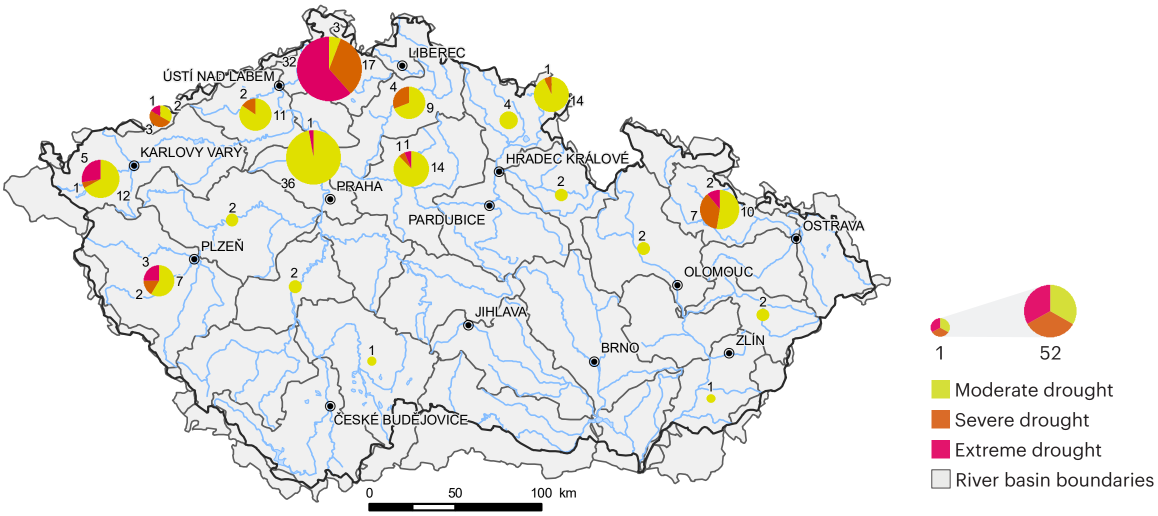
Data source: Czech Hydrometeorological Institute

The **groundwater level in the shallow circulation and springs** was normal in 2021 from a total year perspective, unlike in previous years (Figure 5, Figure 6). However, there were temporal and regional fluctuations. Sub-normal levels in **shallow wells** were detected at the beginning of the year in the Berounka basin, then at the beginning and end of the year in the Ohře, Dolní Labe, Lužická Nisa and Horní Odra basins. The yield of **springs** were extremely and strongly below-normal in the Berounka and Lužická Nisa basins at the beginning of the year, while at the end of the year the yields were slightly below-normal in the Horní and Střední Labe, Horní Odra and Morava basins. Springs were found to have strongly to extremely below-normal yields in the Ohře and Dolní Labe basins almost throughout the year (except for July),

Considering the usual annual water level regime, the state of **deep aquifers** was worst in January, when 39% of deep wells were severely or extremely below-normal, 25% of the wells were within the normal range, and 20% of the wells were severely or extremely above normal. The best state of deep aquifers was recorded in August, when 45% of wells had levels within the normal range and 15% of wells had levels that were strongly or extremely above normal.

Figure 5

Duration of drought in springs in Czechia [number of weeks], 2021

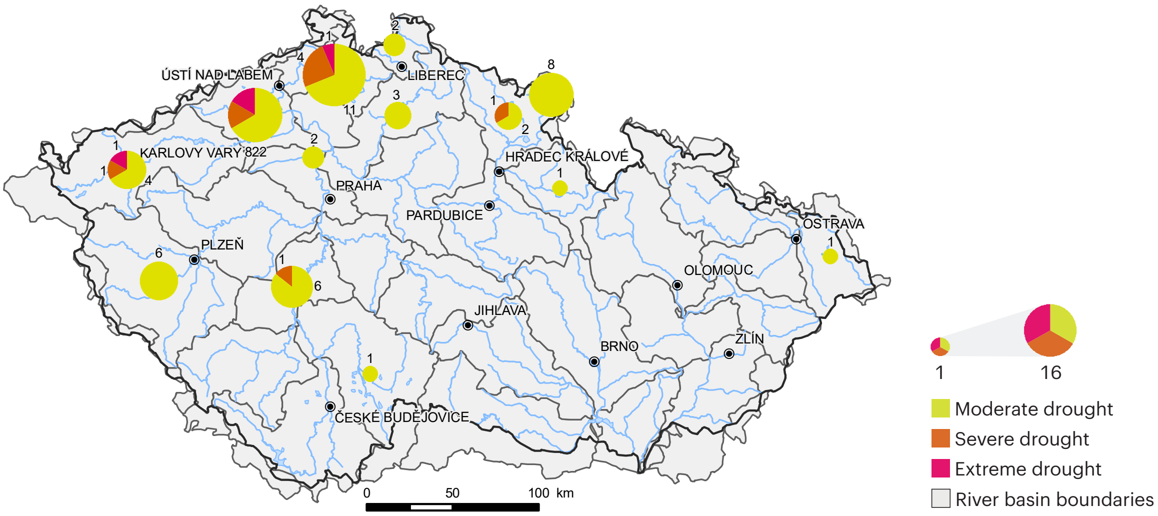


River basin data are aggregated and processed using the current drought index.

Data source: Czech Hydrometeorological Institute

Figure 6

Duration of drought in shallow wells in Czechia [number of weeks], 2021



River basin data are aggregated and processed using the current drought index.

Data source: Czech Hydrometeorological Institute

As regards **flood situations**, the most significant period in 2021 was from May to early September, when flood activity levels were frequently exceeded on streams due to repeated rain and storms with torrential precipitation. River levels also rose during the winter, with several flood situations occurring due to snowmelt and precipitation in January, February and December. The first half of spring, October and November 2021 were calm in terms of flooding, with no significant run-off events exceeding flood activity 2 or 3. The third degree of flood activity was recorded in May on the River Hvozdnice in the Jakartovice profile, and in the River Úslava in the Prádlo profile. In June on the River Volyňka in the Sudslavice profile, and on the Botič in the Praha-Nusle profile. The highest peak flows in terms of recurrence interval were reached in July at Brzina in the Hrachov profile and Svitávka in the Zákupy profile, both with a recurrence interval of 20 years. The third degree of flood activity was also reached in July on the River Novohradka in the Luže profile and on the Úslava (Plzeň-Koterov and Prádlo profiles) and on the Lužická Nisa in the Proseč nad Nisou profile, on the Otava (Rejštejn and Sušice profiles), Bělá (Jeseník and Mikulovice profiles), Stružka (Rychvald profile) and on the Smědá (Višňová profile).


1
Environment and health
1.1 | Water availability and quality

1.1 | Water availability and quality

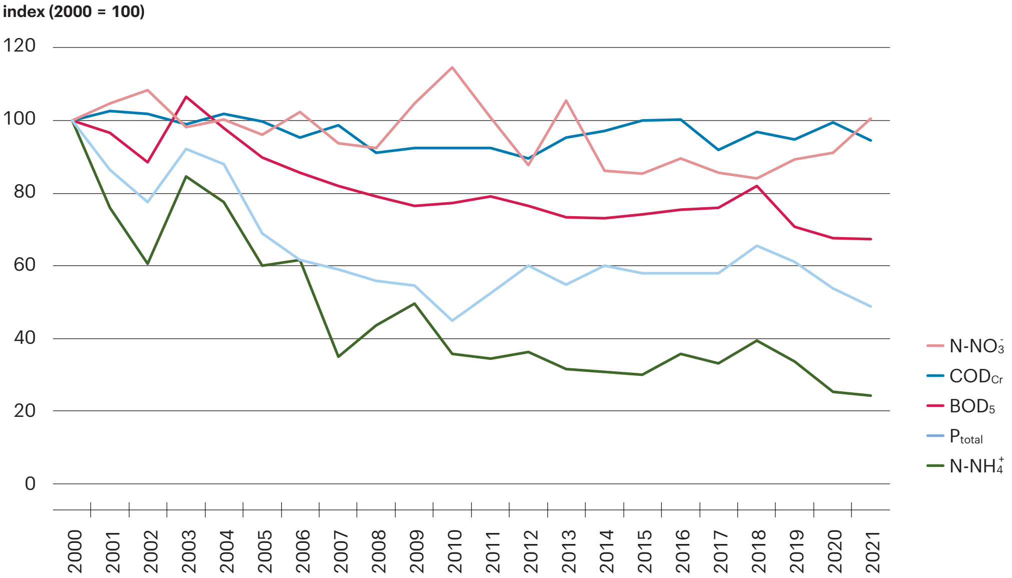
Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Water quality in watercourses	↗	→	→	~
Bathing water quality	~↗	~↗	~↗	✓
Groundwater quality	N/A	~↗	~↗	~
Population supplied with water from the public water supply	↗	↗	→	✓
Waste water treatment	↗	↗	↗	✓
Waste water discharge	N/A	↘	→	~
Groundwater and surface water abstraction by sector	↘	↘	↘	~
Water consumption from the public water supply and water losses in the water supply network	↘	→	→	~

1.1.1 | Surface water quality

Water quality in watercourses in Czechia is monitored on 1 024 representative river profiles, with 124 profiles being used for the assessment in 2021. For the assessment of the 2000–2021 period, the **basic $CHSK_{Cr}$, BSK_5, $N\text{-}NH_4^+$, $N\text{-}NO_3^-$ and P_{total} indicators** were selected. Over the 2000–2021 period, the best reductions in watercourses were in **$N\text{-}NH_4^+$** pollution (a 75.8% decrease in average concentration) and P_{total} (a decrease of 51.2%, Chart 3). The average concentration of ammoniacal nitrogen reached in 2021 was 0.120 $mg.l^{-1}$. The fall is mainly due to more efficient waste water treatment and a decline in livestock production. The total phosphorus concentration in 2021 reached an average of 0.140 $mg.l^{-1}$, while this fall was due to more thorough cleaning and a reduction in the use of phosphates in detergents. Based on the above indicators, a water quality map of watercourses is also produced for a two-year period under review and the watercourse sections are classified into five quality classes (Figure 7).

Chart 3

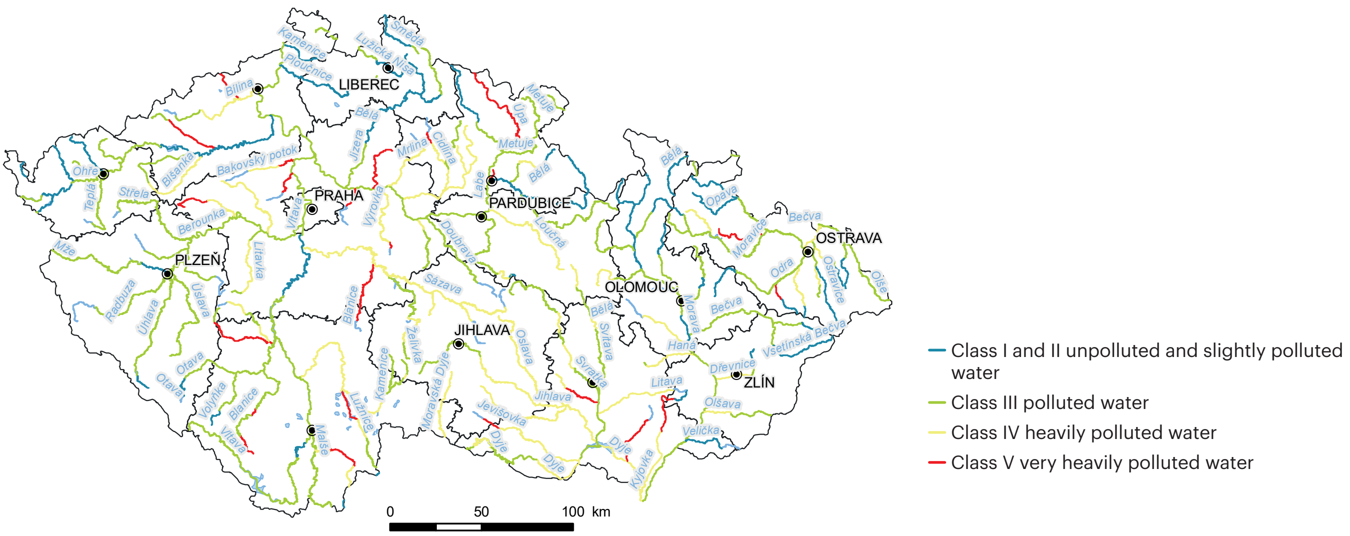
Trend in pollution concentration indicators in watercourses in Czechia [index, 2000 = 100], 2000–2021



Data source: Czech Hydrometeorological Institute from the state enterprise Povodí

Figure 7

Water quality in watercourses in Czechia, 2020–2021



Data source: T. G. Masaryk Water Research Institute

The assessment of **water quality in watercourses for the 2010–2021** period was carried out for several indicators listed in Government Regulation No. 401/2015 Coll. These are COD_{Cr}, BOD_5, total organic carbon (TOC), $N\text{-}NO_3^-$, $N\text{-}NH_4^+$, total phosphorus (P_{total}) and thermotolerant coliforms, halogenated organic compounds (AOX), benzo(ghi)perylene, dissolved metals (Pb, Hg, Cd) and the sum of pesticides. Chlorophyll was assessed according to Czech Technical Standard 75 7221, updated in 2017.

COD_{Cr} shows a basically steady state over the period under assessment with concentrations between 18 and 20 $\mu g.l^{-1}$ without significant fluctuations. The environmental quality standard – annual average values are above the limit for approximately 5%–15% of the profiles. The average **BOD_5** concentrations from 2010 to 2021 decreased slightly with a small spike in 2018. The values exceeded the average for approximately 10% (in 2020 and 2021) to 17% of the profiles during the period under review. **TOC** concentrations ranged from 6.7 to 7.4 μg.l^{-1} in the 2010–2021 period. The number of profiles exceeding the environmental quality standard – annual average ranged from 8% to 15% **N-NO$_3^-$** has shown a steady state over the last seven years with concentrations around 3.0 μg.l^{-1}, while 11.4% of the profiles had values exceeding the environmental quality standard – annual average in 2021. **N-NH$_4^+$** concentrations showed a slight decrease with small fluctuations during the period under review. The share of profiles exceeding the environmental quality standard – annual average was around 20%, while this fell to 8.9% in 2021. For **total phosphorus**, the number of profiles exceeding the environmental quality standard – annual average values averages around 38% over the period under review, with the share of profiles exceeding the environmental quality standard – annual average falling to 26.8% in 2021. **AOX** show a decrease in both concentration and the share of profiles exceeding the environmental quality standard – annual average. At the beginning of the period under review, more than 30% of the profiles were above the environmental quality standard – annual average, while in 2021 this was 11% of the profiles. For **benzo(ghi)perylene**, the percentage of profiles exceeding the environmental quality standard – maximum permissible concentration ranged from 1% to 12% between 2010 and 2020, increasing to 26% in 2021 due to the very low environmental quality standard – maximum permissible concentration limit value.

The maximum values for **dissolved mercury** were at or slightly below the environmental quality standard – maximum permissible concentration of 0.07 μg.l^{-1} in 2011, 2013, 2018, 2020 and 2021. In other years, the environmental quality standard – maximum permissible concentration was exceeded in 1% to 15% of profiles. The environmental quality standard – annual average for **dissolved lead** was not exceeded in any profile during the period under review (with the exception of 2020). **Cadmium** exceeded the environmental quality standard – annual average limit values at only one to three profiles, depending on class, in 2010–2013, 2018 and 2019. **Thermotolerant coliforms** were assessed according to environmental quality standard-P90 (40 KTJ.ml^{-1}). This value was exceeded many times. The lowest number of profiles above the limit was in 2012 (11%), the highest was in 2013 (89%), while the figure for 2021 was 56%.

For the **sum of pesticides**[20], the share of profiles exceeding the environmental quality standard – annual average ranged between 10.1% and 36.7% in the period under review (the lowest was in 2012 (10.1%), the highest in 2013 (36.7%)). In 2021, the share of profiles above the environmental quality standard – annual average was 19.0%.

Chlorophyll does not have any limit in Government Regulation No. 401/2015 Coll., therefore its assessment was carried out according to Czech Technical Standard 75 7221. In this case, classification into five classes is made in accordance with the standard. The occurrence of the most polluted profiles (Class IV and V) was relatively stable (40% on average) in the period under review.

As part of the monitoring of the **quality of natural surface waters used for outdoor bathing**, a total of 284 sites were monitored in the 2021 recreational season, of which 53.2% were classified as category I quality, i.e. water suitable for bathing (50.6% in 2022). The percentage of sites classified as category II quality was 15.9%. Bathing bans were issued due to cyanobacteria overpopulation at nine sites (3.2% of sites), while 29 sites (10.2%) were designated as unsuitable for bathing. In the 2021 bathing season, according to an assessment under Directive 2006/7/EC of the European Parliament and of the Council, 78.2% of inland **bathing water areas in the EU Member States** were classified as category I quality. Czechia scored slightly above average (81.3% of sites had excellent water quality).

[20] *The methodology was changed in the year 2022. The 2010–2021 time series has been recalculated.*

1.1.2 | Groundwater quality

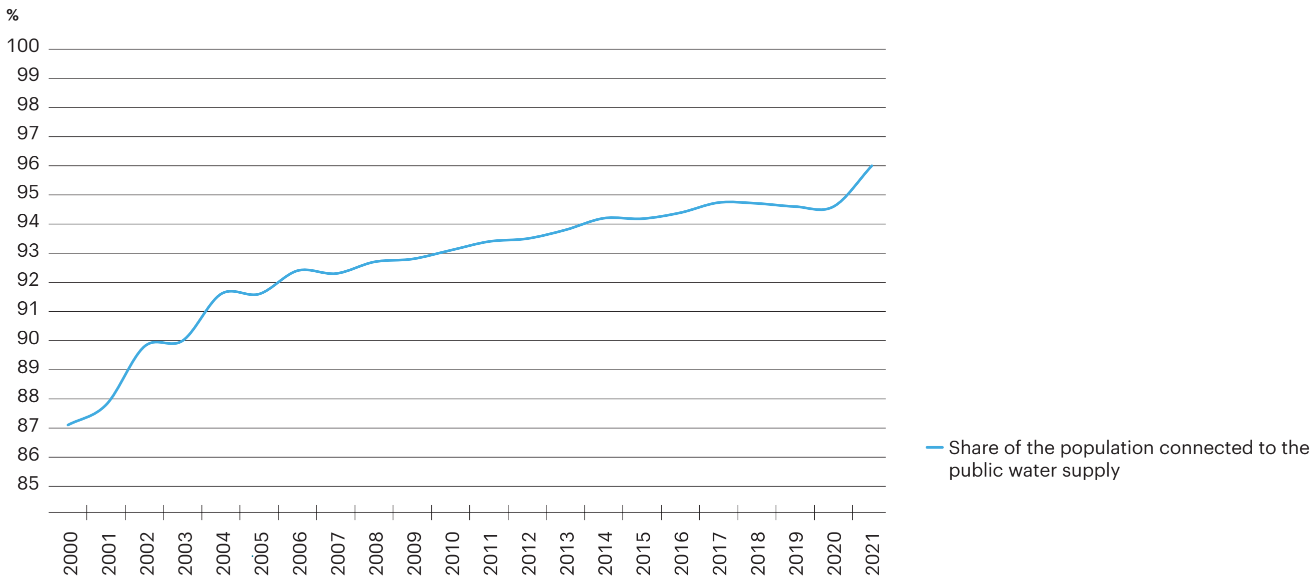
Groundwater quality is also monitored and assessed annually on the basis of Decree of the Ministry of the Environment of the Czech Republic and Ministry of Agriculture of the Czech Republic No. 5/2011 Coll. In 2021, 707 sites were monitored in the State groundwater quality monitoring network, including 202 springs, 227 shallow wells and 278 deep wells. A total of 366 quality indicators were monitored. The number of shallow wells where groundwater limits were exceeded in at least one indicator was 189, while the limit was exceeded in 122 deep wells and 81 springs. The results of the groundwater quality assessment for 2021 were not significantly different to previous years due to the slow dynamics of changes in groundwater chemistry. In 2021, the dominant inorganic groundwater pollution indicators compared to the threshold values of the Ministry of the Environment of the Czech Republic and Ministry of Agriculture of the Czech Republic Decree No. 5/2011 Coll., as amended, were **ammonium ions** (10.9% of above-limit samples) and **nitrates** (10.8% of above-limit samples). Among organic substances, **pesticides** are the main pollutants. In this group, it is often not the active substances of pesticide products directly, but pesticide metabolites that exceed groundwater limits. Excessive concentrations of pesticides were detected in 27.6% of groundwater objects.

1.1.3 | Drinking water supply to the population

The water management infrastructure has been developing over the long term, and is being revitalised, while the share of the population connected to the public water supply is also increasing. The **share of the population connected to the public water supply** has increased significantly compared to 2000, from 87.1% to 96% in 2021 (Chart 4).

Chart 4

Share of the population connected to the public water supply in Czechia [%], 2000–2021



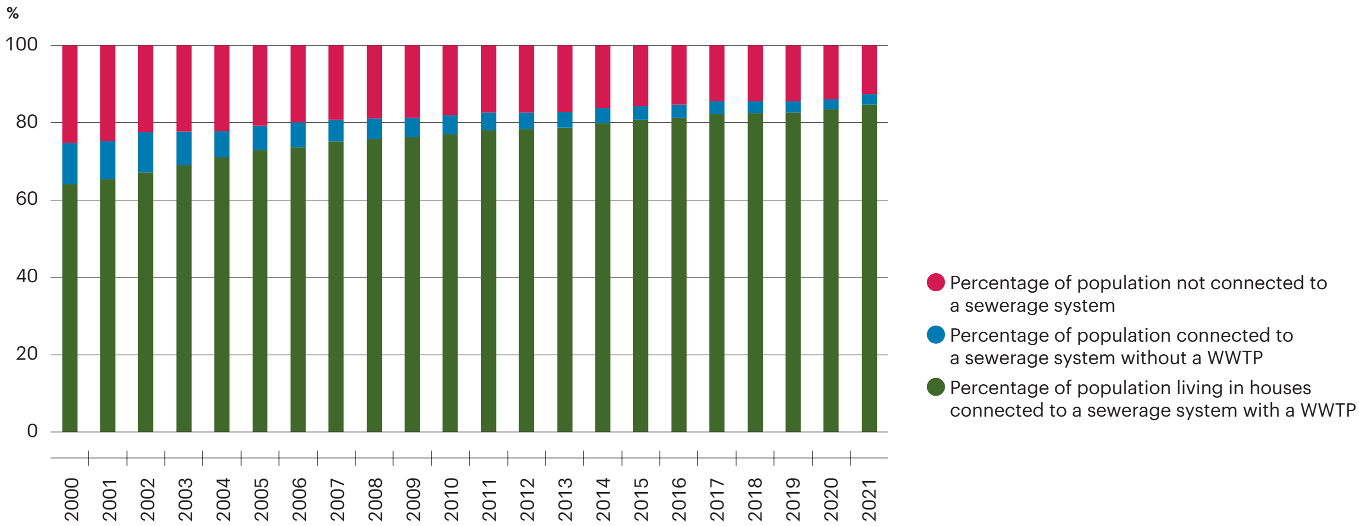
Data source: Czech Statistical Office

1.1.4 | Waste water treatment and discharge

The share of the population connected to a sewerage network was 87.4% in 2021, while the share of the population connected to a sewerage system terminated by a WWTP was 84.7% (Chart 5). Compared to 2000, the share of the population connected to a sewerage system with a waste water treatment plant increased by 20.7 percentage points. 15.3% of the population is still not connected to a sewerage system terminating in a WWTP; the waste water produced in these cases was treated, for example, in domestic sewage treatment plants or collected in cesspools and septic tanks and then taken away for professional treatment.

Chart 5

Percentage of population connected to sewerage systems and sewerage systems terminating in a waste water treatment plant in Czechia [%], 2000–2021



Data source: Czech Statistical Office

The total volume of water discharged into a public sewerage system, which includes chargeable rainwater, was 524.8 mil. m^3 in 2021, an increase of 3.3% compared to 2020. Of this, the volume of water discharged into the public sewerage system excluding rainwater in 2021 was 451.8 mil. m^3 (of which 440.7 mil. m^3 was treated and 11.1 mil. m^3 untreated). The share of treated waste water from water discharged to sewers has been high for a long time (94%–98% since 2000). WWTPs also treat a portion of uncharged rainwater. The quantity shows large year-on-year fluctuations, which correspond to the precipitation conditions of the given year. 436.8 mil. m^3 of rainwater was treated in 2021.

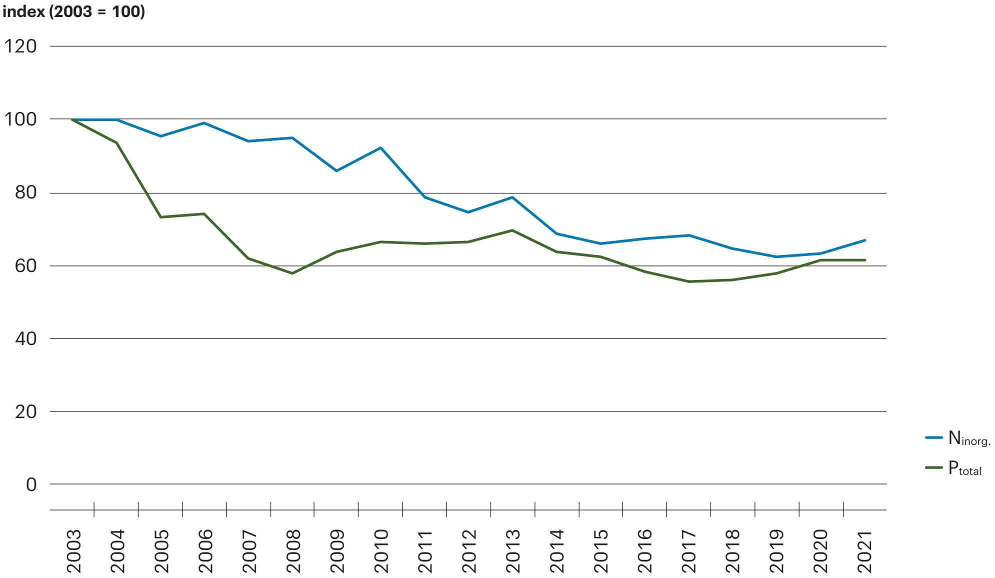
The number of WWTPs for public use was 2 861 in 2021. The number of WWTPs increased by 2.7% year-on-year. Due to the construction and reconstruction of WWTPs, the total number of WWTPs with nitrogen and/or phosphorus removal (tertiary treatment) in Czechia increased by 6 compared to 2020 to 1,663. Only 21 treatment plants with purely mechanical treatment remained in 2021.

Since 2000, the **total volume of discharged waste water** has decreased by 16.1% to 1,512.0 mil. m^3. The structure of waste water discharges reflects the structure of water users. The largest share in 2021 was taken by public sewerage, at 58.2% (i.e. 879.6 mil. m^3), and energy with 21.9% (i.e. 330.9 mil. m^3). Waste water from industry accounted for 16.9% (256.2 mil. m^3), the other category accounting for 2.9% (43.3 mil. m^3) and waste water from agriculture accounting for only 0.1% (2.1 mil. m^3).

Monitoring the amount of pollution in discharged waste water is particularly important because it significantly affects the quality of surface and groundwater. Since 2000, the quantity of discharged pollution has been on a downward trend, with minor fluctuations (there was a significant deviation in 2002, caused by the extreme flooding in that year). Compared to 2000, **BOD_5** has decreased by 74.1% and **COD_{Cr}** has decreased by 54.1%. In terms of pollution discharged, nitrogen (**$N_{inorg.}$**) increased by 0.3% year-on-year, phosphorus (**P_{total}**) increased by 5.4%, while suspended solids fell by 2.0%. In the longer term, $N_{inorg.}$ has fallen by 33.3% and P_{total} by 38.4% since 2003 (Chart 6). The long-term decline is mainly influenced by the targeted application of biological nitrogen removal and biological or chemical phosphorus removal in the waste water treatment technology in new and intensified WWTPs, while it is further influenced by a reduction of phosphates used in detergents.

Chart 6

Pollution discharged from point sources in the $N_{inorg.}$ and P_{total} indicators in Czechia [index, 2003 = 100], 2003–2021



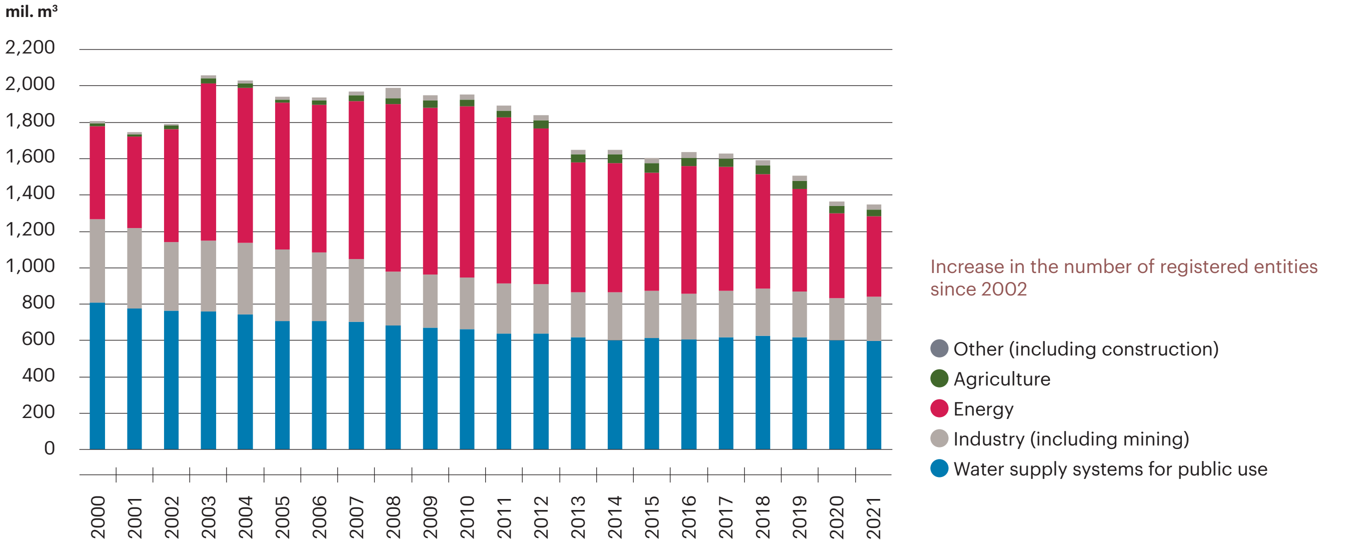
Data source: state enterprise Povodí, T. G. Masaryk Water Research Institute

1.1.5 | Efficient use of water

Surface and groundwater abstraction reflects the development of the economy, the hydrometeorological conditions of the year in question, and the behaviour of households. Total water abstraction (i.e. the sum of surface water and groundwater abstraction) has fallen by 25.3% since 2000. In 2021, total water abstraction was 1,348.8 mil. m^3, a decrease of 1.3% compared to 2020. The highest abstraction was for the public water supply, accounting for 44.4% (598.9 mil. m^3) of total abstraction in 2021. The energy sector is another major customer, accounting for 32.8% of total consumption (442.1 mil. m^3). Industry is the third-most-important water user, accounting for 242.9 mil. m^3 of water abstraction in 2021, i.e. 18.0% of total abstraction. Water withdrawals for agriculture accounted for only 2.7%, and abstraction for other sectors, including construction and waste water activities, accounted for 2.1% of total water abstraction in 2021 (Chart 7). The majority of abstraction is from surface water (987.8 mil. m^3; i.e. 73.2% of total abstraction), with a smaller part from groundwater (262.1 mil. m^3; 26.8%). When dividing the total abstraction into surface water and groundwater abstraction, there are noticeable differences in the representation of individual economic sectors in terms of the source of the abstracted water.

Chart 7

Total water abstraction by sector in Czechia [mil. m^3], 2000–2021



Until 2001, water abstraction exceeding 15 thous. m^3 per year or 1,250 m^3 per month was recorded. Since 2002, water abstraction by customers above 6 thous. m^3 per year or 500 m^3 per month has been recorded – in accordance with Section 10 of Ministry of Agriculture of the Czech Republic Decree No. 431/2001 Coll.

Data source: Ministry of Agriculture of the Czech Republic, state enterprise Povodí, T. G. Masaryk Water Research Institute, Czech Statistical Office

A significant part of abstracted water is intended for drinking water production. In 2021, 579.1 mil. m^3 of water was produced and intended for use. **Drinking water** billed to households and other customers amounted to 478.7 mil. m^3, of which 71.6% was billed to households. Billed water fell by 0.5% year-on-year. In 2021, 96.0% of the population was supplied with water from public water supply.

Water consumption per capita supplied from the public water supply was 159.7 l per capita per day of the total amount of water produced in 2021 (in 2020 it was 159.0 l per capita per day). Household consumption was 93.2 l per capita per day (in 2020 it was 91.1 l per capita per day).

The upward trend in **water and sewerage prices** continued in 2021, with average water and sewerage prices reaching CZK 43.8 per m^3 and CZK 38.5 per m^3 without VAT.

There has been a slight year-on-year decrease in **water losses** in the water supply network, both in absolute terms (from 87,840 thous. m^3 to 86,501 thous. m^3) and as a proportion of the total volume of water produced for use (from 15.1% in 2020 to 14.9% in 2021). Losses of drinking water in the water supply network are caused by accidents and leaks from the public water supply systems. The proportion of drinking water losses in the water supply network has decreased significantly since 2000, when it was 25.2%.

Access to water resources is strongly dependent on the geographical location and physical and geographic conditions of each country. The most at-risk countries in Europe, i.e. those with the highest WEI[21], in July 2015[22] were Spain, Portugal, Italy, Belgium and the Netherlands. Water scarcity in these areas is due to both adverse natural conditions (climate, nature of the river network, geological conditions, etc.), anthropogenic interference with the water regime and water management in the country.

Detailed visualisations and data

https://www.envirometr.cz/data

[21] The WEI index expresses water scarcity and describes the pressure that total water abstraction puts on water resources (calculated as total water abstraction divided by the volume of renewable water supplies). It identifies countries with high abstraction relative to their resources and that are therefore prone to water scarcity (water stress). The WEI warning threshold, which separates regions with sufficient water from those with scarce water, is around 20. Serious water shortages can occur when the WEI exceeds 40.

[22] Data for the years 2016–2021 are not available at the time of publication.

1 Environment and health

1.2 | Air quality

1.2 | Air quality

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Emissions of selected air pollutants	↘ (green)	↘ (green)	↘ (green)	~ (yellow)
Emissions from transport*				
Emissions of basic pollutants from transport	↘ (green)	↘ (green)	↘ (green)	✓ (green)
Emissions of greenhouse gases from transport	↗ (red)	↗ (red)	~↗ (yellow)	~ (yellow)
Emissions of PAH from transport	↗ (red)	↗ (red)	~↗ (yellow)	~ (yellow)
Emissions from household heating	~↗ (yellow)	↘ (green)	↘ (green)	✗ (red)
Compliance with limit values for selected pollutants	~↗ (yellow)	→ (yellow)	↗ (green)	~ (yellow)
Air quality in terms of human health protection	~↗ (yellow)	~↗ (yellow)	↗ (green)	~ (yellow)
Air quality in terms of ecosystem and vegetation protection	↗ (green)	→ (yellow)	↗ (green)	~ (yellow)

** Due to the heterogeneity of the topics underlying the construction of the indicator, an assessment of the sub (elementary) indicators is presented.*

1.2.1 | Emissions of air pollutants

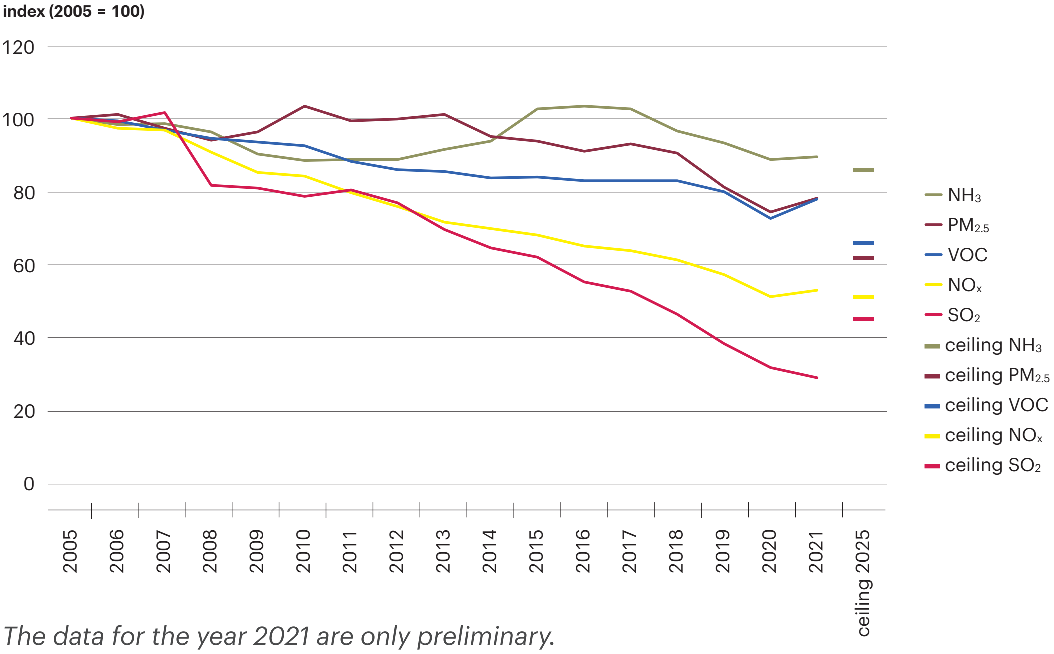
Emissions of the main air pollutants (NO_X, SO_2, NH_3, VOC, $PM_{2.5}$ and also emissions of PM_{10}, CO, and B(a)P) are related to the way households heat their homes, the intensity of road transport, and the structure of the national economy (the structure of GDP and the industrial sectoral structure), as well as success in implementing air pollution reduction measures.

Emissions of selected air pollutants (substances with national emission reduction commitments: NO_X, SO_2, NH_3, VOC, $PM_{2.5}$) are falling in the long term. The largest decline in pollutants was recorded between 1990 and 2000, especially in the early part of the period, as a result of structural changes in the national economy. The decline in pollutant emissions in the following years was supported by innovative developments in all sectors, a reduction in the material and energy intensity of the economy, and the obligation to comply with legislative requirements for emissions from air pollution sources.

Meeting the obligations of Directive 2016/2284 of the European Parliament and of the Council on the reduction of national emissions of selected air pollutants, the so-called **emission ceilings**, assumes a percentage reduction in emissions compared to 2005 values. It is clear from the latest submission of the emission balance that unless there are significant changes in the current trend (additional measures), the required emission reductions by 2025 may not be achieved for all substances (Chart 8).

Chart 8

Trends in total emissions of selected pollutants in Czechia and national emission ceilings for 2025 [index, 2005 = 100], 2005–2021



The data for the year 2021 are only preliminary.

