Report
on the Environment of the Czech Republic

cenia

Ministry of the Environment
of the Czech Republic

Drawn up by:
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Czech Environmental Inspectorate
Czech Gas Association
Czech Geological Survey
Czech Hydrometeorological Institute
Czech Office for Surveying, Mapping and Cadastre
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Research Institute for Soil and Water Conservation, public research institution
Road and Motorway Directorate of the Czech Republic
State Environmental Fund of the Czech Republic
T. G. Masaryk Water Research Institute, public research institution
Transport Research Centre

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Introduction

The Report on the Environment of the Czech Republic (hereinafter 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, and submitted for approval to the Government of the Czech Republic and subsequently submitted to the Chamber of Deputies and the Senate of the Parliament of the Czech Republic for discussion.

It is a comprehensive evaluation document, which assesses the state of the environment in the Czech Republic, including the entire context, on the basis of the data available in the given year of assessment.

Starting with the Report on the Environment of the Czech Republic for the year 2005, CENIA, Czech Environmental Information Agency, is responsible for drawing it up.

The Report for the year 2016 was discussed and approved by the Government on 30. 11. 2017 and then provided to both chambers of the Parliament of the Czech Republic for discussion.

The Report is also published in electronic form (http://www.cenia.cz and http://www.mzp.cz) and it is distributed at the same time on a USB flash drive, along with the Statistical Environmental Yearbook of the Czech Republic 2016 and Reports on the Environment in the Regions of the Czech Republic 2016.

Methodology

The Report on the Environment (hereinafter as "Report") is the basic environmental reporting document in the Czech Republic. The methodology of the report did not change significantly in the period 1994–2008 and therefore the document was published in a similar form, only with minor changes. Due to the needs and demands for information and technical support for the formulation and implementation of environmental strategies by the Ministry of the Environment, a modification in the methodology of the Report was made in 2009 in order to better reflect the requirements of these agents and to provide the relevant conclusions for policy decisions. The Report is normally based on authorised data obtained from monitoring systems, statistical surveys, national inventories and updates of territorial registers administered by organizations both within and outside the governance of the Ministry of the Environment. Data for international comparison are provided by Eurostat, the European Environment Agency (EEA) and also the Organisation for Economic Co-Operation and Development (OECD).

Use of indicators to describe the state of the environment

The methodological basis of the Report is represented by the indicators, i.e. the indicators with precise methodology and linked with the Czech Republic's main environmental topics and objectives of the State Environmental Policy of the Czech Republic 2012–2020. The data collection and the creation of the indicators laid down in the current State Environmental Policy of the Czech Republic 2012–2020 have not yet been fully provided and the Report therefore contains a selection of available indicators. Environmental Indicators are among the most commonly used environmental assessment instruments. Based on data, they demonstrate the state, specifics and development of the environment and can indicate newly arising environmental problems. Assessments on the basis of indicators are clear and user-friendly. The indicator-based assessment methodology follows the methodological trends used in the EU and is thus in accordance with the reporting at both national and European levels.

Environmental assessment using a set of key indicators

The formation and development of a set of key indicators stemmed from the need to identify a small range of politically relevant indicators, which together with other information respond to the selected priority policy issues and address major current issues. The set is therefore an effective tool for drawing up the Report and for evaluating the fulfilment of the objectives and priorities of State Environmental Policy of the Czech Republic 2012–2020.

The set of key indicators is selected and updated in accordance with the following criteria:
- relevance to the current environmental problems;
- relevance to the current State Environmental Policy, strategies under implementation and under preparation, and international commitments;
- availability of high-quality and reliable data over a long period of time;
- relation to sectoral concepts and environmental aspects;
- "cross-cutting" nature of the indicator – the effort to capture as many causal links as possible, i.e. indicator selected in order to represent both the causes and consequences of other phenomena;
- link to indicators defined at the international level and detailed at the EU level.

The proposed set of indicators is not static, but is constantly being adapted to the needs of the current State Environmental Policy of the Czech Republic 2012–2020, to environmental problems and the availability of the source data sets. The overall structure has been extensively modified in the presented Report for 2016.

The Report 2016 is made up of thematic units that cover the particular environmental compartments and economic factors that affect the state of the environment: Climate system, Air quality, Water management and quality of water, Nature and landscape, Forests, Land and agriculture, Industry and energy, Transport, Material flows, Waste and Financing. These thematic units are further broken down to individual indicators.

Each thematic unit of the Report 2016 is, unlike in the previous reports, introduced with short information pointing out the importance of the theme, and also evaluating the possible effects of the state and development of the individual environmental compartments and other factors on human health and ecosystems, which the theme in question deals with. In summary, for each thematic unit, the introduction also provides an overview of the current conceptual, strategic and legislative documents, including the binding targets resulting therefrom. Each thematic unit is further divided into individual indicators that are evaluated in a similar structure as was used in the reports for the years 2008–2015. Each indicator is accompanied with a key question, key messages, followed by a graphic and text evaluation.

Each thematic unit (except for the thematic unit Waste) is concluded with an international comparison which enables a comprehensive assessment of the status of the Czech Republic in the global context of the theme.

In the Report 2016, the former thematic unit Air quality and climate is divided into thematic unit Climate system and thematic unit Air quality. Thematic unit Climate system includes Temperature and precipitation conditions, a newly included indicator Run-off conditions and the state of groundwater in the context of climate change, and indicator Greenhouse gas emissions. Thematic unit Air quality no longer contains the individual indicators Emissions of acidifying substances, Emissions of ozone precursors and Emissions of primary particulate matter and precursors of secondary particles, but contain indicator Pollutant emissions and indicator Emissions of heavy metals. The Report 2016 has also divided three thematic units previously named Nature, Land and landscape, Agriculture into two thematic units Nature and landscape, Land and agriculture. Indicator Landscape fragmentation has been expanded in the Report 2016 with evaluation of the homogenization of landscape. Indicator Nature protection is extended to evaluate the occurrence of specially protected species and invasive species in the territory of the Czech Republic. In the 2016 Report, thematic unit Transport has been extended with indicator Energy and fuel consumption in transport. Thematic unit Waste and material flows has been separated into two thematic units Material flows and Waste.

The Report 2016 is, similar to the Report 2015, supplemented with a brief overview of the involvement of the Czech Republic in various international activities in the field of the environment and newly includes the final thematic part Strategies and policies in the environmental sector, dedicated to their brief introduction and evaluation, in particular the mid-term evaluation of the State Environmental Policy of the Czech Republic 2012–2020 and the National Emission Reduction Programme of the Czech Republic.

Availability of data sets

With respect to the Report's preparation schedule, some data are not available as of the submission and closing date for publication. Availability of data used for international comparison is affected by partial reporting deadlines and the subsequent verification and validation of data. For that reason, the international data are not available in most cases for the given year of the assessment of the Report.

Indicator assessment structure

Each indicator in the Report is presented in a short introduction in the form of the key issue and the main key messages and also in the form of summative evaluation using graphical icons. This is followed by the actual evaluation of the indicator with graphical elements and its text evaluation.

Meanings of emoticons

The trend is developing positively, in accordance with the objectives set.

The trend is developing neither positively nor negatively and can be referred to as stagnating.

The trend is developing negatively, not in accordance with the objectives set.

N/A It cannot be evaluated.

Key messages of the Report

The development of the state of the environment in the Czech Republic in 2016 was affected by economic growth. The Czech economy is characterized by a higher proportion of industry, which has a long-term effect on the development of direct environmental burden. A positive finding, however, is the continued decrease in energy and material intensity of the Czech economy – to create a unit of economic output, less pollution is produced than in the past. Despite the growth of the economy, the state of the environment of the Czech Republic remained stabilized in 2016.

The preservation and in many respects even improvement of the state of the environment is the result of long-term financial support channelled to the individual components of the environment, and also the result of meeting the international and national legislative and strategic goals. A more significant and continuous improvement of the state of the environment in the Czech Republic was hindered, however, by the increasing demands of the consumer society and the growth of industrial production on the consumption of raw materials and energy. Another important factor affecting the state of the environment in the Czech Republic is the development of hydrometeorological conditions that are, in the context of climate change, more volatile with more frequent occurrence of hydrometeorological extremes.

Air quality in the Czech Republic stagnated in 2016. From the perspective of the impact on human health, air quality was unsatisfactory mainly in areas where multiple sources of pollution such as transport, local domestic heating, industrial production, and also the pollution from abroad are combined.

Water management has not been significantly impaired in spite of continued drought, the amounts of water abstraction and waste water discharge returned to the original trend after the upswing in 2015. While the quality of bathing water is permanently improving, the quality of water in streams varies, depending on the current meteorological conditions and among other influences on the extent of use of mineral fertilizers and agrochemicals in agriculture or on the degree of dilution of the discharged wastewater from stationary sources. An increasing problem is the quality of groundwater. One of the ways to reduce the pollution of water and other environmental components is, next to further reduction of industrial and municipal pollution, also to reduce pollution by chemical substances used in agriculture and to respect the principles of their correct application. It is also important to support organic farming which is relatively well developed in the Czech Republic, but it is desirable to further increase the proportion of organically farmed land, particularly arable land.