Data source: Czech Hydrometeorological Institute

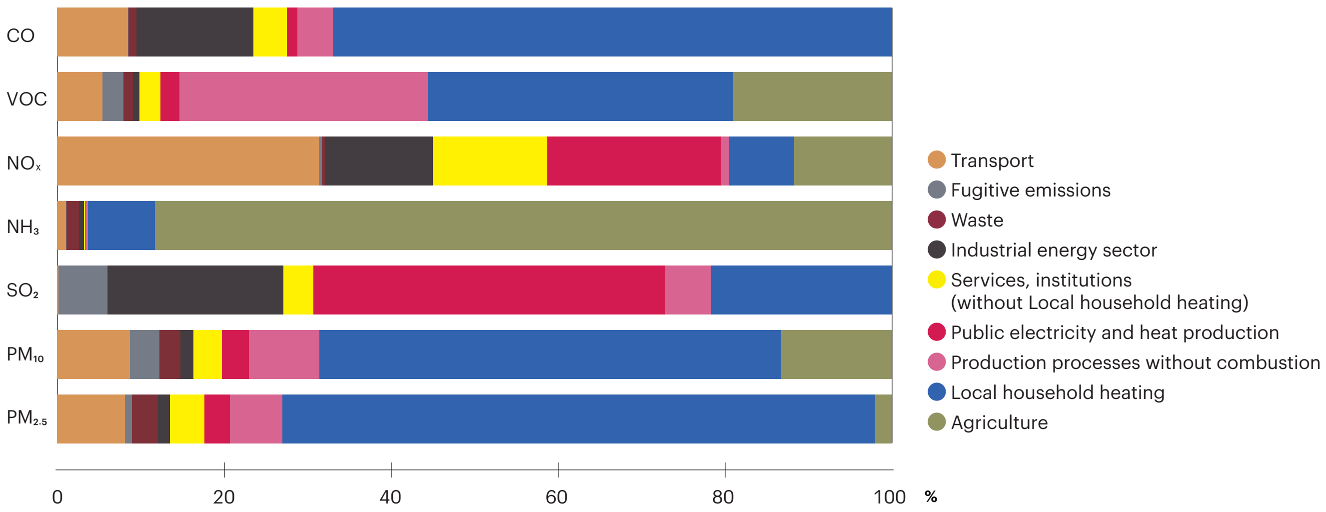
SO_2 and NO_X emissions are decreasing over the long term (SO_2 by 96.5% and NO_X by 79.15% in the 1990–2021 period) as a result of the introduction of technologies and production processes in line with requirements to apply best available techniques, change the fuels used, and reduce the energy intensity of the economy. The long-term development of NH_3 emissions (a 54.0% decrease in the 1990–2021 period) is mainly related to the agricultural policy of the Czech Republic. Although **NH_3 emissions** are decreasing, the dynamics are not as pronounced as for other pollutants. In the long term, **emissions of PM_{10}, $PM_{2.5}$ and VOC** are decreasing (by 89.7%, 88.6% and 62.2% respectively in the 1990–2021 period), however the situation in individual years is directly influenced by the meteorological conditions in the respective heating season and is also significantly influenced by the type of fuel used in household heating systems. The long-term fall in **CO emissions** (by 58.1% in the 1990–2021 period) is linked to trends in industrial production.

The **most important groups of emission sources** differ according to the pollutants (Chart 9). For NO_X emissions, transport was the main source in 2020[23] (31.4%) as well as the public power and heat generation sector (20.8%). VOC emissions came from both household heating (36.3%) and non-combustion production processes (29.6%). In the case of SO_2 emissions, the majority emitter was the public energy and heat production (42.1%), followed by household heating (21.6%). NH_3 emissions were mainly from the agricultural sector (90.7%). For suspended particulate matter in the PM_{10} and $PM_{2.5}$ size fractions, the dominant source in 2020 was household heating, accounting for 71.1% of total $PM_{2.5}$ emissions and 55.3% of total PM_{10} emissions. In the case of CO emissions, the main source is also local household heating (66.9%).

[23] *Data for the year 2021 are not available at the time of publication. They will be published in February 2023 at the earliest.*

Chart 9

Sources of emissions of selected pollutants by sector in Czechia [%], 2020



Data for the year 2021 are not available at the time of publication. They will be published in February 2023 at the earliest.

Data source: Czech Hydrometeorological Institute

Emissions from household heating have a significant impact on air quality in settlements. Especially in local combustion plants burning solid fuels (coal, wood), a large quantity of particles is often produced due to imperfect combustion (especially during startup), to which polycyclic aromatic hydrocarbons and other substances that have a negative impact on the health of the population bind. In addition, these emissions tend to be emitted from lower chimneys than industrial emissions, so they do not have the opportunity to disperse in the ambient air, thus exposing the population to high concentrations.

In 2020[24], PM_{10} emissions from household heating amounted to 23.5 thous. t, $PM_{2.5}$ to 23.0 thous. t and B(a)P to 13.2 t. Year-on-year, emissions of all three substances decreased by 8.5% in the case of PM_{10} and $PM_{2.5}$, and by 7.1% in the case of B(a)P. CO emissions from household heating are also significant, amounting to 532.5 thous. t in 2020 (a year-on-year decrease of 2.6%), as well as VOC emissions, which reached 72.7 thous. t (a year-on-year decrease of 3.7%). The decrease in heating emissions occurred despite a cooler heating season in 2020 compared to 2019[25], while the number of degree days in 2020 was 3,882, or 50 degree days more than in the previous year. The decrease in emissions was related to a reduction in coal fuel consumption and also to boiler replacements, including through boiler subsidies.

Emissions from transport are another major source of pollutants with an impact on air quality, especially in urban agglomerations and in the vicinity of major roads with high traffic intensity. Given its high energy intensity and continued dependence on fossil energy sources, transport is the third-largest category of greenhouse gas emissions (after public electricity and heat generation, and manufacturing), making development in transport essential in terms of decarbonising the economy and moving towards climate neutrality.

Emissions of NO_X, VOC, CO and suspended particulate matter (PM) from transport declined over the 2000–2021 period, most notably in the case of VOC and CO emissions, which fell by 78.5% and 83.1% respectively over this period (Chart 10). The decline was related to the gradual introduction of stricter emissions standards for new vehicles (the EURO emissions standards) and the associated modernisation of technologies, including the use of end-of-pipe technologies for emissions removal. The slight increase in NO_X and especially PM emissions

[24] *Data for the year 2021 are not available at the time of publication.*

[25] *The heating season is characterized by the 'degree day' unit, which is the product of the number of heating days and the difference between the average indoor and outdoor temperatures. Degree days thus show how cold or warm it was for a certain period of time, and how much energy was needed to heat buildings.*

after 2000 was due to the increasing share of more emissions-intensive diesel propulsion in the passenger car fleet. The development of PM emissions is also influenced by the fact that these emissions also come from non-combustion processes such as tyre and brake abrasion.

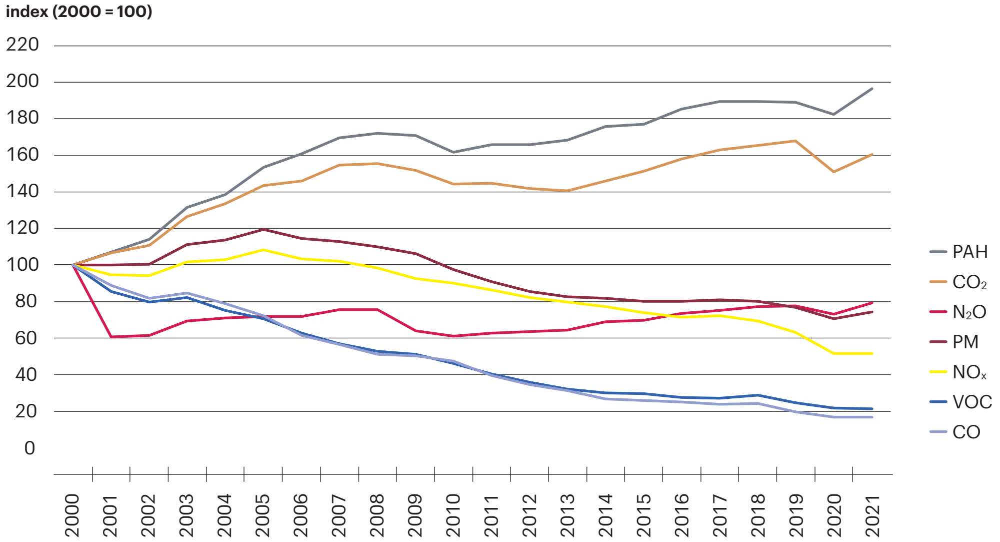
Emissions of polycyclic aromatic hydrocarbons (PAHs) from transport, which pose significant risks to public health, increased in the 2000–2021 period as fossil fuel consumption increased, with transport PAH emissions in 2021 roughly double those in 2000.

In a **year-on-year comparison** between 2020 and 2021, pollutant emissions were stagnant, with the exception of PM emissions, which increased by 5.3% year-on-year, and PAH emissions (up 7.7%). However, the year-on-year trend in emissions is distorted by the impacts of the COVID-19 pandemic, which caused a temporary decline in passenger and freight transport in 2020, and hence lower air pollution from transport. The post-2020 recovery in transport has been more pronounced for freight transport than for passenger transport, and public transport in particular has not yet returned to pre-COVID levels. The stagnation of emissions alongside the increase in transport is a positive finding, indicating a continuation of the current trend of reducing the emissions intensity of transport.

CO_2 emissions from transport increased by 60.6% between 2000 and 2021 and by 6.5% year-on-year in 2021. Emissions trends reflect the growth in fossil fuel consumption and the continued relatively low use of alternative fuels and propulsion in transport. N_2O emissions were stagnant during this period, contributing only about 1% of total greenhouse gas emissions from transport (in CO_2 eq.) in 2021.

Chart 10

Emissions of air pollutants and greenhouse gases from transport in Czechia [index, 2000 = 100], 2000–2021



Data source: Transport Research Centre

The most emissions-intensive mode of transport is **passenger car transport**, accounting for the largest share of total transport emissions in 2021 in terms of VOC (80.5%) and CO (78.3%). This was followed by road freight transport with more than one third of the emissions of NO_X, PM, PAH and CO_2. Road transport as a whole is the source of more than 95% of VOC, CO, PM and PAH emissions, and 88.9% of NO_X emissions, which also come from diesel-powered rail transport (6.9% of emissions) and air transport (4.0% of emissions).

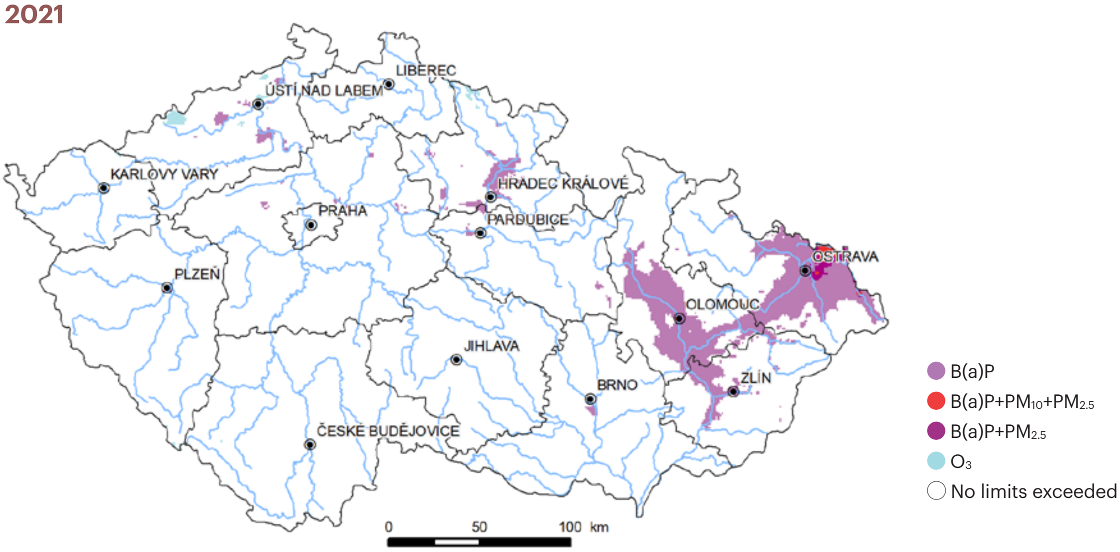
1.2.2 | Air quality situation

Air quality has a major impact on human health and quality of life, as well as on ecosystems and vegetation, so it is necessary to ensure compliance with limit value for pollutants and the long-term reduction of air pollution load. Currently, the most significant air pollutants are suspended particulate matter, benzo(a)pyrene, nitrogen oxides and ground-level ozone, which are present both in small settlements where households burn solid fuels, as well as in industrial and traffic-laden areas.

Air pollution is one of the many factors that affect the health of the population, and its effects are already evident at very low concentrations. In 2021, 6.1% of Czechia was defined as having exceeded at least one air pollution limit [26] without including ground-level ozone, and 19.7% of the population lived in this area. The ground-level ozone limit was exceeded in 2021 over only a minimal area of the territory, a very significant year-on-year change. However, pollutant concentrations are still exceeded in a number of locations, with the Moravian-Silesian, Olomouc and Zlín Regions remaining the most polluted areas (Figure 8). In 2021, one smog situation was declared in the Ostrava/Karviná/Frýdek-Místek agglomeration, excluding Třinec, due to threshold values being breached for PM_{10} suspended particulate matter over a total of 58 hours.

Figure 8

Areas where human health protection limit values for selected groups of substances were exceeded in Czechia, 2021



Data source: Czech Hydrometeorological Institute

The limit values for **suspended PM_{10} and $PM_{2.5}$ particulate matter** are still exceeded in Czechia on a long-term basis, but over an increasingly small area. The limit value for the daily average concentration of PM_{10} (Chart 11) was exceeded in only 0.1% of the territory in 2021 (0.001% in 2020), with 0.4% of the Czech population exposed to above-limit concentrations in this assessment year. The highest number of cases when the daily average PM_{10} concentration was exceeded was at stations in the Ostrava/Karviná/Frýdek-Místek agglomeration. In 2020, a stricter limit value of 20 $\mu g.m^{-3}$ for the annual average concentration of $PM_{2.5}$ came into effect, and this was exceeded in only 0.3% of the territory in 2021 (Chart 11), with 1.5% of the Czech population exposed to above-limit concentrations in this assessment year.

The severity of **population exposure to suspended particles** depends on the concentration of suspended particles, their size, shape and chemical composition. Long-term exposure to suspended particulate matter leads to an increase in mortality (approximately 3.7% nationally in 2021[27]), with vulnerable people (the long-term sick

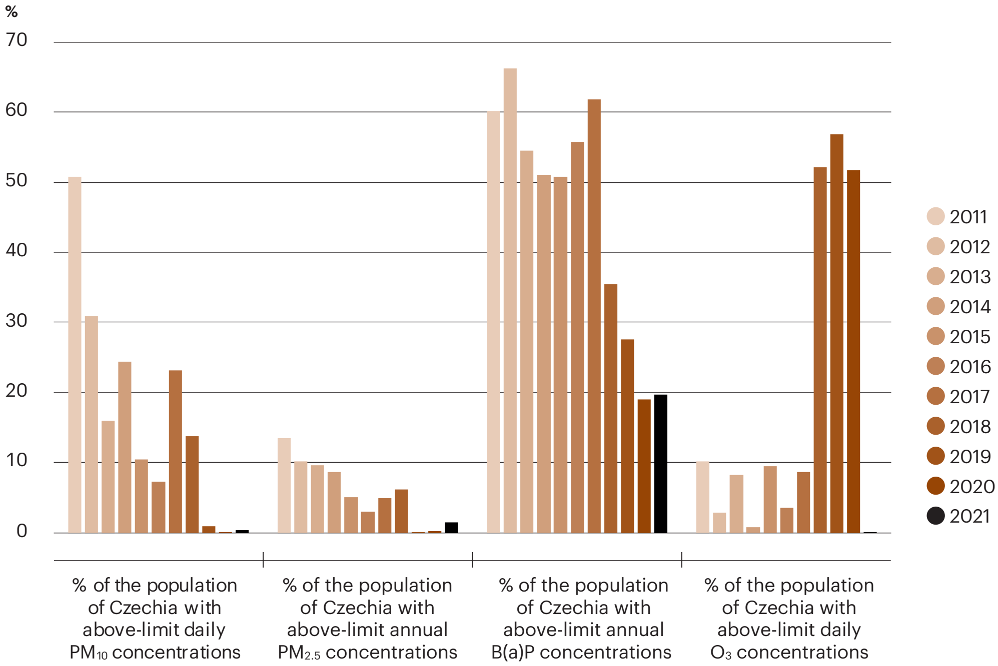
[26] *Act No. 201/2012 Coll., on air protection, Annex 1, point 1+2+3: exceeding the limit values without ground-level ozone for at least one listed pollutant (SO_2, CO, PM_{10}, $PM_{2.5}$, NO_2, benzene, Pb, As, Cd, Ni, B(a)P)*

[27] *Updated WHO Guidelines apply from 2021, with an annual average PM_{10} concentration of 15 $\mu g.m^{-3}$ (previously 20 $\mu g.m^{-3}$). The values from 2010 have therefore been recalculated.*

or elderly) always being most affected. Air pollution is the biggest environmental health risk in Europe and has a significant impact on the health of the European population, especially in urban areas. As a result, air pollution is considered the leading cause of premature death and disease in Europe, where 91% of the urban population is still exposed to concentrations of air pollutants that exceed the World Health Organisation (WHO)[28] recommended values for air quality for 2021. More than 307 thous. premature deaths were attributed to chronic exposure to $PM_{2.5}$ fine particles in 2020. As part of the Zero Pollution Action Plan or Green Deal for Europe, the European Commission has set a target to reduce the number of premature deaths caused by $PM_{2.5}$ by at least 55% compared to 2005 by 2030. Around 11% of the urban population in the EU27 was exposed to daily above-limit PM_{10} concentrations in 2020[29].

Chart 11

Share of the population of Czechia exposed to above-limit concentrations [%], 2011–2021



O_3 daily average – 26th maximum value over the last three years of daily 8-hour moving average greater than 120 μg.m^{-3}
B(a)P annual average – annual average greater than 1 ng.m^{-3}
PM_{10} daily average – 36th maximum daily average value greater than 50 μg.m^{-3}
$PM_{2.5}$ annual average – annual average greater than 20 μg.m^{-3}
In the year 2020, a stricter limit of 20 μg.m^{-3} for the annual average concentration of $PM_{2.5}$ came into force.

Data source: Czech Hydrometeorological Institute

Benzo(a)pyrene (B(a)P) is considered the most problematic pollutant in Czechia, is produced by imperfect combustion, and is mostly bound to the fine fraction of suspended $PM_{2.5}$ in the air. High concentrations are reached in industrial locations, but long-term above-limit concentrations are found especially in small settlements with solid fuel heating. The limit value for B(a)P was exceeded in 6.1% of the territory, where 19.7% of the population lived in 2021 (Chart 11). B(a)P concentrations show a significant annual trend with peaks in winter due to worsening dispersion conditions and emissions from local household heating. B(a)P has been shown have primarily carcinogenic effects. According to the National Institute of Public Health, a theoretical estimate of the probability of developing cancer under lifetime exposure to measured concentrations of B(a)P in Czechia ranges from two to

[28] *More at: WHO global air quality guidelines: https://apps.who.int/iris/bitstream/handle/10665/345329/9789240034228-eng.pdf?sequence=1&isAllowed=y*
[29] *Data for the year 2021 are not available at the time of publication.*

77 people per 100 thous. lifetime-exposed inhabitants, depending on the type of urban location. About 17% of the urban population in Europe was exposed to annual above-limit B(a)P concentrations in 2020[30].

Ground-level (tropospheric) ozone (O_3), formed by chemical reactions from the so-called ozone precursors (VOC, NO_X, CO and CH_4), together with their precursors, is a major pollutant and a strong oxidizing agent, thus negatively affecting human health and ecosystems. In humans, it has a strong irritant effect on the conjunctivae of the eyes, damages the respiratory system in particular, and in higher concentrations causes breathing difficulties and an inflammatory reaction of the mucous membranes in the respiratory tract. Its concentrations are mainly influenced by meteorological conditions (intensity and duration of sunshine, air temperature and precipitation). 2018 and 2019 were very favourable for ground-level ozone formation due to high temperatures in the summer months (Chart 11). In 2021, the ozone limit value for the protection of human health was exceeded in only 0.2% of the territory, and 0.02% of the population was exposed to above-limit concentrations. Approximately 12% of the urban population in Europe was exposed to above-limit concentrations of ground-level ozone (O_3) in 2020[31].

High concentrations of **nitrogen oxides** (NO_X) cause respiratory problems, especially in congested areas. The limit values for NO_2 were not exceeded once again in 2021. Neither daily nor hourly **sulphur dioxide** (SO_2) limit values were exceeded at any site in 2021, nor were the limit values set for arsenic, cadmium, lead, nickel and carbon monoxide (CO).

Air pollution together with atmospheric deposition has a negative impact not only on humans but also on ecosystems and vegetation. Ground-level ozone damages plant assimilation organs and therefore has a negative impact on forest, grassland and agricultural vegetation. Vegetation is consequently less resilient to biotic and abiotic factors, which also affects individual habitats and ecosystems. The **O_3 limit values for the protection of ecosystems and vegetation** (AOT40 exposure index) was exceeded at 35.9% of stations in Czechia in 2021 (calculated as an average for 2017–2021). Other limit values for the protection of ecosystems and vegetation for SO_2 and NO_X were not exceeded in 2021.

Pollutants from the air are transferred through **atmospheric deposition** to other environmental components, especially water and soil, thereby reducing the resilience of vegetation to external influences and affecting the water regime and biodiversity. The process contributes significantly to the self-cleaning of the atmosphere. It consists of a wet component (atmospheric precipitation) and a dry component (deposition of gases and particles by various mechanisms), and represents the direct input of pollutants to other environmental compartments. Despite the long-term decline in pollutants, the burden on ecosystems caused by atmospheric deposition remains high in many areas of Czechia. The highest total sulphur deposition values were recorded in the Ore Mountains and the Ostrava Region.

Detailed visualisations and data

https://www.envirometr.cz/data

[30, 31] Data for the year 2021 are not available at the time of publication.

1

Environment and health

1.3 | Exposure of the population and the environment to hazardous substances

© Jiří Přech/CENIA

1.3 | Exposure of the population and the environment to hazardous substances

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Releases to water and soil and air emissions of selected hazardous chemicals	N/A	N/A	N/A	N/A
Air emissions of heavy metals and POPs	↘	↘	↘	✓
Contaminated sites (evidence and remediation)	N/A	N/A	N/A	~

1.3.1 | Emissions and spills of hazardous chemicals

For the 2021 reporting year, the required data for releases to water, soil and air were reported to the **Integrated Pollution Register** from 1,387 sites (of which 1,185 were above-limit reports). There were 250 reports of releases to water (232 of which were above-limit). There were 24 substances reported in above-limit quantities in spills to water. In terms of releases to water, a total of 947.3 $kg.year^{-1}$ of arsenic and its compounds, 695.8 $kg.year^{-1}$ of chromium and its compounds, 52.9 $kg.year^{-1}$ of cadmium and its compounds, 283.2 $kg.year^{-1}$ of lead and its compounds, and 77.5 $kg.year^{-1}$ of mercury and its compounds were reported in 2021. In 2021, two above-limit reports of releases to soil were submitted, namely 53.7 thous. $kg.year^{-1}$ of nitrogen and 43.0 thous. $kg.year^{-1}$ of phosphorus. There were 1,135 reports of releases to air (of which 951 were above-limit). Releases of selected hazardous chemicals into the air are processed under indicators of chap. 1.2.1. Emissions of air pollutants (Air emissions of selected pollutants, Emissions from transport and Emissions from household heating).

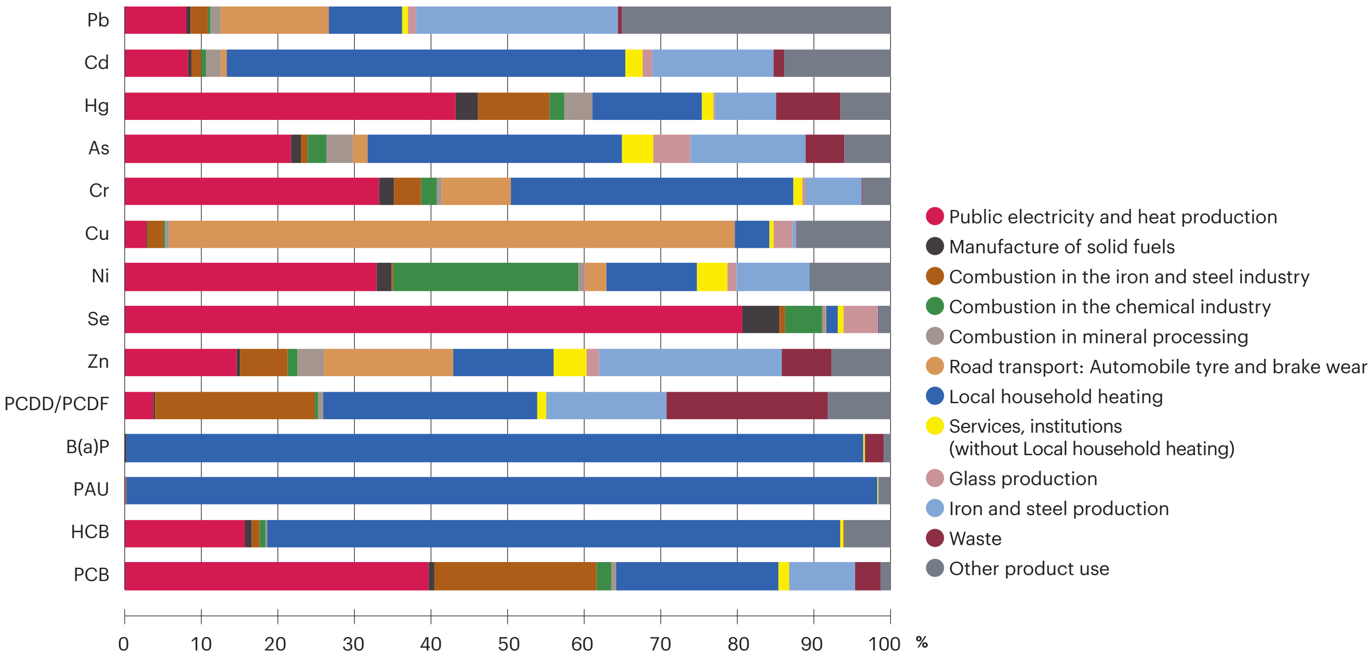
Air emissions of heavy metals have been decreasing in the long and medium term, despite the considerable fluctuations between years caused by the development of the economy, the characteristics of the heating seasons and the variable content of heavy metals in the fuels and raw materials used. Copper emissions from brake abrasion increased in line with the development of transport performance between 2010 and 2019.

Heavy metals are metals with a specific gravity greater than 4.5 $g.cm^{-3}$. They are bound in most fossil fuels, from which they are released during the combustion process. Heavy metals have carcinogenic and mutagenic properties and their danger lies mainly in their potential transfer to environmental compartments (especially the soil), where they accumulate. The main **sources of heavy metal emissions** (Chart 12) in Czechia in 2020[32] were the public power and heat generation sector (producing 80.6% of the selenium emitted, 43.3% of the mercury emitted and 33.3% of both chromium and nickel emitted), local household heating (52.0% of cadmium emissions, 36.9% of chromium emissions and 33.2% of arsenic emissions), tyre and brake wear (74.0% of copper emissions) and metal processing (26.4% of lead emissions and 23.9% of zinc emissions).

[32] *Data for the year 2021 are not available at the time of publication. They will be published in February 2023 at the earliest.*

Chart 12

Sources of air emissions of selected heavy metals and POPs in Czechia [%], 2020



Data for the year 2021 are not available at the time of publication. They will be published in February 2023 at the earliest.

Data source: Czech Hydrometeorological Institute

Persistent organic pollutants (POPs) are characterised by their ability to accumulate in living organisms, their toxic properties and the resulting negative effects on human health (damage to internal organs, lowered immunity, increased risk of cancer). These substances are very difficult to break down in the environment and remain there for many years. POPs enter the air from a range of industrial sources, but also from household heating, transport, agricultural spraying, evaporation from water bodies, soil and landfill sites. Environmental contamination due to their persistence is an ongoing problem.

Combustion processes are a major **source of POPs** (Chart 12). In the case of polycyclic aromatic hydrocarbons (PAHs), polychlorinated dioxins and furans (PCDDs/PCDFs) and hexachlorobenzene (HCB), local heating is the main source. In the case of polychlorinated biphenyls (PCBs), the main source of emissions is the public power sector. The development of individual groups of POPs substances is volatile, but overall emissions of all these substances have a downward trend, which is already significant in the short term. The most significant long-term reductions since 1990 for these groups were achieved for HCB and PAHs, with reductions of 96.3% and 86.2% respectively.

1.3.2 | Contaminated sites

Old ecological burdens, or contaminated sites, are a manifestation of the negative consequences of economic activity, not only in the industrial and energy sectors. It is therefore necessary to address the consequences of the activities of these sectors, i.e. remediation of the affected sites. The total **number of old ecological burdens** in Czechia is not precisely known, as these sites are being continuously mapped and inventoried, mainly for the purpose of their subsequent **remediation**, which can reduce their number and possible risks to ecosystems and human health. The Evidence System of Contaminated Sites[33] is therefore an incremental database and contained 10,156 contaminated sites in 2021. In the 2010–2021 period, the remediation of 2,172 contaminated sites was completed with compliance with remedial action conditions (including a total of 1,145 sites in 2021) and a further 200 remedial actions were completed in unsatisfactory condition (including a total of 86 sites in 2021).

The remediation of contaminated sites in Czechia is **financed** mainly from the Ministry of Finance of the Czech Republic (so-called "Ecological Contracts"), from the financial resources of individual ministries and also from European funds drawn from operational programmes, especially from the Operational Programme Environment. However, in 2021, no call for proposals was announced for specific objective 3.4 of the Operational Programme Environment.

In selected European countries, an estimated 2.5 mil. potentially **contaminated sites**[34] were identified as of 2011[35], of which 45% (about 1.1 mil. sites) have already been identified[36]. Of these identified sites, 30% (342.0 thous. sites) were identified as requiring remediation and of these 15% (51.3 thous. sites) have already been remediated. In 2011, the average national expenditure of selected European countries on the removal of contaminated sites was EUR 10.7 per capita, representing on average 0.04% of national GDP. Approximately 81% of the national expenditure was spent on the remediation work itself and 15% on investigatory work[37].

Detailed visualisations and data

https://www.envirometr.cz/data

[33] In 2019, the original Evidence System of Contaminated Sites database was merged with the list of Territorial Analytical Documents and with other databases of other ministries that recorded old environmental burdens or contaminated sites in their areas of responsibility. Indications of the potential presence of a contaminated site, identified by CENIA through the National Inventory of Contaminated Sites project from the study of remote sensing mapping data, have also been added to the database. The number of records of sites increased with this expansion (this is also true for remediation) and the inventory process itself has seen a further increase in recorded sites. Since 2020, the total number of sites has been shown without excluded sites.

[34] The definition of the term in each country is based on national regulations. In Czech terminology, these are old ecological burdens.

[35] More recent data are not available at the time of publication.

[36] Site identification or a preliminary study has been carried out.

[37] These data reflect the situation in only 27 of the 39 EEA member states surveyed, and in addition the underlying data for all countries are incomplete, and in some cases the definitions and interpretations used to identify sites differ. Although most European countries have adopted national or regional legislation regulating exploration and remediation activities at contaminated sites, no European framework strategy has yet been developed.

1 Environment and health

1.4 | Noise pollution and light pollution

1.4 | Noise pollution and light pollution

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Noise pollution burden of the population	N/A	N/A	↘	~
Noise reduction measures in transport and development of transport infrastructure	N/A	N/A	↗	✓
Brightness of the night sky	N/A	N/A	N/A	~

1.4.1 | Noise pollution burden of the population and ecosystems

Noise pollution affects the quality of the environment and is a source of health risks for the population. Excessive noise causes stress, the cause of a number of civilisational diseases. The most frequently occurring effect of noise on humans is considered to be noise annoyance, i.e. subjective effects of acoustic discomfort, as well as sleep disturbance and effects on activities. The most serious health effects of noise are those on the auditory organ and the cardiovascular system. Noise also affects animals, and can lead to disruption of populations and loss of biodiversity.

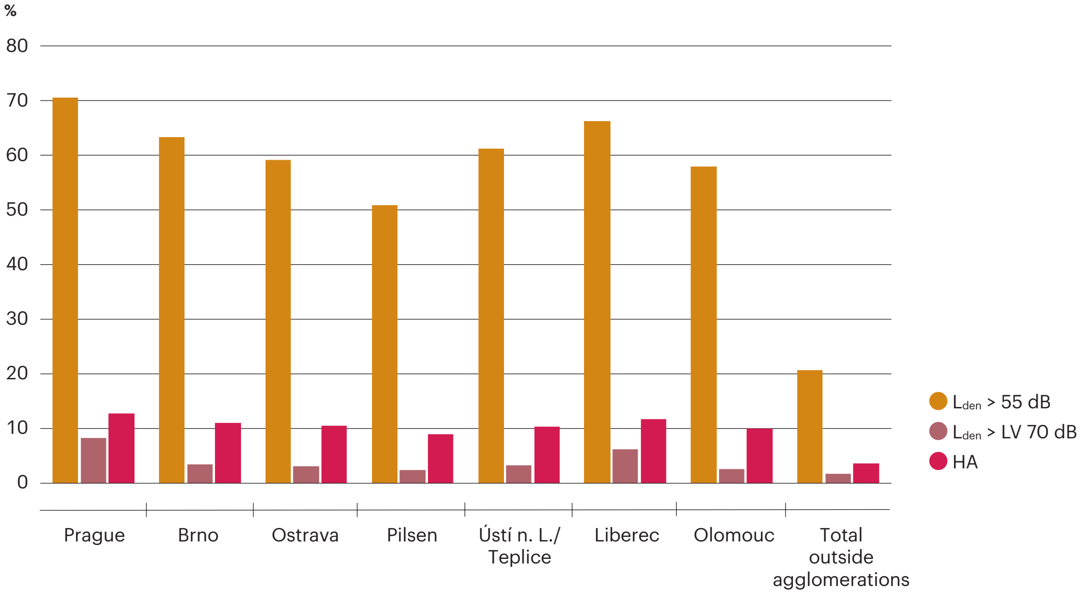
Road transport is the main category of ambient noise sources in Czechia and across the EU. According to the results of the 3rd round of the Strategic Noise Mapping from 2017[38], a total of about 2.5 mil. people in Czechia are exposed to road traffic noise above 55 dB according to the all-day (24-hour) noise pollution indicator L_{den}, or about a quarter of the Czech population. Of these, 213.6 thous. people were exposed to noise above the 70 dB limit value, for which action plans to reduce noise pollution are developed. At night (22:00–06:00, according to the L_n indicator), 279.6 thous. inhabitants were exposed to noise above the 60 dB limit value.

Urban agglomerations with a population of over 100 thous. are in particular exposed to noise pollution from road traffic. For the day and night noise pollution indicators (Chart 13, Chart 14), the highest share of inhabitants exposed to noise pollution is identified in the Prague agglomeration, while the Liberec agglomeration also has high noise pollution; in other agglomerations the situation is relatively more favourable. Outside the urban agglomerations, the noise situation is monitored only in the vicinity of roads with a traffic intensity of more than 3 mil. vehicles per year. The highest numbers of inhabitants exposed to noise pollution from road transport according to the L_{den} and L_n indicators were in the Central Bohemia, Moravia-Silesia and Hradec Králové Regions, through which the main road and motorway routes with high traffic intensity pass.

[38] Strategic noise mapping is carried out in accordance with the requirements of Directive 2002/49/EC of the European Parliament and of the Council on the assessment and management of environmental noise at five-year intervals. The noise situation in 2018–2022 will be assessed by the 4th round of Strategic Noise Mapping, the results of which will be available in 2022.

Chart 13

All-day (24-hour) noise pollution from road transport in agglomerations and outside agglomerations according to the L_{den} and HA indicators [% of exposed population included in noise mapping], 2017

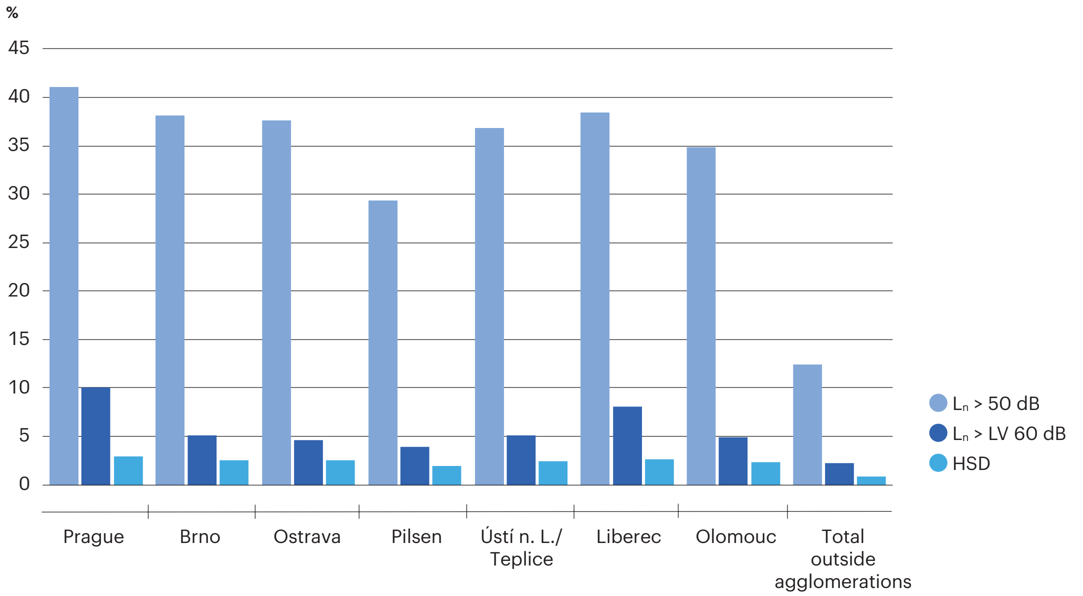


HA – high annoyance
Outside agglomerations, data are only available for roads with traffic volumes higher than 3 mil. vehicles per year.
Data for the years 2018–2021 are not available.

Data source: National Reference Laboratory for Environmental Noise

Chart 14

Night-time (22:00 to 06:00) noise pollution from road transport in agglomerations and outside agglomerations according to the L_n and HSD indicators [% of exposed population included in noise mapping], 2017



HSD – high sleep disturbance
Outside agglomerations, data are only available for roads with traffic volumes higher than 3 mil. vehicles per year.
Data for the years 2018–2021 are not available.

Data source: National Reference Laboratory for Environmental Noise

Compared to the results of the last round of noise mapping (2012), the total number of inhabitants exposed to road traffic noise above the limit value (both in and outside agglomerations) decreased by 19.3% in the case of the all-day noise pollution indicator L_{den}. Despite this overall decline, there were agglomerations and regions where the number of inhabitants exposed to high all-day noise pollution (according to the L_{den} indicator) increased above the limit value between the 2nd and 3rd round of the Strategic Noise Mapping. These were the Prague and Liberec agglomerations and the Moravia-Silesia and South Moravia Regions. These conclusions must be interpreted in the context of methodological changes in noise mapping which, however, had less influence on the determination of high noise exposure.

Operation on the main railway lines, which are used by at least 30 thous. trains per year, was a source of all-day noise pollution (L_{den} indicator) above the limit value of 70 dB for 19 thous. inhabitants, especially outside urban agglomerations. Václav Havel Airport in Prague caused noise pollution above the limit value for 2.4 thous. inhabitants during the day and 3.4 thous. people at night, mostly living in the Prague agglomeration.

Noise pollution from road transport is reduced by the **development of road infrastructure** by diverting transit traffic away from settlements and by **implementing noise protection measures** on transport infrastructure such as noise barriers and low-noise asphalt. In 2021, CZK 576.7 mil. was spent on the implementation of noise protection measures on road infrastructure managed by the Road and Motorway Directorate, a significant year-on-year increase in investment by 47.7%, but construction activity was affected by the COVID-19 pandemic in 2020. The total length of noise barriers on roads and motorways in 2020[39] was 450.6 km.

Of the **new motorway sections**, two sections of the D11 Hradec Králové–Smiřice–Jaroměř motorway, 22.4 km long, were put into operation in 2021 (investment costs CZK 7.7 bil.), a section of the D35 Opatovice n. L. – Časy motorway (length 12.6 km, investment costs CZK 4.7 bil.), the south-eastern Otrokovice bypass on the D55 motorway and the Lubenec bypass on the D6 motorway. Noise-control measures on these sections were part of the construction budget. As far as bypasses and relocations are concerned, the Chrudim bypass was put into operation on the I/37 road in 2021 (length 4.6 km, cost CZK 617.6 mil.), the north-eastern Krnov bypass on the I/47 road (length 7.7 km, cost CZK 1,263.5 mil.), the Osová Bítýška bypass on the I/37 road (2.8 km, CZK 328.1 mil.) and the relocation of the I/27 road in the Třemošenský rybník – Orlík section (1.6 km, CZK 269.2 mil.).

CZK 139.8 mil. was invested in the construction of **noise barriers on railways** in 2021, while 9.3 km of new noise barriers were handed over for use. Compared to 2020, this was a roughly sevenfold increase in investment, but 2020 was not a normal year and investment in noise barriers fluctuates considerably from year to year depending on the state of completion of corridor sections. The highest investment, CZK 234.8 mil., was in 2015. Another railway noise-reduction measure was the grinding of the rail tops to reduce the acoustic load. CZK 18.7 mil. was invested in rail grinding in 2021, while the length of the grinded sections was 61.4 km (roughly twice as much as in 2020).

1.4.2 | Brightness of the night sky

Light pollution (also popularly known as light smog) produced by artificial lighting at night is one of the major problems of civilization with negative impacts on human health, the environment, the economy, safety and visibility of the night sky. Light pollution is generally caused by any artificial light source and is typically caused by directing light into undesirable areas (e.g. the sky, open landscape or into windows), by illumination outside the necessary time periods (e.g. lighting a shopping centre car park outside opening hours), or by using sources with inappropriate spectral characteristics (particularly in the blue part of the spectrum). Although experts say light pollution is harmful to humans, animals and plants, it is not currently regulated by Czech legislation, and no legislation specifies which administrative body protects this public interest, or limit values for light pollution. A suitable measure for assessing the level of light pollution is the **brightness**[40] **of the sky**. Artificial sky brightness

---

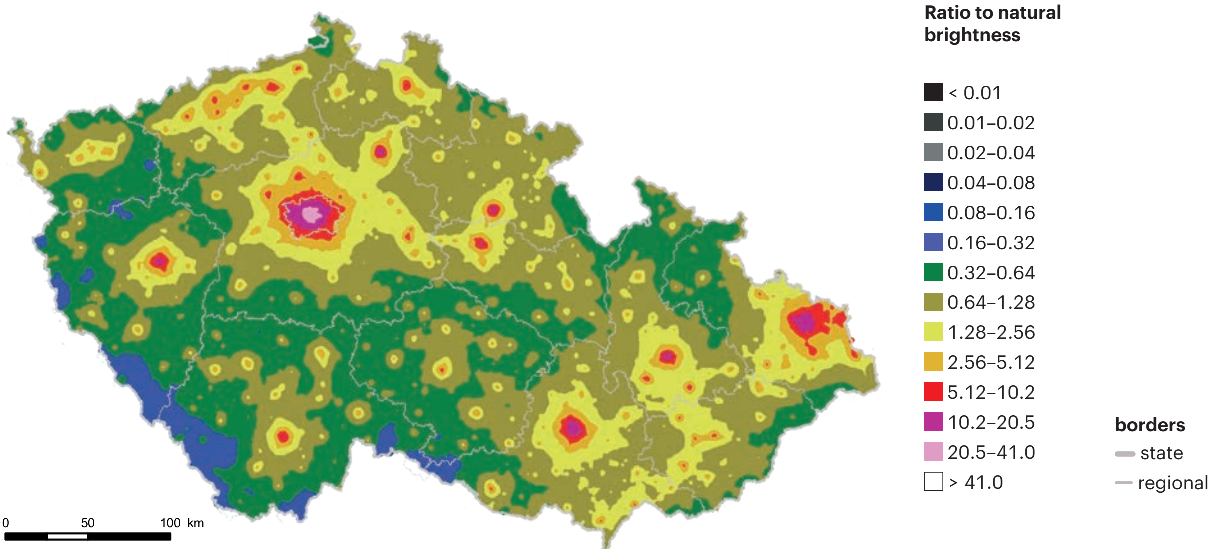
[39] Data for the year 2021 are not available at the time of publication.

[40] Brightness is a photometric quantity and can be defined as the luminous flux per unit solid angle per unit area of the source, expressed in candelas per m^2 (L; cd per m^2).

is caused by light artificially added to the night-time environment, and is usually expressed as the ratio to the natural brightness of the night sky[41] (Figure 9). In Czechia, however, we can no longer find any area not affected by artificial brightness because light from cities spreads tens or even hundreds of kilometres away due to scattering in the air. The current level of light pollution is steadily worsening due to the increasing number of luminaires or illuminated areas.

Figure 9

Artificial brightness of the night sky over Czechia, 2016



Data for the years 2017–2021 are not available at the time of publication.
Adapted from: Falchi et al. (2016): The New World Atlas of Artificial Night Sky Brightness, https://doi.org/10.5880/GFZ.1.4.2016.001

Data source: Czech Astronomical Society, 2017, https://svetelneznecisteni.cz

The inappropriate type of artificial lighting and, especially the lack of difference between day and night light intensity, results in a disruption of **circadian rhythm** (the natural cycles of day and night), which leads to changes in the behaviour of organisms. Current studies show that night-time exposure to light radiation leads to insufficient regeneration of the human body during sleep, and suppressed production of the hormone melatonin (which influences circadian rhythms in physiological processes), even at very low light intensities. Repeated disturbance of the dark phase of the night by light (especially if it contains a blue spectral component) significantly increases the risk of so-called diseases of civilization, such as immune disorders, psychiatric diseases including depression, sleep and memory disorders, cardiovascular diseases, insulin resistance and obesity, and especially many forms of cancer.

Czechia is **comparable to other European countries** in terms of the artificial brightness of the night sky. The entire territory of Czechia can already be considered polluted by artificial brightness. Almost 7.3% of the Czech population (20.5% of Europe's population) lives in an area where the dark sky is no longer visible due to artificial lighting.

Detailed visualisations and data

https://www.envirometr.cz/data

[41] *The natural brightness of the sky consists of the scattered light of the Moon, bright planets, stars, the Milky Way, zodiacal light, airglow (radiation from the upper layers of the Earth's atmosphere) and other astronomical phenomena.*

Environment and health

1.5 | Society preparedness for and resilience to emergencies

1.5 | Society preparedness for and resilience to emergencies

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Public money spent on adaptation to climate change	N/A	N/A	N/A	N/A
Issuing Integrated Warning Service System alerts*	N/A	N/A	N/A	✓
Events and interventions arising from natural disasters	N/A	↗	∿↗	✗
Amount of damage caused by natural disasters	∿↗	∿↗	↗	✗
Preventive and educational activities for population protection and crisis management	N/A	∿↗	↘	✗
Number of major accidents reported	↗	↗	↘	∿

** It is not possible or meaningful to set a trend for the operation of the alert system. The criterion for its success is not the number of alerts issued, but the quality, accurate and timely issuing of alerts.*

1.5.1 | Preparedness for weather extremes

Effective financial support for measures to protect against the risks of climate change or natural hazards is essential to improve the adaptation of the population and economic sectors to these risks. The aim of the measures is mainly to reduce the level of risk (e.g. to reduce flood risks in floodplains of watercourses) and to effectively combat extreme manifestations of climate change and their impacts, not only on the landscape but also on the socio-economic system.

In the **Operational Programme Environment 2014–2020**, priority axis 1 (improving water quality and reducing the risk of floods) in the supported area 1.3 (ensuring flood protection within town limits and rainwater management) and 1.4 (support for preventive flood protection measures) focused on this issue. Projects in these areas also address water retention in landscapes and settlements, including better water management, including in the context of the growing importance of addressing drought. This is the focus of support in the Operational Programme Environment for the development of water supply infrastructure to ensure sufficient drinking water for the population, specifically supported area 1.2 (ensure the supply of drinking water of adequate quality and quantity). In addition, drought is also addressed under priority axis 4 (protection and care of nature and landscape) in support area 4.3 (strengthening the natural functions of the landscape). In total, almost 1,600 projects worth CZK 12.2 bil. had been approved for the above-mentioned areas in the Operational Programme Environment 2014–2020 by the end of 2021 (of which CZK 6.6 bil. has already been reimbursed).

Since 2017, the issue of drought has also been addressed through the national subsidy **programme Dešťovka (Rainwater)** announced in the National Programme Environment. The aim of this programme is to provide motivation for efficient water management and thus reduce the amount of drinking water abstracted from surface water and groundwater sources. A total of CZK 540 mil. was allocated in two calls, while 8,689 projects with a total amount of support of CZK 335.1 mil. had been approved by 2021 (see chapter 1.6 Adapted settlements for more information on the Rainwater programme).

Adaptation measures to mitigate the impacts of climate change are also addressed in the national subsidy programme of the Ministry of the Environment of the Czech Republic, the **Landscape Management Programme**, especially its Sub-programme B for improving the preserved natural and landscape environment, where 5,987 actions with a total volume of CZK 313.4 mil. were supported in 2014–2021. Another programme is the **Natural Landscape Function Restoration Programme**, where it is possible to mitigate the impacts of climate change on water, forest and non-forest ecosystems. Between 2014 and 2021, CZK 111.1 mil. was spent on 863 actions under this programme.

At the **Ministry of Agriculture of the Czech Republic**, measures to mitigate the negative impacts of climate change (i.e. in particular flood control measures, water retention in the landscape in relation to drought) were implemented from more than 10 national programmes and in particular from the **Rural Development Programme** as a transnational source. The national programmes of the Ministry of Agriculture of the Czech Republic in 2014–2021 financed the implementation of about 1,900 measures or structures in these areas to protect property worth more than CZK 2.1 bil. and about 84 thous. inhabitants. The total amount of funds disbursed from the national programmes administered by the Ministry of Agriculture of the Czech Republic in 2014–2021 was more than CZK 12.5 bil. It is also important to mention land consolidation (complex or simple), financed mainly from the Rural Development Programme, which contribute to the elimination of the negative impacts of climate change, especially in terms of reducing the adverse effects of floods and droughts and addressing runoff conditions in the landscape. Complex and simple land consolidation is currently being carried out on almost 38.4% of the agricultural land fund (almost 1.6 mil. ha). CZK 2.1 bil. was spent on land consolidation between 2014 and 2021 through the implementation of anti-erosion, hydrological and ecological measures. The Rural Development Programme also finances agri-environmental-climate measures, specifically in the area of landscape care, while such measures had been implemented on almost 23.5 thous. ha of agricultural land in the 2014–2021 period. The Rural Development Programme spent CZK 1.8 bil. in the same period in the field of forest protection, or within the framework of support for investments in the development of forest areas, improving the viability of forests and forest-environmental and climate measures.

In addition to the Ministry of the Environment of the Czech Republic and the Ministry of Agriculture of the Czech Republic, the issue of adaptation to climate change is also addressed by the **Ministry of Regional Development of the Czech Republic and the Ministry of Industry and Trade of the Czech Republic**. The Ministry of Regional Development of the Czech Republic administers the **Integrated Regional Operational Programme**, which has a specific objective 1.3 Increasing preparedness to address and manage risks and disasters in the area of protection against natural hazards. Support is primarily aimed at protection against extreme/long-term drought, above-average snowfall and massive icing, hurricanes and wind storms, and accidents related to the release of hazardous substances. Specifically, this supports increased preparedness of the basic components of the Integrated Rescue System for dealing with emergencies related to climate change and accidents involving hazardous substances. A total of 871 projects were submitted in seven calls for proposals with a total volume of CZK 15.9 bil., while a total of 474 projects with a total volume of CZK 4.0 bil. had been completed and reimbursed by the end of 2021.

In connection with the prevention of negative impacts of drought on industrial enterprises, the Ministry of Industry and Trade of the Czech Republic announced a new call from the **Operational Programme Enterprise and Innovation for Competitiveness** programme with a total allocation of CZK 130 mil. in 2021. It has also prepared a methodology aimed at preparing an assessment of the water management of industrial enterprises (the so-called water audit). The benefits of the water audit should be in particular a more careful handling of water and water resources by enterprises. The Ministry of Industry and Trade of the Czech Republic will support new technologies and processes to enable water recycling in manufacturing plants, as well as the installation of closed circulation circuits and processes to optimise water consumption within a separate manufacturing process.

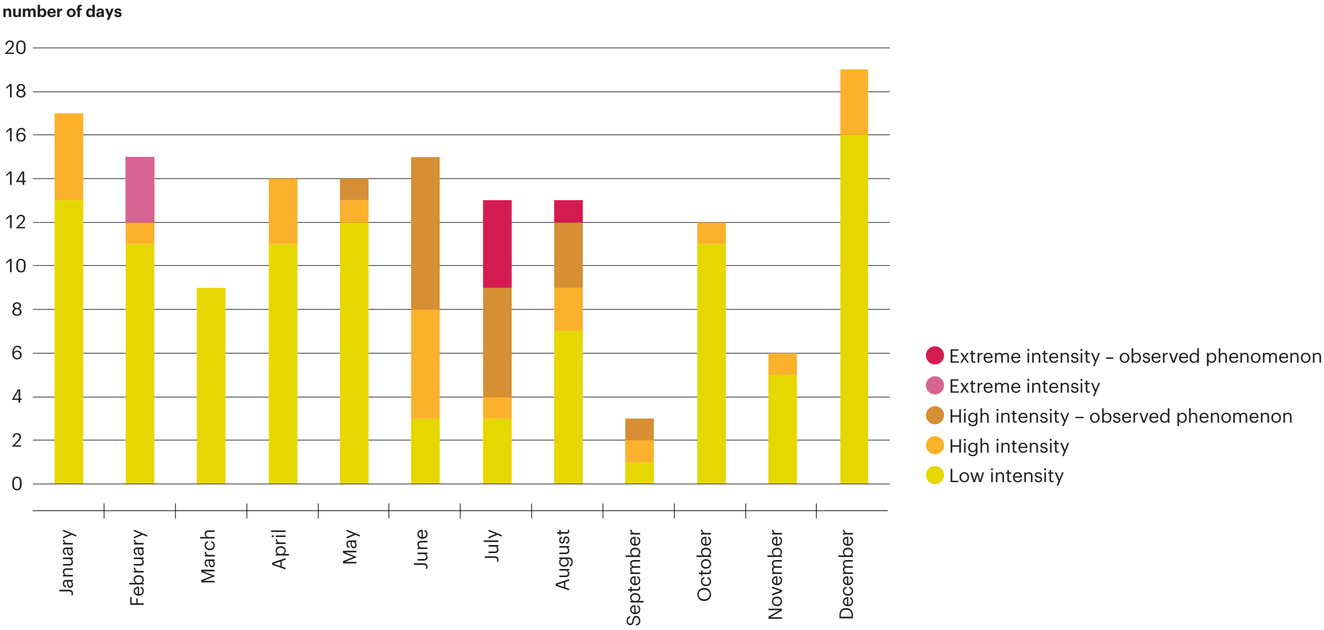
The **Integrated Warning Service System** is jointly provided by the Czech Hydrometeorological Institute and the Meteorological Service of the Army of the Czech Republic for operational meteorology and hydrology. Warning information on dangerous meteorological and hydrological elements and phenomena is issued in accordance with the recommendations of the World Meteorological Organization (WMO) and transmitted to the European

Meteoalarm system[42]. The purpose of issuing alerting reports is to warn the public, state administration and economic entities in time of the risk of dangerous phenomena, to mitigate the consequences, and to support the elimination of any consequences that have already occurred.

A total of 202 alerts were issued in 2021, of which 148 were forecast alerts and 54 warned of the imminent occurrence of a dangerous phenomenon. There were 182 alerts about meteorological phenomena, while 20 alerts were related to hydrological phenomena. Meteorological and hydrological alerts were in effect for a total of 150 days, i.e. 41% of the days in the year. Alerts for low-intensity events were significantly more prevalent (102 days, Chart 15). A total of 40 days had warnings for high intensity events, and 8 days for extreme intensity events. Alerts for high and extreme intensity events were issued mainly in the summer months and related to storms and associated flood events, high temperatures and, in August, extreme precipitation. The shortest validity of alerting messages during the year was in September (3 days), while the longest was in December, when alerts were in effect for a total of 19 days, including 3 days for high intensity events (severe icing and flood alert).

Chart 15

Number of days with alerts by highest intensity in each month of the year [number of days], 2021



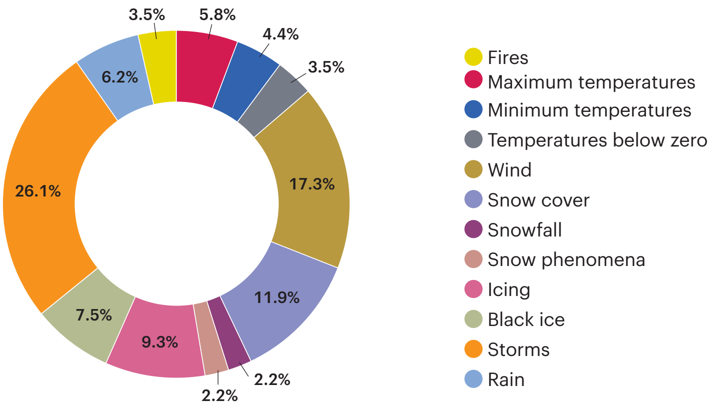
Data source: Czech Hydrometeorological Institute

According to the **representation of each group of phenomena in the warnings**, the most frequent alerts in 2021 were for thunderstorms (26.1%, Chart 16) and strong winds (17.3%). Alerts of new snow cover (11.9%), icing and sleet were frequent. The alerts for the highest, extreme intensity events warned of severe icing in February, and storms and flood risk in July.

[42] *Read more: https://www.meteoalarm.org*

Chart 16

Alerts by hazard group [% of warnings issued], 2021



Data source: Czech Hydrometeorological Institute

An **assessment of the success of the issued alerts**[43] by the Integrated Warning Service System for 2021 was prepared according to the established methodology for a total of 345 events. 84.9% were successful or partially successful. The partially successful alerts were mostly underestimations (19.4% of events), so the warning was issued for a lower intensity event than actually occurred. In the case of events rated as unsuccessful, undetected phenomena (lack of warning) predominated over warnings for phenomena that did not occur (false alarms). No alerts were rated as very unsuccessful in 2021.

1.5.2 | Impact of emergencies and crisis situations

In connection with the increasing impacts of climate change, an increased incidence of extreme events requiring the activation of the Integrated Rescue System can be expected. The main coordinator of the Integrated Rescue System is the Fire Rescue Service of the Czech Republic which, in addition to fires, has to deal with other **emergencies caused by climate change**, such as prolonged droughts, hurricanes and wind storms, floods, above-average snowfall and massive icing, as well as emergencies caused by human activity, such as accidents associated with releases of hazardous substances.

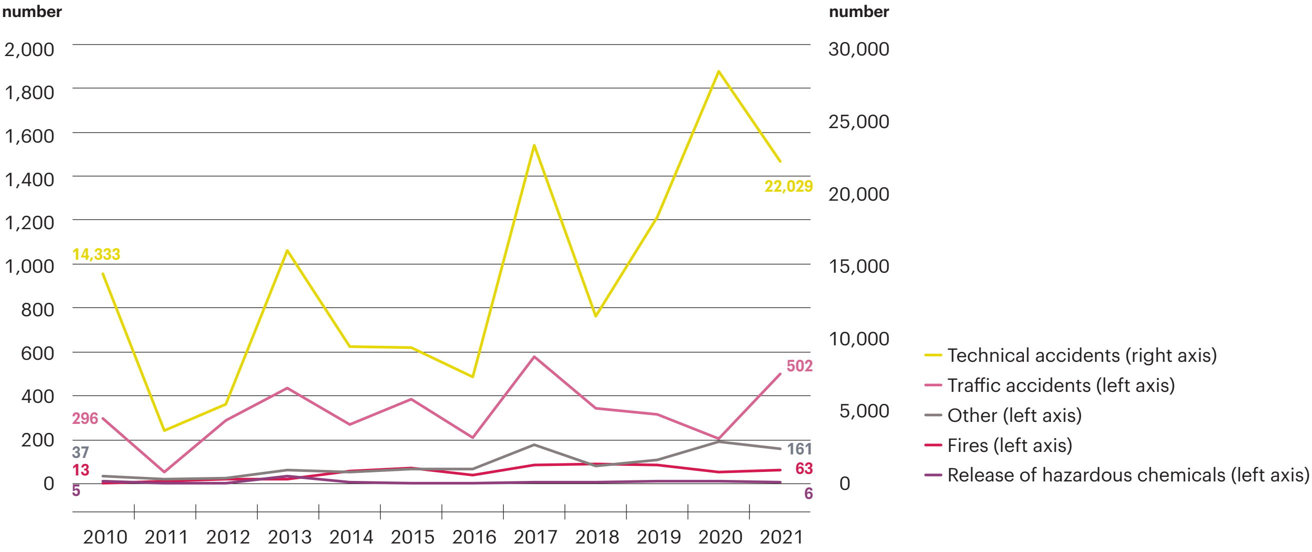
In 2021, there were a total of 22,761 incidents related to natural disasters, requiring 34,053 related interventions involving 27,756 fire protection units. Compared to 2020, there was a decrease in all cases, by about 20% in the number of incidents and fire protection units involved, and by 10% in the number of related interventions. 11 people died, 289 injured and 1,985 evacuated as a result of natural disasters in 2021. Damage caused by fires due to natural disasters amounted to CZK 9.2 mil. On the other hand, a total of 600 people were saved, and the values saved in the case of fires amounted to CZK 19.7 mil.

In terms of developments since 2010 (Chart 17), we can note an increase in the number of technical accidents, fires and other incidents, mainly related to strong winds. The exception is traffic accidents, where the increase is mainly due to snow and ice. Extreme winds hit South Moravia in 2021 during severe storms and a tornado that was one of the strongest recorded in Europe in 20 years. High winds together with floods, inundation and rain are the main causes with a dominant long-term contribution to all events.

[43] *Assessment of the success of meteorological warning information in 2021, Czech Hydrometeorological Institute, February 2022, more at: https://www.chmi.cz/files/portal/docs/tiskove_zpravy/2022/Kompletní_vyhodnoceni_vystrah_2021.pdf*

Chart 17

Number of incidents related to natural disasters in Czechia, 2010–2021

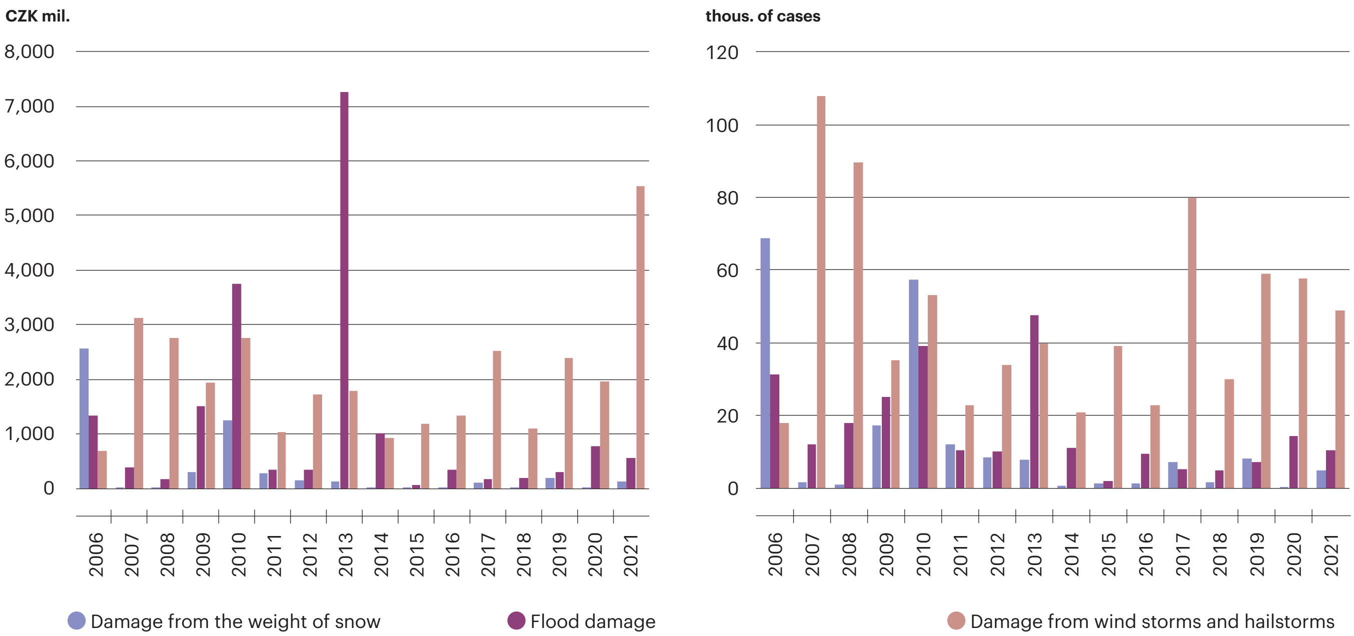


Data source: Ministry of the Interior of the Czech Republic – General Directorate of the Fire Rescue Service of the Czech Republic

A comprehensive view of the issue of **monitoring and settlement of damages after natural disasters** is shown by the statistics of the Czech Insurance Association which, in addition to the reported damage caused by floods, also monitors damage caused by wind storms, hailstorms and the weight of snow (Chart 18). Within these statistics there are fluctuations in both the volumes and numbers of cases of damage related to natural disasters. Since 2006, insurers have recorded more than 1.2 mil. insurance events caused by the above-mentioned natural events with total damage of CZK 56.5 bil., of which 64 thous. claims with damage of CZK 6.2 bil. in 2021. Wind storms and hailstorms account for the largest share of both the number of claims and total damage. 2021 was no exception in this respect, with a significant increase in damage caused mainly by the storm and the devastating tornado in the Břeclav and Hodonín Regions and the downburst in Stebno (2021).

Chart 18

Insurance events in natural disaster insurance in Czechia [CZK mil., thous. of cases], 2006–2021



Data source: Czech Insurance Association

However, another manifestation of climate change, **long-term drought**, has not yet been recorded in the statistics of insurance companies. This is one of the most serious manifestations of climate change, with the greatest potential impacts not only on biodiversity but also on the population and the economy. In this context, between 2015 and 2021, compensation of CZK 4.4 bil. was paid to farmers from national sources, and in the case of forestry, contributions were provided to mitigate the impact of the bark beetle calamity in forests of more than CZK 11.3 bil.

Recurring natural disasters caused by natural hazards require a comprehensive approach to dealing with the damage and restoration of property after these disasters. This is why the Ministry of the Interior of the Czech Republic, in cooperation with other ministries, has developed the **strategy for the restoration of the territory** in relation to declared crisis states (i.e. states of danger or emergency). These form a document creating the framework conditions for the provision of state aid primarily through programme financing under the competence of designated ministries (e.g. through the programmes of the Ministry of the Environment of the Czech Republic "Elimination of Damage after Natural Disasters", the Ministry of the Environment of the Czech Republic "Elimination of the Consequences of Floods on State Water Management Assets", the Ministry of Rural Development of the Czech Republic "Restoration of Municipal and Regional Assets after Natural Disasters" and "Element", and relevant operational programmes as part of EU funds).

In the 2005–2021 period, recovery strategies were developed mainly in the context of devastating floods, wind storms and hurricanes. The total amount of damage (represented by the total cost of restoration) caused by these floods and inundations amounted to approximately CZK 44 bil. in the 2005–2021 period, with no exceptional flooding or inundation occurring between 2014 and 2021. In the case of wind storms and hurricanes, the recovery strategy was developed in the context of Hurricane Kyrill in 2007, when the total cost of restoring property reached almost CZK 7.5 bil. The damage to private and public property related to the tornado in Moravia in 2021 was estimated at CZK 15 bil.

Preventive and educational activities related to public protection and crisis management include the issue of the protection of people in relation to common risks and emergencies. The guarantor of population protection, fire prevention and the Integrated Rescue System is the Fire Rescue Service of the Czech Republic which, in the field of population education through preventive and educational activities, works with children in kindergartens, pupils and students in primary and secondary schools, at universities, the adult population, the elderly, and disabled citizens. The field of preventive and educational activities is based primarily on personal contact between members of the Fire Rescue Service of the Czech Republic and the public. 2020 and 2021 were quite exceptional years due to the measures related to the spread of COVID-19 and therefore cannot be assessed in comparison with the previous period. It was possible to organise most of the activities in the summer months as normal, but in subsequent periods only to a very limited extent under the declared state of emergency, while observing all protective measures. There is a high level of public interest in safety issues among all target groups, and a future trend of further increase in the interest of the population can be expected.

1.5.3 | Origin of emergencies

The **major accident prevention system**[44] requires the operators of facilities containing selected hazardous chemicals or mixtures to put in place all measures to prevent a major accident from occurring, as well as to establish procedures to deal with one in the event that an accident occurs despite the precautions taken.

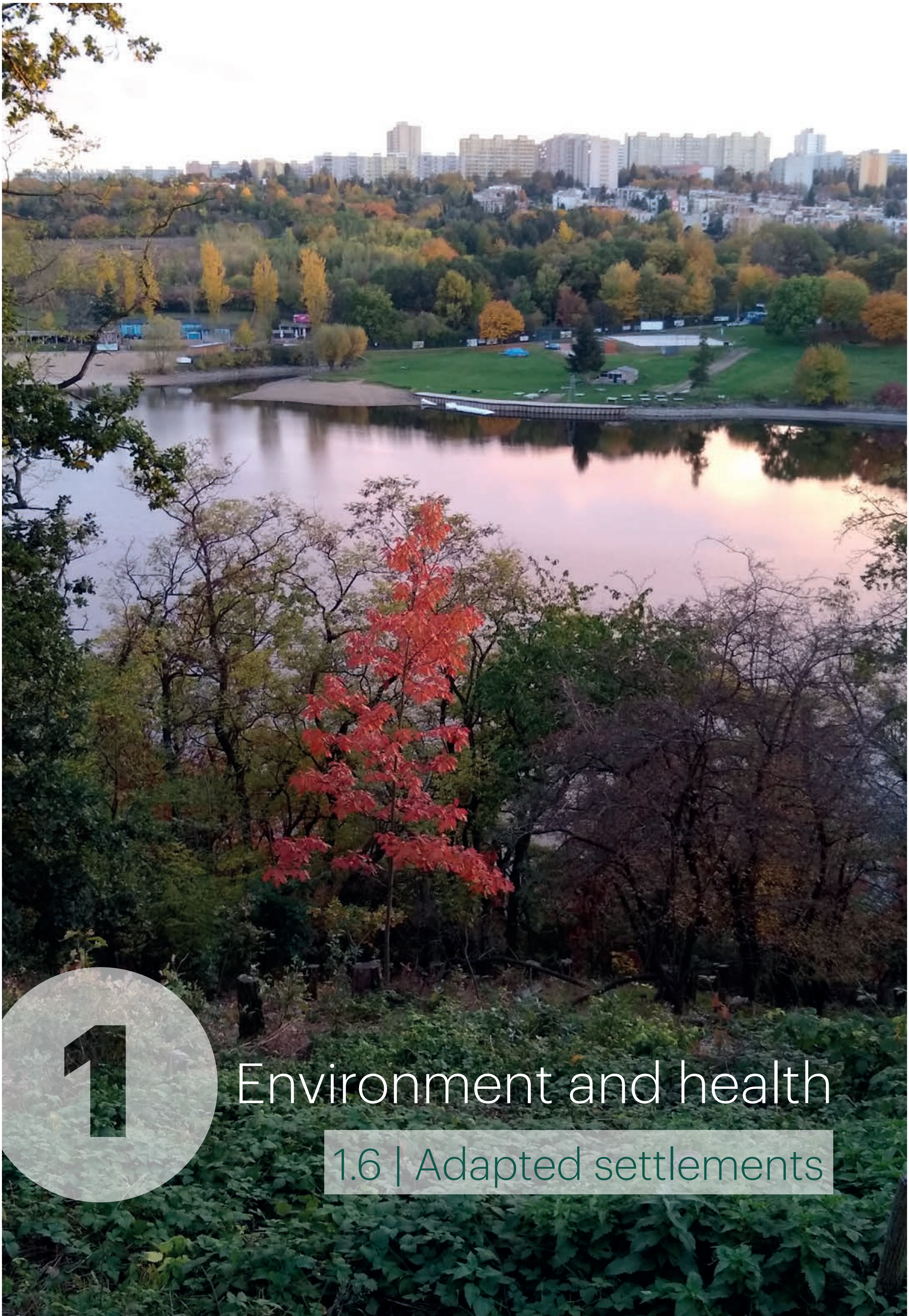
In Czechia, a total of 207 facilities were included in the major accident prevention system in 2021, of which 94 facilities are in Category A (lower risk) and 113 in Category B (higher risk). These are mostly chemical plants or production plants where hazardous substances are handled, but also, for example, fuel or chemical warehouses.

Five major accidents occurred in Czechia in 2021, two of which were in the Central Bohemia Region (at two different facilities) and one each in the Zlín, Ústí nad Labem and Moravia-Silesia Regions. These included hazardous substance spills, an explosion and a fire.

Detailed visualisations and data

https://www.envirometr.cz/data

[44] *Act No. 224/2015 Coll., on the prevention of major accidents, implements the relevant European Union regulation (Directive 2012/18/EU of the European Parliament and of the Council, the so-called Seveso III) and establishes a prevention system.*



1 Environment and health

1.6 | Adapted settlements

1.6 | Adapted settlements

Indicator	**Long-term trend (15 years and more)**	**Medium-term trend (10 years)**	**Short-term trend (5 years)**	**State**
Number of municipalities with adaptation plans	N/A	N/A	↗	✗
Brownfields	N/A	N/A	N/A	~
Local Agenda 21	↗	~↗	↘	✗
Sustainable Urban Mobility Plans	N/A	N/A	↗	✓
Supported projects for the use of rainwater and grey water	N/A	N/A	↗	✓
Green areas in cities	N/A	N/A	→	~

1.6.1 | Adaptation of settlements to climate change

The impacts of climate change in settlements and urban areas are a complex cross-sectoral environmental issue that has been at the forefront of strategic documents at national and local level in recent years. However, the process of **introducing concrete adaptation measures into planning practice** has been slow, despite a significant shift in 2021. While at national level climate change is seen as a priority environmental problem for Czechia in various strategic and conceptual documents, this trend is not yet fully evident at lower administrative levels (regions, cities, municipalities)[45]. The preparation and implementation of an adaptation strategy at local level is a very challenging process, with many obstacles to be taken into account. In the preparatory phase, these are related, for example, to insufficient competences of the authorities (e.g. insufficient comprehensive knowledge of the issue, different attitudes of individual departments of the authorities). In the planning phase, cities face mainly property rights and difficult coordination between districts, authorities and institutions. In the implementation phase, the main obstacle is finance or the readiness of the relevant legislation. On the other hand, it is a fact that an increasing number of domestic cities and municipalities are beginning to realise that the ability to adapt to climate change through appropriate adaptation measures will be a determining factor in improving the quality of life of their inhabitants.

Adaptation strategies must be adopted not only at EU, international and national level, but also and especially at local level to prepare for the adverse impacts of climate change and to prevent or minimise any damage. These strategies often have an urban dimension, as local public administrations are best placed to respond to and adapt to climate change. Impacts of climate change in a particular town or city may manifest themselves in the near future with serious economic, environmental and social consequences. Measures taken now will be much more effective and cheaper than future solutions to problems such as flash floods, overheating of buildings and public transport, or lack of water resources.

[45] *AUBRECHTOVÁ Tereza, GELETIČ Jan, HALÁSOVÁ Olga, LEHNERT Michal, DOBROVOLNÝ Petr. Administrative Response of Czech Towns and Cities to Adaptation Processes Related to Climate Change. Urban Planning and Territorial Development. Brno: Institute of Spatial Development, issue 1/2019. ISSN 1212-0855.*

The **first adaptation strategies of towns and cities** started to emerge after 2015 (Prague, Brno, Plzeň), and their example was followed by other towns and cities, which financed adaptation strategies mainly with the support of the EEA and Norway Grants (e.g. within the UrbanAdapt project), and also through the National Programme Environment which aimed, among other things, to support the involvement of municipalities in the Covenant of Mayors ("Covenant"). The Covenant is a joint initiative of towns and cities, municipalities and the European Commission, and is the main source of EU support for towns and cities in their climate change adaptation activities. By joining the Covenant[46] a municipality is obliged to prepare a Sustainable Energy and Climate Action Plan ("SECAP") within two years. Although the SECAP is not a standard adaptation strategy, given its scope it can be considered a document addressing the adaptation of settlements to climate change.

In 2021, 39 municipalities or urban districts and one micro-region comprising another 13 municipalities had **adaptation strategies or plans** (or non-binding "road maps" for adaptation) in Czechia; the number of inhabitants living in this territory amounted to over 3 mil. Compared to the previous year, when 18 municipalities had these documents approved, this is a significant positive development. In addition to these cities and municipalities, three regions, including Prague, and Mendel University in Brno also have approved adaptation strategies or plans. However, the issue of adaptation to climate change is being addressed to at least some extent by another 14 municipalities within the Smart City concept. Transport, greenery and energy are the central themes of the adaptation strategies or plans of the towns, cities and municipalities. The introduction of sustainable mobility plans contributes to the adaptation of transport systems, while for green spaces the focus is usually on urban greenery and its aesthetic/recreational functions, but without a comprehensive solution to its functionality in terms of adaptation to climate change. One newly addressed issue is rainwater management, which most towns and cities are beginning to address through the creation and integration of relevant master plans.

1.6.2 | Conceptual development of settlements and use of brownfields

In connection with the updating of spatial and strategic plans, incentives should be used for the reuse of **brownfield sites**, which are often located in the centres of towns and municipalities and represent a major problem for the sustainable development of settlements. These are abandoned properties (land, buildings, premises) that are not used, are neglected and possibly contaminated, cannot be used effectively without their overall regeneration, and arise as a remnant of industrial, agricultural, military or other activities. In most cases, the costs of revitalising these areas are so high that they exceed the real financial possibilities of the owners and continue to deteriorate and burden their surroundings.

The issue of brownfields has long been addressed by CzechInvest, the agency for the promotion of entrepreneurship and investment, which manages the publicly accessible **National Database of Brownfields**[47]. A total of 1,920 brownfields with a total area of 5,355.4 ha **were registered** in this database in the 2014–2021 period. In 2021, a total of 679 brownfields with a total area of 2,070.5 ha were newly registered in Czechia.

Brownfields in Czechia are being **regenerated**; 157 sites were removed from the National Brownfield Database in 2021 due to their sale or successful regeneration, including through subsidy programmes. It is necessary to continue to support the regeneration of brownfields so they can potentially be used in the future.