Acreage of arable land within the agricultural land resources dropped even in 2016 in favour of permanent grassland, which is positive from the perspective of protection against erosion, protection of water quality and water retention in the landscape and biodiversity conservation. Nevertheless, the total acreage of the agricultural land resources in the Czech Republic has been falling in the long term, especially in favour of built-up areas. Their increase, significantly influenced by the development of transport infrastructure, causes negative fragmentation of the landscape and the loss of suitable habitats.

The total area of forest land grew in 2016, in addition, the species composition of forest stands held the trend of gradual approximation to the natural structure of the forests. However, forest stands are still threatened primarily by cloven-hoofed game and wild boars, and also by a high degree of defoliation.

Despite the fact that industrial production grew in 2016, the electricity production and also final energy consumption continues to fall. The overall energy and material demands of the economy continue to decrease. However, consumption of energy in transport is increasing, still, the transport performance of the environmentally more favourable railway is growing both in passenger and freight transport.

In 2016, waste generation decreased after the previous marked increase in 2015, and waste treatment applies principles of circular economy with an emphasis on material recovery.

A key prerequisite for the improvement of the state of individual components of the environment is also its financial support. Most funding has been channelled in the long term to protection of the water, or waste water management, to waste management, and last but not least to the protection of air and climate, in the context of which the implementation continued in 2016 of programmes supporting thermal insulation, energy savings and heating technology replacements (e.g. the New

Green Savings Programme or the so called boiler subsidies). The volume of funding spent by the state budget and local budgets, however, dropped significantly in 2016 due to closing the previous Operational Programme Environment 2007–2013 and the gradual take off of the subsequent Operational Programme Environment 2014–2020, with a smaller financial allocation.

Main findings of the Report

Climate system

- In terms of temperature, the year 2016 was significantly above-normal on the territory of the Czech Republic, the average annual temperature 8.7 °C was higher by 1.2 °C than long-term normal in 1961–1990. It was the eighth warmest year since 1961. Precipitation was normal in 2016 in the Czech Republic.
- Hydrological drought continued in the territory of the Czech Republic, especially in Eastern Bohemia and North Moravia.
- Greenhouse gas emissions in the Czech Republic in the period 1990–2015[1] fell by 35.1% to 127.1 Mt CO_2 eq. (without LULUCF and indirect CO_2). Compared to 2015, however, emissions grew by 1.0%, which represents 1.3 Mt CO_2 eq.
- Emission intensity of the Czech economy is steadily decreasing.

Air quality

- In 2016, SO_2 emissions decreased year-on-year by 12.8% and NO_x emissions by 4.4%. Dust and VOC emission production stagnated in 2016, compared with the previous year, and CO emissions production grew by 4.9% and NH_3 emissions by 2.4%. In the period 2000–2016, the greatest decline was in SO_2 emissions by 52.0%, NO_x by 46.0%, VOC emissions by 42.1%, TSP emissions by 37.0%, CO emissions by 25.7% and emissions of NH_3 by 15.9%.
- All monitored heavy metals emissions declined between 2005 and 2015, the most significant decline was observed in the nickel emission by 58.2% and lead by 47.9%.
- In 2016, the limit values for benzene, arsenic, nickel, lead and cadmium were not exceeded in any of the monitored sites. The limit values for sulphur dioxide and carbon monoxide have not been exceeded.
- Air pollution limits for suspended particulates PM_{10} a $PM_{2.5}$, benzo(a)pyrene and ground-level ozone have been exceeded repeatedly in the burdened localities of the Czech Republic in 2016.

Water management and water quality

- Total abstractions of (surface and ground) water grew in 2016 year-on-year by 2.0% to 1,634.9 mil. m^3. Compared to 2000, abstractions decreased by 9.4%.
- Water consumption in households has stabilized, in 2016 totally 88.3 l per person per day was consumed, which is more by 0.4 l per person per day than in 2015. In comparison with 2000, however, consumption decreased by 17.8%.
- In 2016, the volume of discharged waste water increased by 4.9% year-on-year to 1,700.8 mil. m^3.
- The volume of discharge phosphorus (P_{total}) decreased year-on-year by 6.4% to 1,058 t and of suspended solids by 5.2% to 9,417 t.
- In 2016, 84.7% of the population of the Czech Republic was connected to a public sewer system, which is by 0.5 percentage points more than in 2015 and by 8.9 percentage points more than in 2000.
- In 2016, the Czech Republic operated a total of 2,554 wastewater treatment plants, which is by 2.4% more than in 2015 and 2.1 times more than in 2002. The number of WWTPs with tertiary treatment amounted to 1,382 in 2016, which is by 6.0% more than in 2015 and 2.8 times more than in 2002.
- According to the cumulative assessment of the basic indicators tracked pursuant to the national standard CSN 75 7221, the water quality in the monitored watercourses of the Czech Republic is satisfactory, but still a big part of streams is assessed by class III (polluted water) and worse.
- As opposed to the year 2000, concentrations significantly decreased in 2016 for $N\text{-}NH_4^+$ (by 64.2%), phosphorus (by 41.9%) and BOD_5 (by 24.6%) in the watercourses on the monitored profiles. In particular, the concentration of chlorophyll decreased year-on-year (by 19.1%).
- The quality of bathing waters improved at the monitored sites. In 2016, 138 sites had water suitable for bathing (i.e., 53.5%, which is by 8.9 percentage points more than in 2015).
- Contamination has been found in a number of samples of groundwater, especially with ammonium ions (11.8% of the samples exceeded), nitrates (10.6% of the samples exceeded), and pesticides and their metabolites (28.2% of the samples exceeded the limit for the sum of pesticides).

[1] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Nature and landscape

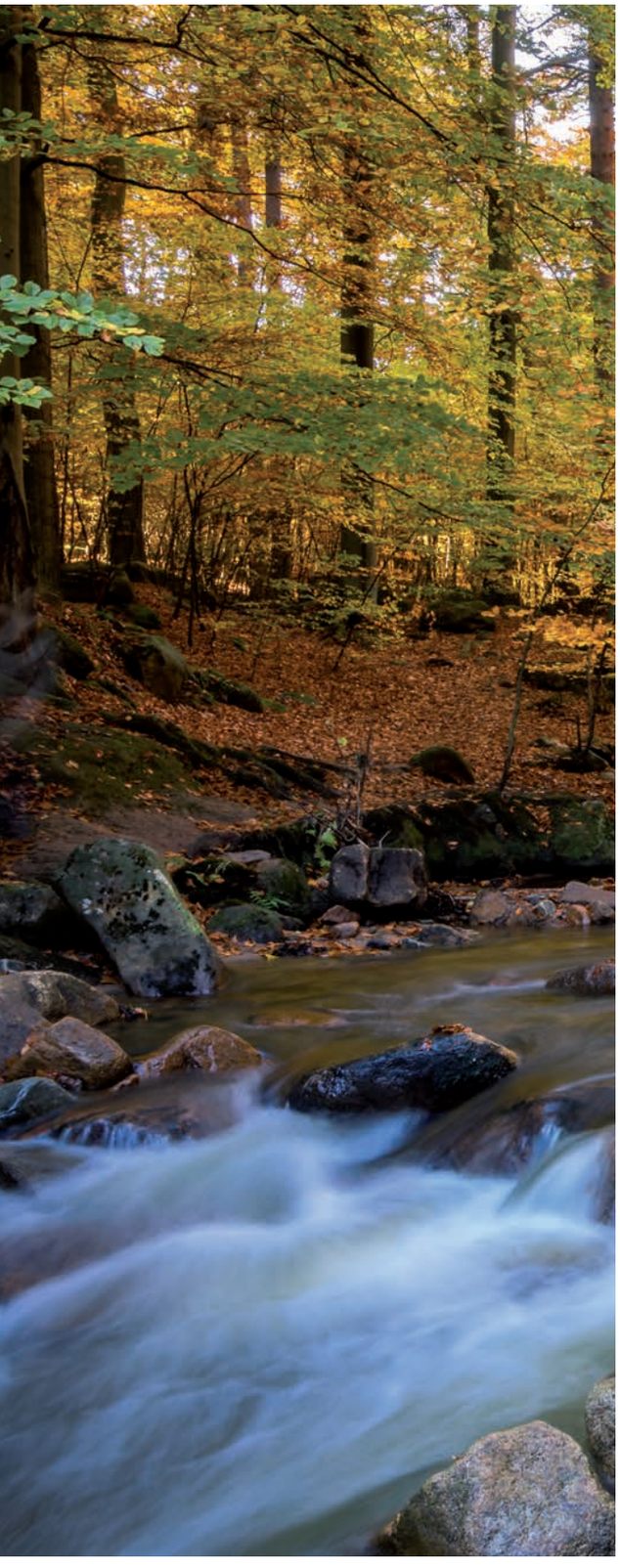
- In 2016, year on year in the agricultural land fund, the area of permanent grassland increased by 0.3% to 12.7% of the territory of the Czech Republic and the acreage of arable land decreased by 0.2% to 37.6% of the territory. The total acreage of the agricultural land fund in the Czech Republic in the period 2000–2016 decreased by 1.5% to 53.4% and year-on-year by 0.1%.
- The size of the built-up and other areas increased by 0.2% between years 2015 and 2016, since the year 2000 it grew by 4.1%.
- The decrease in the number of unfragmented areas is slowing down, still, the landscape fragmentation process continues.
- In 2016, 23.0% of the area of the Czech Republic was spatially protected, both through specially protected areas and NATURA 2000 sites.
- In 2016, 8 rescue programmes were implemented for the most vulnerable specially protected species: marsh angelica, sand pink – Czech variant, long-stalked pondweed and Gentianella praecox from the realm of plants, and for freshwater pearl mussel, Aesculapian snake, European ground squirrel and Eurasian otter from among animals.
- Since 1982, the population levels of common bird species in the Czech Republic have continued to decline, and in overall, between the years 1982–2016 they decreased by 5.4%. The population levels of woodland bird species decreased by 14.9% in total and population levels of birds in the agricultural landscape dropped by 33.5%.