[46] *More than 160 municipalities in the Czech Republic had joined the Covenant by 2021.*

[47] *As the CzechInvest agency is preparing a new database based around GIS, on which it is cooperating with the Research Institute for Soil and Water Conservation, a targeted update of all data is being carried out together with the polygon-layer plotting of sites. At the same time, thanks to the Passportisation project, in which CzechInvest staff from the regions collect data from municipal leaders with authorised municipal authorities, CzechInvest has a more detailed overview of brownfields across the Czech Republic. This is the reason why the number of newly inserted sites is significantly higher for 2021. The statistics also include the number of newly inserted sites for subsidy purposes from 2021 onwards. In the past, only the Operational Programme Enterprise and Innovation for Competitiveness programme was registered, but under this programme entrepreneurs could also apply for subsidies for functioning real estate. Nowadays, the programmes are focused purely on brownfield sites, so the data are monitored in more detail.*

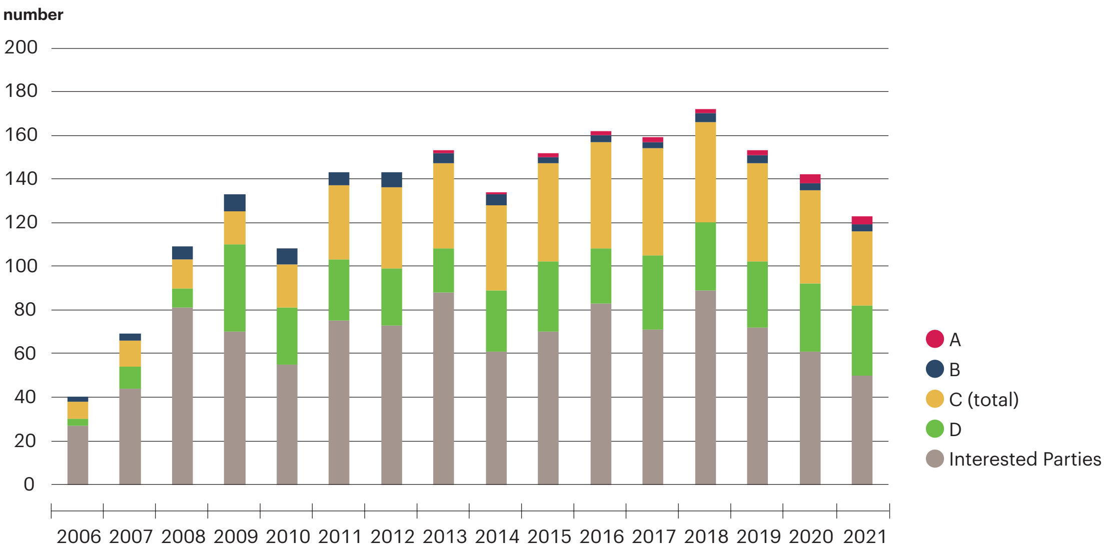
The voluntary **Local Agenda 21** tool also contributes to the conceptual development of settlements. This is a state-guaranteed programme to support the sustainable development of municipalities and regions. This tool is based on close cooperation by the relevant authorities not only with commercial entities and associations operating in the locality, but above all with the public, i.e. the people living in the given settlement or region. The programme is managed by the Ministry of the Environment of the Czech Republic, which provides financial support from the state budget, while methodological and expert support is provided technically and administratively by CENIA[48].

In the long term, i.e. over the last 15 years, we can see a very significant upward trend in the number of implementers (including the Interested Party category) from 40 in 2006 to 123 in 2021 (Chart 19), partly thanks to the favourable development, especially at the beginning of the period under review. On the other hand, in the short term, i.e. in the last five years, the number of Local Agenda 21 implementers has shown a significantly downward trend. If the current trends continue, the targets for the number of implementers set in the State Environmental Policy of the Czech Republic 2030 (500 registered entities) will not be met. This is mainly due to movement in the Interested Party category, where strong fluctuations can be observed during the decline over the period under review. In 2021, there was also a more significant decline in implementers in Category C. The reasons for this may be varied, the main ones being a change in political leadership in the municipalities or cities concerned, the need to meet more demanding criteria and tasks in the transition to the next phases of Local Agenda 21 implementation, a simple loss of interest, insufficient funding, and unforeseen exceptional situations such as the COVID-19 pandemic. The low level of promotion of the programme towards potential implementers also plays a significant role.

The largest group of implementers is made up of municipalities (towns/cities), followed by small municipalities, with lower interest from other groups of implementers, i.e. regions, micro-regions and Local Action Groups. However, in order to promote greater involvement of all groups in Local Agenda 21, a new methodology for evaluating the implementation of Local Agenda 21 has been gradually developed and approved for each group since 2019, and this is now better adapted to the reality and conditions of each group of implementers.

Chart 19

Overview of Local Agenda 21 implementers in Czechia by level of achievement [number], 2006–2021



In the case of level C, several sub-levels can be distinguished from 2017 onwards, i.e. C, C, C** and C***.*

Data source: CENIA

[48] *More information about Local Agenda 21 is available at https://ma21.cenia.cz/.*

The range of areas covered by Local Agenda 21 is wide – from the environment, to health, territorial development, social issues, education and transport. Sustainable urban mobility is one of the key issues that many cities are also addressing through **Sustainable Urban Mobility Plans**. Their purpose is to ensure the availability of transport in cities while minimising its negative impacts on health, society (traffic congestion and land use) and the environment (noise and pollution), thus improving the quality of life of the population. The creation and implementation of Sustainable Urban Mobility Plans takes place within the Concept of Urban and Active Mobility for the period 2021–2030, approved by the government in January 2021, for six size categories of cities, A–F. Category A is Prague Capital City, Category B Brno and Ostrava, while other categories are defined by the lowest number of inhabitants, namely 75 thous. (Category C), 42 thous. (Category D), 25 thous. (Category E) and under 25 thous. inhabitants (Category F).

A Sustainable Urban Mobility Plan focuses not only on addressing transport issues, but also on influencing and satisfying mobility requirements. The Sustainable Urban Mobility Plan has so far been prepared in accordance with the Methodology for the Preparation of Sustainable Urban Mobility Plans for Cities of the Czech Republic (Transport Research Centre, 2015). One of the conditions for funding urban projects from the Operational Programme Transport and Integrated Regional Operational Programme in the 2014–2020 programming period was to have either a full-fledged Sustainable Urban Mobility Plan or a simplified version of a Sustainable Urban Mobility Framework, which focuses on public transport. In September 2021, the new **Sustainable Urban Mobility Plan Methodology, SUMP 2.0**[49], developed as an output of the Technology Agency of the Czech Republic project MOBILMAN – Human Dimension of Sustainable Urban and Regional Mobility Plans, was submitted for final comments and certification.

The process of approval of a Sustainable Urban Mobility Plan and Sustainable Urban Mobility Framework is led by the Ministry of Transport of the Czech Republic, which cooperates with the Ministry of Regional Development of the Czech Republic and relevant partners, especially from the professional and academic spheres. The Sustainable Urban Mobility Plan and Sustainable Urban Mobility Framework approval process is carried out by the Commission for the Assessment of Urban Mobility Documents, which is appointed by the 1st Deputy Minister of Transport.

By the end of 2021, a total of 26 sustainable urban mobility documents had been submitted for discussion to the Commission for the Assessment of Urban Mobility Documents. For all cities and urban agglomerations above 100 thous. inhabitants, the documents were verified as Sustainable Urban Mobility Plans. For towns below 100 thous. inhabitants, Sustainable Urban Mobility Plans were verified in 11 cases (e.g. České Budějovice, Ústí n. L.), eight projects in which not all the requirements defined by the Methodology were met, were verified as Sustainable Urban Mobility Frameworks. Currently, the Sustainable Urban Mobility Plans of Chomutov, Karlovy Vary, Mladá Boleslav and Prostějov are being prepared for submission to the Commission for the Assessment of Urban Mobility Documents.

1.6.3 | Water management system in settlements

Rainwater that falls on the ground partly evaporates through evapotranspiration, part infiltrates into the soil and the rest is runoff from the area. The share of these components depends on the degree of urbanisation of the area. The more the area is built up and has a greater share of impermeable surfaces, the higher the runoff. In order to adapt to climate change, it is necessary to retain as much rainwater as possible in an area.

Currently, **subsidies** are offered **for the use of rainwater for citizens, municipalities, regions, public institutions**, etc. For example, municipalities can use the subsidy to capture rainwater in underground tanks and use it to irrigate municipal greenery, to cool streets or to flush toilets in public buildings. In addition to lower consumption

[49] *Read more: https://www.mdcr.cz/Dokumenty/Veda-a-vyzkum/Certifikovane-metodiky/Ostatni-metodiky/Metodika-planu-udrzitelne-mestske-mobility-SUMP-2*

of water from the public water supply, the aim is also sufficient infiltration of water back into the soil, and therefore an increase in the level of groundwater sources, and a reduction in pressure on the capacity of the sewerage system for rainwater, which is overwhelmed during periods of heavy rainfall. Subsidies for municipalities and regions can be drawn, for example, for underground storage tanks and infiltration equipment, as well as for the construction of green roofs and the replacement of impermeable surfaces at parking lots or other public areas with permeable ones. Subsidies for citizens can be drawn for the accumulation of rainwater for garden watering and toilet flushing, as well as for the use of treated waste water (greywater).

The above-mentioned financial support can be drawn primarily from the **subsidy title "Dešťovka" (Rainwater)** intended for the family house and apartment building segment. This title was announced in 2017 and is financed from the national funds of the State Environmental Fund of the Czech Republic under the National Programme Environment. A total of CZK 540 mil. has been allocated in the two calls so far, while 8,689 projects had been approved by 2021 with a total amount of support of CZK 335.1 mil. In the vast majority of cases, projects or applications concerning the storage of rainwater for garden watering or for concurrent toilet flushing and garden watering predominated (almost 8,600 applications), while the remainder were projects or applications concerning the use of treated waste water (greywater) with the possible use of rainwater. The total volume of storage tanks acquired with the support from the "Dešťovka" (Rainwater) programme is almost 42 thous. m^3.

The Rainwater programme for owners and builders of family houses, recreational buildings and apartment buildings has been incorporated since October 2021 under the New Green Savings subsidy programme funded by the National Recovery Plan as part of calls for family houses and apartment buildings. In November 2021, a call was announced through the National Programme Environment aimed at supporting effective rainwater management in built-up areas of municipalities and intended for listed public entities and other legal persons. The allocation from the call for this type of measure is CZK 992 mil.

Rainwater management measures are also supported by **European funds under the Operational Programme Environment 2014–2020**, priority axis 1 "Improving water quality and reducing flood risk", supported area 1.3 "Ensure urban area flood protection and rainwater management", specifically activity 1.3.2 "Urban area rainwater management" (the so-called **"Rainwater for Municipalities"**). The total allocation of the supported area 1.3 is approx. CZK 2.9 bil., and calls are regularly issued for activities related to the management of rainwater in urban areas. In 2020, the 144th call, the so-called "Velká Dešťovka" ("Big Rainwater"), was announced with a total allocation of CZK 1 bil., which was followed in 2021 by the 159th call with an allocation of CZK 0.5 bil. By the end of 2021, 196 projects had been approved for activity 1.3.2 with a total volume of CZK 0.8 bil. of total eligible expenditure, the implementation of which is expected to enable the retention of a total of 24,157 m^3 of rainwater in urban municipal areas.

Legislatively, the issue of rainwater management is addressed in particular by **Act No. 254/2001 Coll., on water and on amendments to certain other laws (Water Act)**, while other requirements for rainwater management are set out in **Act No. 183/2006 Coll., on spatial planning and the building code (Building Act)** and in particular through the **implementing decree of the Building Act No. 501/2006 Coll., on general requirements for land use**. The requirements for dealing with rainwater are set out in the form of the definition of building land on which the infiltration or retention and regulated drainage of rainwater from built-up or paved areas must be ensured. At the same time, **Act No. 274/2001 Coll., on water supply and sewerage and on amendments to some other laws**, introduced a payment for the volume of rainwater discharged, which motivates the owners of buildings to manage rainwater, because when they are disconnected from the public sewerage system, the payment is cancelled or reduced. However, the same law defines exceptions where the charges for the disposal of rainwater do not apply. Thanks to such exemptions, a large share of owners whose buildings discharge rainwater into the public sewerage system do not pay for the discharge and are therefore not motivated to manage rainwater on their own land.

1.6.4 | Quality of greenery in cities

The urban environment, population and biodiversity are among the categories significantly affected by climate change. Factors that can influence the immediate impact of climate change are **green areas** (especially high greenery) and water resources in a city and their quality (the degree of ecosystem services provided). Greenery in settlements and water areas significantly increase the level of adaptation of the urban system and population, especially to extreme temperatures. Greenery in settlements and water areas represent important resting zones with the possibility of natural shading, improve the microclimate of the area, increase evapotranspiration, increase biodiversity in the given location, reduce surface runoff, noise and dust, and thus improve the health conditions of the population and the quality of life in cities in general. The spatial accumulation of greenery and water areas in settlements or the uniformity of their spatial distribution and their interconnectedness play important roles in the adaptation of the settlement environment. In addition, factors including the size, spatial distribution and quality of green and water areas significantly counteract urban overheating and reduce the negative impacts of the built-up urban environment.

The assessment of the quality of green spaces in cities is based on the **representation of green areas in settlements and water areas in the urban area** of all 61 cities in the Czech Republic with over 20 thous. inhabitants (i.e. including regional cities), based on the classification of Earth observation data. The share of green and water areas in 2020[50] ranged from 45.7% (Havířov) to 91.9% (Trutnov) of the total urban area (Chart 20), with an average share of 76.0%. There have been significant changes compared to the last measurement in 2017, especially in the 76% to 80% share of green and water areas in the total urban area category, where the share of cities has decreased, mainly in favour of the "higher" 86% to 90% category.

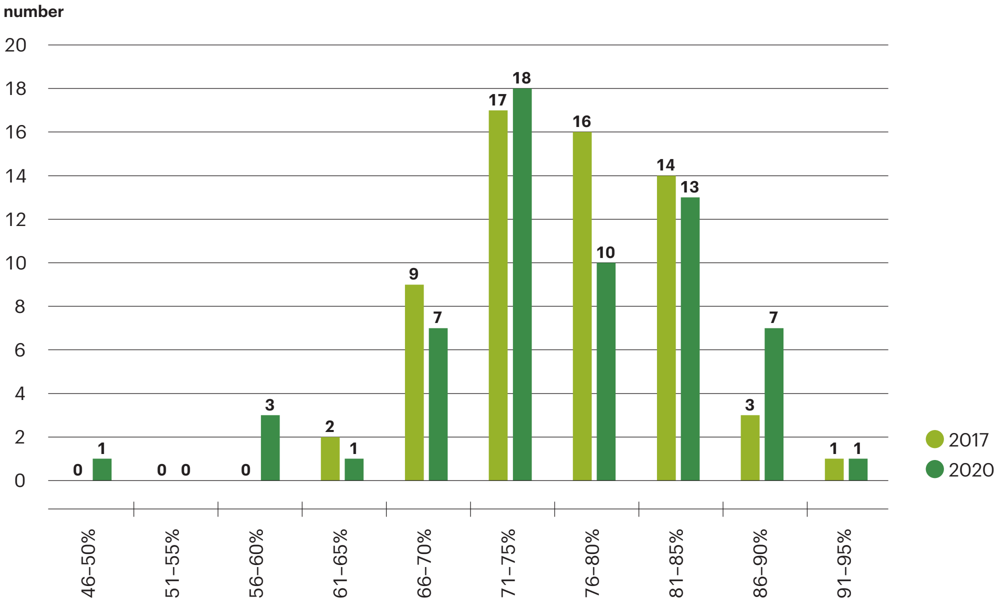
Despite the generally high share of total urban greenery in the urban area, we must state that a significant part of this share is **low greenery** (e.g. low mown lawns, thickets, etc.), the potential of which for providing ecosystem functions and increasing adaptive capacity is low compared to high greenery. Low greenery represents on average 59.1% of the urban area, i.e. 78.0% of the total greenery in settlements. The lowest share of low greenery in the total area was identified in Karlovy Vary (25.7%), while the highest was in Přerov (75.6%). In contrast, **high greenery (trees)** occupies on average only 13.3% of the urban area, i.e. 19.8% of the total greenery in settlements, and the numerical representation corresponds to this with more than 60% (i.e. 37) of the surveyed cities having a share of tall greenery only between 1% and 20% of the total urban area.

Water areas are also an important element in the urban microclimate that deserves more attention. The highest share of water areas and wetlands in the urban area of the surveyed cities in 2020 was identified in Hodonín (7.4%), due to the local wetlands and ponds and nearby (Old) Morava River. The second highest proportion of water areas in 2020[51] was identified in Cheb (6.7%) in relation to the presence of reservoirs and the Ohře River. The lowest share of water areas was recorded in Kladno (0.01%) and in Vsetín (0.02%).

[50, 51] *Data for the year 2021 are not available at the time of publication.*

Chart 20

Number of cities in Czechia with a population of over 20 thous. according to the share of green and water areas in the total urban area of these cities [number], 2017, 2020

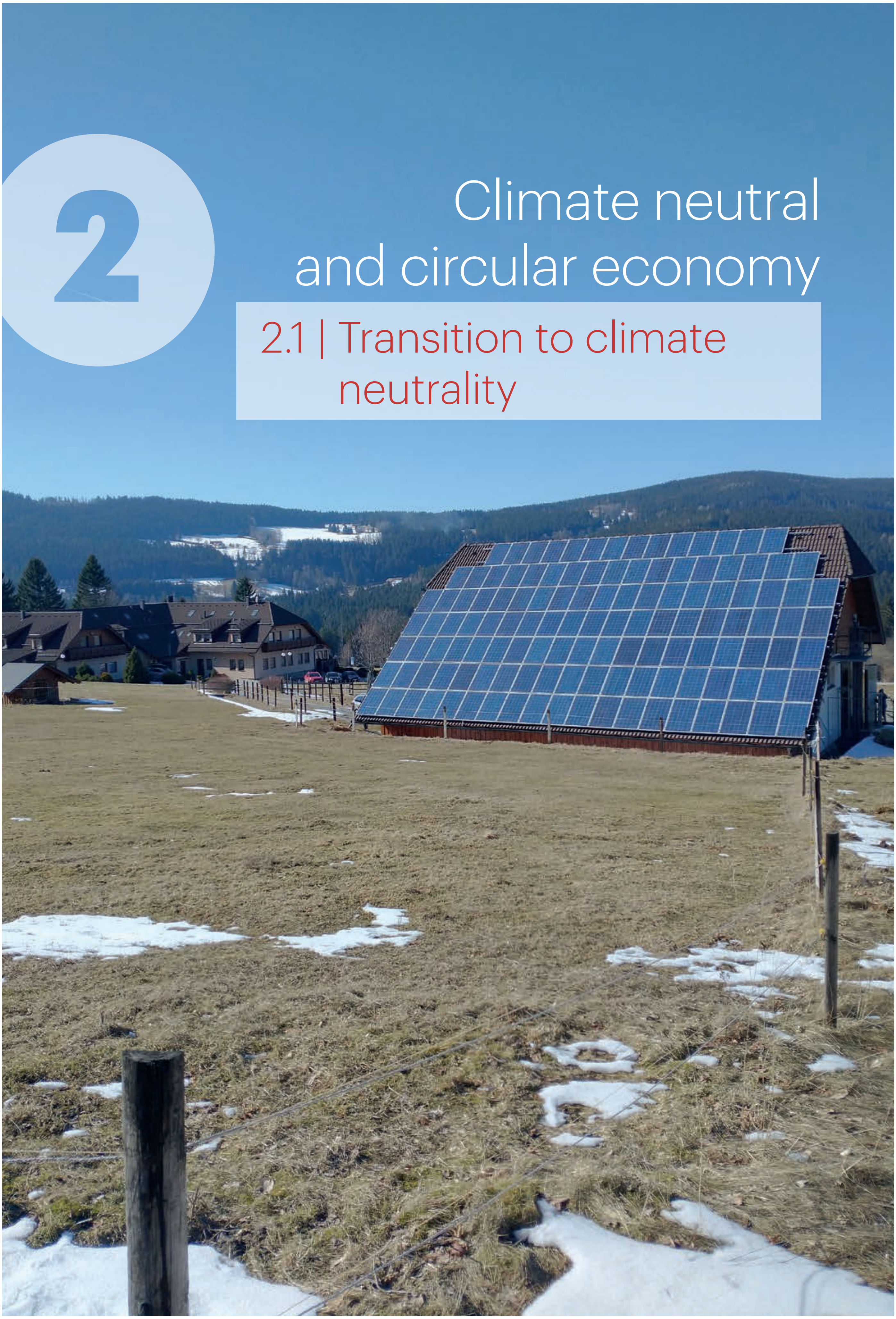


Data for the year 2021 are not available at the time of publication.

Data source: CENIA, Sentinel-2, Czech Statistical Office

Detailed visualisations and data

https://www.envirometr.cz/data



2 Climate neutral and circular economy

2.1 | Transition to climate neutrality

2.1 | Transition to climate neutrality

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Greenhouse gas emissions (without LULUCF)	↘ (green)	~↗ (orange)	~↗ (orange)	~ (orange)
Electricity and heat generation*				
Gross electricity generation	○ (green)	○ (green)	○ (green)	✕ (red)
Gross heat generation	N/A	○ (green)	○ (green)	N/A
Share of the balance of foreign trade in electricity in domestic consumption	~↗ (orange)	↘ (green)	↘ (green)	~ (orange)
Household heating by fuel	↗ (red)	→ (orange)	→ (orange)	✕ (red)
Energy and fuel consumption in transport	↗ (red)	↗ (red)	~↗ (orange)	✕ (red)
Energy intensity of the economy*				
Development of the energy intensity of the economy	N/A	↘ (green)	↘ (green)	~ (orange)
Structure of primary energy sources	N/A	○ (orange)	○ (green)	~ (orange)
Energy efficiency	N/A	~↗ (orange)	~↗ (orange)	✓ (green)
Energy import dependence	N/A	↗ (red)	↗ (red)	✓ (green)
Use of renewable energy sources	↗ (green)	↗ (green)	↗ (green)	✓ (green)
RES consumption in transport	↗ (green)	↗ (green)	↗ (green)	~ (orange)

** Due to the different time series trends underlying the construction of the indicator, an assessment of the sub (elementary) indicators is presented.*

2.1.1 | Greenhouse gas emissions

Czechia participates in the implementation of the European Green Deal (EGD), which aims to transform the European economy and society and achieve climate neutrality by 2050. The implementation of the EGD contributes to the achievement of the objectives of the 2015 Paris Agreement, which formulates a long-term climate protection goal – contributing to keeping the global average temperature rise well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C. As part of the pathway towards climate neutrality, an ambitious EU-wide target of reducing greenhouse gas emissions by 55% by 2030 compared to 1990 levels has been adopted. The Fit for 55 legislative package amends EU legislation in such a way as to achieve this objective.

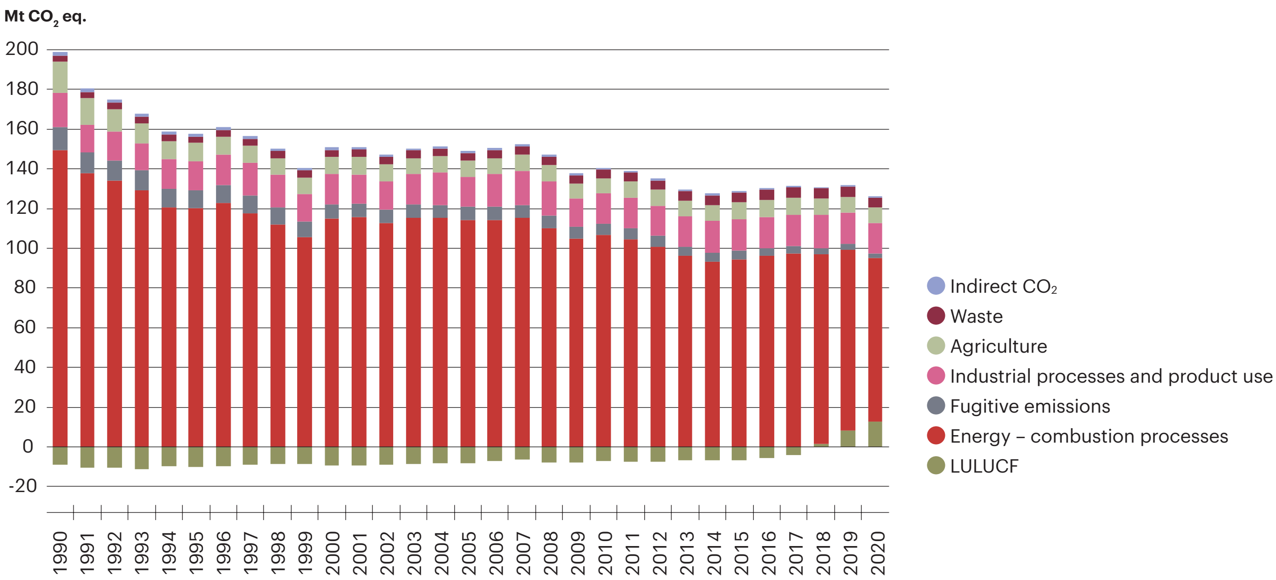
Total **aggregate greenhouse gas emissions** in Czechia (excluding the LULUCF sector, including indirect CO_2 emissions) decreased by 43.0% (85.5 Mt CO_2 eq.) in the 1990–2020 period[52], and by 8.3% year-on-year to 113.3 Mt CO_2 eq. in 2020 (Chart 21). The significant fall in emissions at the end of the period under review must be interpreted in the context of the COVID-19 pandemic, which significantly impacted the economy and thus emissions in 2020. Including emissions and removals in the LULUCF sector, aggregate emissions have fallen by only 33.6% since 1990.

In a **sectoral decomposition**, the long-term downward trend of emissions is registered in the fuel combustion sector (1A), which accounted for 72.6% of total aggregate emissions excluding LULUCF in 2020. The energy industry is currently the main contributor to the decrease in emissions from combustion processes through the gradual change in the energy mix and the impact of the COVID-19 pandemic on energy consumption in 2020. In the last five years under review (2016–2020), emissions from the energy industry have fallen by 23.6% and fell by 15.4% year-on-year in 2020. In contrast, emissions from transport have continued to increase, except in 2020, while emissions from household and commercial heating fluctuate according to the temperature conditions of the heating seasons. Among the other sectors, a slight but statistically significant upward trend is registered for emissions from waste, which have increased by 42.7% since 2000.

The situation in the LULUCF (land use, land use change and forestry) sector is unfavourable. The balance of emissions and removals in LULUCF has progressed to positive values since 2018 (emissions outweigh biomass carbon storage) with up to 12.8 Mt CO_2 eq. in 2020. According to the LULUCF emissions balance, Czechia was ranked 1st in the EU27 in 2020; overall, six EU27 countries have a positive LULUCF emissions balance (including Ireland, the Netherlands and Denmark). The high LULUCF emissions in Czechia are due to record forest logging that exceeds biomass growth due to the bark beetle calamity.

Chart 21

Aggregated greenhouse gas emissions in Czechia by sector [Mt CO_2 eq.], 1990–2020



Data for the year 2021 are not available due to the preparation schedule of the emissions inventory.

Data source: Czech Hydrometeorological Institute

[52] *Data for the year 2021 are not available due to the preparation schedule of the emissions inventory.*

Per capita greenhouse gas emissions in Czechia (10.6 t CO_2 eq. per capita) were the third-highest in the EU27 (after Luxembourg and Ireland) in 2020. The emissions intensity of GDP generation in Czechia was the third-highest in the EU27 after Bulgaria and Poland. The high specific greenhouse gas emissions in Czechia are related to the structure of GDP formation with a high share of industry, and also to the export character of the economy.

Greenhouse gas emissions from installations covered by the **EU Emissions Trading System** (EU-ETS) fell by 29.8% in the 2005–2021 period. In 2021, emissions increased by 5.8% year-on-year to 57.9 Mt CO_2 eq., but the year 2020 was not a normal year due to the COVID-19 pandemic, and in the long term the downward linear trend of emissions in the EU-ETS of around 1.7 Mt CO_2 eq. per year continued. This trend should make it possible to meet the EU-ETS emissions reduction target of 43% by 2030 compared to 2005.

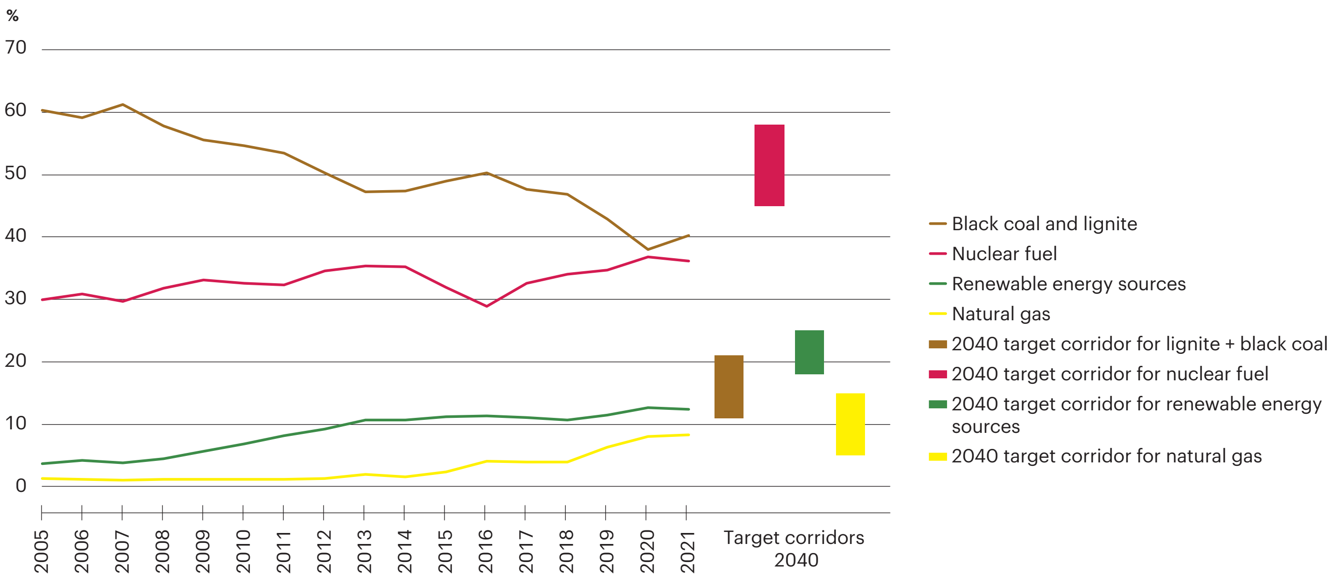
Non EU-ETS emissions, which mainly include small and mobile sources of air pollution (mainly waste management, agriculture, transport and households), decreased in Czechia by 12.0% to 58.7 Mt CO_2 eq. in the 2005–2020 period[53]. Emissions from these sources are subject to the effort-sharing principle and related European legislation – Decision 406/2009/EC of the European Parliament and of the Council (ESD) and Regulation (EU) 2018/842 (ESR), which set reduction targets for individual Member States. According to the Commission's proposal to amend the ESR Regulation, the Czechia should reduce ESR emissions by 26% by 2030 compared to 2005, which will be difficult given the current trend in ESR emissions.

Electricity generation, following the slump caused by the COVID-19 pandemic in 2020, increased by 4.3% year-on-year in 2021 to 84,907.3 GWh. **In terms of fuels**, most **electricity** in 2021 was generated from lignite (37.0%) and nuclear fuel (36.2%). Renewable sources accounted for 12.4% of electricity generation, natural gas 8.3% and coal 3.3%. More detailed information on renewable energy sources is provided in chapter 2.1.3.

The **structure of electricity generation** has set target corridors for 2040, which result from the National Energy Concept. The target fuel shares are currently met only for natural gas. The share of renewables and nuclear fuel is currently lower than the targets, while the share of coal is higher. Gradually, however, the composition of this mix is changing in the desired direction (Chart 22).

Chart 22

Share of electricity generation by fuel type in Czechia [%], 2005–2021



The target corridors for each source (nuclear 46%–58%, renewables and secondary sources 18%–25%, natural gas 5%–15%, lignite and black coal 11%–21%) are plotted in the right-hand side of the graph in the corresponding colours.

Data source: Energy Regulatory Office

[53] *Data for the year 2021 are not available at the time of publication.*

Exports still outweigh imports in **foreign trade in electricity**. In 2021, 15,153.0 GWh of electricity was imported and 26,228.3 GWh was exported. The foreign balance was thus negative again in that year and amounted to 11,075.3 GWh, which is 9.1% higher than in the previous year. The Czech Republic's target is a gradual decline in electricity exports and maintenance of the balance in the range of +/–10% of domestic consumption by 2040. In 2021, domestic electricity consumption amounted to 73,661.4 GWh, thus the share of the balance in consumption reached 15.0% and thus does not yet reach the required values.

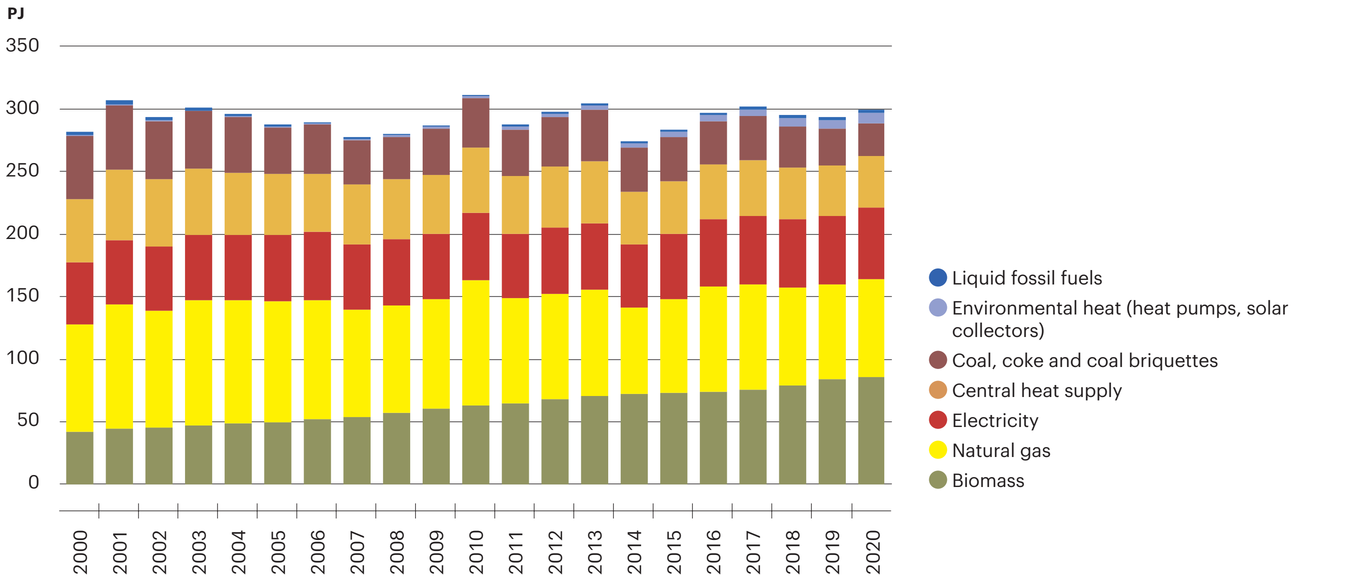
Gross heat generation for sale (i.e. for heat supply systems, as well as for production in household boilers, housing associations, etc.) has been declining in the long term. In the 2010–2020 period[54] it fell by 24.3% to 111,205.3 TJ. There was thus a 3.0% year-on-year decline in 2020. In 2020, most heat was produced from solid fossil fuels (51.3%) and natural gas (30.7%), with renewables and biofuels accounting for 10.4%.

The availability of heating systems, the price of fuels and the convenience of operation of the heating system influence the **heating of households**. The heating method also varies from one region or municipality to another. In areas with larger agglomerations and in cities close to industrial facilities, from which residual heat can be used, a system of thermal energy supply (district heating) is usually used, while in smaller and less accessible municipalities individual heating of houses or flats is more often used.

In 2020[55], most of the heat produced in households was from biomass (86.2 PJ, 28.8%) and natural gas (77.7 PJ, 26.0%). However, household consumption of natural gas also includes consumption for cooking and water heating. The situation is similar for electricity (57.5 PJ, 19.2%), which includes not only heating but also consumption for the operation of household electrical appliances, even in those households heated in other ways. Central heating supplies 13.7% of energy (40.9 PJ) to households. Household consumption of solid fossil fuels, included under the heading "Coal, coke and coal briquettes", has been on a steady downward trend, producing 26.6 PJ of heat in 2020, representing 8.9% of total household fuel consumption (Chart 23). Solid fuels (fossil fuels but also biomass) have an adverse effect on air quality in settlements when burned in households, so it is desirable to reduce them as much as possible.

Chart 23

Household fuel consumption in Czechia [PJ], 2000–2020



Data for the year 2021 are not available and will be completed in January 2023.

Data source: Czech Statistical Office

[54] *Data for the year 2021 are not available at the time of publication.*

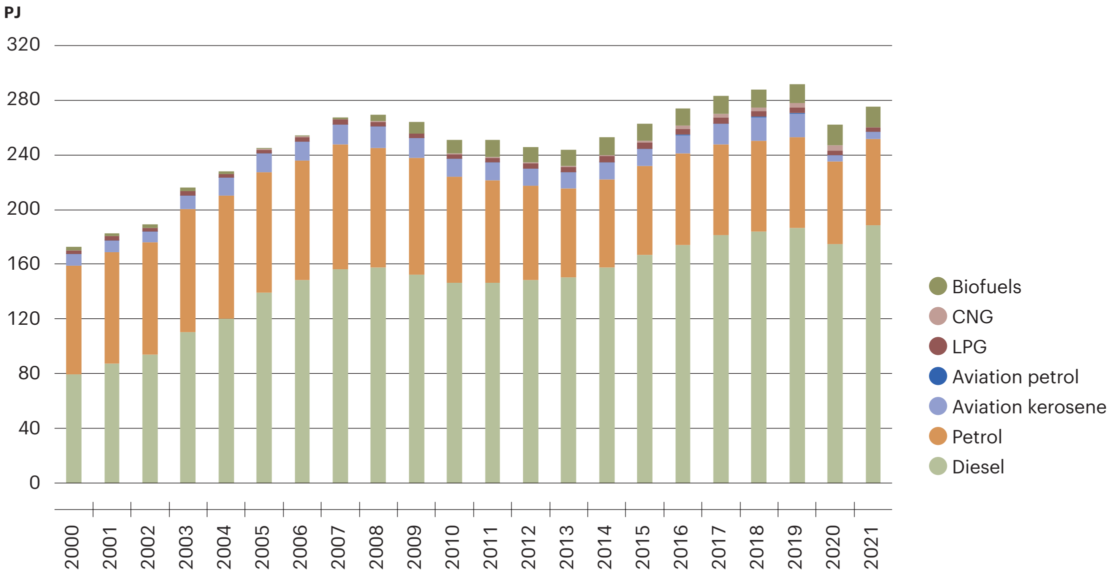
[55] *Data for the year 2021 are not available and will be completed in January 2023.*

Transport is a major energy consumer that is also carbon-intensive due to its dependence on petroleum products. **Energy consumption in transport** increased by 61.3% in the 2000–2021 period (Chart 24). Following the slowdown in transport and thus the decline in energy consumption in 2020 due to the COVID-19 pandemic, energy consumption increased by 6.1% year-on-year, but has not yet reached pre-pandemic levels as the performance of public passenger transport modes in particular was still significantly lower in 2021 than in 2019. The share of fossil fuels (i.e. petroleum fuels plus CNG) in the total energy consumption from combustion of fuels in transport was 94.6% in 2021. Passenger car transport is the largest consumer of energy in transport, accounting for 63.9% of total transport energy consumption in 2020[56], excluding electricity consumption in railways and electric traction in public transport.

Diesel consumption grew significantly over the 2000–2021 period, except for in 2020, more than doubling over the whole period to 4.3 mil. t (including bio-based components), the highest value since 2000. Diesel combustion accounted for 67.7% of total transport energy consumption in 2021. **Petrol consumption** fluctuates with passenger car transport performance, and was 1.5 mil. t in 2021, 18.6% less than in 2000. The significant (order of magnitude) increase in **CNG consumption** after 2005 has slowed in recent years, with CNG consumption reaching 93 mil. m^3 in 2021.

Chart 24

Energy consumption in transport by fuel in Czechia [PJ], 2000–2021



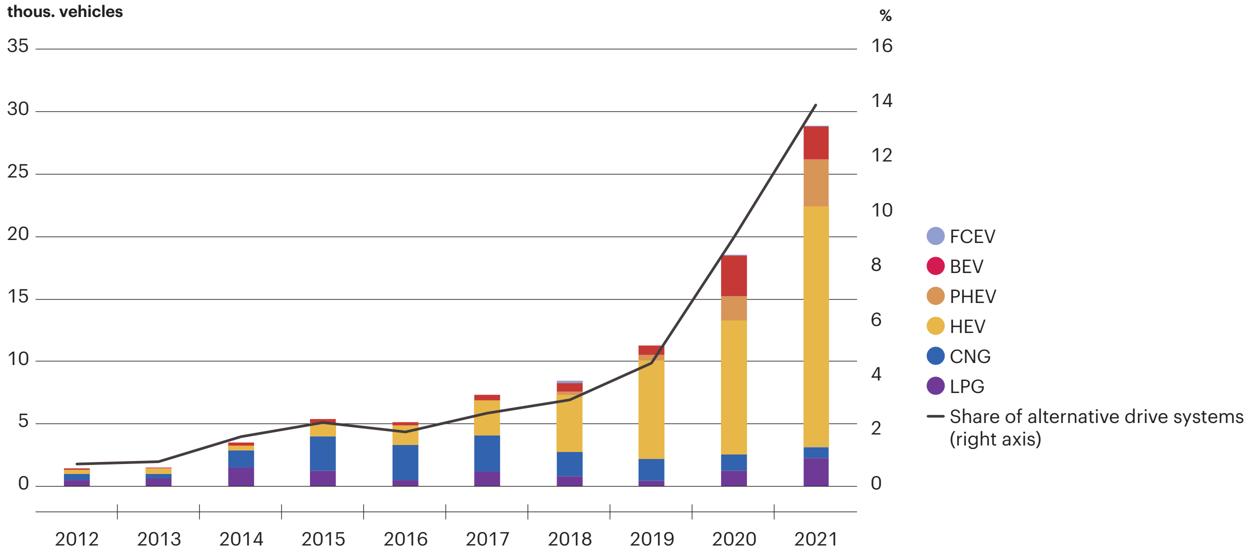
Data source: Czech Statistical Office

In 2021, in total 28.8 thous. new **alternative-fuel passenger cars** were registered in Czechia, including 2,646 battery electric vehicles (BEVs), 3,735 plug-in hybrids (PHEVs), 19,338 other hybrids (HEVs) and nine fuel cell electric vehicles (FCEVs). Overall, alternatives accounted for 13.9% of new passenger vehicle registrations in 2021, up 4.5 percentage points year-on-year. BEV registrations fell by 19.0% year-on-year, while hybrid vehicle registrations (especially petrol-electric), on the other hand, recorded significant year-on-year increases (Chart 25).

[56] *Data for the year 2021 are not available at the time of publication.*

Chart 25

Registrations of new alternatively powered passenger cars per year and the share of vehicles with alternative propulsion in total registrations of new passenger cars [thous. vehicles, %], 2012–2021



BEV – battery electric, PHEV – plug-in hybrid, HEV – other hybrids (without plug-in), FCEV – fuel cell electric (hydrogen), CNG – compressed natural gas, LPG – liquefied petroleum gas

Data source: Transport Research Centre, Car Importers Association

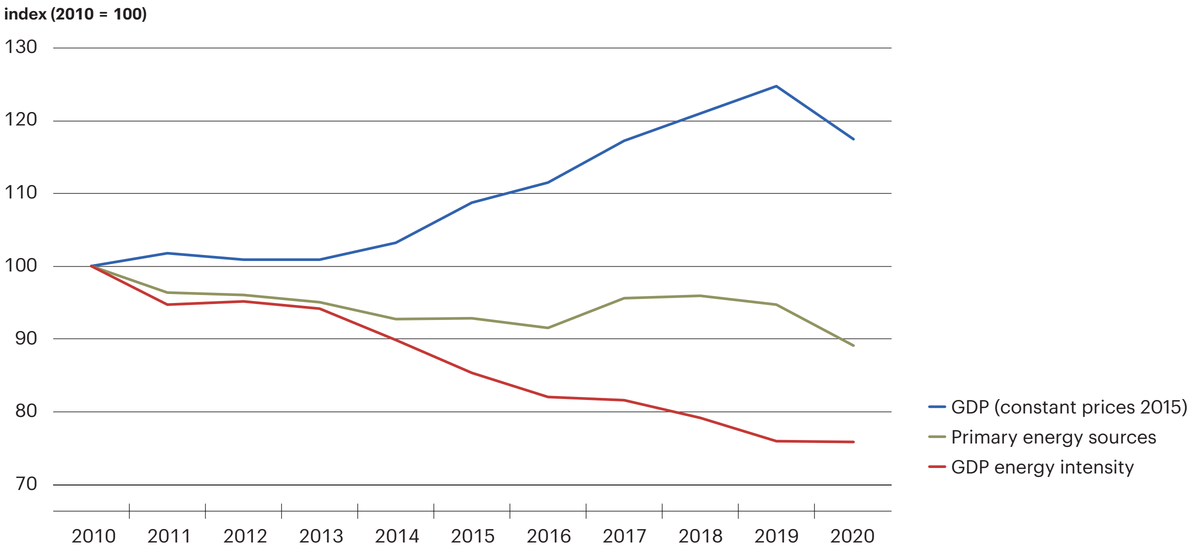
2.1.2 | Energy efficiency[57]

The aim of the State Energy Concept of the Czech Republic is to achieve a diversified mix of **primary energy sources** by 2040 with a defined target structure of individual sources. The actual structure of the primary energy sources still differs considerably from these targets, with solid and liquid fuels having a higher share and other sources having a lower share. However, the shares of the different types of primary energy sources are slowly changing in the desired direction, with the exception of liquid fossil fuels, which have a higher share in the energy mix, which is still increasing.

In 2020, measures due to the COVID-19 pandemic had an impact on the **energy intensity of the economy**. They led to a 5.9% year-on-year decline in the consumption of primary energy sources, but also to a 5.8% decline in GDP. This has led to an overall year-on-year decline in the energy intensity of the economy of 0.1% (Chart 26) to 335.8 MJ.thous. CZK^{-1}.

Chart 26

GDP energy intensity in Czechia [index, 2010 = 100], 2010–2020



Data for the year 2021 are not available at the time of publication.

Data source: Czech Statistical Office, Ministry of Industry and Trade of the Czech Republic

When comparing the **energy intensity of different sectors**, the energy intensity of industry increased by 6.9% year-on-year in 2020. Other sectors decreased their intensity, with more significant declines in construction (9.6%) and in agriculture and forestry (4.2%). Energy intensity stagnated year-on-year in transport.

Internationally, the **energy intensity of the EU27 economy** fell from 4.23 to 4.13 TJ.mil. EUR^{-1} in 2020. Compared to the EU27 average, Czechia is still 36.6% more energy intensive, with energy intensity falling from 5.72 to 5.64 TJ.mil. EUR^{-1} in 2020.

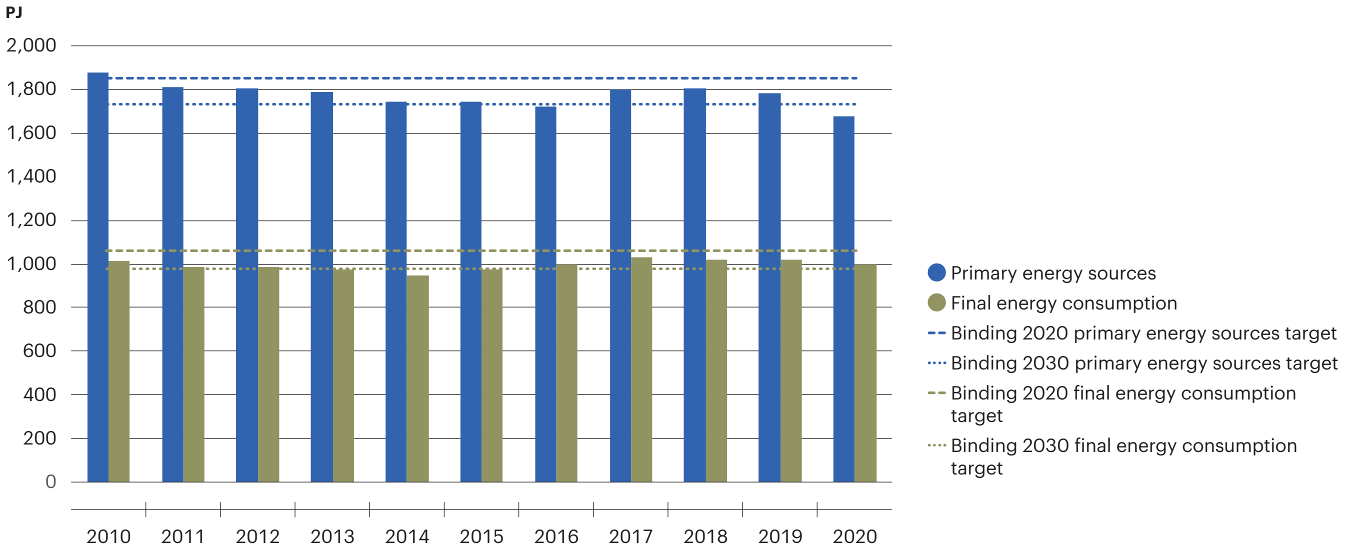
The **energy efficiency** indicator tracks energy savings, and as part of its assessment targets are set for the level of primary energy sources that cannot be exceeded. The total **consumption of primary energy sources** in Czechia decreased year-on-year to 1,677.6 PJ in 2020. Thus, the 2020 target was met (not to exceed 1,855 PJ, which has now not been exceeded since 2011), as was the 2030 target (not to exceed 1,735 PJ) for the first time.

Further targets are set for maximum **final energy consumption**. In Czechia, this was 998.5 PJ in 2020. Hence the 2020 target (set at 1,060 PJ) was met. Another target the Czech Republic will work towards is 990 PJ for 2030 (Chart 27).

[57] *Data for the year 2021 are not available at the time of publication.*

Chart 27

Primary energy sources consumption and final energy consumption compared to 2020 and 2030 targets in Czechia [PJ], 2010–2020



Data for the year 2021 are not available at the time of publication.

Data source: Ministry of Industry and Trade of the Czech Republic

Energy import dependence shows the extent to which an economy is forced to import energy sources to be able to meet its energy needs. The Czech Republic has set a target of not exceeding 65% energy import dependence by 2030 and 70% by 2040. Over the last ten years, Czechia's energy import dependence has been on an increasing trend, rising from 25.5% in 2010 to 39.0% in 2020.

Czechia is characterised by a relatively high energy import dependence on Russia, which reached 23.7% in 2020, and it is almost totally dependent on imports of natural gas and crude oil. Import energy dependence in 2020 was 86.0% for natural gas and 101.7% for crude oil (values above 100% are related to fuel storage).

2.1.3 | Renewable energy sources

The use of renewable energy sources is advantageous in terms of energy security and climate neutrality. However, it is limited by local geographical, climatological and meteorological conditions, as well as time and space availability.

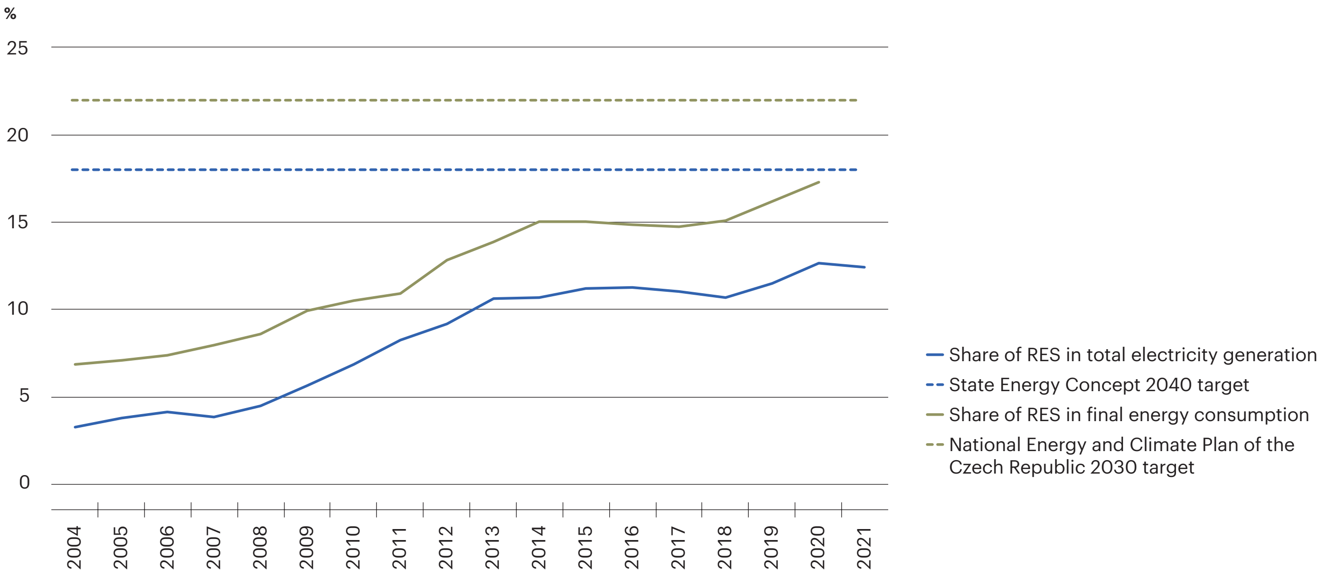
Electricity generation from renewable sources reached 10,547.3 GWh in 2021, an increase of 2.5% year-on-year. The amount of electricity from RES is fairly evenly distributed between the four main sources, each with shares of more than 20%, and two smaller sources. Biomass (25.3%) accounted for the largest share of electricity generation from RES in 2021, followed by biogas (24.6%), hydropower (22.8%) and photovoltaics (20.4%). Electricity was also generated from wind power (5.7%) and from waste (1.2%) to a lesser extent.

The National Energy and Climate Plan of the Czech Republic sets a target of a 22% share of RES in gross final energy consumption by 2030. In 2020[58] this share was 17.3%.

The **second target for renewable energy sources** resulting from the State Energy Concept is to achieve a share of RES in electricity generation in the range of 18%–25% by 2040. In 2021, this share was 12.4% (Chart 28).

Chart 28

Renewable energy sources targets and their fulfilment in Czechia [%], 2004–2021



The objective of the State Energy Concept of the Czech Republic for 2040 is to ensure a share of annual electricity generation from RES and secondary sources in the range of 18–25%, however only the lower limit, i.e. 18%, is marked on the graph.
Data for the share of RES in final energy consumption for the year 2021 are not available at the time of publication.

Data source: Energy Regulatory Office, Ministry of Industry and Trade of the Czech Republic

The **generation of heat from renewable sources** for heating and boiler plants has been growing over the long term, reaching 11,566.0 TJ in 2020[59], an increase of 13.8% year-on-year. Biomass is the largest source, accounting for 77.6% in 2020. Other renewable heat sources are waste (15.4%), biogas (6.1%) and heat pumps (0.9%).

Growing the use of **RES in transport** is essential to reduce the dependence of transport on fossil energy sources, to reduce the carbon intensity of transport and greenhouse gas emissions from transport. Binding targets for the

[58, 59] *Data for the year 2021 are not available at the time of publication.*

share of RES in final energy consumption in transport are set by Directive 2009/28/EC on the promotion of the use of energy from renewable sources and Directive (EU) 2018/2001 on the promotion of the use of energy from renewable sources, as recast. These targets, including measures for their implementation, are part of the National Renewable Energy Action Plan. The targets are set at 10% RES energy in transport by 2020 and 14% RES energy by 2030.

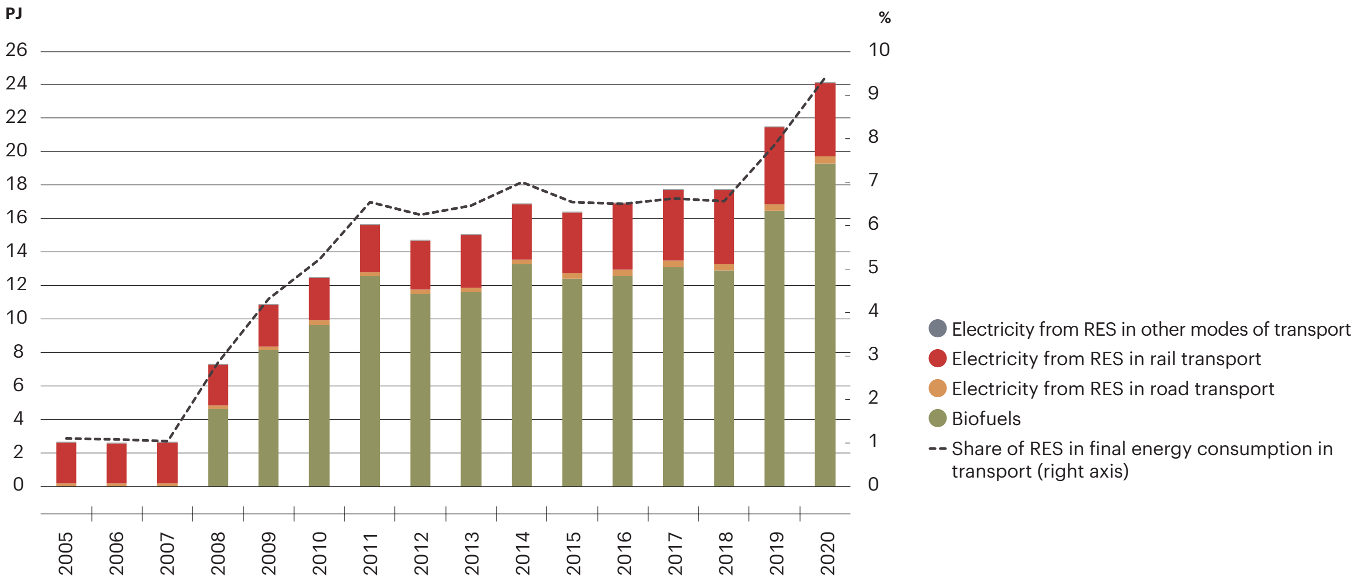
The **consumption of RES energy in transport** in Czechia, determined according to the internationally harmonised SHARES methodology[60], has had a significant upward trend in the 2005–2020 period[61], increasing almost tenfold, and in the last five years (2016–2020 period) by 42.5% (Chart 29). In a year-on-year comparison between 2019 and 2020, RES consumption in transport increased by 12.3% to 24.2 PJ, representing 9.4% of final energy consumption in transport (annual growth of 1.5 p.p.). In 2020, biofuels accounted for the largest share of RES energy consumption in transport with 79.9%, while the share of RES electricity consumed in rail transport was 18.1%, and RES electricity consumed in road transport accounted for only 1.7%.

The **consumption of biofuels** in Czechia is growing, while a major part of their consumption was the mandatory blending of biocomponents into petrol and diesel. The consumption of FAME, the bio-based component of diesel, reached 353.9 thous. t in 2021, an increase of 36.7% between 2016 and 2021. The consumption of bioethanol (including ETBE) increased by 50.7% over that period.

Despite the acceleration of the growth in the share of RES at the end of the period under review, the target of 10% RES energy in transport by 2020 was not met. In total twelve EU27 countries met the target, with Sweden having the highest share of RES in transport at 31.9% in 2020.

Chart 29

Energy consumption from RES in transport in Czechia and the share of RES in final energy consumption in transport [PJ, %], 2005–2020



Data for the year 2021 are not available at the time of publication.

Data source: Ministry of Industry and Trade of the Czech Republic

Detailed visualisations and data

https://www.envirometr.cz/data

[60] *Short Assessment of Renewable Energy Sources (SHARES), more at: https://ec.europa.eu/eurostat/web/energy/data/shares*

[61] *Data for the year 2021 are not available at the time of publication.*

2

Climate neutral and circular economy

2.2 | Transition to a circular economy

© Edita Koblížková/CENIA

2.2 | Transition to a circular economy

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Material intensity of the economy	↘	↘	↘	✓
Share of secondary raw material production volume in direct material input	N/A	~↗	↗	~
Waste generation	N/A	↗	↗	✗
Ecolabelling*				
Total number of valid Environmentally Friendly Product and Environmentally Friendly Service ecolabel licences	↘	↘	↘	✗
Total number of valid EU Ecolabel licences	↗	~↗	~↗	✓
Waste treatment structure	N/A	○	○	✓
Municipal waste treatment	N/A	○	○	~

** Due to the different time series trends underlying the construction of the indicator, an assessment of the sub (elementary) indicators is presented.*

2.2.1 | Material intensity of the economy

The **material intensity of the economy** fell by 45.2% between 2000 and 2020[62], down 2.0% year-on-year to 31.7 kg.(CZK 1,000 GDP)$^{-1}$ (Chart 30). A falling material intensity indicates a reduction in the natural resource intensity of the economy as a result of increasing efficiency in converting material inputs into economic output. The situation in 2020 represents a relative decoupling, with the economy's output falling by 5.6% year-on-year as a result of the COVID-19 pandemic, but domestic material consumption falling more sharply by 7.5% to 157.7 mil. t.

The falling trend of material intensity is also statistically significant in the medium term (last 10 years) and short term (last 5 years evaluated), with material intensity decreasing on average by 2% per year.

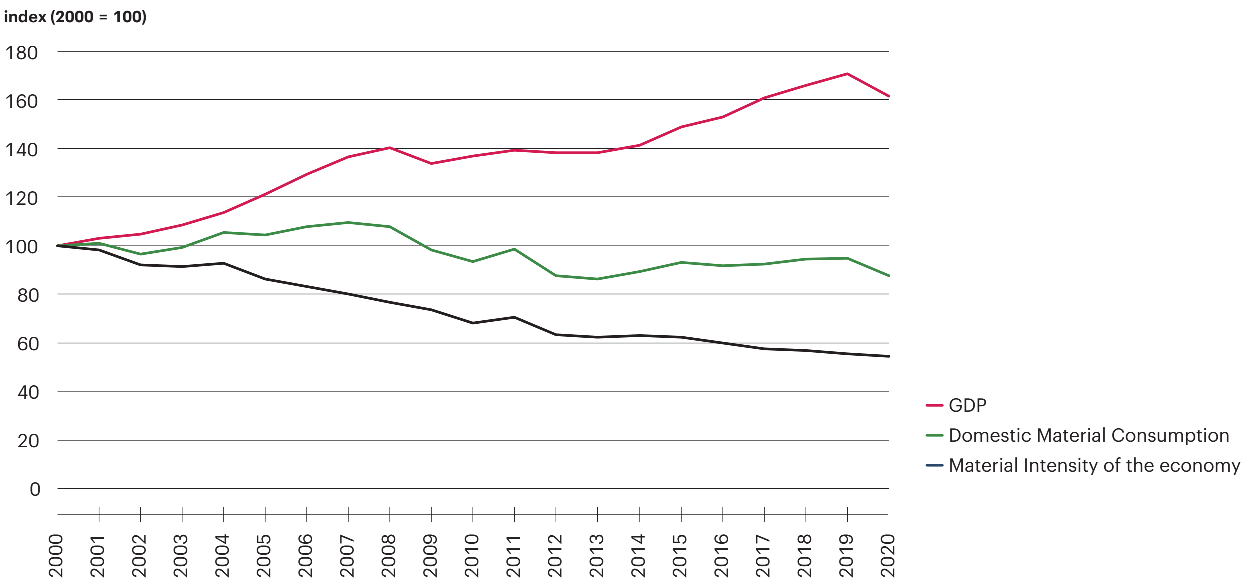
Even in the majority of years in the 2000–2020 period, the development of material intensity was characterised by **relative decoupling**, in which the environmental burden represented by material consumption per unit of GDP decreases, but in absolute terms DMC has the same trend direction as the economy (i.e. it increases when the economy grows and decreases when it goes down). This is a consequence of the structure of GDP generation in Czechia with its high share of industry, and also of the fact that the economic growth during the period under review was significantly influenced by manufacturing and its more material-intensive sectors. Absolute decoupling,

[62] *Data for the year 2021 are not available at the time of publication, and will be published in December 2022.*

in which the environmental burden decreases in absolute terms despite economic growth, which is the optimal development from an environmental perspective, was rare during the period under review. It occurred five times during the assessment period, most recently in 2016.

Chart 30

Development of material intensity of the economy, domestic material consumption and GDP in Czechia [index, 2000 = 100], 2000–2020



GDP in constant 2015 prices.
Data for the year 2021 are not available at the time of publication.

Data source: Czech Statistical Office

The intensity indicators of material flows, and hence the per capita and per unit of GDP environmental burdens associated with the extraction and consumption of materials, are slightly above average in Czechia, due to the structure of the economy, compared to other EU27 countries. **Domestic material consumption per capita** in Czechia in 2020[63] reached 14.7 t per capita, 8.5% above the EU27 average. The material intensity of the Czech economy in 2020 was 0.5 t.(1,000 PPS)$^{-1}$, 16.5% higher than the EU27 average material intensity.

The indicator of the **share of secondary raw material production volume in direct material input** shows the relative size of secondary raw material production to the total material input into the economy. Direct material input measures the input of materials used in the economy, i.e. all materials that have economic value and are used for production and consumption.

In the short term, the share of secondary raw material production volume in direct material input has an increasing trend. In 2018[64] it was 8.3% and since 2011, when it was 8.0%, a rather fluctuating trend can be observed in the medium term with no major fluctuations. In the future, in line with the principles of circular economy and the need to replace primary raw materials with secondary ones, this share will have to be increased (e.g. by introducing closed recycling systems for reusable materials).

[63] *Data for the year 2021 are not available at the time of publication.*

[64] *Data for the years 2019–2021 are not available at the time of publication.*

2.2.2 | Waste prevention

A key current trend in waste management is the move towards a **circular economy**, whereby material flows are closed in long-term cycles and the emphasis is on waste prevention, product reuse, recycling and conversion to energy instead of mineral extraction and landfilling.

Total waste generation (the sum of total generation of non-hazardous and hazardous waste) between 2009 and 2021 increased by 23.6% to 39,896.6 thous. t. It is also showing a significantly increasing trend in the medium and short term. Reducing waste generation is possible by preventing its origin, which is in line with the principles of circular economy. Total generation of **non-hazardous waste** contributes significantly to total waste generation (95.9% in 2021). Between 2009 and 2021, the total generation of non-hazardous waste increased by 27.1% to 38,259.8 thous. t. It is also showing a significantly increasing trend in the medium and short term. Total generation of **hazardous waste** in the 2009–2021 period decreased by 24.3% to a total of 1,636.7 thous. t. This waste can be prevented by reducing the hazardous substances in products.

The total generation of **municipal waste**[65] in the 2009–2021 period increased by 10.9% to 5,904.4 thous. t. It is also increasing in the medium term. On the positive side, there was a slight reduction in the generation of **mixed municipal waste** in the medium term. Between 2009 and 2021, the generation of mixed municipal waste decreased by 16.1% to 2,755.9 thous. t.

The generation of **packaging waste** increased by 48.6% between 2009 and 2020[66] to a total of 1,328.7 thous. t. A significant upward trend can be observed in the medium and short term.

A **sustainable approach to waste or packaging generation** is one of the principles guaranteed by the ecolabelling of products and services. **Ecolabelling** is the labelling of products and services that are demonstrably more environmentally friendly throughout their life cycle, as well as being better for the health of the consumer. Their quality must remain at a very high level, and their utility properties are tested by accredited laboratories. Ecolabels are awarded after a comprehensive verification of the entire product life cycle, and certified products or services can be identified by a simple and easy-to-remember symbol, the ecolabel logo.

The most common classic ecolabels used in Czechia are the Czech national ecolabel Environmentally Friendly Product/Environmentally Friendly Service, and the EU Ecolabel. The certification authority for both ecolabels is CENIA.

In 2021, there were a total of 34 valid licenses to use the Czech Environmentally Friendly Product/Environmentally Friendly Service ecolabel in Czechia, which corresponds to 48 certified products; in the case of the EU Ecolabel, there were 22 licenses for 5,201 certified products. In terms of long-term development, there is a significant downward trend in the number of licences for the Czech Environmentally Friendly Product and Environmentally Friendly Service ecolabels, whereas the number of EU Ecolabel licences is increasing, despite fluctuations over the last ten years (Chart 31). It is therefore clear that, if current trends are maintained, the Environmentally Friendly Product/Environmentally Friendly Service ecolabel will fail to achieve the target set for 2030 (100 valid licences), unlike the EU Ecolabel where the target is likely to be achieved (25 valid licences). The criteria for ecolabel certification are continuously updated according to the latest knowledge and available technologies so that the ecolabel remains a symbol of environmental excellence. This means only 10% to 20% of environmentally friendly products obtain ecolabel certification. Unfortunately, motivation to recertify has fallen for many license holders after the conditions were made stricter. The strict criteria, coupled with low consumer awareness of the true value of ecolabels, is leading to license holders losing interest in ecolabels, especially for the Czech Environmentally Friendly Product/Environmentally Friendly Service ecolabels. For the EU Ecolabel, the situation is more favourable thanks to better consumer education and the associated higher demand for certified products. The most valid ecolabel licenses for Environmentally Friendly Product/Environmentally Friendly Service and EU Flower are currently found in the furniture, paper, cosmetics and pharmaceuticals categories.

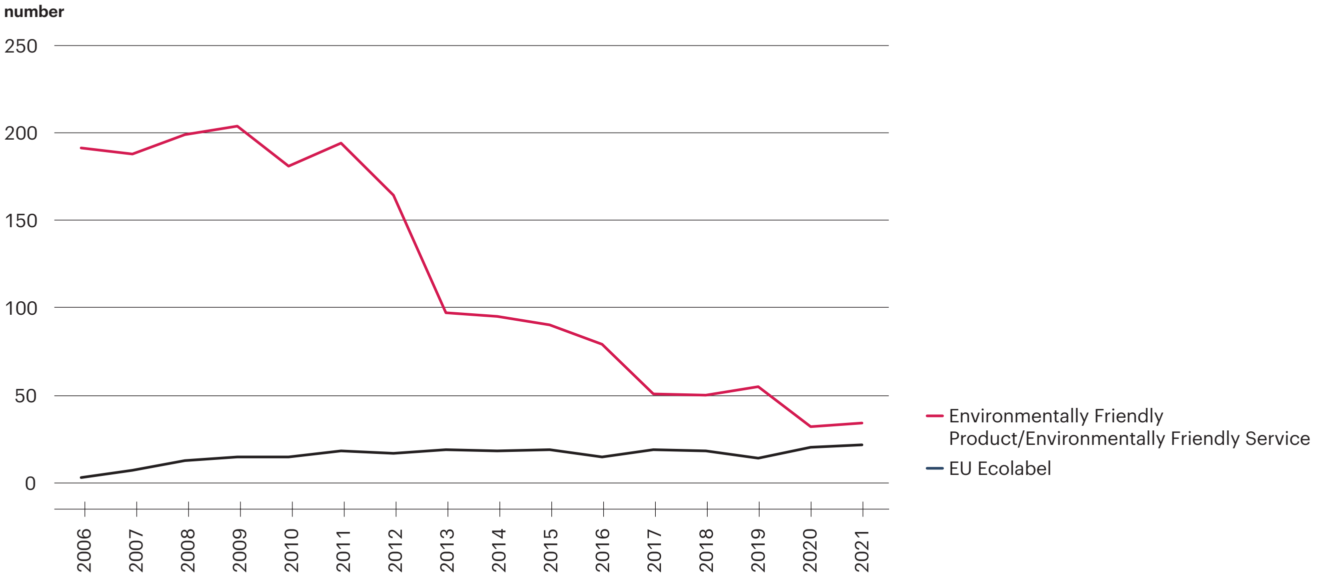
[65] *Due to a change in the methodology, waste catalogue numbers 20 02 02 (soil and stones) and 20 03 06 (waste from sewage cleaning) are not included in total municipal waste generation since 2020.*

[66] *Data for the year 2021 are not available at the time of publication.*

In the international context, we can compare the number of licences or products and services certified with the EU Ecolabel in individual European countries. Across the EU27, a total of 2,042 licences were valid for 83,413 certified products and services as of September 2021. Czechia ranked 14th in the number of licenses together with Estonia, and 7th in the number of certified products and services among all EU27 countries.

Chart 31

Valid Czech Environmentally Friendly Product/Environmentally Friendly Service and EU Ecolabel licences in Czechia [number], 2006–2021



Data source: CENIA

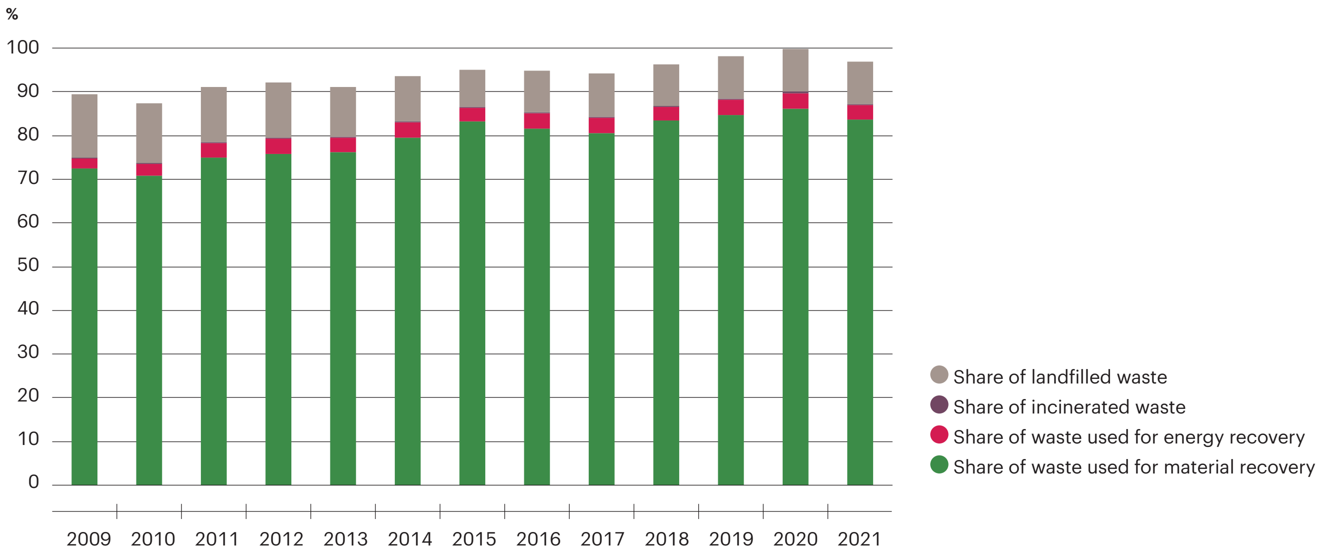
2.2.3 | Compliance with the waste treatment hierarchy

Waste recovery, especially material recovery, dominates **overall waste treatment** and is increasing in the medium and short term (Chart 32). Between 2009 and 2021, the share of **materially recovered** waste in total waste generation, which in 2021 was 39,896.6 thous. t, increased from 72.5% to 83.6%. The share of **energy recovery** increased from 2.2% to 3.4% between 2009 and 2021. The share of **landfilling** fell from 14.6% to 9.6% between 2009 and 2021. **Incineration** removes about 0.2% of the waste generated each year, a negligible proportion compared to landfilling.

The aim is to further reduce the share of landfilling in total waste generation in favour of material and energy recovery, i.e. in accordance with the current waste treatment hierarchy. It is important to use the right (especially legislative[67]) tools for this gradual change, which can significantly help the transition to a circular economy.

Chart 32

Share of selected waste treatment methods in total waste generation in Czechia [%], 2009–2021



The data was determined using the methodology Mathematical expression of the "Waste management indicator system" calculation valid for the given year.

Data source: CENIA

Municipal waste[68] is a specific group of waste and this is reflected in the way it is **treated**. Unlike other waste groups, disposal by **landfilling** dominates in this case. However, since 2009, the share of municipal waste disposed of by landfilling in total municipal waste generation, which was 5,904.4 thous. t in 2021, has decreased from 64.0% to 47.6% in 2021 (Chart 33). However, there has been an increase in the short term (since 2017). Diversion from landfilling is increasing the share of **material recovery** of municipal waste, which increased from 22.7% in 2009 to 37.5% in 2021. It has a significantly increasing trend in the medium term. At the same time, the importance of **energy recovery** from municipal waste increased from 6.0% in 2009 to 12.1% in 2021. The situation is diametrically different for **incineration** (unlike energy recovery of municipal waste, municipal waste is only disposed of by incineration, so it is not used in any way), where the percentage is almost zero (0.06% in 2021).

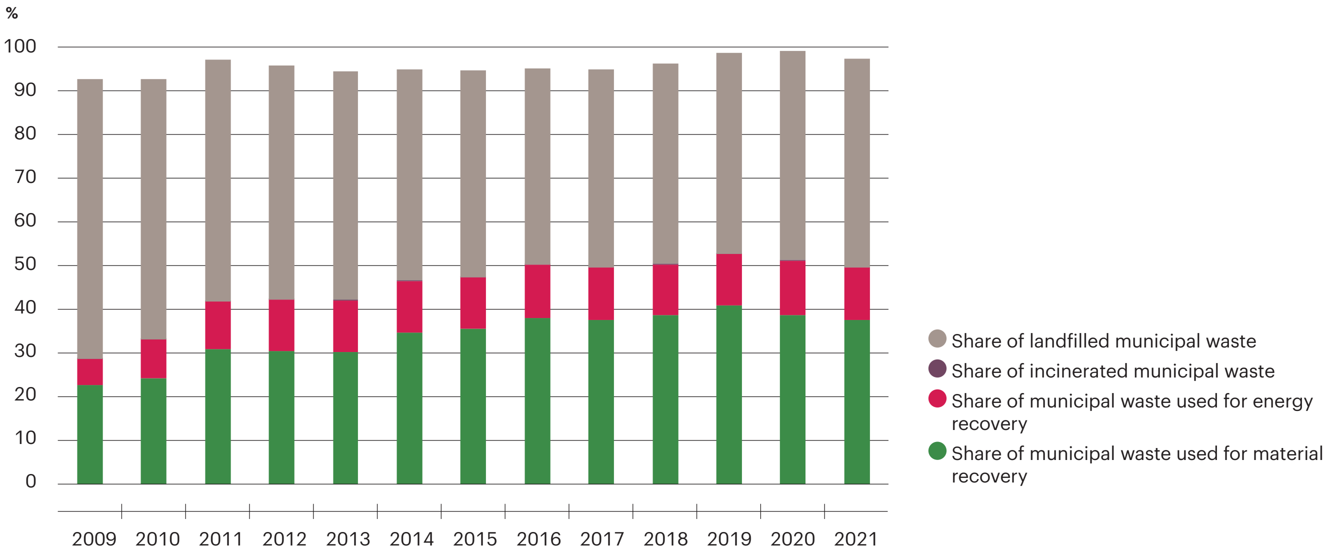
[67] *In the context of the transition to a circular economy, active legislative support for material recycling is necessary, as the preparation and transition to systems supporting the circular economy are very time-consuming and problematic without such support (as shown by cases from other countries).*

[68] *Due to a change in the methodology, waste catalogue numbers 20 02 02 (soil and stones) and 20 03 06 (waste from sewage cleaning) are not included in municipal waste treatment and total municipal waste generation since 2020.*

Nevertheless, the situation in municipal waste treatment in Czechia is not satisfactory (landfilling of municipal waste is above the EU28 average, and recycling is below average). The aim is to reduce the share of landfilling in the total generation of municipal waste more drastically and at the same time increase its material and energy recovery, in accordance with the current hierarchy of waste treatment methods and circular economy principles associated with the need to meet the circular economy objectives[69]. If the current trend continues, achieving the 2025, 2030 and 2035 targets for municipal waste recycling, 2035 municipal waste landfilling and 2035 municipal waste energy recovery will be challenging.