Forests

- The damage to forest stands in the Czech Republic expressed as a percentage of defoliation still remains high. In 2016, in the category of older stands (60 years and more), 74.8% of conifers and 41.9% of deciduous trees were damaged. In 2000, older stands were damaged in 64.8% for conifers and in 25.8% for deciduous trees. In younger stands (up to 59 years), the situation was more favourable, in 2016, 25.7% of conifers and 22.4% of deciduous trees were damaged. The level of damage in the younger stands in the year 2000 was 19.4% for conifers and 15.1% for deciduous trees.
- The proportion of deciduous trees in the total forest area of the Czech Republic gradually increases, in 2016 it accounted for 26.7% of the total forest area, in 2000 it was 22.3%.
- Between 2015 and 2016, the total area of forest land grew by 1,380 ha, and the area of forest was 33.0% of the territory, in the year 2000, forests accounted for 32.7% of the territory of the Czech Republic.

Land and agriculture

- On the Czech Republic's territory, 56.7% of agricultural land is potentially threatened with water erosion, of that 17.8% with extreme erosion. Wind erosion is a threat for 18.3% of agricultural land.
- In 2016, the territorial analytic documents registered 9,307 contaminated sites, including sites registered in the incremental database Evidence System of Contaminated Sites (4,927 sites).
- The consumption of mineral fertilisers slightly increased year-on-year by 2.9% to 141.1 $kg.ha^{-1}$. However, there has been a significant increase compared to the year 2000 by 85.9%.
- The consumption of livestock manure slightly decreased year-on-year by 4.0% to 69.2 $kg.ha^{-1}$. The consumption of plant protection products stagnated in 2016 compared to 2015 (increased by 0.5% to 4.9 thous. t). The consumption of calcium materials that enhance the production capability of the soil decreased by 9.5% to 258.0 thous. t.
- In monitoring the content of risk elements and substances in the soil, it was found in 2016 that the prevention values were exceeded for all persistent organic pollutants except for HCH. The highest share in the excess was recorded in PAH (20.0%).
- In 2016, the Czech Republic had already 4,243 organic farmers, which is by 3.6% more than in 2015 and 7.5 times more than in 2000.
- The proportion of organically farmed land is growing. In 2016, 506.106 ha, i.e. 12.0% of the total area of the agricultural land fund was organically farmed. The share rose year-on-year by 1.9% and in comparison with the year 2000 it increased 3.1 times.



Industry and energy sector

- In the period 2000–2016, the total mining in the Czech Republic decreased by 25.1%, year-on-year by 3.4%. The area affected by mining in the Czech Republic is decreasing every year, and on the other hand, the amount of reclaimed areas is increasing. In the year 2001, unreclaimed areas had 825 km^2, in 2015 they had only 550 km^2. By 2016, the acreage of unreclaimed areas further decreased to 538 km^2.
- The industrial production in 2016 increased year-on-year by 3.5%.
- In the period 2010–2015, final energy consumption decreased from 1,058.0 PJ to 1,010.2 PJ, however, year-on-year it slightly grew (by 2.8%).
- Energy intensity of the Czech economy has a decreasing trend, since 2010 it has declined in total by 13.6%. The transportation, agriculture and industry sectors represent the most significant proportion in the economy's energy intensity.
- In the Czech Republic in 2016, households were heated predominantly by the heat supply system (35.7%) and natural gas (34.8%). Solid fuel heating is not falling (15.0%).
- Combustion heaters have a major impact on air emissions. In 2015, the total emissions of PM_{10} were generated by household heating in 36.4%, the total emissions of B(a)P even in 97.3%.
- Electricity production decreased by 0.7% in 2016. Half of the electricity is produced in the Czech Republic from coal (50.4%), another important source is the nuclear fuel (28.9%), other fuels or resources have lower shares, in the order of percents.
- Foreign trade with electricity in 2016 had an export character. The balance of exports and imports for the whole year amounted to 11.0 TWh, which corresponds to 12.3% of the overall amount of electrical energy produced in the Czech Republic.
- The production of electricity from renewable energy sources has stagnated since 2014 at the value of 9,300 GWh per year.

Transportation

- The total performance of passenger transport is growing, in 2016 it increased year-on-year by 4.5% to 119.0 bil. passenger-kilometres (pkm), since 2000, the performance of passenger transport grew by 17.3%. Railway performance is steadily growing in passenger transport, in 2016 it rose by 6.6% to 8.0 bil. pkm. The share of public passenger transport in the Czech Republic in 2016 in the overall performance of passenger transport (without air transport) was 33.6%.
- Energy consumption in the transport sector is growing, in 2016, it increased year-on-year by 4.2% to 274.0 PJ, which is 58.6% higher energy consumption in the transport sector than in 2000. The share of renewable sources in overall energy consumption in transport in 2015[2] reached 6.5%, the target of the National Action Plan for energy from renewable sources to consume 10% of energy from RES in the transport sector by the year 2020 is not being achieved yet.
- The emissions of NO_x, VOCs, CO and suspended particles from transport stagnated in 2016, however, CO_2 emissions increased by 4.1%, N_2O emissions by 4.4% and PAH emissions by 4.3%. In comparison with 2000, emissions of NO_x, VOCs, CO and suspended particles from transport decreased significantly due to the renewal of the vehicle fleet and to reducing its emission intensity.
- Noise from road traffic exceeding the limit values of noise indicators was affecting, based on the results of 2nd round of the Strategic Noise Mapping, 2.5% of the Czech population with all-day exposure and 6.2% of the population of urban agglomerations with a population of over 100 thous.

[2] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Material flows

- Domestic material consumption in 2015[3] in the Czech Republic increased year-on-year by 4.2% to 167.2 mil. t and was lower by 7.1% than in 2000. The growth of material consumption in 2015 was influenced by the growth of industrial and construction production. The material intensity of the Czech economy is decreasing in the long term, in the period 2000–2015 it decreased by 37.1% to 39.1 kg.(CZK 1,000)$^{-1}$.

Waste

- Total waste generation in the period 2015–2016, after an increase between 2014–2015 in connection with the development of construction activity, dropped by 8.3% to 34,242.1 thous. t. Since 2009[4], it increased by 6.1%.
- In the waste treatment, material recovery significantly dominates, although the share of materially recovered waste decreased slightly between 2015 and 2016 from 83.2% to 81.6%, it grew between 2009 and 2016 from 72.5% to 81.6%. The most common way of waste disposal is landfilling, the percentage of landfilled waste is decreasing, however (since 2009 from 14.6% to 9.5% in 2016, despite a slight year-on-year increase in 2015–2016 from 8.6% to 9.5%).
- Landfilling also prevails in the treatment of municipal waste, the share of landfilled municipal waste has been declining in the long term (year-on-year 2015–2016 from 47.4% to 45.0% and since 2009 from 64.0% to 45.0% in 2016).
- The generation of packaging waste grew by 5.7% year-on-year 2015–2016 to 1,149.8 thous. t and since 2009 it increased by 28.6%. At the same time, however, the rate of recycled packaging waste is growing (year-on-year 2015–2016 from 74.3% to 75.3%, and since 2009 from 68.8% to 75.3% in 2016).
- The take-back of selected products is rather increasing, especially in portable batteries and accumulators (year-on-year 2015–2016 by 48.0% to 2.1 thous. t and since 2009 by 408.4%).