Chart 33

Share of selected municipal waste treatment methods in total municipal waste generation in Czechia [%], 2009–2021



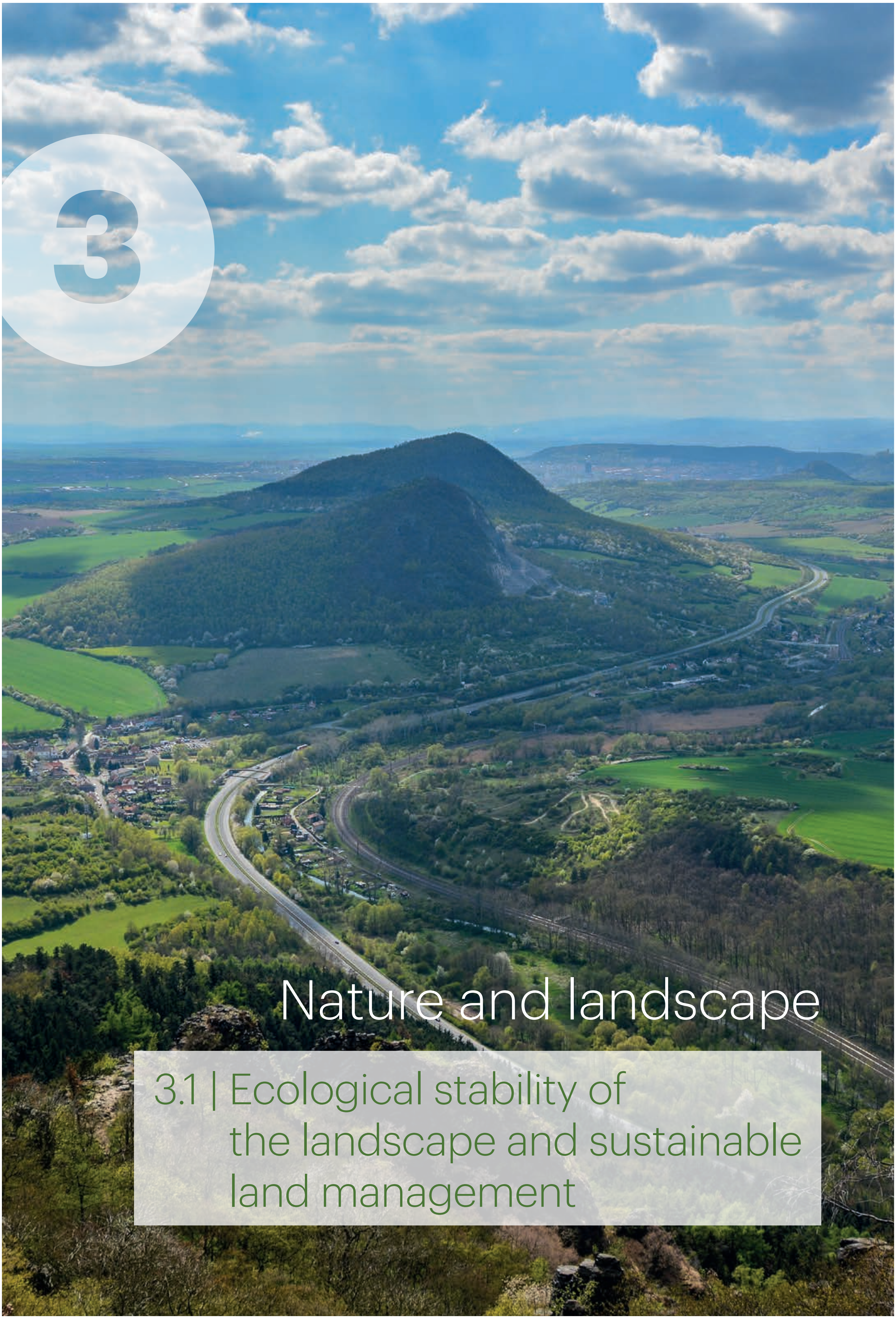
The data was determined using the methodology Mathematical expression of the "Waste management indicator system" calculation valid for the given year.

Data source: CENIA

Detailed visualisations and data

https://www.envirometr.cz/data

[69] *The targets for municipal waste are given in Act No. 541/2020 Coll., on waste.*



Nature and landscape

3.1 | Ecological stability of the landscape and sustainable land management

3.1 | Ecological stability of the landscape and sustainable land management

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Infiltration capacity of soils	N/A	N/A	N/A	N/A
Land use	↗	↗	↗	✕
Quality of agricultural and forest soil*				
Quality of agricultural soil	N/A	N/A	N/A	N/A
Quality of forest soil	N/A	N/A	N/A	✕
Erosion and compaction of agricultural soil	N/A	↗	↝	✕
Consumption of fertilisers and plant protection products	↝	↝	↘	~
Land take	↝	↗	↗	✕
Mineral extraction and reclamation*				
Mineral extraction	↘	↝	↘	N/A
Reclamation after mineral extraction	↗	↗	↗	N/A
Organic farming	↗	↗	↗	~
Average size of fields	N/A	↘	↘	✕
Forest health condition	↘	↘	↘	✕
Sustainable forest management	↝	↝	↝	~
Tree species composition of forests	↗	↗	↗	✕

** Due to the different time series trends underlying the construction of the indicator, an assessment of the sub (elementary) indicators is presented.*

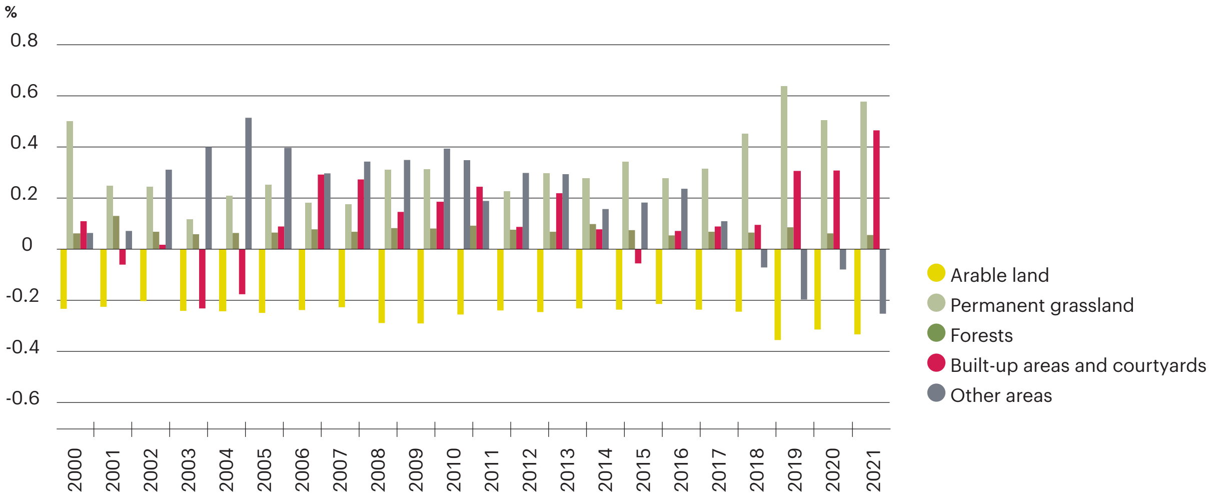
3.1.1 | Water retention in the landscape

Water retention in the landscape is fundamentally influenced by land use, especially the share of paved areas and agricultural management. Within land use, agricultural land has been declining in the long term, falling by 1,500 ha in 2021, a year-on-year fall of 0.04%. Within agricultural land, hop farms and orchards have been declining for a long time. The area of built-up land has been growing for a long time. Between 2020 and 2021, the area of built-up land increased by 621 ha, a 0.5% increase year-on-year (Chart 34). This is associated with an increase in impermeable surfaces (preventing infiltration of rainwater into the soil) from 2.31% in 2006 to 2.39% of Czechia's land area in 2015 (Chart 35).

For agricultural soils, the **infiltration capacity of soils** is evaluated. In 2021, soils with lower/medium to low infiltration capacity together accounted for 38.3% of agricultural land. Dual soil groups (medium/low and lower medium/low infiltration capacity) accounted for 1.5% of the agricultural soils.

Chart 34

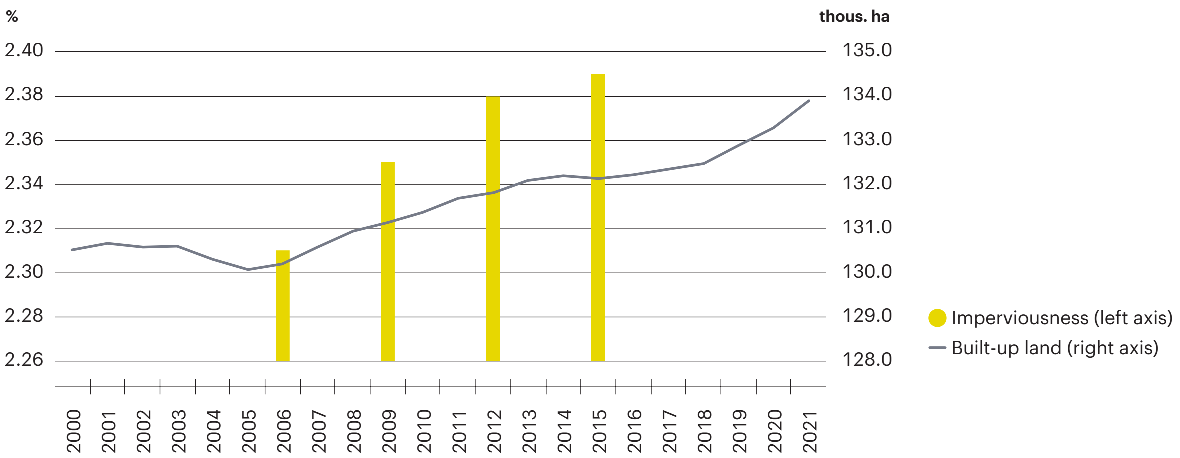
Land use in Czechia [annual % change], 2000–2021



Data source: State Administration of Land Surveying and Cadastre

Chart 35

Development of built-up areas and impermeable surfaces in Czechia [%, thous. ha], 2000–2021



Data source: State Administration of Land Surveying and Cadastre, EEA

3.1.2 | Soil degradation

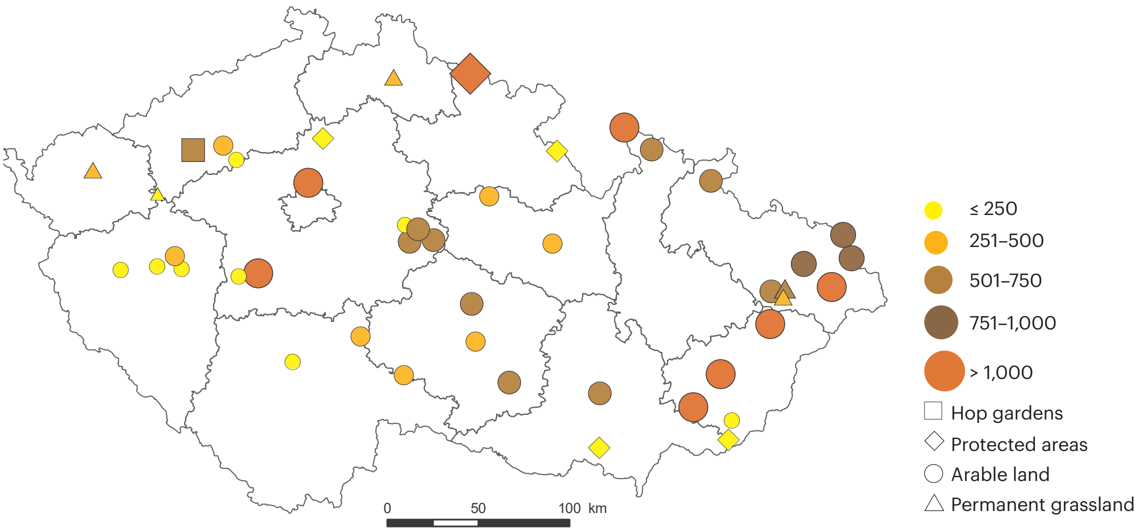
The **quality of agricultural soil** is determined by a number of properties (e.g. soil structure, soil reaction (pH), sorption capacity, humus content). The quality of agricultural soil is negatively affected by the content of hazardous elements and substances in the soil. The presence of hazardous elements is often determined by the geological subsoil and is also influenced by the use of mineral fertilisers and plant protection products. Both inorganic pollutants and hazardous elements (e.g. As, Cd, Ni, Pb, Zn) and persistent organic pollutants (POPs) are monitored as part of the long-term **monitoring of the content of hazardous elements and substances in soil** (basal soil monitoring). These include in particular 12 polycyclic aromatic hydrocarbons (12 PAHs), polychlorinated biphenyls (PCBs) and organochlorine pesticides (HCH, HCB, DDT group substances).

Based on the results of the determination of the content of hazardous elements in the soil during extraction with aqua regia, cadmium content was the most problematic in the 1998–2021 period with 9.8% of above-limit samples for all soils (i.e. for light and other soil types that include sandy-loamy, loamy, clay-loamy and clay soils), followed by arsenic (9.1%), chromium (5.8%), zinc (7.0%) and beryllium (4.5%).

Organic pollutants are determined annually at the same 40 selected basal soil monitoring sites and five sites in protected areas (Krkonoše Mountains National Park, Kokořínsko, Pálava, White Carpathians, Eagle Mountains) from the topsoil perspective. In 2021, the preventive value was exceeded for PCBs, PAHs and DDT. The highest share of samples exceeding the preventive values was measured for the sum of 12 PAHs. PAHs are also produced by natural processes, but are currently present in the environment at higher levels, partly as a result of human activity, particularly the imperfect combustion of carbon-based fuels. They have a high bioaccumulation capacity and, depending on their structure, some of them have carcinogenic effects. Limits were exceeded at a total of seven selected arable land observation sites and one sample from a site in a protected area (Figure 10). DDT levels were exceeded at four sites. The limit for PCB content in arable land was exceeded at three monitoring sites in 2021.

Figure 10

Sum of 12 PAHs in topsoil of agricultural soils (basal soil monitoring) in Czechia [μg.kg^{-1} dry weight], 2021



Based on samples from 40 selected monitoring sites and five sites in protected areas. The preventive value for the sum of 12 PAHs according to Decree No. 153/2016 Coll. is 1,000 μg.kg^{-1} dry matter.

Data source: Central Institute for Supervising and Testing in Agriculture

Pond and river sediments can be deposited on agricultural land to improve its production characteristics. Sediments must first undergo analysis and can only be used on agricultural land if they meet the relevant limits according to Decree No. 257/2009 Coll. The content of hazardous elements and organic pollutants is monitored, as well as the grain composition, organic matter content, pH and nutrient content. The highest percentages of samples exceeding the limit values in the 2009–2021 period were recorded for PAHs (19.4% overall) and for cadmium (16.6% of samples) for the 1995–2021 period. 5% to 8% of the samples were found to be above the limit for arsenic, zinc and DDT.

Forest soils are threatened by acidification and a reduction in the content of basic elements. The available data show acidification and reduction in the content of alkaline nutrients in forest soils, mainly in the upper mineral horizons, in different parts of Czechia[70]. The unavailability of these nutrients has a negative effect on the formation of the assimilative organs of trees, manifested by defoliation. In the past, forest soils were negatively affected by acidification caused by acid deposition from anthropogenic air pollution. Acidification of forest soils is also influenced by management, which determines the species composition and intensity of logging. For the long-term sustainability of forest management, it is a prerequisite that nutrient losses from biomass extraction (logging) do not exceed nutrient replacement by natural processes (weathering, atmospheric deposition).

The most serious form of soil degradation in our country is **erosion**, to which Czechia is vulnerable due to intensive farming relying on mineral fertilisers. In addition, climate change is increasing the risk of erosion events due to the occurrence of localised high intensity precipitation following periods of drought. Water erosion, expressed by long-term potential soil loss (G)[71] higher than 2.1 $t.ha^{-1}.rok^{-1}$ (i.e. above the lower limit of moderately endangered land), threatens 51.7% of the agricultural land fund, while 15.6% is at extreme risk (G higher than 10.1 $t.ha^{-1}.rok^{-1}$). The areas most endangered by water erosion (potential soil particle loss of 10.1 $t.ha^{-1}.rok^{-1}$ and more) are the areas bordering the Moravian valleys and hills and uplands of Czechia. Wind erosion[72] potentially threated 36.6% of agricultural land in 2021[73], with 4.5% being the most threatened soils, located mainly in South Moravia and the Polabí region. The number of 271[74] recorded erosion events in 2021 was lower than in previous years and was consistent with the balanced pattern of temperature and precipitation over the year. In the long term, about half of the erosion events occur in areas with maize, which is unambiguously the most erosion-prone crop. Most erosion events occur on fields without erosion protection measures, and primarily on soils without cover or with little crop cover. 90.3% of the area[75] of the EU28 was at risk of water erosion according to the latest available model data. The most threatened soils are mainly in southern Europe (Italy, Slovenia, Greece). The sandy soils characteristic of the glacial deposits of the northern countries (Denmark, Germany, the Netherlands, Scandinavia and the Baltic Sea area) are most at risk from wind erosion, which is estimated to affect around 9.6% of the EU28 area. The highest annual loss of soil productivity due to erosion is recorded in Slovenia (3.3%) and Greece (2.6%). The lowest is in Denmark and Finland (0.0003%). In Czechia, this value is 0.1%[76].

Among the phenomena that cause soil degradation is soil **compaction**, which negatively affects both the productive and non-productive properties of the soil. As a result of compaction, rainfall infiltration is reduced, surface runoff is accelerated, and the risk of erosion increases, natural soil processes are suppressed as the water, air and thermal regimes of the soil are disturbed and the soil organic matter content is therefore reduced. The potential vulnerability of lower level soils to compaction is partly due to the type of soil – so-called genetic

[70] Šrámek V., Jurkovská L., Fadrhonsová V., Hellebrandová-Neudertová K., 2013: Chemistry of forest soils of the Czech Republic by typological category – results of monitoring of forest soils as part of the "BIOSOIL" project. Forest Research Reports, 58: 314. Available from: https://www.vulhm.cz/files/uploads/2019/01/324.pdf

[71] The calculation of the average long-term soil loss G is based on the Universal Soil Loss Equation (USLE): $G = R \times K \times L \times S \times C \times P$ [$t.ha^{-1}.year^{-1}$]. The following factors are included as inputs to the equation: the rainfall and runoff factor by geographic location on arable land according to the LPIS (R), the soil erodibility factor (K), the slope length factor (L), the slope steepness factor (S), the crop/vegetation and management factor by climatic regions (C), and the erosion control practices efficiency rate (P).

[72] The methodology for determining the potential soil vulnerability to wind erosion was used. Data on climatic regions (sum of daily temperatures above 10°C, average moisture certainty over the growing season, probability of dry growing seasons, average annual temperatures, annual precipitation) and data on the main soil units (genetic soil type, soil substrate, grain size, soil skeleton, degree of hydromorphism) from farmland classification data were used. The resulting assessment is expressed as the product of the climate region factor and the main soil unit factor.

[73] In 2021, the informative layer of erosion vulnerability of agricultural soils to wind erosion was updated and the representation of soils in all vulnerability categories increased.

[74] An overview of recorded erosion events is available on the farmland erosion monitoring web portal: https://me.vumop.cz/app/

[75] Panagos, P., Borrelli, P., Poesen, J., Ballabio, C., Lugato, E., Meusburger, K., Montanarella, L., Alewell, C. The new assessment of soil loss by water erosion in Europe. Environmental science & policy, 2015; 54: 438-447. https://doi.org/10.1016/j.envsci.2015.08.012

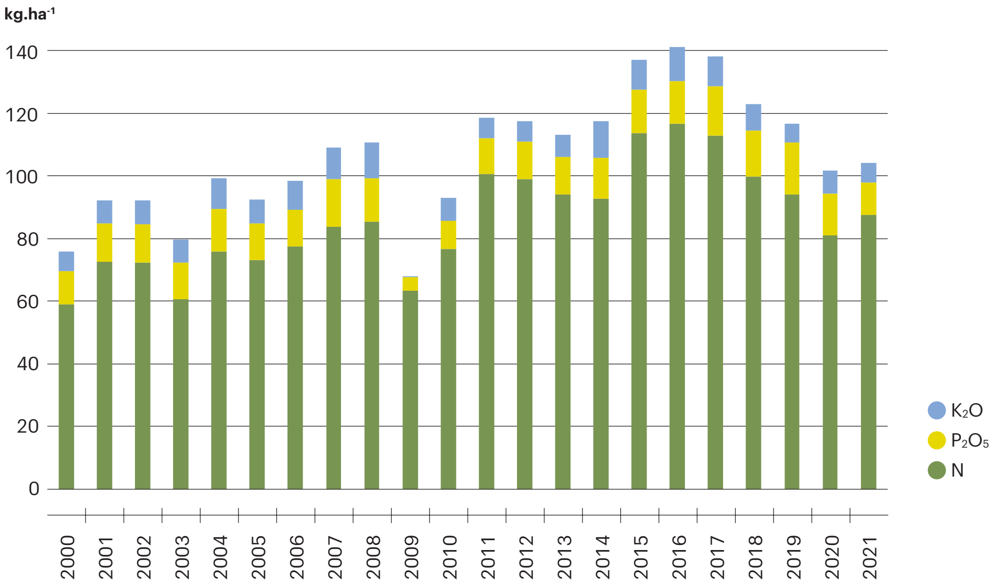
[76] Panagos, P., Standardi, G., Borrelli, P., Lugato, E., Montanarella, L., Bosello, F. Cost of agricultural productivity loss due to soil erosion in the European Union: From direct cost evaluation approaches to the use of macroeconomic models. LandDegrad Dev. 2018; 29: 471–484. https://doi.org/10.1002/ldr.2879

compaction, which is typical of soils with higher clay content. Of the total area of soils at risk of compaction, genetic compaction accounts for only 30%, while compaction caused by intensive farming accounts for 70%. For agricultural soils, high potential vulnerability of the lower layers to compaction was assessed for 16.2% of the agricultural land area.

The quality of farmland is affected by the consumption of fertilisers and plant protection products. Compared to 2000, the **consumption of mineral fertilisers** has increased gradually (by 37.3%). Since 2016, the trend has been downward, however mineral fertiliser consumption has increased by 2.5% year-on-year to 104.2 kg net nutrients.ha^{-1} in 2021 (Chart 36). Decreases were recorded compared to 2020 for phosphate fertiliser consumption, down 24.2% to 10.2 kg.ha^{-1}, and for potassium fertiliser consumption (down 13.1% to 6.3 kg.ha^{-1}). The consumption of nitrogen fertilisers increased by 8.3% year-on-year to 87.7 kg.ha^{-1}. In terms of the composition of mineral fertiliser consumption, nitrogen fertilisers clearly predominate, accounting for 84.2% of total consumption. Although the total consumption of mineral fertilisers has been decreasing in recent years, their consumption still significantly exceeds that of manure fertilisers, which are beneficial for the soil in terms of improving its sorption properties, structure, and increasing the presence of soil organisms. Total mineral fertiliser consumption in the EU27 in 2020[77] was 135.2 kg.ha^{-1}.

Chart 36

Mineral fertiliser consumption in Czechia [kg net nutrients.ha^{-1}], 2000–2021



Data source: Ministry of Agriculture of the Czech Republic

In 2021, 27.5 kg of N, 15.2 kg of P_2O_5 and 26.5 kg of K_2O per hectare of utilised agricultural land was supplied through **livestock manure** (manure, slurry, etc.) and **organic fertilisers** (mainly digestate from biogas plants, compost). Total net nutrient input from manure and organic fertilisers was 69.2 kg.ha^{-1}, an increase of 0.3% year-on-year.

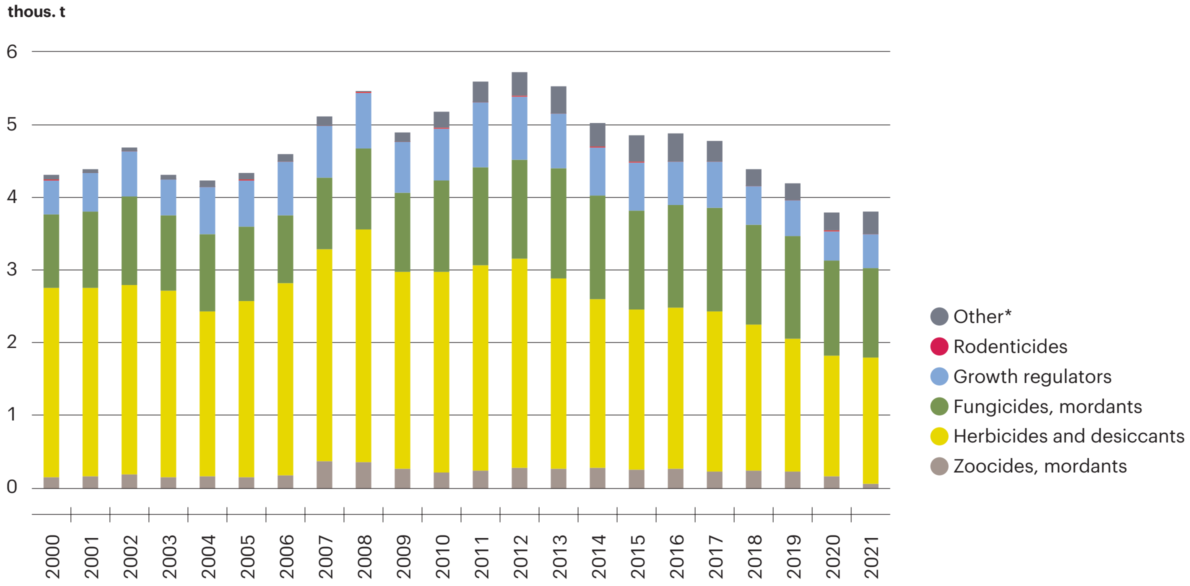
Agricultural soil in Czechia has an acid soil reaction, so it is important to add lime. The modification of the soil reaction by application of **calcium compounds** contributes to improving the fertility and productive capacity of soils by maintaining and improving their physical, chemical and biological properties. In 2021, a total of 318.0 thous. t of calcium materials were consumed, a year-on-year decrease of 6.0%. The average soil reaction value of agricultural soil in the 2015–2020 period in Czechia was 6.0 pH (i.e. slightly acidic). The share of alkaline soils (with a pH higher than 7.2) was only 11.5% of the agricultural land area, the share of soils with neutral pH was 15.2%, and 73.3% of soils had weakly to extremely acidic soil reaction in the period under review.

[77] *Data for the year 2021 are not available at the time of publication.*

The **consumption of plant protection products** is influenced by the actual occurrence of crop diseases and pests in a given year, and this varies according to the weather patterns during the year. Consumption of plant protection products has fallen by 11.7% since 2000. In 2021, the consumption of active substances amounted to 3,797.5 thous. kg (Chart 37). Herbicides and desiccants accounted for the largest share of total consumption (45.8%), followed by fungicides and mordants (32.2%) and growth regulators (12.2%).

Chart 37

Consumption of active substances in plant protection products and other products by purpose of use in Czechia [thous. t of active substances], 2000–2021



**Other – excipients, repellents, mineral oils, etc.*

Data source: Central Institute for Supervising and Testing in Agriculture

Weather patterns, bans on certain active ingredients, and changes in herbicide application strategies in winter crops, often in response to the progress of the current season, are responsible for the decline. There was a significant reduction in insecticide-based products, with consumption falling mainly due to the ban on the active ingredients chlorpyrifos and thiacloprid as one of the most widely used groups in the control of insect pests of rapeseed and virus vectors in cereal crops, while the overall consumption of active substances in the group Zoocides, mordants decreased by 62.1%.

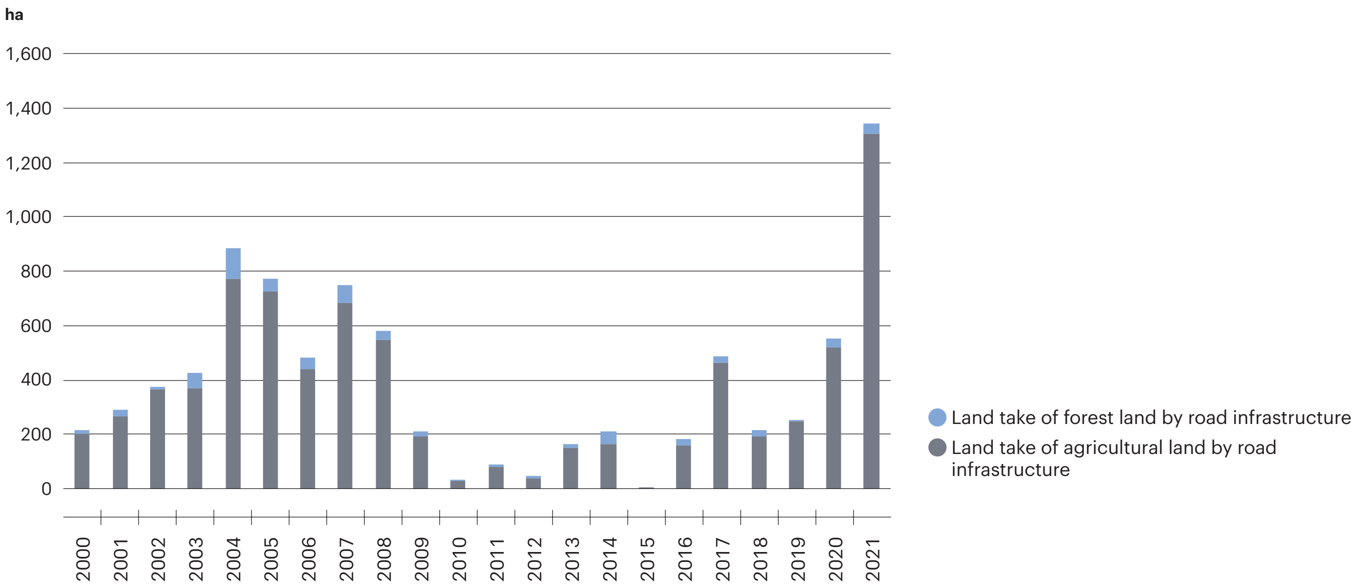
Excessive use of plant protection products and mineral fertilisers contributes to the deterioration of soil quality, a decline in the biodiversity of soil micro-organisms, and negative impacts on the quality of surface water and groundwater. Measures and targets to reduce the adverse effects of plant protection products are defined in the National Action Plan for the Safe Use of Pesticides in the Czech Republic 2018–2022.

Soils are also being degraded by land take for construction purposes. In 2021, a total of 1,3 thous. ha of agricultural and forest land was subject to land take for road infrastructure[78] (Chart 38).

[78] *Data for the year 2021 are not available at the time of publication.*

Chart 38

Land take for road infrastructure in Czechia [ha], 2000–2021



Data source: Transport Research Centre

Mineral extraction is another form of land degradation. Thanks to rich deposits, their mining has a long tradition in Czechia and predetermines the industrial focus of the country. However, it also has a significant impact on the environment and affects the health of living organisms, including people.

In the 2000–2021 period, the **extraction of mineral resources** in Czechia tended to decrease. In 2021, total production was 117.6 mil. t, 3.5% more than in the previous year of 2020 and 27.1% less than in 2000.

The largest volumes are mined for construction materials (68.5 mil. t in 2021), with building stone and gravel being the most important commodities. Of energy raw materials (31.2 mil. t in 2021), lignite and hard coal mining is significant in Czechia. However, their production has been declining significantly in recent years due to the decline in mining. While in previous years both of these raw materials covered domestic consumption and were exported abroad, we now have to import hard coal. Of non-metallic raw materials, limestone and cement are mined in the largest volumes in Czechia (17.9 mil. t in 2021).

After the mining activities have ceased, mining deposits are gradually **reclaimed**. The area affected by mining has been gradually decreasing since 2001, while the amount of reclaimed area has been increasing. In 2020[79] there were 430.4 km^2 of unreclaimed land in Czechia (825.0 km^2 in 2001). In contrast, the total area reclaimed in 2020 was 274.8 km^2 (only 155.0 km^2 in 2001).

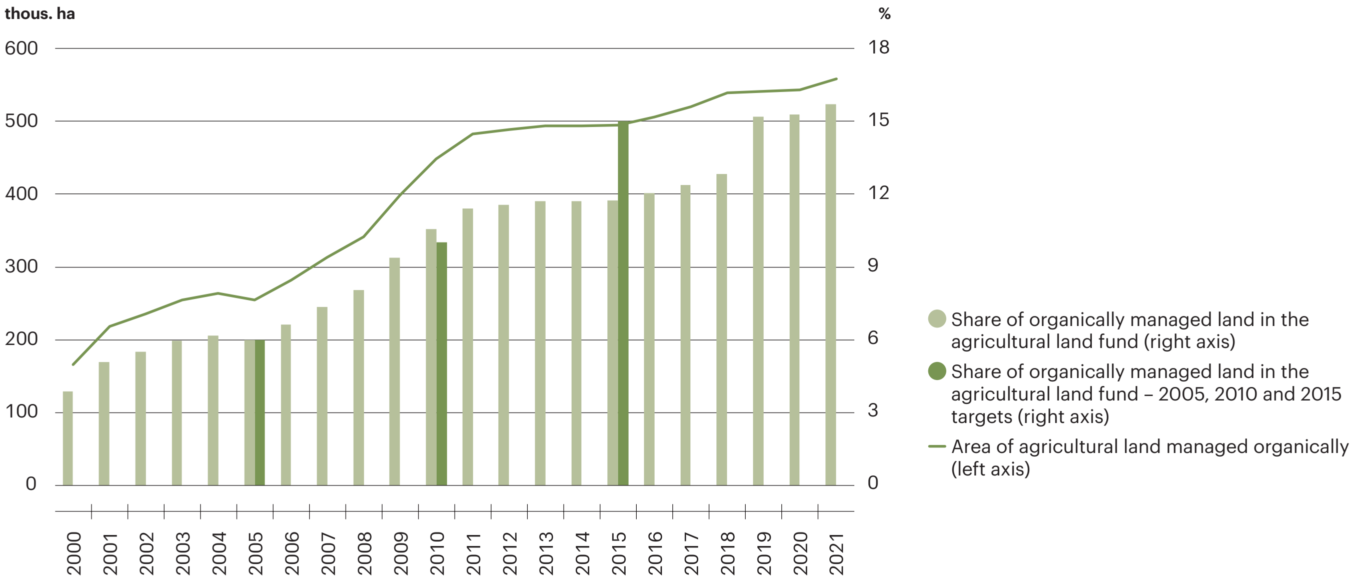
[79] *Data for the year 2021 are not available at the time of publication.*

3.1.3 | Non-productive functions and ecosystem services of the landscape

Organic farming is one way to maintain and improve soil fertility and ecological functions. The **area of organically managed land** (Chart 39) has increased significantly since 2000 thanks to subsidy support, from 165.7 thous. ha to 558.1 thous. ha in 2021; the share of organically managed land in the agricultural land fund registered in the LPIS in 2021 was 15.7% (in 2020 it was 15.3%).

Chart 39

Area and share of organically managed land in agricultural land in Czechia [thous. ha, %], 2000–2021



Until 2018 (inclusive), the share of organically managed land of the total agricultural land in the agricultural land fund was calculated, while from 2019 it is the share of organically managed land in relation to the total land in the agricultural land fund registered in the LPIS.

Data source: Institute of Agricultural Economics and Information, Ministry of Agriculture of the Czech Republic

Permanent grassland has the largest share of the structure of organically managed land, and in 2021 occupied 80.4% (448.7 thous. ha), followed by arable land, which in 2021 occupied 18.4% (102.8 thous. ha). The area of arable land under organic management is growing (9.7% year-on-year). The balance of the area of organically managed land, i.e. 1.2%, is made up of permanent crops (vineyards, orchards, hops) and other areas. Although permanent grassland has an important function in the landscape and is used for organic livestock farming, it is necessary to increase the share of other categories, especially arable land and orchards, in the future, mainly to increase the production of organic food and for the sustainable management and use of agricultural land.

Since 2000, the number of **organic farming entities (ecofarms)** farming according to established organic principles has increased significantly, from 563 to 4,794 entities in 2021. The number of ecofarms increased by 129 year-on-year. The total number of organically reared animals in 2021 was 440.4 thous. head, with cattle farming significantly predominating with a share of 63.2%.

The number of **organic food producers** has also been increasing over the long term. While in 2001 there were 75 producers of organic food, by 2021 there were already 944. Despite the growing trend, the Czech market for organic food is still underdeveloped – the average annual per capita consumption of organic food in 2020[80] was

[80] *Data for the year 2021 are not available at the time of publication.*

CZK 562, and the share of organic food in total food and beverage consumption was 1.8%. Apart from the still relatively high average price of organic food, this mainly due to the underdeveloped marketing and distribution network for organic products, as well as the underdeveloped processing sector for organic products. A large share of organic food is imported, with distributor imports accounting for around 49% in 2020.

Czechia is home to some of the largest fields in Europe[81], a result of the collectivisation and intensification of agriculture that took place from the late 1940s and especially in the 1950s[82]. Large **fields** increase the vulnerability of soils to degradation and reduce landscape diversity, with a negative impact on biodiversity. However, the average size of fields has been declining, decreasing by an average of 1.7% per year between 2010 and 2021. In 2021, fields in the 5–20 ha category occupied the largest area (1,283.1 thous. ha; 36.1%) in Czechia. There are 4,141 of the largest fields of 60 ha or more, and these cover an area of 352.7 thous. ha (9.9%; average size 85.2 ha).

Forest ecosystems are an important element of the ecological stability of the landscape. Forest covers about a third of the territory of Czechia and are slowly expanding. In addition, wood, as a renewable material, has significant potential for the transition to sustainable production and consumption systems. In addition, stable forest ecosystems support biodiversity, regulate the water regime of the landscape, protect soil from erosion, improve air quality, and provide recreational and aesthetic functions. The current species composition, age, and spatial structure of some forests, however, especially large spruce monocultures established in the past, pose an increased risk in terms of the manifestations of climate change.

The ability of forests to perform some of their functions can be assessed through their **health status** expressed as the degree of defoliation, defined as the relative loss of the assimilative apparatus in the crown of a tree compared to a healthy tree growing in the same stand and habitat conditions (Chart 40). In 2021, 79.3% of conifers and 40.1% of deciduous trees were classified in defoliation classes 2 to 4 for older stands (60 years and older) and 29.5% of conifers and 28.1% of deciduous trees for younger stands (up to 59 years old). Currently, the health of forest stands is negatively affected by manifestations of climate change such as drought, strong winds and the lengthening of the growing season. The most affected stands are spruce forests suffering from the continuing gradation of the bark beetle. In addition, many forest stands are characterised by an inappropriate species composition with a high proportion of aged stands that are less resistant to the manifestations of climate change. High defoliation rates and a diverging trend in the representation of defoliation classes mean that the long-term health of forest stands remains unsatisfactory. In 2021, 27.2% of conifers and 30.0% of deciduous trees in Europe were in defoliation classes 2 to 4[83]. The aforementioned factors causing defoliation are the reason why Czechia is among the countries with the highest defoliation rates in Europe.