Financing

- Financial support of environmental protection provided from public sources declined significantly in 2016 year-on-year. In the case of expenditure on environmental protection from central resources (i.e., in particular, from the state budget and state funds) the year-on-year decrease was 66.7% to CZK 15.4 bil., the expenditure of local budgets decreased by 31.1% to a total of CZK 30.9 bil. Compared to 2000, however, both the central resources and local budgets saw an increase in expenditure by 52.8% and by 107% respectively.
- The year-on-year decline in 2016 is related, in particular, to the intensive final spending of Operational Programme Environment 2007–2013 in 2015, when projects originally scheduled for the 2014–2020 programming period were frontloaded. In 2016, the implementation of the Operational Programme Environment 2014–2020 was taking off, which meant in particular the publication of calls, projects processing and administration of project applications, while more significant drawing of fund will be felt from 2017 on. The allocation of the Operational Programme Environment 2014–2020 is also approximately half compared to the previous programming period (EUR 3.2 bil., i.e. about CZK 86.2 bil. of total eligible expenditure), therefore, many projects had the funding significantly reduced so that a maximum number of projects could be supported.

[3] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

[4] *Overall assessment of the trend postponed because of changes of the calculation methodology.*

Environmental assessment by thematic units

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5	Emissions of heavy metals	N/A	🙂	🙂	43
6	Air quality in terms of human health protection	🙂	😐	😐	45
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13	Landscape fragmentation	☹	☹	☹	94
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15	State of animal and plant species of Community importance in 2006 and 2012	N/A	N/A	N/A	103
16	State of natural habitats of Community importance in 2006 and 2012	N/A	N/A	N/A	106
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	Thematic unit / Indicator	Change since 1990	Change since 2000	Change since 2010	Page
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28	Final energy consumption	😐	😐	😐	180
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30	Energy intensity of the economy	🙂	🙂	🙂	187
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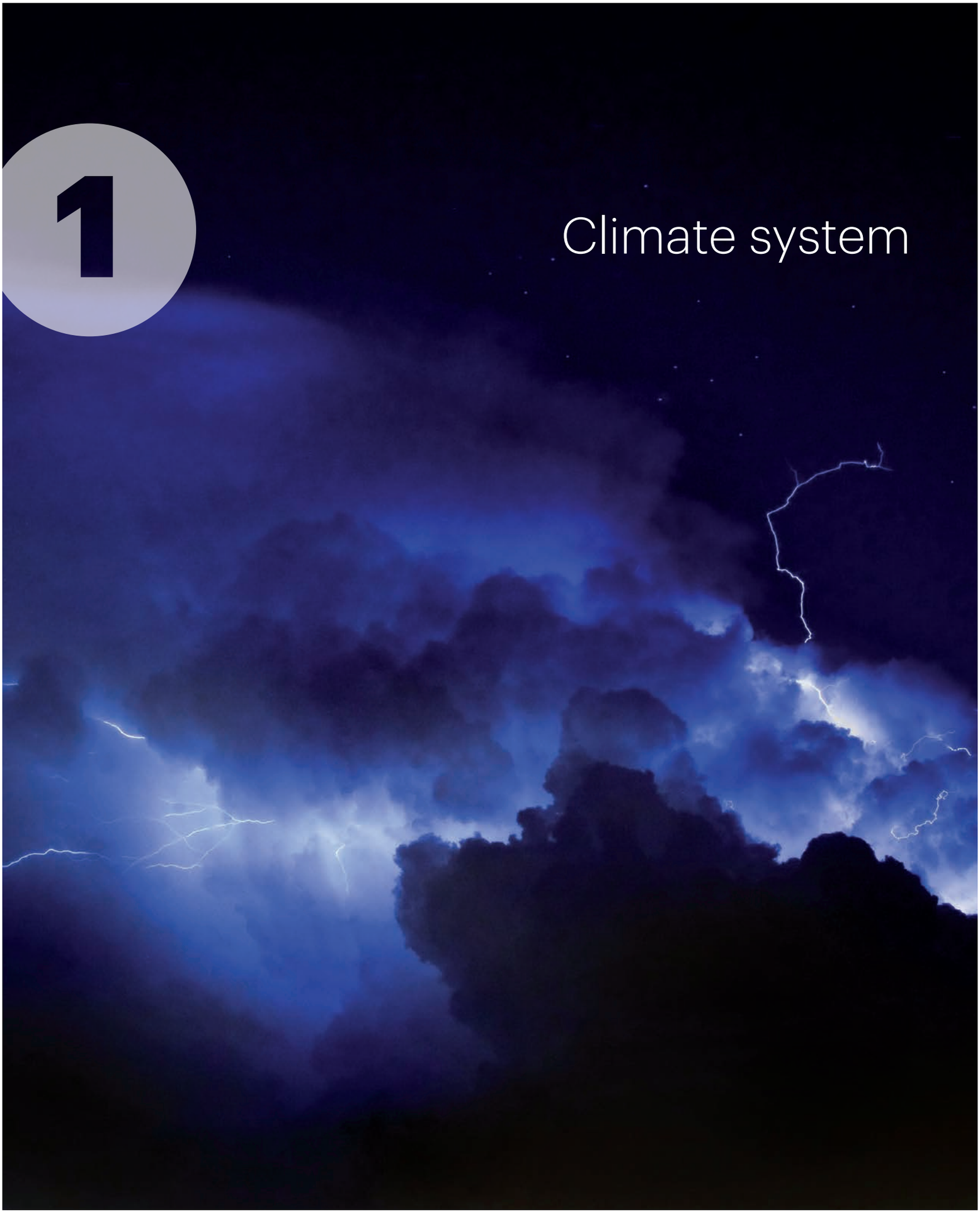
34	Energy and fuel consumption in transport	☹	☹	☹	210
35	Emissions from transport	😐	😐	☹	214
36	Noise pollution burden of the population	N/A	N/A	😐	217
	Transport in the global context	–	–	–	221
9	**Material flows**				**226**
37	Domestic material consumption	🙂	😐	😐	228
38	Material intensity of GDP	🙂	🙂	🙂	231
	Material flows in the global context	–	–	–	234
10	**Waste**				**236**
39	Total waste generation	N/A	☹ *	☹	240
40	Municipal waste generation and treatment	N/A	😐 *	😐	243
41	Waste treatment structure	N/A	🙂 *	🙂	246
42	Packaging waste generation and recycling	N/A	😐 *	😐	249
43	Generation and recycling of waste from selected products	N/A	🙂 *	🙂	252
11	**Financing**				**258**
44	Investments and non-investment costs of environmental protection	🙂	🙂	🙂	261
45	Public expenditure on environmental protection	🙂	😐	☹	266
	Investments in environmental protection and revenues from the environmental taxes and charges in the global context	–	–	–	272

*Change since 2009.

1 Climate system



Climate system

The protection of the climate system of the Earth ranks among the key environmental topics worldwide. Its importance lies, inter alia, in the fact that climate change and the measures associated with it affect the economies of individual countries and human welfare. Measures to protect the climate system and to reduce the negative impacts of climate change are divided into mitigation and adaptation. The first of them focuses on the mitigation of climate change through reducing the anthropogenic burden on the climate system, which occurs in the form of changes in the composition of the atmosphere (greenhouse gas emissions) and changes in the character of the Earth's surface (deforestation, construction development). The second group of measures is adaptation, which aims to reduce the impact of manifestations of climate change on natural and anthropogenic systems. The growing shortage of water is expected to be the most serious manifestation of climate change on the territory of the Czech Republic.

In addition to long-term climate changes, the state of the environment, human health and ecosystems are also affected by the development of the hydrometeorological situation in the given year. The hydrometeorological conditions have a direct impact on the dispersion of pollutants in the atmosphere, and thus on their atmospheric concentrations, the formation of ground-level ozone, the quantity and quality of surface water and groundwater, water balance, and may increase the risk for human health because of high temperatures. The hydrometeorological conditions also affect sectors of the national economy, such as agriculture, energy and water management, and thus the degree of environmental burden caused by those sectors. For example, this means emissions from the production of electricity and heat, pollution of water due to the consumption of fertilizers in agriculture or water abstraction for irrigation. The development of the economic burden is then projected into the state of the environment and risks to human health.

References to current conceptual, strategic and legislative documents

The Kyoto Protocol, second control period
- 20% reduction of aggregated greenhouse gas emissions in the EU by 2020 compared to 1990

Europe 2020 – strategy for smart, sustainable and inclusive growth
- a reduction of greenhouse gas emissions in the EU by 20%, increase in energy efficiency by 20% (both compared to 1990) and increase in the share of RES in the final energy consumption to 20% (targets 20/20/20 by 2020)

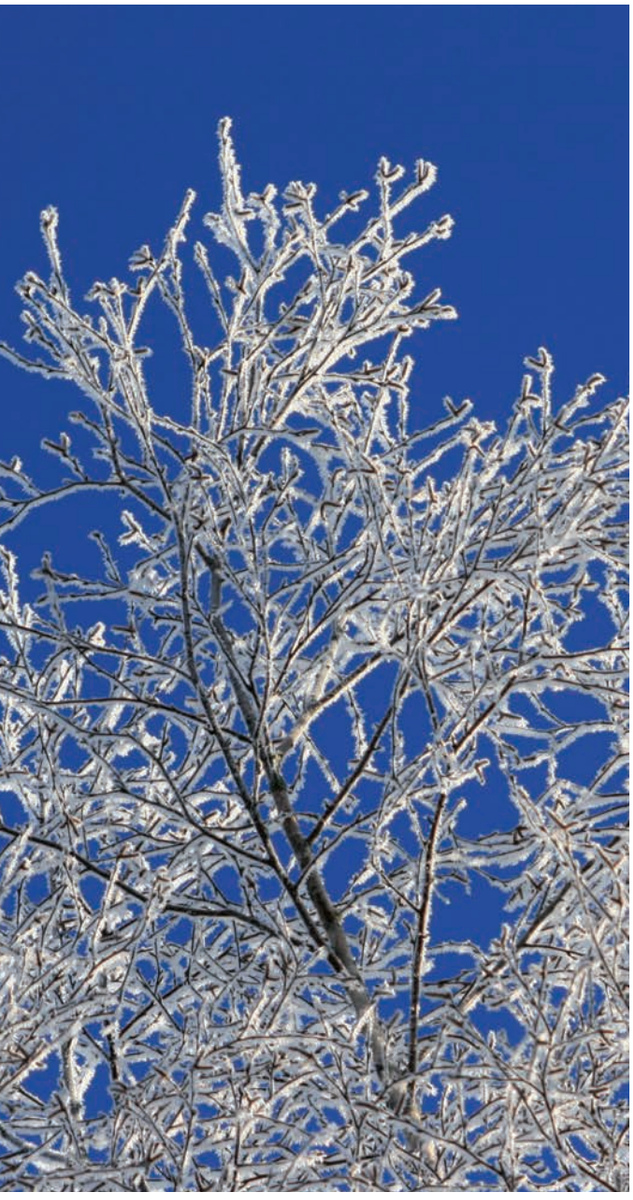
Green paper – a 2030 framework for climate and energy policies
- at least 40% reduction of aggregated greenhouse gas emissions in the EU by 2030 compared to 1990

Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy
- mitigation of the effects of floods and droughts, the provision of the sufficient supply of good quality surface water and groundwater as needed for sustainable, balanced and equitable water use

European Parliament and Council Directive 2007/60/EC on the assessment and management of flood risks
- framework for the assessment and management of flood risks in order to reduce the adverse effects on human health, the environment, cultural heritage and economic activity associated with floods in the Community

State Environmental Policy of the Czech Republic 2012–2020
- reduction of greenhouse gas emissions within the EU ETS by 21% and prevention of the increase in emissions outside the EU ETS by more than 9% by 2020 compared to the 2005 level (targets for the Czech Republic stipulated by the EU climate-energy package)

Climate Protection Policy in the Czech Republic
- reduction of greenhouse gas emissions of the Czech Republic up to 2020 by at least 32 Mt CO_2 eq. in comparison with 2005, and by 44 Mt CO_2 eq. by the year 2030



• achieving an indicative level of 70 Mt CO_2 eq. of emissions in the year 2040 and 39 Mt CO_2 eq. emissions in the year 2050

Strategy on Adaptation to Climate Change in the Czech Republic
• mitigating the impacts of climate change by means of adaptation measures, conservation of the welfare and preservation, and possibly improvements, of the economic potential
• assessment of likely impacts of climate change on selected economic and environmental sectors, proposals of specific adaptation measures

State Energy Policy of the Czech Republic (2015)
• achieving a 40% decrease in CO_2 emissions by 2030 compared to 1990 and a further decrease of emissions in line with the EU strategy towards decarbonisation of the economy by 2050 with regard to the economic possibilities of the Czech Republic

Strategy of Environmental Security 2016–2020, with an outlook to 2030
• extension of the existing measures that will lead to an increase in environmental safety in terms of risk sources of anthropogenic origin, which are most often the cause of serious accidents and can be misused for terrorist attacks, and in terms of danger of natural origin (extreme weather events, extensive floods, long-term drought, slope instability, natural fires and other)

Resolution of the Government of the Czech Republic No. 620/2015 on preparation for the implementation of measures to mitigate the negative impact of drought and lack of water
• implementation of the measures to fulfil the objectives of protection against negative effects of drought
• the draft concept of protection against the effects of drought for the territory of the Czech Republic with the use of the implemented measures

1 | Temperature and precipitation conditions

Key question

What were the temperature and precipitation conditions on the Czech Republic's territory in 2016?

Key messages

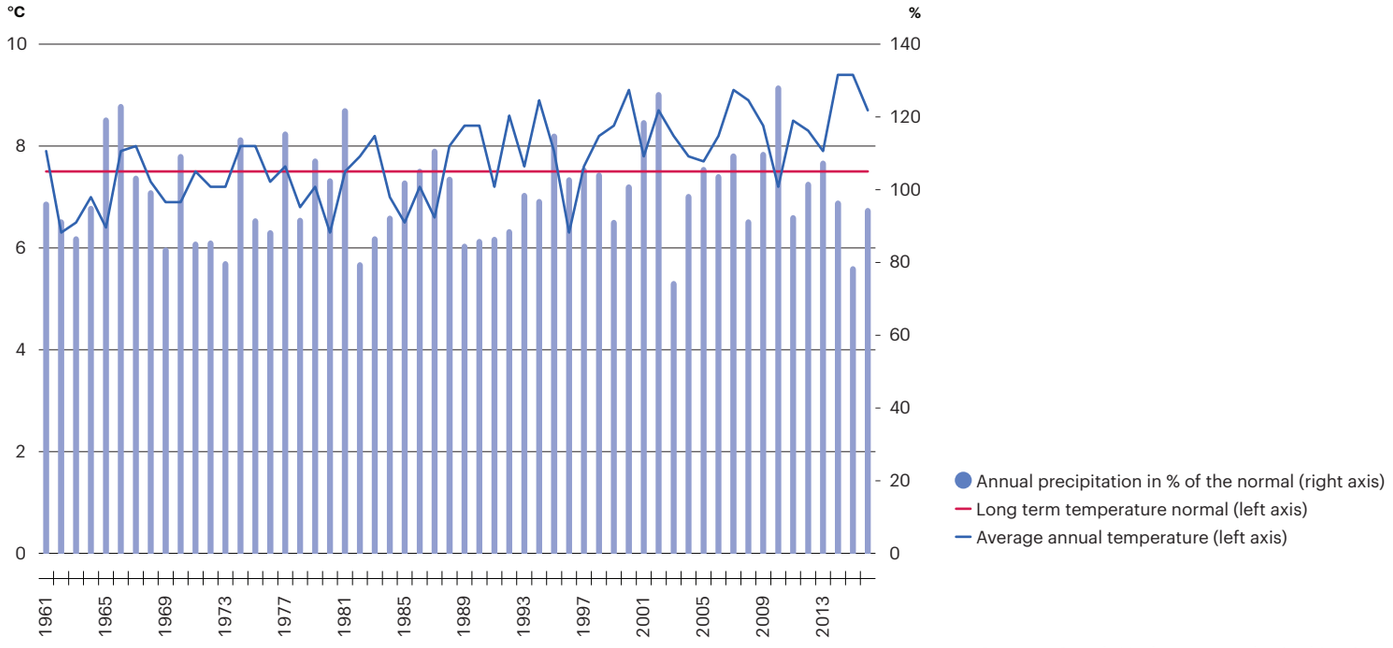
In terms of temperature, the year 2016 was significantly above-normal on the territory of the Czech Republic, the average annual temperature 8.7 °C was higher by 1.2 °C than the long-term average in 1961–1990. It is the eighth warmest year since 1961. Exceptionally above-normal temperatures occurred in February, very hot or hot were the months of June, July and September.

Precipitation was normal in 2016 in the Czech Republic. August and December were dry compared to normal, when only around 50% of the monthly normal precipitation fell, by contrast, above-normal rainfall was recorded in February, July and October. However, precipitation was distributed unevenly on the territory of the Czech Republic, precipitation deficit in the annual total was recorded in particular in Eastern Bohemia.