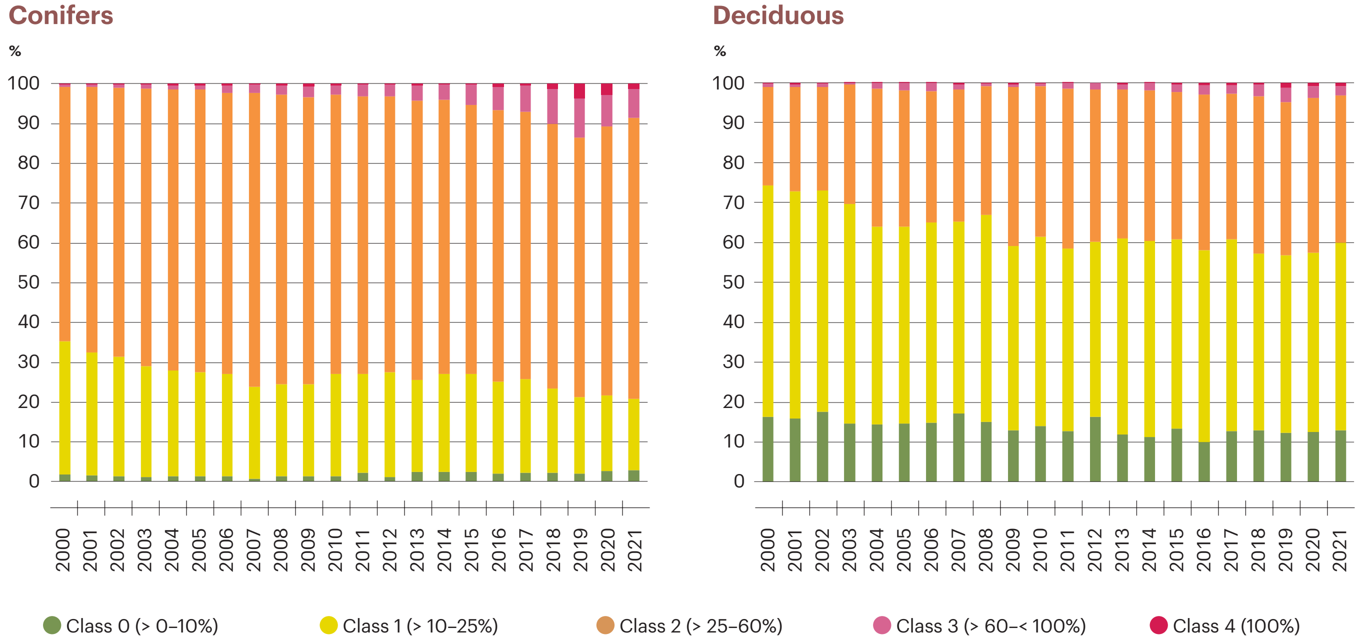
[81] *Lesiv, Myroslava, et al. Estimating the global distribution of field size using crowdsourcing. Global change biology. 2019. 174-186. https://doi.org/10.1111/gcb.14492*

[82] *Lerman, Zvi. Agriculture in transition economies: from common heritage to divergence. Agricultural economics. 2001. 95–114. https://doi.org/10.1111/j.1574-0862.2001.tb00057.x*

[83] *Michel A., Kirchner T., Prescher A-K., Schwärzel K., editors. Forest Condition in Europe: The 2022 Assessment. ICP Forests Technical Report under the UNECE Convention on Long-range Transboundary Air Pollution (Air Convention). Eberswalde: Thünen Institute. 2022. https://doi.org/10.3220/ICPTR1656330928000*

Chart 40

Defoliation of older conifer and deciduous stands (60 years and older) in Czechia by class [%], 2000–2021

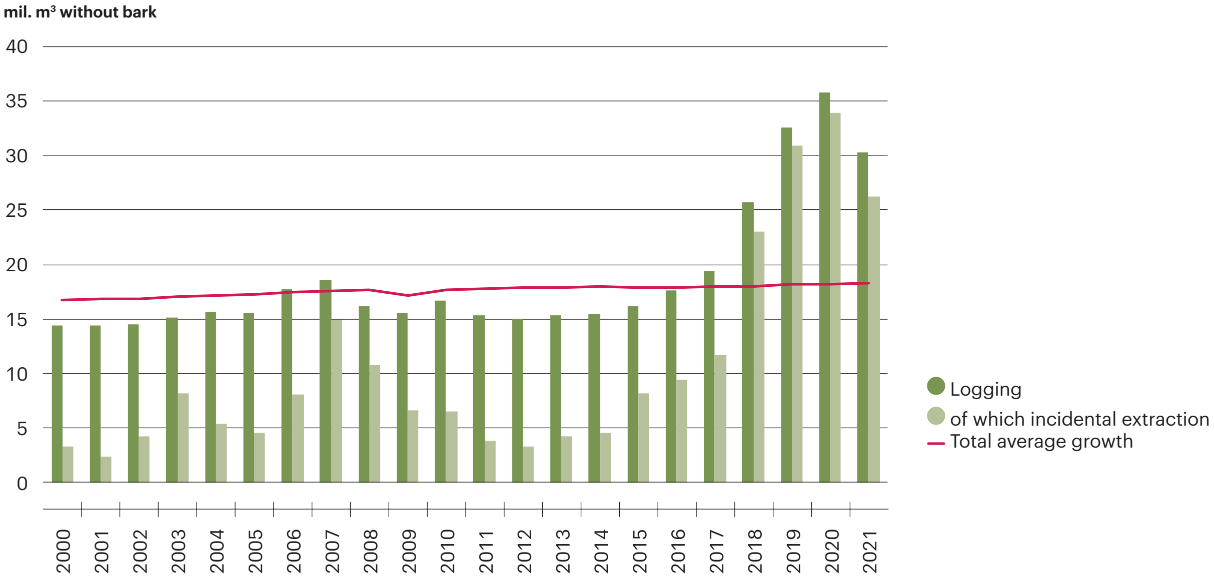


Data source: Forestry and Game Management Research Institute

Large-scale logging following the bark beetle calamity in 2021 was recorded. However, for the first time since its start in 2015, the volume of logging decreased year-on-year to 30.3 mil. m^3 of wood without bark (Chart 41). The share of incidental (calamity-related) logging in total logging in 2021 decreased from 94.8% to 86.9% compared to 2020, which is still a very high value indicating a severe bark beetle calamity. At the same time, the volume of logging again significantly exceeded total average growth, which was 18.3 mil. m^3 of wood without bark in 2021. Many so-called calamity clearings have recently been created in areas with high logging volumes. The massive tree felling is also affecting the overall carbon balance of the forests. While in the previous period Czech forests were carbon sinks, in recent years they have become carbon sources. The main cause of this unfavourable situation is the effect of drought, especially on tree species planted outside their ecological optimum (predominantly Norway spruce in the lower vegetation stages), and the subsequent infestation of these tree species by insect pests. However, this situation can be considered temporary, as due to the massive regeneration of forests on large calamitous clearings, an increase in growth and a gradual restoration of the CO_2 sequestration ecosystem service can be expected in the coming years.

Chart 41

Comparison of timber logging with the total average growth rate in Czechia [mil. m^3 without bark], 2000–2021



Data source: Czech Statistical Office, Forest Management Institute

The majority (74.1%) of forest ecosystems in Czechia are economic forests whose main mission is sustainable management ensuring the fulfilment of all ecosystem services, including the production of wood as a sustainable renewable raw material. Increasing the resilience of these forests to the manifestations of climate change and improving their productive and non-productive functions can be achieved by using nature-like **management practices** and maintaining a diverse forest structure. A management method can be considered close to nature when it uses the creative forces of nature to the maximum extent to achieve the goal of forest management, respects habitat conditions and where the economic measures are carried out in accordance with natural processes and the condition of stands. According to data from forest management plans[84], grazing farming methods (shelterwood, strip, clear-cutting) are used almost exclusively. The long-term application of predominantly grazing management methods has resulted in a significant predominance of simple-structured forest stands (81.1% of forests)[85]. At the same time, however, there has been a gradual reduction in the size of intentional restoration elements to the current average of about 0.35 ha, leading to groupings and age differentiation even in these forest stands. In terms of forest shapes, tall forests clearly predominate (about 97.2% of the stands), characterised by a long regeneration cycle. However, there are efforts to increase the proportion of medium and low forests with a very short regeneration cycle and forests with a richer structure, which is positive in terms of forest resilience and biodiversity support. Many species of forest organisms are threatened by the lack of dead wood left in forests to decompose spontaneously. The amount of dead wood in Czechia slowly increases.

One of the principles of nature-like management is the use of **natural regeneration** in genetically appropriate stands. There was a highest recorded total area of regeneration in 2021 (49.8 thous. ha), which corresponds with the highest recorded logging after the bark beetle calamity. The trend in natural regeneration is fluctuating. However, in 2021, the area of natural regeneration increased and its share of the total area of forest regeneration rose to 18.3%. A range of management measures, both forestry and hunting, are necessary to promote natural and artificial forest regeneration. For hunting measures, it is particularly necessary to comply with the game breeding and hunting plan, especially in view of the persistent extensive damage caused when these animals gnaw on established forest crops and natural regeneration areas, as well as on agricultural crops and land. Damage caused by wildlife can also be reduced by establishing fields and grazing areas. Of the forestry

[84] *The data from the draft part of the forest management plans are influenced by the owner's management plans and may not correspond to the actual representation of individual management methods.*

[85] *Kučera M., Adolt R., editors: National Forest Inventory in the Czech Republic - results of the second cycle 2011–2015 [online]. First edition. Brandýs nad Labem: Institute for Forest Management Brandýs nad Labem, 2019 [cit. 29/ 6/ 2021]. ISBN 978-80-88184-24-9. Available from: https://nil.uhul.cz/downloads/2019_kniha_nil2_web.pdf*

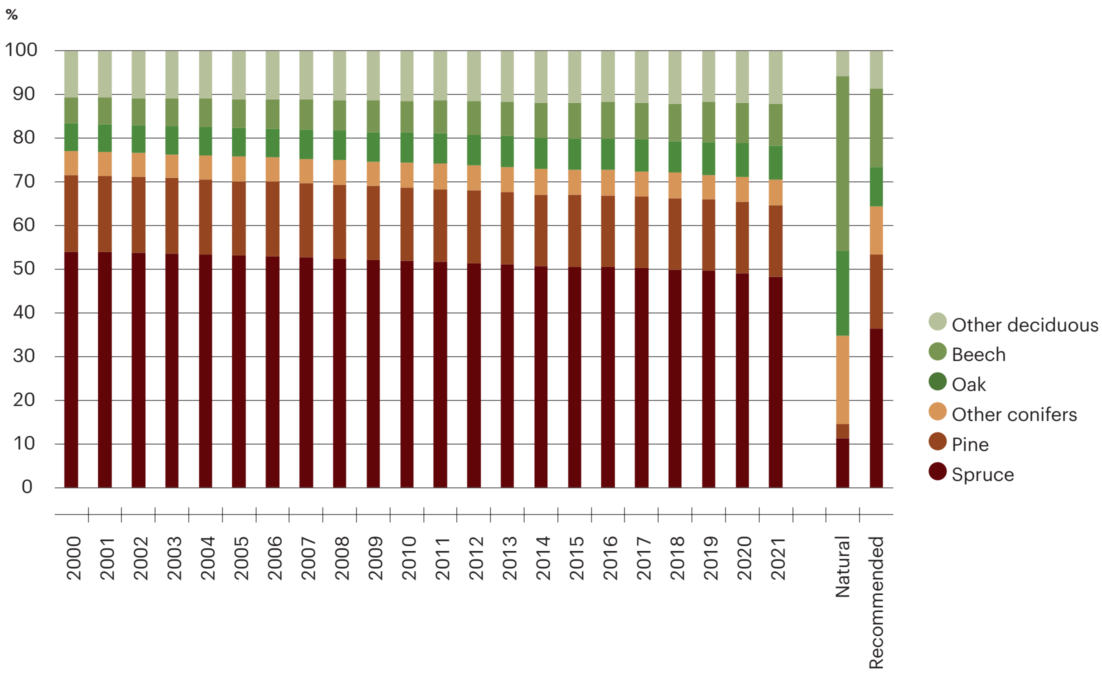
measures, it is appropriate to mention the consistent protection of the forests and the timely tending of stands in relation to the tree species present. After the previous increase in monitored game numbers, there has been a stagnation in recent years, except for fallow deer, the population of which more than doubled in the 2000–2021 period.

A tool for introducing responsible forest management and at the same time informing consumers about the origin and environmental consequences of logging is the **certification of forest land** using the standards of international certification organisations, which has been adopted in Czechia especially since 2000. Currently, PEFC (Programme for the Endorsement of Forest Certification Schemes) and FSC (Forest Stewardship Council) certificates are available. In 2021, 66.7% of forest land had PEFC certification and 5.1% FSC certification. Most of the forest land with FSC certification also had PEFC certification. As a result, a total of 67.6% forest land was certified in 2021, which is a relatively high proportion compared to other European states, where, on average, about half of forest land in European countries is certified.

A key aspect of nature-friendly forest management is a targeted approach to the appropriate **species composition of forests**. The current species composition of forests is significantly different from the reconstructed natural and recommended composition[86], mainly due to the widespread planting of spruce and pine monocultures in the past. The overall share of deciduous trees in forests has been increasing slowly since 2000, rising from 22.3% to 28.7% in 2021, with deciduous trees projected to increase to 35.6%, which is the recommended composition (Chart 42). In terms of individual tree species, spruce is the most common tree species with a share of 48.1%, followed by pine (16.0%), beech (9.3%) and oak (7.6%). In recent decades, a targeted change in species composition towards a more natural (and more stable) structure of forest stands is evident and manifested by more frequent planting of deciduous trees at the expense of conifers. In 2021, a record 21.2 thous. ha were reforested with deciduous trees and 19.5 thous. ha with conifers, although the most frequently planted tree species remained spruce (12.1 thous. ha for a share of 29.8%), followed by beech (9.8 thous. ha for a share of 24.2%) and oak (6.9 thous. ha for a share of 17.1%).

Chart 42

Species composition of forests in Czechia, reconstructed natural and recommended composition [%], 2000–2021



Data source: Forest Management Institute

Detailed visualisations and data

https://www.envirometr.cz/data

[86] The reconstructed natural composition is close to the climax composition in the time before the forest was influenced by man. The recommended forest species composition is a compromise between the current and natural tree species composition, taking into account economic interests, non-productive forest functions and knowledge related to climate change adaptation.

3 Nature and landscape

3.2 | Biodiversity

3.2 | Biodiversity

Indicator	Long-term trend (15 years and more)	Medium-term trend (10 years)	Short-term trend (5 years)	State
Fragmentation of the landscape	↗ (red)	↗ (red)	↗ (red)	✕ (red)
Conservation status of species and habitats of Community importance	N/A	~ (yellow)	N/A	✕ (red)
Conservation status of bird species	↘ (red)	↘ (red)	↘ (red)	✕ (red)
Common bird species*				
Abundance of all common bird species, forest bird species and farmland bird species	↘ (red)	↘ (red)	↘ (red)	✕ (red)
Indicator of the impact of climate change on common bird species	↗ (red)	↗ (red)	↗ (red)	✕ (red)
State of plant, animal and fungi species according to the red lists	↘ (red)	↘ (red)	↘ (red)	✕ (red)
Share of species on red lists that are also protected species	N/A	N/A	N/A	N/A
Specially protected areas and Natura 2000 sites in the national territory	↗ (green)	↗ (green)	↗ (green)	~ (yellow)
Share of habitats and species in local Natura 2000 sites	N/A	N/A	N/A	N/A
Non-native species in Czechia	N/A	N/A	N/A	✕ (red)
International trade in endangered species protected under CITES	N/A	N/A	N/A	N/A
Breeding of endangered species in zoos	N/A	N/A	N/A	~ (yellow)

** Due to the different time series trends underlying the construction of the indicator, an assessment of the sub (elementary) indicators is presented.*

3.2.1 | State of habitats, species and landscapes

Landscape fragmentation leads to the loss of original habitat qualities and connectivity important for animal migration. In the 2000–2016 period[87], the area of unfragmented landscape decreased by 11.7% from 54.1 thous. km^2 in 2000 (68.6% of the territory) to 50.0 thous. km^2 in 2010 (63.5% of the total area) and further to 47.8 thous. km^2

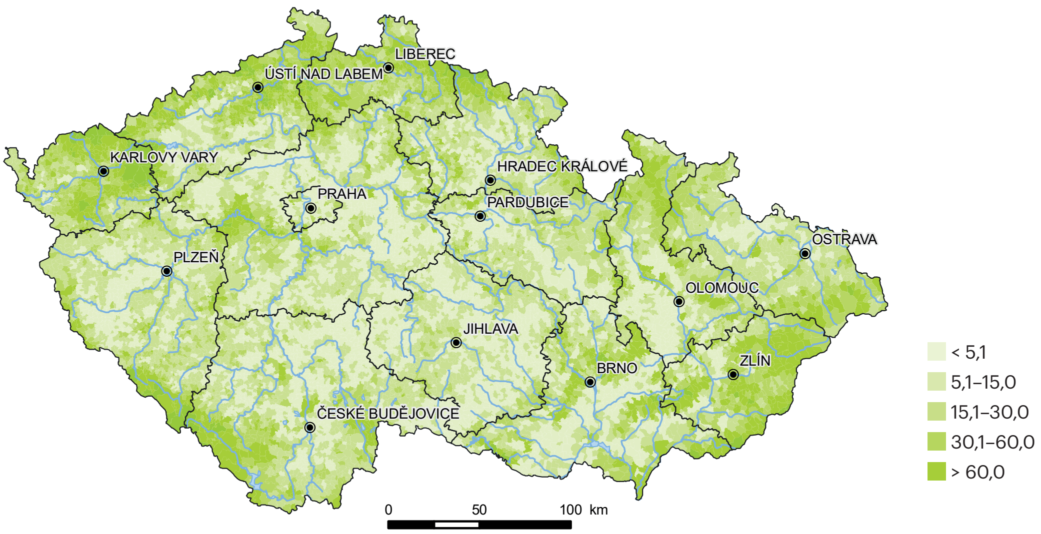
[87] *Data for the years 2017–2021 are not available at the time of publication.*

(60.6% of the territory) in 2016. According to forecasts[88], the process of landscape fragmentation by transport will continue and in 2040 the share of unfragmented landscape will reach only 53%.

The **average share of natural habitat area** to cadastral land area was 12.9% nationally in 2021 (a year-on-year decline of 0.1 percentage points since 2016). Areas with maximum disturbance of natural structures are located in the most agriculturally exploited areas and in urban agglomerations, while natural and close-to-nature landscapes are found mainly in the border mountains and are associated with designated specially protected areas (Figure 11).

Figure 11

Share of natural biotopes in the area of cadastral territories in Czechia [%], 2021



Data source: Nature Conservation Agency of the Czech Republic

Based on the results from 2013–2018[89], 59.8% of species are in poor or bad conservation status, indicating a gradual improvement in conservation status (66.5% in 2007–2012). However, despite this improvement, the overall **status of species of Community importance** is not good, and largely reflects the conservation status of endangered species in Czechia, the overall state of biodiversity in the Czechia, and the overall state of the Czech landscape in general.

The **overall conservation status of species of Community importance** slightly deteriorated in the 2013–2018 assessment period[90] compared to the previous period. While there was an improvement in the "Good conservation status" category from 15.3% to 18.0% between 2000–2006 and 2007–2012, and this remained stable in 2013–2018, there was a deterioration in the bad conservation status category from 23.0% to 24.6% between 2007–2012 and 2013–2018. There were 50.8 plant species in poor conservation status in 2013–2018.

Despite a gradual improvement in the conservation status of habitat types of Community importance, 79.6% of habitats are still assessed as poor or bad (49.5% and 30.1% respectively), compared to 82.8% in the 2007–2012 period and 88.2% in the 2000–2006 period.

In an **international comparison** of the conservation status of species of Community importance for the 2013–2018 period[91], Czechia ranks among the European average. Czechia has 30.3% of species in good conservation status, with Cyprus having the most (63.6%) and Croatia the least (7.2%). Luxembourg has the highest number of species in bad conservation status (45.0%) and Bulgaria the lowest (3.2%). Czechia has 25.8% of species in bad conservation status. Only 30.4%[92] of species of Community importance at European level (EU28) are in good conservation status[93]. Romania has the highest number of habitat types of Community importance in good conservation status

[88] *Evernia (2020): Elaboration of the indicator of landscape fragmentation in the Czech Republic by transport based on the national transport census in 2016. Liberec, 2020. 23 s.*

[89, 90, 91] *Data for the years 2019–2021 are not available at the time of publication due to the indicator being reported in six-year cycles.*

[92] *This is the average value for the states listed. An expert assessment at European level indicates an even lower 28% share of species in a good state. More at: https://www.eea.europa.eu/ims/conservation-status-of-species-under*

[93] *Data for the years 2019–2021 are not available at the time of publication.*

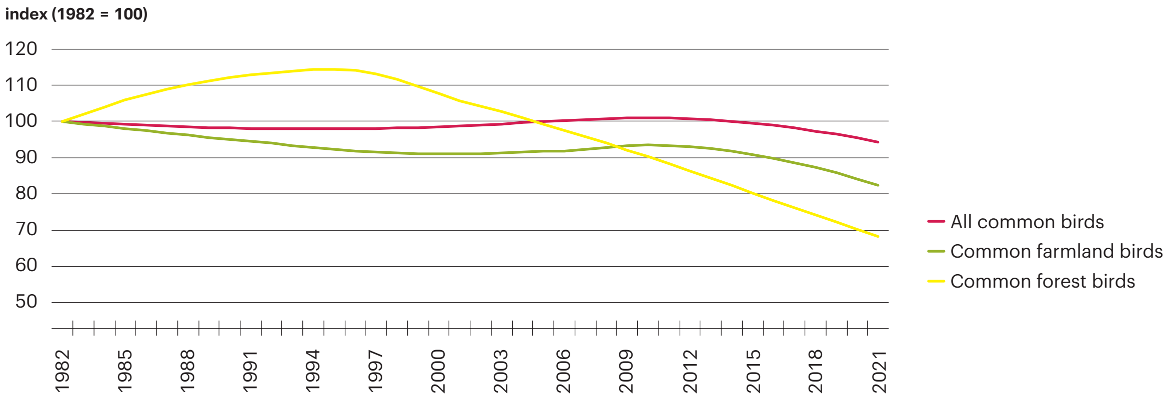
(68.2%) of the habitat types assessed, Belgium has the lowest (4.3%), while the EU28 level is 23.9%[94]. In Czechia, 19.4% of the assessed habitat types are in good conservation status. Belgium (79.6%) and Denmark (76.6%) had the highest number of habitats in a bad status, with Romania again the least (3.5%). At EU level, 33.4% of the assessed habitats are in a bad status, while this figure for Czechia is 30.1%. On average across the EU, 39.0% of assessed habitats are in a poor status and 3.7% are in an unknown status.[95]

In Czechia, according to the most recent assessment (2013–2018)[96], 50% of the populations of **wild bird species** have an increasing or stable **population abundance** conservation status in both long-term and short-term assessments. For short-term abundance changes, 26% of wild bird populations were assessed as increasing, 19% as stable, followed by 2% as fluctuating, 48% as decreasing, 2% as uncertain and 23% as unknown. For long-term abundance changes, 35% of bird populations were assessed as increasing and 15% as stable. The other half of bird populations show long-term declining (24%), uncertain (2%) and unknown conservation status (24%). The **population conservation status of bird species** depend to a large extent on the status of their ranges. In the long term, 74% of sites are in a stable or increasing conservation status (i.e. increasing in area), and 72% in the short term.

Birds are an indicator of the overall state of biodiversity; if birds decline, the overall natural diversity of Czechia decreases[97]. Since 1982, the abundance of all **common bird species** in the Czechia has declined by 5.6% overall, with a steady decline throughout the period under review. The main cause of the decline of **birds in agricultural landscapes** is the increasing intensity of agriculture, with a 31.7% decline in their numbers since 1982. A temporary positive development occurred after 1989, when agricultural intensity temporarily decreased[98]. Another decline followed since the late 1990s[99] (Chart 43). The abundance of some well-known species (partridge (Perdix perdix), lapwing (Vanellus vanellus), meadow pipit (Anthus pratensis) and western yellow wagtail (Motacilla flava)) has decreased to a fraction of the baseline, and the situation is not improving.[100] The abundance of **forest bird species** declined slightly until about 2000, followed by a period of stability and then a decline again in recent years, with a value in 2021 that was 17.7% lower than in 1982. At the same time, forest habitat specialists are mostly reducing their numbers (e.g. red-breasted flycatcher, wood warbler, goldcrest) and replacing them with species with a wide ecological valence, such as the blackbird, song thrush, European robin, Eurasian blackcap, great tit and blue tit. Rare and highly specialised species are becoming even rarer, and biodiversity at the local and regional level is declining overall.

Chart 43

Indicators of all common bird species, forest bird species and farmland bird species in Czechia [index, 1982 = 100], 1982–2021



Data source: Czech Statistical Office

[94] *Read more: https://www.eea.europa.eu/ims/conservation-status-of-habitats-under*

[95] *Read more: https://www.eea.europa.eu/ims/conservation-status-of-species-under*

[96] *Data for the years 2019–2021 are not available at the time of publication due to the indicator being reported in six-year cycles.*

[97] *Vermouzek, Z. (2022): Common bird species indicator for 2021. Study for the Ministry of the Environment of the Czech Republic. Unpublished. 14.s.*

[98] *Reif J., Voříšek P., Šťastný K., Bejček V. & Petr J. (2008a): Agricultural intensification and farmland birds: new insights from a central European country. Ibis 150: 596-605.*

[99] *Reif J. & Vermouzek Z. (2018): Collapse of farmland bird populations in an Eastern European country following its EU accession. Conservation Letters 2018, doi: 10.1111/conl.12585.*

[100] *Vermouzek Z. & Zámečník V., 2018: Farmland bird indicator for 2018. Study for the Ministry of Agriculture of the Czech Republic. Czech Statistical Office, unpublished, 64 p.*

Since the 1990s, the **impact of climate change on bird species composition** has been increasing. Due to its influence, the northern species are gradually disappearing from Central Europe (whinchat, common grasshopper warbler, icterine warbler), while thermophilic species (Eurasian collared dove, nightingale, and Eurasian golden oriole) are slightly increasing. The area with the greatest species diversity, of which we are currently a part, will be moving northeastwards[101]. The impact of climate change on bird species in Czechia was insignificant in the 1980s, however its importance began to grow after 1990 with a visible acceleration around the turn of the millennium. This was followed by a period of slower growth until about 2010, since when the impact of climate change on bird populations has been increasing again, especially in recent years[102]. The **Climate Change Impact Indicator for Common Bird Specie**s has increased by 17.4% since 2010.

In the 2017 **red lists**[103], 908 species of vascular plants, 162 species of vertebrates (16 species of amphibians, 7 species of reptiles, 25 species of lampreys and fish, 99 species of birds and 15 species of mammals) and over 3,300 species of invertebrates were listed as critically endangered, endangered or vulnerable. A large share of endangered species can be found among reptiles, fish and lampreys, birds, diurnal butterflies and scarab beetles. A large number of endangered plant and animal species are found in the border areas of Czechia, where many protected areas are located, and in the Pannonian region (southern Moravia).

3.2.2 | Protection and care of the most valuable parts of nature and landscape

Protected species are listed in the Annex to the Act on Nature and Landscape Protection No. 114/1992 Coll., Decree No. 395/1992 Coll. as amended[104], Decree of the Ministry of the Environment of the Czech Republic implementing certain provisions of the Act of the Czech National Council mentioned above. Yet there are many more species that deserve attention. These species are included in the so-called red lists, which are continuously updated (the last edition of the Czech specially protected areas lists was published in 2017, but there is also an updated digital database of red lists[105]). Not all endangered species are protected in this way (there are about ten thousand species on the red lists, and around one thousand of them are protected). On the other hand, not all specially protected species are truly endangered, even though the Czech decree calls them protected species categories. The causes are changes in the distribution and ecology of the species, as well as the selection of species for legal protection. As of 2021, 81.5% of **specially protected species were on red lists** (i.e. genuinely endangered).

The total area of **specially protected areas** in Czechia (Figure 12), including both small-area and large-area specially protected areas, was 1,324.7 thous. ha in 2021, i.e. 16.8% of the national territory. Since 2020, it has increased by 931.7 ha, and this increase was mainly due to the creation of new small-area specially protected areas. The area of large-scale specially protected areas, which include national parks and protected landscape areas, amounted to 1,257.2 thous. ha (15.9 % of the territory of Czechia). Small specially protected areas in 2021 covered 115.9 thous. ha, i.e. 1.5% of the national territory. In 2021, 4 new small-area specially protected areas were created and their total area increased by 1.0 thous. ha. Almost a third of the small-area specially protected areas are located in a protected landscape area or a national park. In 2021, there were 1,153 **Natura 2000** sites, the total area of which was 1,115.4 thous. ha in 2021, i.e. 14.1% of the territory of Czechia. Of these, 41 bird areas covered a total of 703.4 thous. ha, and 1,112 sites of Community importance covered a total of 795.6 thous. ha. The majority of Natura 2000 sites lie within the territory of another specially protected area; 35.9% of the Natura 2000 area was outside other specially protected areas. The total area of specially protected areas and Natura 2000 sites, taking into account their overlaps, was 1,725.7 thous. ha, or 21.9% of the area of Czechia.

[101] *Huntley B., Green R. E., Collingham Y. C. & Willis S. G. (2007): A Climatic Atlas of European Breeding Birds. Lynx Edicions, Barcelona.*

[102] *99 species in the Czech Republic were evaluated.*

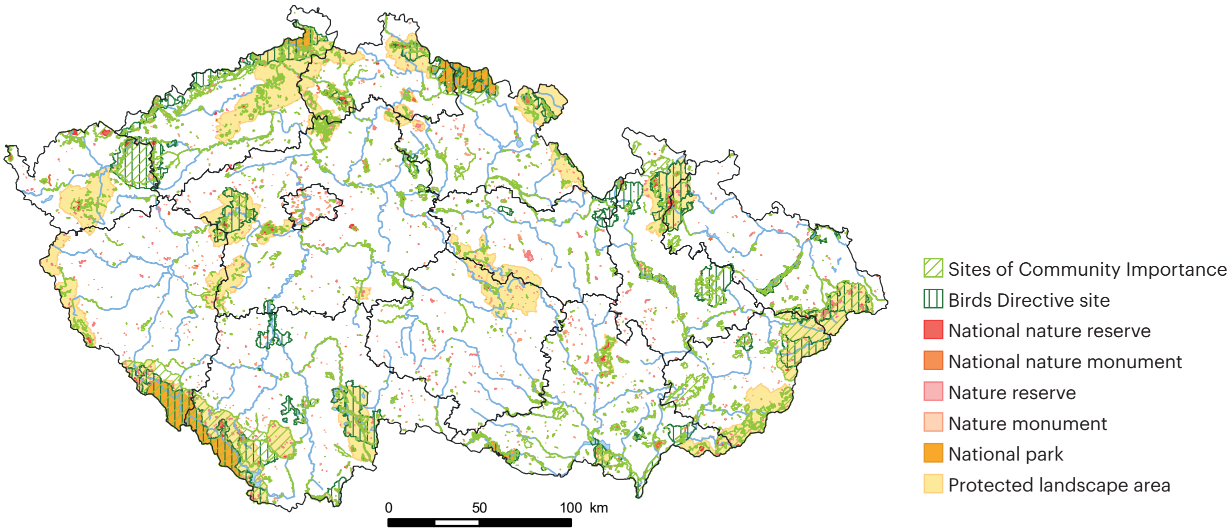
[103] *Data for the years 2018–2021 are not available at the time of publication.*

[104] *Read more: https://portal.nature.cz/redlist/v_cis_vyhl.php?akce=none&choice=1&plny_vypis=1*

[105] *Read more: https://portal.nature.cz/redlist/v_cis_redlist.php?akce=none&choice=1&plny_vypis=1*

Figure 12

Specially protected areas and Natura 2000 sites in Czechia, 2021



Data source: Nature Conservation Agency of the Czech Republic

In the last reporting year of 2019[106], Luxembourg had the highest proportion of protected areas (51.4%) and Finland the lowest (13.2%). In Czechia, 21.9% of the state is protected according to the EEA international comparison.[107]

The **representation of individual habitats in Natura 2000 sites according to cover classes** distinguishes nine habitat types and three cover classes, which express what share of the Natura 2000 site area is occupied by a particular habitat type (or species)[108]. Information is reported for the 2013–2018 period[109]. The majority of covered sites are bogs, mires & fens (71.4%).

3.2.3 | Invasive species

Populations of native plant and animal species and individual valuable communities in Czechia are endangered by the spread of geographically **non-native species**, especially invasive species. Of the total of 1,454 non-native plant species that occur or have been recorded in Czech territory, 61 species are considered invasive[110, 111]. Of the 595 non-native species, 113 are considered invasive. The highest number of invasive species occurs along watercourses and roads that facilitate their spread. Increased numbers of invasive species are also recorded in human settlements and their surroundings. From a geographical point of view, a high number of invasive species occurs in the North-Pannonian sub-province (southern Moravia), where a higher number of endangered plant and animal species are also found.

[106] *Data for the years 2020 and 2021 are not available at the time of publication.*

[107] *Read more: https://www.eea.europa.eu/data-and-maps/daviz/complementarity-between-european-designations-3/#tab-chart_6*

[108] *Read more: https://www.eea.europa.eu/themes/biodiversity/state-of-nature-in-the-eu/article-17-national-summary-dashboards/natura-2000-coverage*

[109] *Data for the years 2019–2021 are not available at the time of the publication due to the indicator methodology.*

[110] *Pyšek P., Danihelka J., Sádlo J., Chrtek J. Jr., Chytrý M., Jarošík V., Kaplan Z., Krahulec F., Moravcová L., Pergl J., Štajerová K. & Tichý L. (2012): Catalogue of alien plants of the Czech Republic (2nd edition): checklist update, taxonomic diversity and invasion patterns. Preslia 84: 155–255.*

[111] *Pyšek P., Chytrý M., Pergl J., Sádlo J. & Wild J. (2012): Plant invasions in the Czech Republic: current state, introduction dynamics, invasive species and invaded habitats. Preslia 84: 575–629.*

3.2.4 | Wildlife conservation in human care

The exploitation of wildlife for international trade is the second-most-serious cause of species loss on our planet, immediately after the destruction of natural habitats[112]. Imports, exports and the number of seizures of specimens in **international trade in CITES-protected endangered species** have shown a steady upward trend. Reptiles are the most-imported group of live animals into Czechia, with 14 thous. individuals in 2021. Birds (mainly parrots, but also raptors for falconry purposes) are the most exported group of animals, with 25 thous. live specimens in total. In recent years, the number of exported artificially cultivated plants has increased sharply (a total of 39 thous. plants were exported in 2021).

Plants (mainly cacti) dominate the live specimens seized due to illegal trade, with 101 specimens seized in 2021. Of the inanimate specimens seized during illegal imports, the majority are invertebrates – corals. In recent years, there has been an increase in the number of seizures of traditional Asian medicine products containing specimens of endangered species.

According to Act No. 162/2003 Coll., the Act on Zoological Gardens, the main mission of zoological gardens is to contribute to the preservation of the biodiversity of wild animals by breeding them in human care, with special attention to the conservation of endangered species, as well as to educate the public about nature conservation. In 2021, 327 **specially protected species of Czech fauna** (326 in 2020, 1,860 endangered species of world fauna (1,872 in 2020) and 71 rare breeds of domestic animals (64 in 2020) were bred **in zoos**. Endangered species of the world's fauna represented the largest number of individuals.

Detailed visualisations and data

https://www.envirometr.cz/data

[112] *More at: www.mzp.cz/cites and https://sysnet.shinyapps.io/CITES_public/*

Financing environmental protection

Financing environmental protection

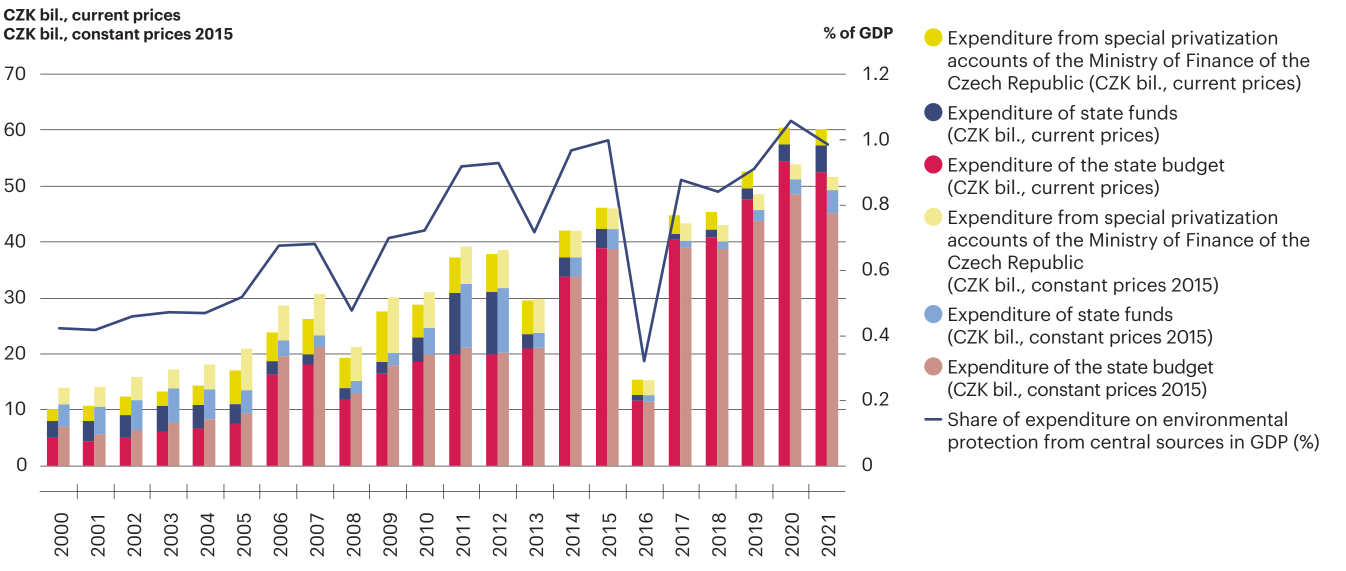
Public expenditure on environmental protection

Funding for environmental protection is an essential prerequisite for improving the state of the various environmental components, and is also an expression of the public need for environmental protection at central and regional level. This need can be quantified not only by the volume of funds spent from the own resources of economic entities, but also by the amount of financial support from public sources, or budgets. Public sources of expenditure on environmental protection include both national sources, i.e. the state budget and state funds (central sources) and territorial budgets of regions and municipalities, as well as related funds from European or international sources[113].

The volume of **environmental protection expenditure from central sources** in 2021 decreased slightly by 0.5% year-on-year to a total of CZK 60.1 bil. (i.e. by 0.07 p.p. to 0.98% of GDP). The volume of funds provided by the **state budget**, as the main central source of expenditure, decreased by 3.4% year-on-year to CZK 52.5 bil. in 2021 (Chart 44). On the contrary, **expenditure from state funds**, among which the State Environmental Fund of the Czech Republic plays a crucial role, increased by 57.6% to CZK 4.8 bil., especially in connection with increased support for water management projects. In addition to the state budget and state funds, the funds of the defunct National Property Fund of the Czech Republic are a specific category of central financing sources in environmental protection, and are managed by the Ministry of Finance of the Czech Republic through its **special privatization accounts** and from which CZK 2.8 bil. was spent in 2021.

Chart 44

Public expenditure on environmental protection from central sources in Czechia [CZK bil., % of GDP, current prices, constant prices 2015], 2000–2021



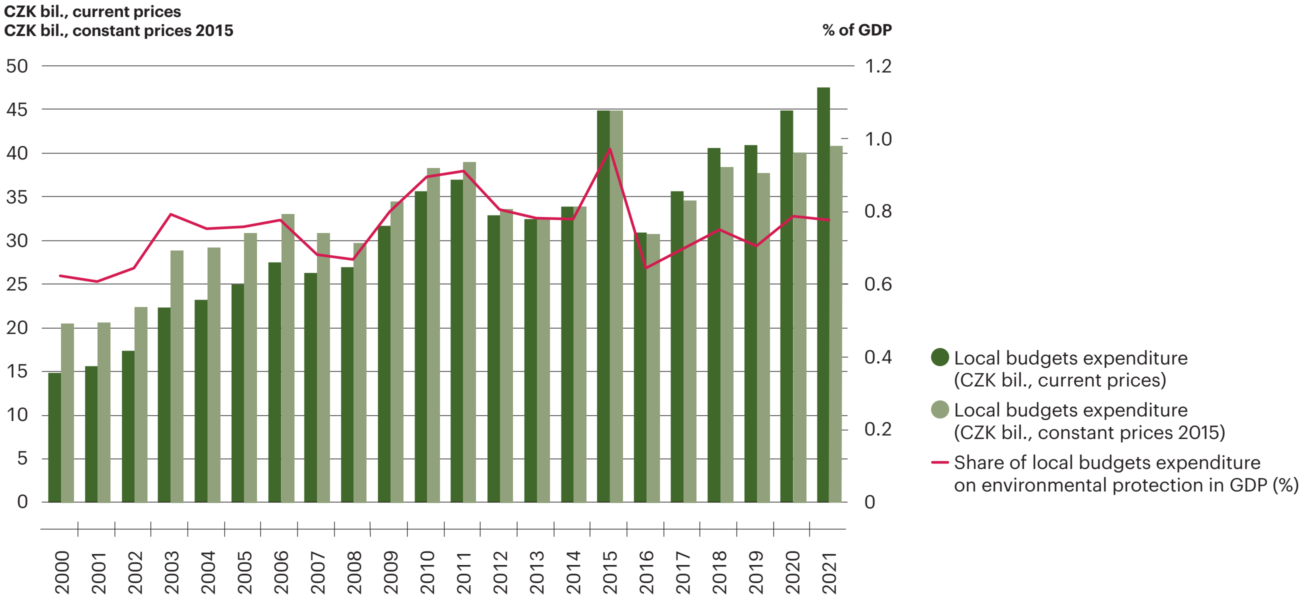
Data source: Ministry of Finance of the Czech Republic, Czech Statistical Office

[113] Information concerning public expenditure is based on the budgetary structure of the Ministry of Finance of the Czech Republic, which also monitors the funds provided primarily for the purpose of creating and protecting the environment over the long term. Given that financial transfers (e.g. from the state budget, state funds, etc.) can also be a source of expenditure for territorial budgets, some of these expenditures are duplicated with expenditure from central sources or European funds. For this reason, expenditure from central sources, territorial budgets and European or international sources is assessed separately and cannot therefore be summarised.

Expenditures of municipal and regional budgets for environmental protection, which are intended to finance ongoing actions implemented based on municipal or regional competence, increased by 5.8% year-on-year to a total of CZK 47.5 bil. in 2021. However, in the context of stronger GDP growth, the share of this expenditure in GDP stagnated or slightly decreased by 0.01 p.p. to 0.78% of GDP (Chart 45).

Chart 45

Public expenditure on environmental protection from territorial budgets in Czechia [CZK bil., % of GDP, current prices, constant prices 2015], 2000–2021



Data source: Ministry of Finance of the Czech Republic, Czech Statistical Office

In terms of programmatic focus, the largest financial support from national sources in 2021 was again directed to air protection and the climate, where the implementation of programmes aimed at supporting insulation, energy savings and changes in heating technologies to reduce air pollution from local heating plants using solid fuels and to reduce greenhouse gas emissions. This includes, for example, the "boiler subsidies" paid to support the replacement of boilers and the **New Green Savings Programme**[114], which received 90,669 applications seeking support of CZK 25.5 bil. during the 2014–2021 programming period. 58,712 claims worth almost CZK 13.5 bil. had been paid out by the end of 2021. Other priority areas of support included water protection and biodiversity and landscape protection. In this area, the majority of the funds were spent on support for protected parts of nature (e.g. through the Landscape Management Programme and the Natural Landscape Function Restoration Programme) and on ensuring the society-wide functions of forests. In territorial budgets, particular attention was paid to the appearance of municipalities and public greenery. Last but not least, the priority areas of public support included waste management, especially the recovery and disposal of municipal waste and waste prevention.

In addition to the national subsidy programmes for environmental protection, mainly administered by the State Environmental Fund of the Czech Republic, public spending on environmental protection has been strengthened since 2004 thanks to **direct EU support and the possibility of co-financing projects from other foreign sources**. At present, these are mainly the Financial Mechanisms of the European Economic Area and Norway, the LIFE and Interreg programmes, and the Swiss-Czech Cooperation Programme. Of the European funds, the Operational Programme Environment is the strongest in terms of subsidies, and is the main source of financing in environmental protection from EU sources, and the Rural Development Programme, the aims of which include the restoration, preservation and improvement of natural ecosystems dependent on agriculture.

The total allocation of the **Operational Programme Environment 2014–2020** (including reallocations) is EUR 2.8 bil. (CZK 71 bil.) of EU funds, respectively EUR 3.3 bil. (CZK 83.8 bil.) of total eligible expenditure. From the

[114] The administrator and payment unit of the New Green Savings Programme is the Ministry of the Environment of the Czech Republic. The State Environmental Fund of the Czech Republic is entrusted with some administrative tasks, especially the selection and assessment of applications.

beginning of the programming period to 31 December 2021, the managing authority of the Operational Programme Environment announced 159 calls and 1 call for financial instruments, of which 4 new calls were announced in 2021 with an allocation of approx. EUR 31.2 mil. (CZK 0.8 bil.) of total eligible expenditure. As of 31 December 2021, from the beginning of the programming period, 15,375 applications for support of approx. EUR 6.7 bil. (CZK 171 bil.) of total eligible expenditure. Based on the subsequent recommendation of the selection committee, 9,470 legal acts have been issued since the beginning of the programming period for the implementation of projects worth EUR 3.5 bil. (CZK 91 bil.) of total eligible expenditure. Of this, approximately EUR 2.5 bil. (CZK 65.3 bil.) of total eligible expenditure has been financed by the subsidy beneficiaries since the beginning of the programming period.

The Operational Programme Environment also finances the **"boiler subsidies"**, in which 3 calls for individual regions were announced for the 2014–2020 programming period with a total allocation of approx. EUR 406.3 mil. (CZK 10.4 bil.) of total eligible expenditure. In all three calls, 107 thous. solid fuel boiler replacements with a total volume of EUR 463.7 mil. (CZK 11.9 bil.) had been approved by the end of 2021. The financial allocation from the Operational Programme Environment was supplemented by CZK 1.5 bil. from the New Green Savings programme.

In 2021, preparations for the new **Operational Programme Environment for the 2021–2027 programming period** were carried out. On 4 October 2021 the programme document of the new programme has been approved by the government of the Czech Republic, the total allocation of the Operational Programme Environment 2021–2027 is approx. CZK 61.2 bil.

The **Rural Development Programme 2014–2020** also implemented support contributing to improving the environment, including in particular agro-environmental-climate measures, organic farming measures, forestry-environmental and climate services and forest protection, Natura 2000 payments and payments for less-favoured areas. In these measures, CZK 9.4 bil. was disbursed from the Rural Development Programme 2014–2020 in 2021.

The implementation of the **Modernisation Fund**, an investment instrument of the European Investment Bank and the European Commission, started in 2021. This fund is aimed at supporting green projects that will significantly reduce Czechia's dependence on burning coal and accelerate the transition to clean energy sources. The investment aims to contribute to the reduction of greenhouse gas emissions through energy savings and the development of renewable energy sources. The allocation of the fund depends on the prices of emission allowances and is estimated at CZK 300 bil. to 2030. In 2021, the State Environmental Fund of the Czech Republic announced seven calls from three Modernisation Fund programmes with a total allocation of CZK 18.3 bil. and started accepting the first applications for support.

In 2021, the acceptance of applications for the New Green Savings programme was completed, while the **successor programme New Green Savings 2021+** was launched, the financing of which will be provided by the State Environmental Fund of the Czech Republic from the resources of the **National Recovery Plan**. The National Recovery Plan is the Czech Republic's plan for reforms and investments to mitigate the impact of the COVID-19 pandemic and restart the economy using funds from the Next Generation EU recovery plan's Recovery and Resilience Facility. In 2021, preparations for the administration of the National Recovery Plan under the so-called components, for which the Ministry of the Environment of the Czech Republic acts as the owner, with a total allocation of almost CZK 25 bil., were underway. In autumn 2021, the first two calls under the New Green Savings 2021+ programme were announced with a total allocation of CZK 11 bil., and two calls within the National Programme Environment for water management in municipalities with an allocation of CZK 1.8 bil. and to support energy savings in public buildings with an allocation of CZK 3.3 bil. By the end of 2021, New Green Savings 2021+ had received 6,649 applications with a total requested support of CZK 1.0 bil. together with 36 applications for about CZK 832 mil. under the National Programme Environment calls.

Within the framework of support for energy savings and emissions reduction, it is also worth mentioning the operational programmes of the Ministry of Industry and Trade of the Czech Republic, especially the **Operational Programme Technologies and Applications for Competitiveness** 2021–2027, the most important area of which is Priority 4 "Transition to a low-carbon economy" with a total allocation of CZK 29.1 bil. The Operational Programme Technologies and Applications for Competitiveness builds on the **Operational Programme Enterprise and Innovation for Competitiveness**, a key programme of the 2014–2020 programming period, under which, for example, 3,882 projects with an allocation of CZK 17 bil. were approved under the specific objective "Energy Savings Programme" giving a saving of about 6 PJ.

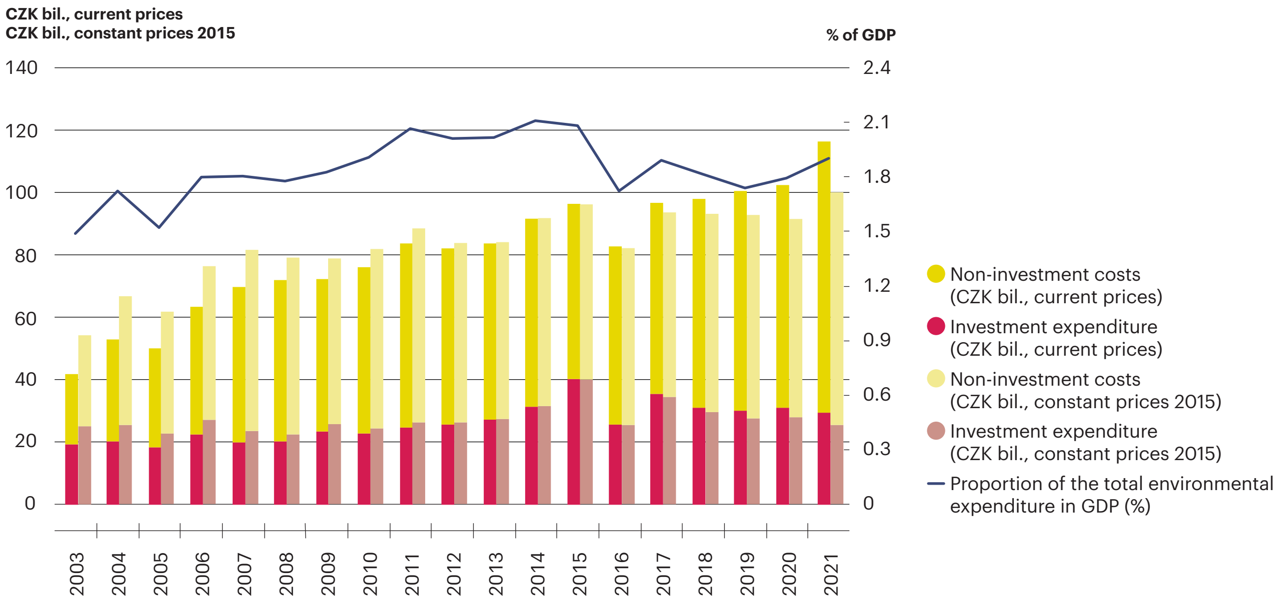
Furthermore, preparations for the **Operational Programme for Equitable Transformation** were under way in 2021. This is targeted support for the most affected regions (coal regions) to mitigate the socio-economic (coal mining decline, economic transformation, etc.) and environmental impacts of the transition. In Czechia, support from the programme with a total allocation of over CZK 40 bil. will be provided to the regions of Karlovy Vary, Ústí nad Labem and Moravia-Silesia, as the regions most affected by the shift away from coal. In November 2021, a call for pre-project preparations for strategic projects under this instrument was announced with a total allocation of CZK 170 mil.

Investments and non-investment costs in environmental protection

An alternative view of the financing of environmental protection is offered by a statistical survey conducted by the Czech Statistical Office, which focuses on the issue of investments and non-investment costs in environmental protection made by both the public and corporate (or private) sectors. In 2021, investments and non-investment costs in environmental protection increased by CZK 14.0 bil. year-on-year, i.e. by 13.7% to CZK 116.3 bil. in current prices (Chart 46). The **total share of investments and non-investment costs to GDP** thus rose by 0.11 percentage points to 1.9% of GDP, mainly thanks to non-investment costs, which has been growing steadily.

Chart 46

Total expenditure on environmental protection in Czechia [CZK bil., % of GDP, current prices, constant prices 2015], 2003–2021



Data source: Czech Statistical Office

However, **investments**, unlike non-investment costs, declined slightly in 2021, by CZK 1.6 bil., or 5.3%, to CZK 29.5 bil., mainly due to lower investment activity in air and climate protection. In investments, expenditure on integrated facilities (i.e. to prevent pollution) continued to outweigh expenditure on terminal facilities (i.e. to remove pollution) in 2021. It is thus possible to note a high level of long-term investment, where an integrated approach to environmental protection is applied based on the principle of introducing and applying BAT and other innovations. The aim of this approach is the gradual modernisation of the production facilities of environmental polluters, leading in particular to the elimination of the negative effects caused by their activities.

From the perspective of the programme focus of investments, the largest investment expenditure in 2021 was on waste water management (CZK 11.9 bil., e.g. in the reconstruction and construction of sewers and waste water treatment plants), and air and climate protection (CZK 6.8 bil., e.g. in reducing industrial emissions) and in waste management (CZK 4.8 bil., e.g. for the collection and transport, respectively the recovery and disposal of, municipal waste). **According to the classification of the investing entity's economic activity (CZ–NACE)**, the greatest share of investments in 2021 were accounted for by the sectors of public administration and defence, and compulsory social security (39.8% of total investments) and water supply, including activities related to waste water, waste and remediation (20.4% of total investments), followed by the energy sector, i.e. the generation and distribution of electricity, gas, heat and air-conditioned air (17.2% of total investments) and the manufacturing industry (15.7% of total investments).

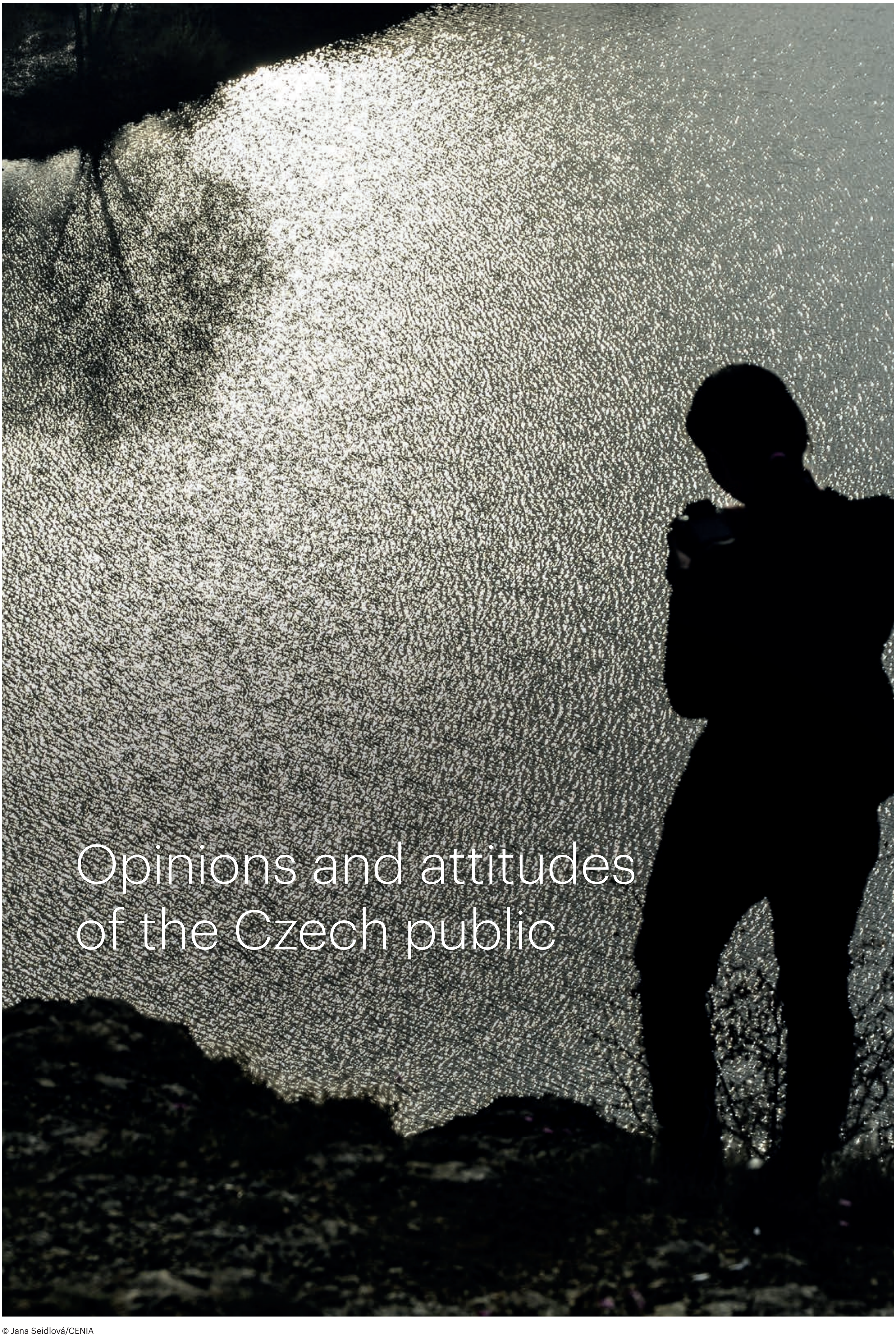
In the case of **non-investment costs or current expenditures**, a long-term increasing trend can be seen. This was also confirmed in 2021, when these costs increased by CZK 15.7 bil. year-on-year (i.e. by 22.0%) to CZK 86.8 bil., and thus continued to form, in addition to investments, a substantial part of the expenditure on environmental protection monitored by the Czech Statistical Office. As in previous years, in terms of programme focus, in 2021 most current expenditure was in waste management (CZK 58.7 bil.) and in waste water management (CZK 15.4 bil.). Other cost-intensive areas are long-term air and climate protection (CZK 5.4 bil. in 2021), as well as soil protection and remediation, and the protection of groundwater and surface water (CZK 3.8 bil. in 2021).

In international comparison of environmental financing, it is possible to compare investments in the Czech Republic in particular, which are above-average in the long term compared to the EU27 average overall, i.e. in the public and corporate (industrial) sectors. While for some new Member States (e.g. Czechia and Hungary), investments in 2019[115] were around 0.7% of GDP at current prices, many of the original Member States did not even reach 0.2% of GDP at current prices (Spain, Finland). The reason for the increased investments in the Czech Republic and other new Member States is primarily the need to comply with the stricter conditions and requirements of the relevant European legislation. The level of investment is also supported by the possibility of drawing on EU funds and other foreign subsidy programmes.

Detailed visualisations and data

https://www.envirometr.cz/data

[115] *Data for the years 2020 and 2021 are not available at the time of publication.*


Opinions and attitudes
of the Czech public

Opinions and attitudes of the Czech public

Regular representative survey of public opinion on Czech society's relationship with the environment

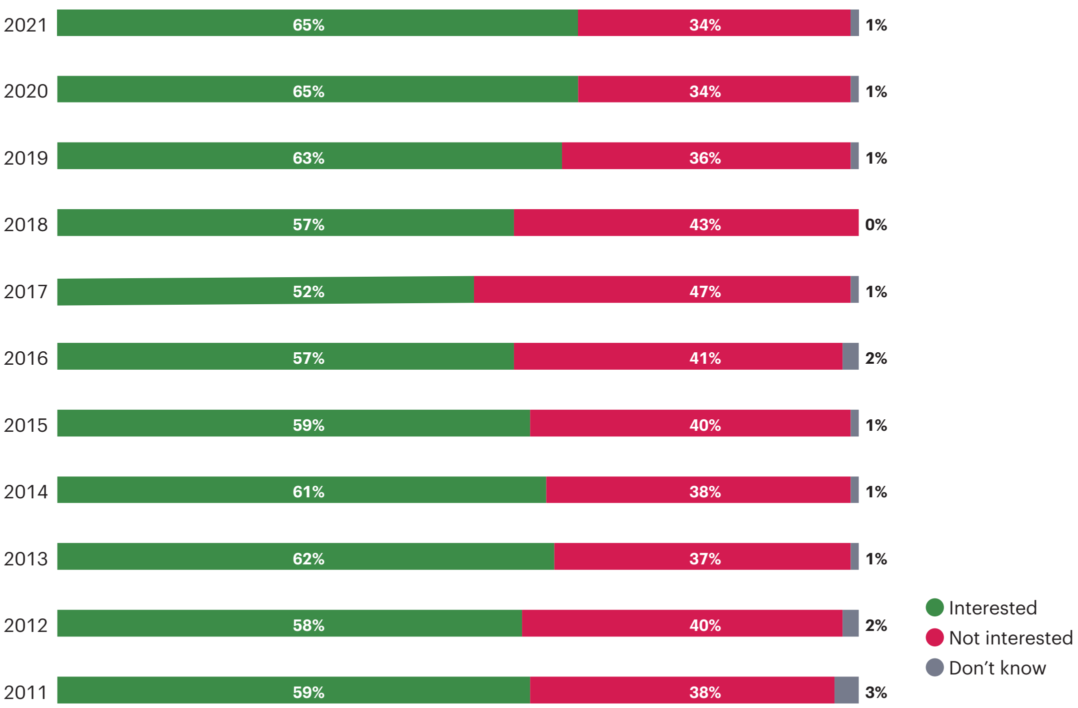
Interest in information about the environment in Czechia

Regular representative sociological surveys conducted by the Centre for Public Opinion Research indicate that less than two thirds of the Czech public were interested in **environmental information** in 2021 (Chart 47). Compared to 2020, the results are similar, with the lowest public interest over the study period (2011–2021) in 2017.

When assessing the **sufficiency or lack of information about the environment** in Czechia, the opinion of the Czech public is not unambiguous, a statistically almost comparable proportion of respondents is of the opinion that there is sufficient (49%) and a lack of (45%) information, while the remaining 6% could not give a clear answer. There have been no statistically significant changes from the previous survey in 2020, but the current sense of information sufficiency has increased slightly to its highest value since the survey began in 2006.

Chart 47

Interest in information about the environment in Czechia [%], 2011–2021



Question asked: Are you interested in information about the environment in the Czech Republic?

Data source: Public Opinion Research Centre, Institute of Sociology, Academy of Sciences of the Czech Republic

Satisfaction with the environment in Czechia

In terms of the state of the environment in 2021, respondents rated the **state in their place of residence** better than the **overall situation in Czechia**. More than three quarters of respondents (76%) expressed satisfaction with the state of the environment in their place of residence, and more than two thirds (69%) in Czechia as a whole, (Chart 48). The number of respondents who were satisfied with the state of the environment in their place of residence and in Czechia as a whole increased year-on-year between 2020 and 2021.

Since the beginning of the monitoring in 2002, at least 70% of respondents have expressed their satisfaction with the state of the environment in their place of residence; the share only dropped slightly below this level in 2004 and 2010. The share of satisfied citizens was highest in 2017, when 79% of respondents expressed satisfaction with the state of the environment in their place of residence. Satisfaction with the state of the environment in Czechia as a whole has long (since the beginning of the monitoring in 2002) been rated by respondents as worse than the environment in their place of residence.

Chart 48

Satisfaction with the state of the environment in Czechia and in the place of residence [%], 2021

Question asked: How satisfied are you with the environment in our country in general and in the place where you live?

Data source: Public Opinion Research Centre, Institute of Sociology, Academy of Sciences of the Czech Republic

Perception of global problems

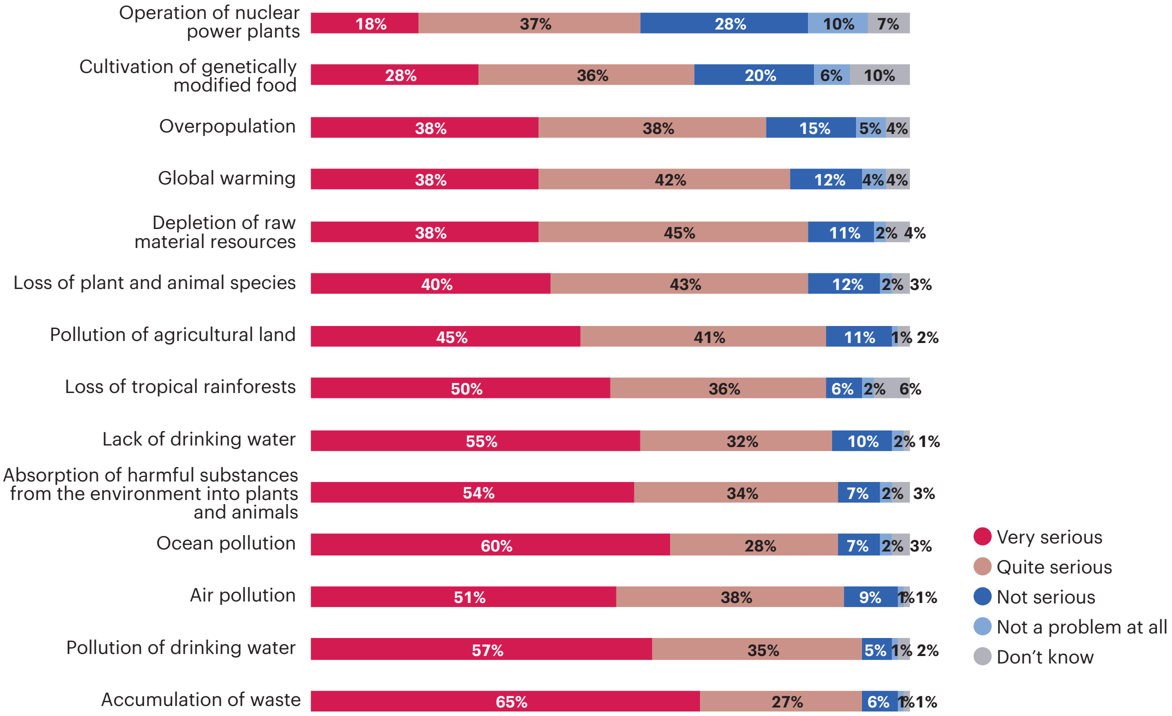
The assessment of selected issues of global phenomena related to human activities and their effects on the environment showed that Czech citizens considered the accumulation of waste and pollution of drinking water to be the most serious problems in 2021 (both phenomena agreed on by 92% of respondents), (Chart 49). The most pressing problem seems to be the accumulation of waste, for which almost two-thirds (65%) of respondents chose the extreme option, i.e. that it is a "very serious" problem, while in the case of drinking water pollution the figure was 57%. The cultivation of genetically modified food is still perceived as a predominantly negative and also society-wide, problem, although it was significantly less frequently identified as a "very serious" problem than the others mentioned. Czech citizens are ambiguous about the operation of nuclear power plants, with more than half of respondents considering it a "very serious" problem, more than three quarters considering it a "not very serious" problem, and a tenth of respondents not considering it a problem (Chart 49).

There were no statistically significant changes compared to the previous survey in 2020, with only the operation of nuclear power plants being considered a very or quite serious problem in 2021 by 55% of respondents, i.e. 5 percentage points more.

There has been a change in the perception of the seriousness of some issues since the start of the monitoring in 2002. In the long term, waste accumulation and pollution of drinking water have been identified as the most serious problems, and in recent years lack of drinking water has been added to the list. The attitudes of Czech citizens towards the loss of rainforests, the pollution of agricultural land, the depletion of raw materials and the loss of species are stable. More than four fifths of the public considered global warming to be a very or quite serious problem in 2006 and 2007, after which it declined to a low of 61% in 2013, and has since increased slightly to the current (2021) four fifths (80%). The share of respondents who rate the cultivation of genetically modified food as a serious problem has, despite various fluctuations, generally followed an upward trend, with just under half (46%) of respondents in 2008 and almost two thirds (64%) in the current survey in 2021. The perception of the operation of nuclear power plants shows an ambiguous trend. A significant fluctuation in the perception of this phenomenon was recorded in 2011, when the highest-ever proportion of respondents (60%) identified it as a very or quite serious problem, while this was connected to the Fukushima nuclear power plant accident.

Chart 49

Severity of global problems [%], 2021



Question asked: How would you rate these phenomena? a) loss of tropical rainforests, b) pollution of drinking water – lakes, groundwater, c) accumulation of waste, d) operation of nuclear power plants, e) pollution, degradation of agricultural land, f) loss of plant and animal species, g) global warming, h) lack of drinking water, i) depletion of raw material resources, j) overpopulation, k) cultivation of genetically modified food, l) air pollution, m) ocean pollution, n) absorption of harmful substances from the environment into plants and animals people then eat.

Data source: Public Opinion Research Centre, Institute of Sociology, Academy of Sciences of the Czech Republic

Irregular representative survey of public opinion on the relationship of Czech society to the environment

Czech public opinion on climate change

According to the Czech Climate 2021[116] survey, the **awareness of the Czech public** about climate issues, both in understanding climate change and the issues of greenhouse gas emissions and the energy sector in Czechia, is **very low**. For example, 72% of respondents incorrectly believe that the hole in the ozone layer contributes to climate change, while 55% of respondents incorrectly believe that all gases in the atmosphere are greenhouse gases. Conversely, only 24% of respondents know that Czechia is one of the largest electricity exporters in the EU (42% do not know), and only 7% know that Czechia produces more greenhouse gas emissions per capita than India, China or the UK.

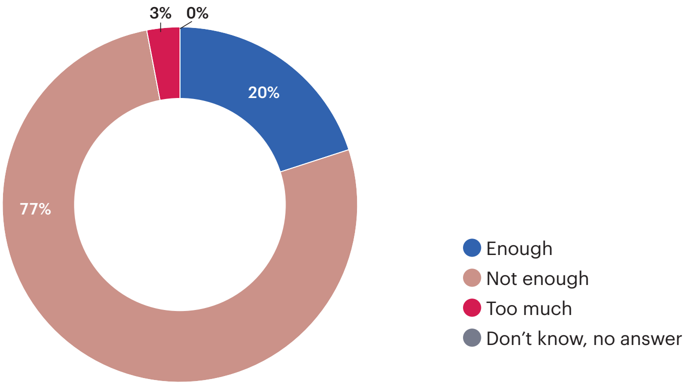
[116] *Krajhanzl, J. et al. (2021): Czech Climate 2021. Map of Czech public opinion on climate change. Department of Environmental Studies at Masaryk University Faculty of Social Studies, in cooperation with Green Dock, z.s.*

Despite this low level of awareness of climate issues, almost two thirds of respondents in Czechia considered **climate change to be a very serious problem** in 2021 (64%), according to a Eurobarometer survey. However, this is a lower share in the EU-wide terms, as EU27 respondents overall considered climate change a very serious problem in more than three quarters of cases (78%).

More than two thirds of respondents in Czechia believe that national governments are responsible for **addressing climate change** (70%), with only one fifth of respondents believing that the government is doing enough to address climate change and, conversely, more than three quarters of respondents (77%) believe that the government is not doing enough to address climate change (Chart 50).

Chart 50

Addressing climate change by the national government [%], 2021



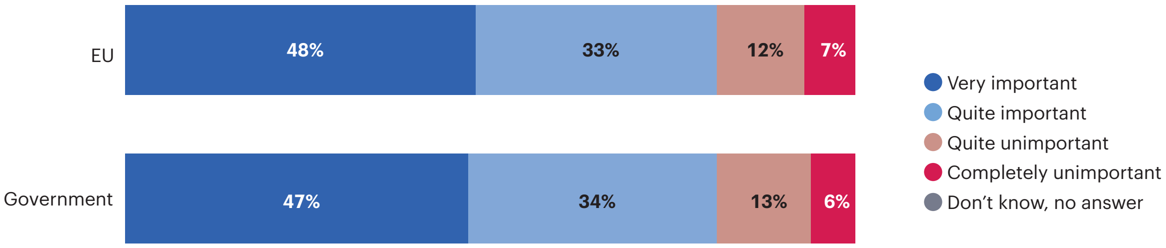
Question asked: Do you think the (NATIONAL) government is doing enough, not doing enough, or doing too much to address climate change?

Data source: Eurobarometer 513

More than four fifths of respondents (81%) in Czechia think it is important that the national government and the EU set targets that are ambitious enough to increase the amount of renewable energy by 2030 (Chart 51).

Chart 51

Importance of setting renewable energy targets to 2030 [%], 2021



Question asked: How important do you think it is for the following authorities to set ambitious targets to increase the amount of renewable energy, such as wind or solar energy, by 2030?

Data source: Eurobarometer 513

Detailed visualisations and data

https://www.envirometr.cz/data

Assessment methodology for trends and state

Each chapter includes an assessment of the state and trend at the level of the strategic objectives of the State Environmental Policy 2030 according to the relevant indicators of the Report on the Environment of the Czech Republic (clear graphics supplemented with graphs, possibly maps and a brief text assessment).

The assessment methodology is based on the statistical analysis of trends (linear regression parameters – trend direction and the statistical significance value) and is used in cases where a homogeneous time series is clearly defined (data for each year without any major change in the data reporting methodology).

Time horizon of the trend:

Trend	Period
Short-term	last 5 years
Medium-term	last 10 years
Long-term	last 15 years and over [117]

The assessment is carried out on three levels:

1. Trend at the level of individual quantities

The assessment of individual quantities of a given indicator (e.g. NO_X emission quantity) is made on the basis of linear regression parameters (linear regression equation $Y = ax + c$, $R^2 = \{0,1\}$).

The time series is converted into an index (percentage) series where the assessed trend start is 100 (e.g. the long-term trend of NO_X emissions in 1990 = 100). The *values* of *a* and R^2 are calculated for each variable.

The *value a* is a linear trend direction that expresses how a quantity has been decreasing or rising since the beginning of the measurement. It is a dimensionless number comparable across all other quantities since it is not dependent on absolute values (the index series removes the influence of units and the actual sizes of numbers), and describes the trend curve from the linear regression parameters. The *value a* indicates the change in % per year.

R^2 is the significance value (determination, $R^2 = \{0,1\}$). R^2 expresses whether the trend is really linear.

The resulting values are converted into the verbal assessment table and used in the text of the assessment of individual quantities, i.e. the result of the calculation is a numerical value used as a basis for verbal assessment in the text.

Value of the *index a* (linear trend direction)	Verbal assessment in the text
0 to +/- 0.5% per year	stagnation
+/- 0.5 to +/- 1% per year	slightly upward/downward trend, gradual trend
+/- 1 to +/- 3% per year	upward/downward trend
+/- 3 to +/- 10% per year	significantly upward/downward trend
over +/-10% per year	very significantly upward/downward trend

[117] *For a time series in a long-term trend, a minimum of 15 years (but no earlier than 1990) is required.*

2. Trend of indicators

The **trend of individual indicators** is assessed by determining the trend of the individual variables from which the indicator is constructed. The aggregate trend is assessed by aggregating the indicator scores composed of time series of individual variables. For individual indicators, the variables entering into the aggregate trend assessment, the chosen aggregation method, and other parameters for the trend assessment are listed in the specific indicator sheets available on the portal https://www.envirometr.cz. A fluctuating trend is established for an aggregate trend when a majority of the number of individual variables has a coefficient of determination less than 0.5. A trend cannot be assessed if there is no time series over a given time period. Structure indicators (e.g. waste treatment structure, municipal waste treatment, etc.) are inherently trendless.

Graphical representation of the aggregate trend		
Positive upward trend	Stagnation	Negative upward trend
Positive downward trend	Fluctuating trend	Negative downward trend
N/A The trend cannot be determined		

Graphical representation of the trend in the structure indicator		
Positive trend	Neutral trend	Negative trend

3. State assessment

State is assessed using the expert estimation method, based on the distance to the target in a given year or generally accepted assumptions. If a target is not set, the general trend is assessed to see whether the development is heading in the right direction and whether the advancement is adequate. The parameters for assessing the state are given in specific indicator sheets available on the portal https://www.envirometr.cz.

Graphical representation of the state		
Good state	Neutral state	Bad state
N/A The state cannot be determined		

List of abbreviations

AOT40 Accumulated Ozone exposure over a Threshold of 40 ppb
B(a)P benzo(a)pyrene
BAT best available techniques
BOD_5 biochemical oxygen demand over five days
CENIA Czech Environmental Information Agency
CNG compressed natural gas
COD_{Cr} chemical oxygen demand by potassium dichromate
COD_{Mn} chemical oxygen demand by potassium permanganate
CZ-NACE Statistical Classification of Economic Activities in the European Community (Nomenclature statistique des activités économiques dans la Communauté européenne)
DDT dichlorodiphenyltrichloroethane
DMC domestic material consumption
DNA deoxyribonucleic acid
EEA European Environment Agency
EGD European Green Deal
ETBE ethyl tert-butyl ether
EU European Union
EU27 Member States of the European Union (without the United Kingdom)
EU28 Member States of the European Union (including the United Kingdom)
EU-ETS European Union Emission Trading Scheme
Eurostat European Statistical Office
FAME fatty acid methyl esters
FSC Forest Stewardship Council certification system
GDP gross domestic product
HA high annoyance
HCB hexachlorobenzene
HCH hexachlorocyclohexane
HSD high sleep disturbance
LPIS Land Parcel Identification System
LULUCF land use, land-use change and forestry
LV limit value
p.p. percentage point
PAH polycyclic aromatic hydrocarbons
PCB polychlorinated biphenyls
PEFC Programme for the Endorsement of Forest Certification schemes (certification system)
PM particulate matter
RES renewable energy sources
SECAP Sustainable Energy and Climate Action Plan
SHARES Short Assessment of Renewable Energy Sources
SUMP Sustainable Urban Mobility Plan
TOC total organic carbon
USLE Universal Soil Loss Equation
VOC volatile organic compound
WEI water exploitation index
WWTP waste water treatment plant

2021