Indicator assessment

Chart 1

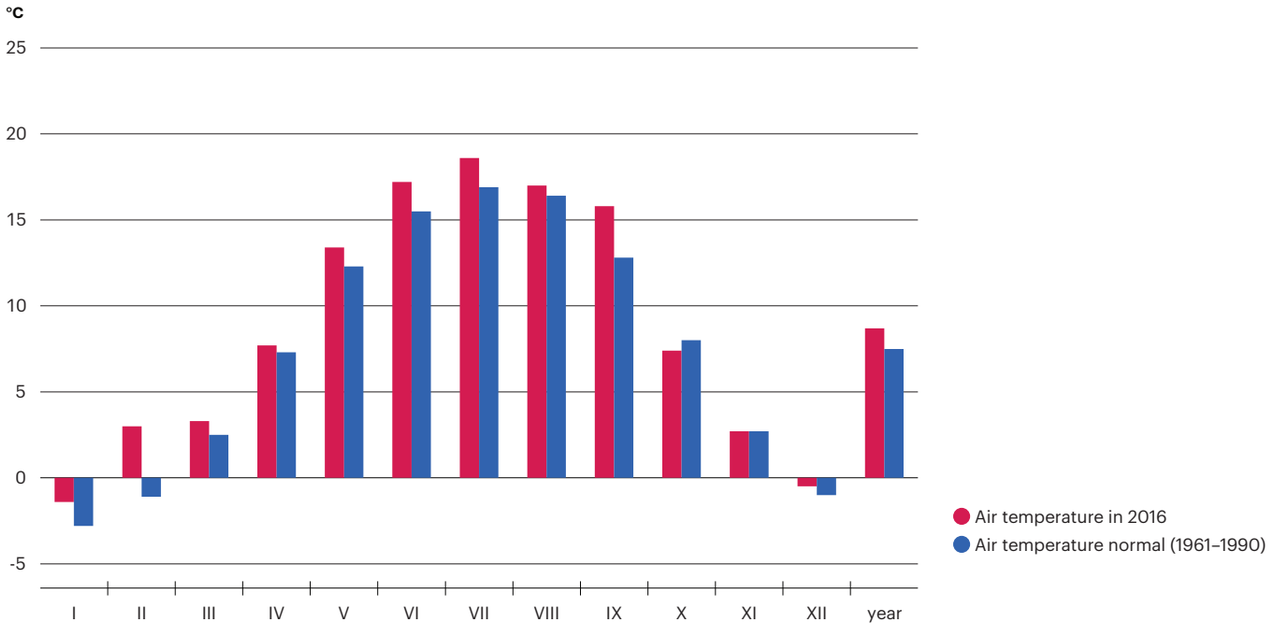
Long-term development of annual average air temperature and annual precipitation totals on the territory of the Czech Republic compared with the long-term normal of 1961–1990, 1961–2016 [°C, %]



Source: Czech Hydrometeorological Institute

Chart 2

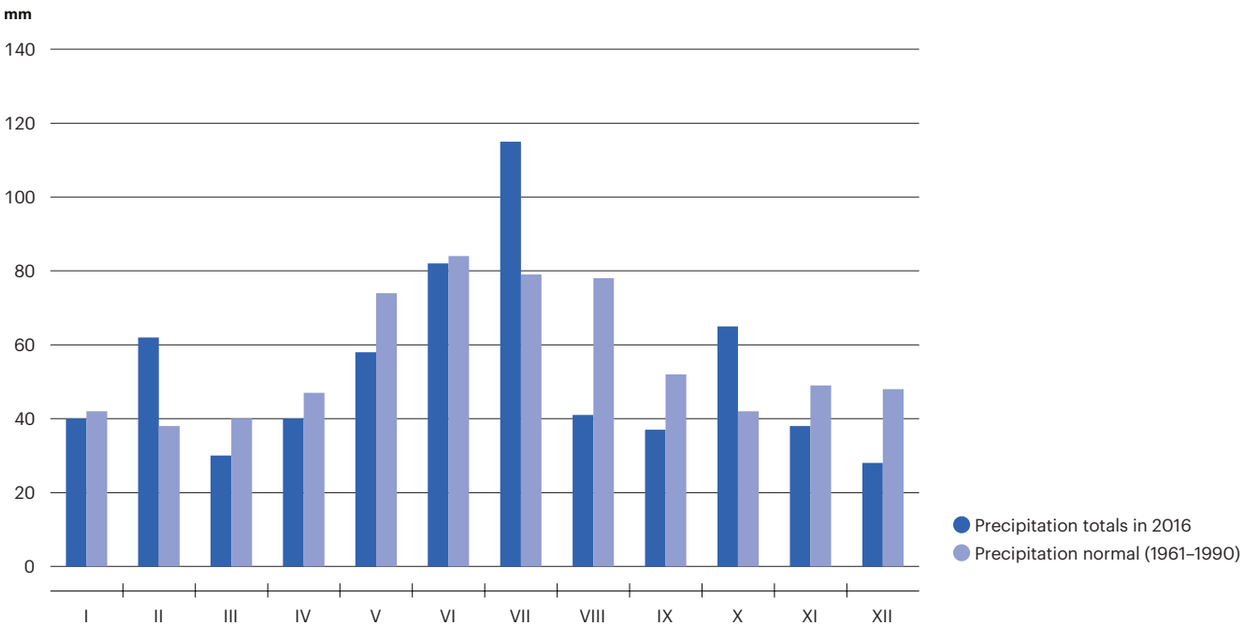
Monthly average air temperature in the Czech Republic territory (areal temperatures) compared with the 1961–1990 long-term temperature normal [°C], 2016



Source: Czech Hydrometeorological Institute

Chart 3

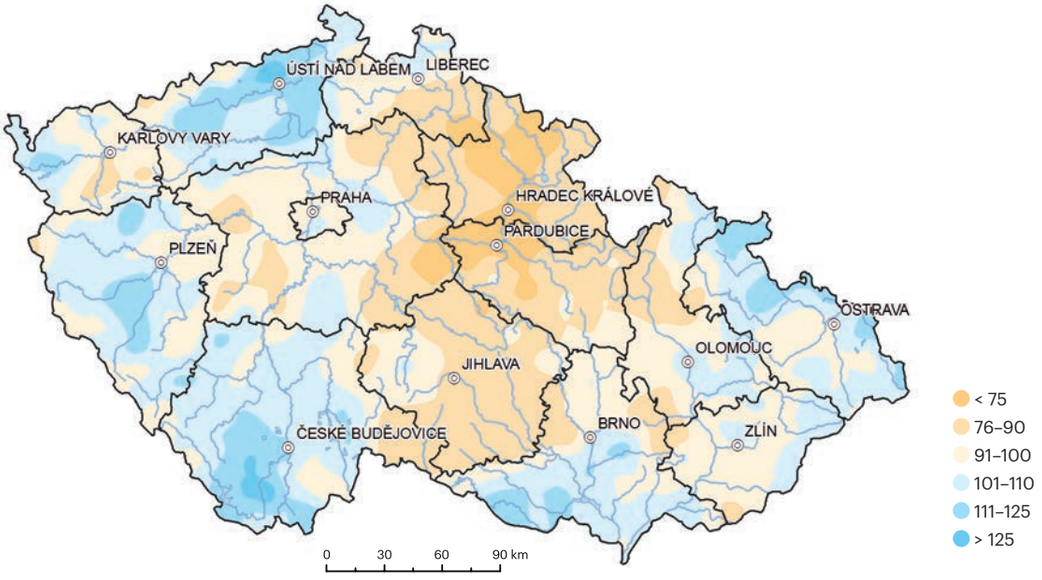
Monthly precipitation totals on the territory of the Czech Republic (areal precipitation) compared with the long-term precipitation normal of 1961–1990 [mm], 2016



Source: Czech Hydrometeorological Institute

Figure 1

Annual precipitation total in the Czech Republic territory compared with the long-term normal of 1961–1990 [%], 2016



Source: Czech Hydrometeorological Institute

In terms of temperature, the year 2016 was **significantly above-normal** (Chart 1) on the territory of the Czech Republic, the average annual temperature 8.7 °C was higher by 1.2 °C than the long-term mean of 1961–1990. The year 2016 is the eighth warmest in the period since 1961, compared with the previous record warm year 2015, the average annual temperature in 2016 was lower by 0.7 °C.

Most of the **months of 2016** were assessed as normal in terms of temperature, though the deviation of average monthly temperatures from the 1961–1990 normal, except for October and November, was positive for all months (Chart 2). The highest deviation from normal at +4.1 °C was recorded in February, which was extremely above-normal in temperature, the lowest deviation was in the temperature-normal October (–0.6 °C). Significantly above-normal or above-normal temperatures were in the months of June, July and September.

At the beginning of the first, at the end of the second and start of the third January decade, periods with temperatures well below normal values occurred. The lowest daily minimum temperature in January and throughout 2016 was measured on 22.01.2016 at the station Rokytská slať in Šumava at –35.3 °C. At the end of January and in February, above-average temperatures prevailed. During the spring, warmer and colder periods took turns. From the perspective of the annual course of the temperature developments, April was interesting as its first half, with an average temperature of 8.7 °C, was warmer by 2.3 °C than the second half of the month. In the last decade of May, two very warm periods occurred with the maximum daily temperature at many stations far in excess of 25 °C. The warmest day of that month was 22.05. when several stations recorded the first tropical day of 2016 with a maximum temperature over 30 °C.

During the **summer months**, the average daily temperature fluctuated considerably on the territory of the Czech Republic. The last decade of June was warm, on 25.06. the maximum air temperature reached at some places 35 °C and more. The highest maximum daily temperature in July was measured on 11.07. at the station Brod nad Dyjí (36.8 °C) and it was also the highest temperature recorded in 2016. After the August with monthly mean temperature close to the normal a very warm beginning of the meteorological autumn followed. September in 2016, with an average temperature of 15.8 °C and a deviation from normal at +3.0 °C was the second warmest September since 1961. The months from October to December were normal in terms of temperature.

In 2016, on average, the Czech Republic recorded 50 **summer days** and 7 **tropical days** (in 2015 it was record 26 days), in both cases the values exceed the long-term normal of 1961–1990, which is 33 summer and 5 tropical days per year. The

highest number of tropical days was recorded at the stations Dobřichovice (29) and Doksany (25). There were 27 **icy days** and 107 **frosty days** on average, which are values below the long-term mean of 1961–1990, which was 39 icy and 120 frosty days per year. The highest number of icy and frosty days in 2016 were registered at high-altitude stations in Krkonoše (the Giant Mountains) and Šumava (the Bohemian Forest).

In terms of **precipitation**, the year 2016 was **normal,** the average annual rainfall on the territory of the Czech Republic at 637 mm represents 95% of the long-term precipitation normal (1961–1990). The average monthly rainfall for most months of 2016 is evaluated as normal (Chart 3). **Precipitation was below-normal** only in the months of August and December, when the monthly rainfall amounted to 53% and 56% of the long-term normal for 1961–1990. On the contrary, **above-normal precipitation** was in the months of February (161% of the 1961–1990 long-term normal), July (146% of the 1961–1990 long-term normal) and October (155% of the 1961–1990 long-term normal).

The **spatial distribution of rainfall** was uneven in the territory of the Czech Republic in 2016. While in East Bohemia in the Hradec Králové and Pardubice Regions, only 75 and 80% of the annual precipitation normal fell respectively (Figure 1), in several regions, the rainfall exceeded the normal, the most in the Ústí nad Labem Region, where 107% of the annual normal rainfall fell. In the course of the year, uneven distribution of rainfall was recorded in April, when only 32 mm (69%) of normal precipitation total fell in Bohemia, while 57 mm (124% of normal) fell in Moravia and Silesia. In May, the highest total precipitation was recorded in the South Bohemia Region, where, on average, 95 mm of precipitation fell (127% of normal). The highest precipitation totals for June were recorded in the west of the country, in July, on the contrary, in the Moravian-Silesian and the Zlín Regions where more than 150 mm of precipitation fell. In September, more substantial precipitation fell in the Ústí nad Labem and Karlovy Vary Regions, where rainfall totals exceeded 80 mm (162% and 148% of normal respectively). The southeast of the Czech Republic, however, was dry during that period, only 32% of the monthly normal rainfall fell in the South Moravian Region.

In 2016, locally **high daily rainfall** was recorded in association with showers and storms. The first period with torrential rainfall occurred at the end of May, on 31.05. the station in Město Albrechtice, Žáry in the Bruntál district recorded 145.8 mm of rain in 24 hours and historically the highest value of 60-minute rainfall in the Czech Republic was recorded at 129.3 mm. Intense thunderstorms with torrential rainfall occurred also in the middle of the second, and during the last decade of July, the highest daily total was measured on 31.07. at the station Lipník nad Bečvou in the Přerov district (91.7 mm), and later at the beginning of August on 05.08. (69.9 mm in Horní Lideč, the Vsetín district).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

2 | Run-off conditions and the state of groundwater in the context of climate change

Key question

How did the temperature and precipitation conditions of 2016 reflect in the amount of surface water and groundwater?

Key messages

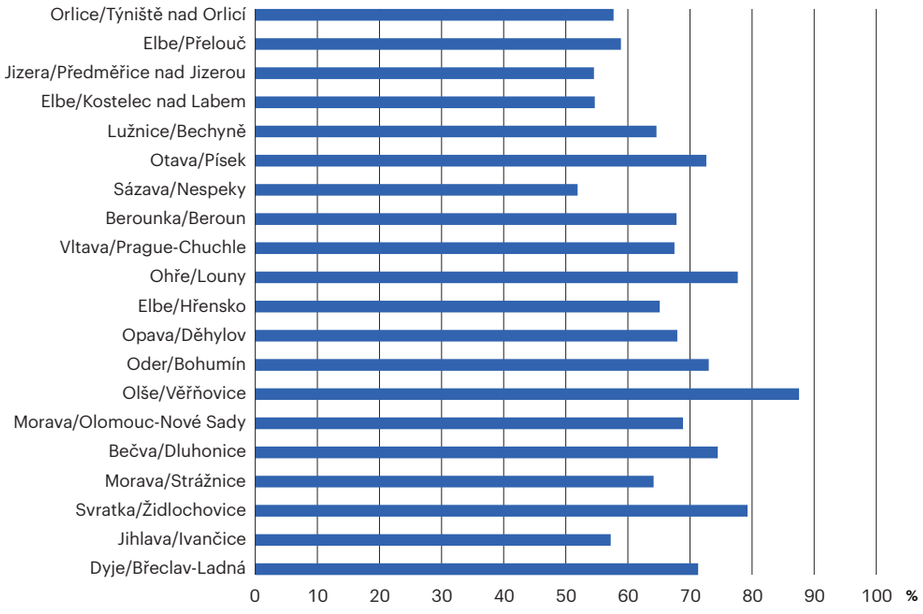
Even though the year 2016 as a whole was normal in precipitation, the occurrence of hydrological drought continued in the territory of the Czech Republic, in particular in Eastern Bohemia and North Moravia.

On any of the monitored major profiles, the average annual flow rate did not reach in 2016 even 90% of the average for the years 1981–2010 and many watercourses were below the 355-day flow rate in the long term. The state of drought manifested even in springs and shallow wells.

Indicator assessment

Chart 1

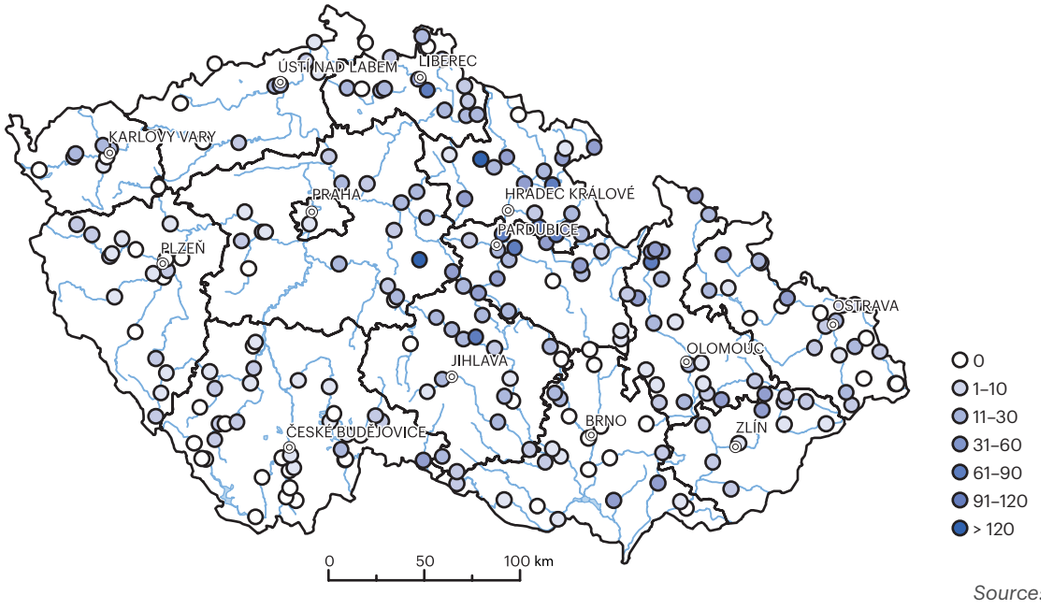
Average annual flow rates in comparison with the long-term averages for the period 1981–2010 [%], 2016



Source: Czech Hydrometeorological Institute

Figure 1

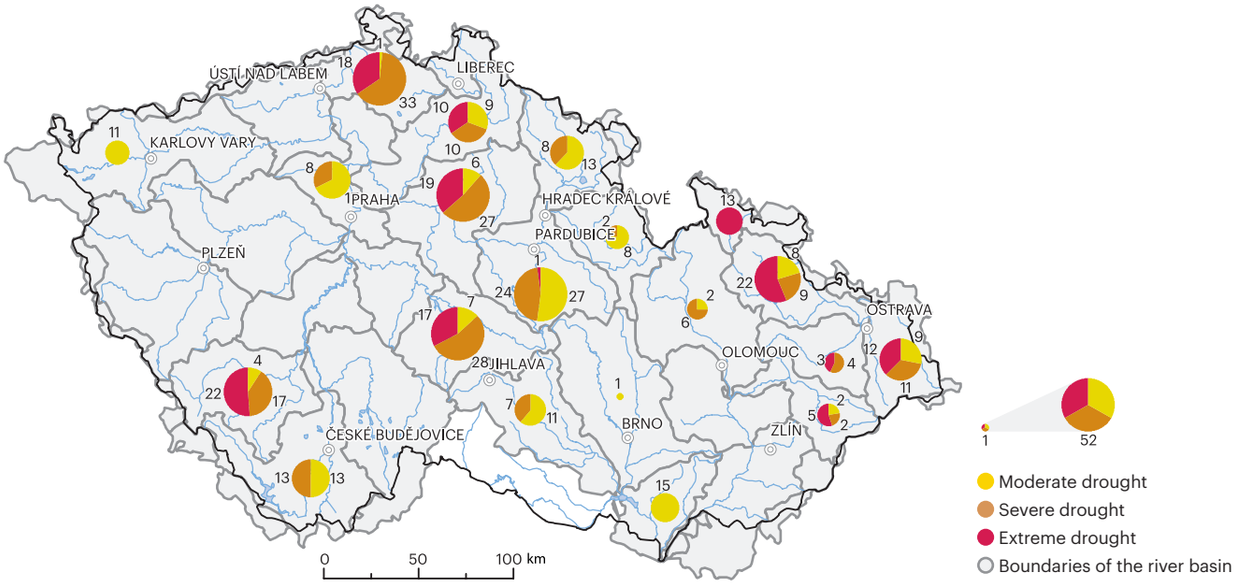
Flow rate smaller than the long-term 355-day flow rate for the period 1981–2010 [number of days], 2016



Source: Czech Hydrometeorological Institute

Figure 2

Duration of drought in springs [weeks], 2016

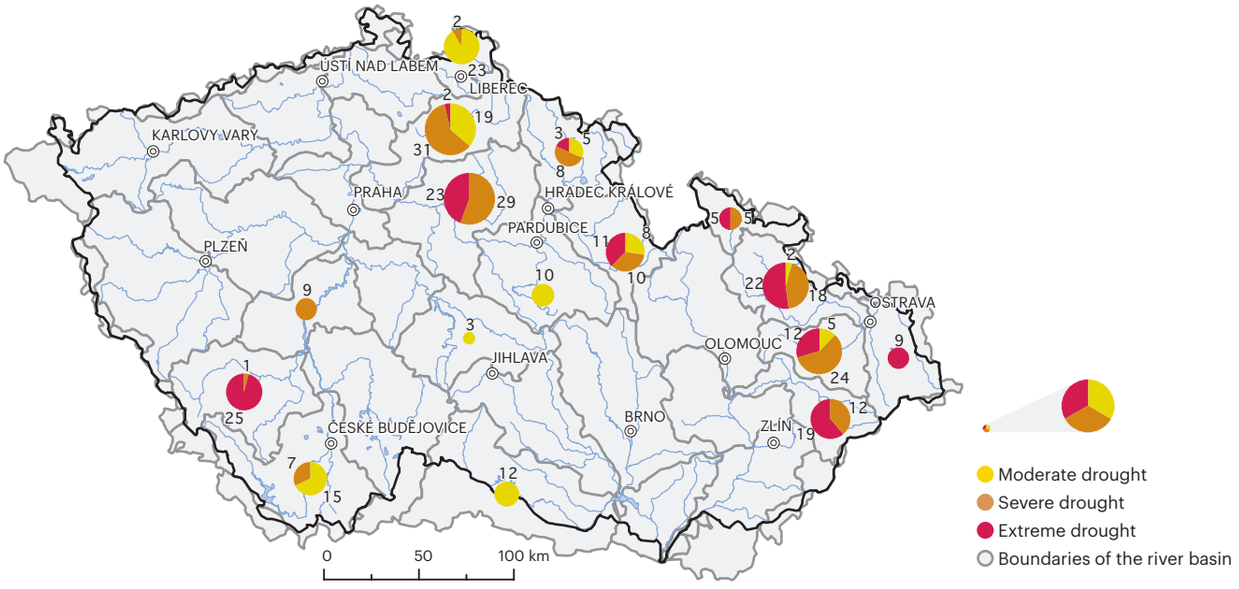


The data are aggregated for the river basins.

Source: Czech Hydrometeorological Institute

Figure 3

Duration of drought in shallow wells [weeks], 2016



The data are aggregated for the river basins.

Source: Czech Hydrometeorological Institute

Although the year 2016 as a whole was normal in precipitation, some months were dry compared with the normal and precipitation was distributed very unevenly in the Czech Republic (see Temperature and precipitation conditions). At part of the individual river basins, the deficit of water resources was not compensated and **hydrological drought** from the previous year 2015 **continued**.

On any of the monitored major profiles, the **average annual flow rate** in 2016 did not reach even 90% of the average for the years 1981–2010 (Chart 1). The most critical situation was on the Sázava River in Nespeky, where the average annual flow rate was only 52% of the long-term flow rate, on the Jizera River in Předměřice nad Jizerou and on the Elbe River in Kostelec nad Labem (on both profiles, the average annual flow rate was only 55% of the long-term flow). On the contrary, the situation was relatively the best on the Olše River in Věřňovice (88% of the long-term flow rate), the Svratka River in Židlochovice (79% of the long-term flow rate) and the Ohře River in Louny (78% of the long-term flow rate).

During the year, the situation was most critical in September, when a number of watercourses did not reach even 50% of the long-term average monthly flow rates. For example, the Orlice River reached only 22% in Týniště nad Orlicí, the Morava River 29% in Olomouc and 32% in Strážnice, the Lužnice River 37% in Bechyně. Low flow rates were also recorded in January, when for example the Oder River in Bohumín reached only 30% of the long-term monthly flow or the Opava River in Děhylov 32%. Although the situation was temporarily improved due to the February above-normal precipitation, the spring flow rates were again below average on a number of watercourses, for example in April the Lužnice River flow rate in Bechyně was only 25% of the long-term monthly flow rate, in May the Opava River reached 36% of the long-term monthly flow rate in Děhylov and in June, the Bečva River in Dluhonice had a flow rate at only 19% of the long-term monthly average.

Drought was recorded in some regions of the Czech Republic also in monitoring the **flow rate of less than Q_{355}**, that is, one that is reached or exceeded on 355 days a year on average. This indicator is important for maintaining the basic water management and ecological functions of the watercourse and its deficit is known as hydrological drought (Figure 1). From this point of view, the most critical situation was in Eastern Bohemia, in the basin of the upper and middle Elbe River. The Vrchlice River on the Vrchlice profile (part of Kutná Hora) and the Javorka River in Lázně Bělohrad fell below Q_{355} on more than 120 days in 2016. Critical situation occurred also e.g. on the Loučná River in Dašice, on the Elbe River in Němčice or on the Metuje River in Krčín (part of Nové Město nad Metují). Overall, 174 of the monitored profiles fell below the Q_{355} in 2016[1].

[1] *The map shows reported profiles of A or B category, provided that the duration of the observation on the profile is at least 29 years (because of the comparison with the long-term average).*

The state of drought manifested itself also on **groundwater** (Figure 2, Figure 3). The most critical situation was in the Elbe catchment area – in the area from the Doubrava up to the Jizera River where both in the springs and in shallow wells the drought lasted in varying degrees throughout the year. A year-long state of drought was also detected in the springs in the catchment area of the Ploučnice, upper Sázava and the Elbe Rivers in the section from the Orlice up to the Doubrava River and in the case of shallow wells in the basin of the Jizera River. Significant drought also hit the springs in the river basins of the Otava, Opava, Ostravice and Olše Rivers, and shallow wells in the basins of the Bečva, Oder and Opava Rivers. Although the drought in groundwater is not as visible as in the surface waters, it may have significant negative effects. Monitoring of the state of groundwater is important not only in terms of its direct use by humans, but in particular because it is an important component of the water cycle in nature and is in interaction with surface waters and other components of the environment.

The **occurrence of floods** was not significant in 2016, degree 3 of flood activity was reached only shortly on 14 July on the Jizera and Smědá Rivers and on 1 August on the Bystřice River, or the Bystřička reservoir. The recurrence time of peak flows usually did not exceed 2 years, it reached the highest value at five years on 27 July on the Želetavka River in Vysočany.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

3 | Greenhouse gas emissions

Key question

Is the development of greenhouse gas emissions in the Czech Republic heading towards meeting national objectives and international commitments?

Key messages[2]

Greenhouse gas emissions in the Czech Republic in the period 1990–2015 fell by 35.1%. In the period 2005–2015, greenhouse gas emissions decreased by 13.2%, which fulfils the prerequisites of the Climate Protection Policy in the Czech Republic for meeting the reduction targets for the years 2020 and 2030. Emission intensity of the Czech economy is steadily decreasing.

In 2015, aggregated emissions grew by 1.0% year-on-year. A growing trend can be seen in emissions from transport, after previous downturn also in emissions from agriculture and emissions from waste are also growing steadily. F-gas emissions produced from the use of products replacing freons are soaring, during the period 2005–2015 they nearly quadrupled.

Overall assessment of the trend

Change since 1990

Change since 2000

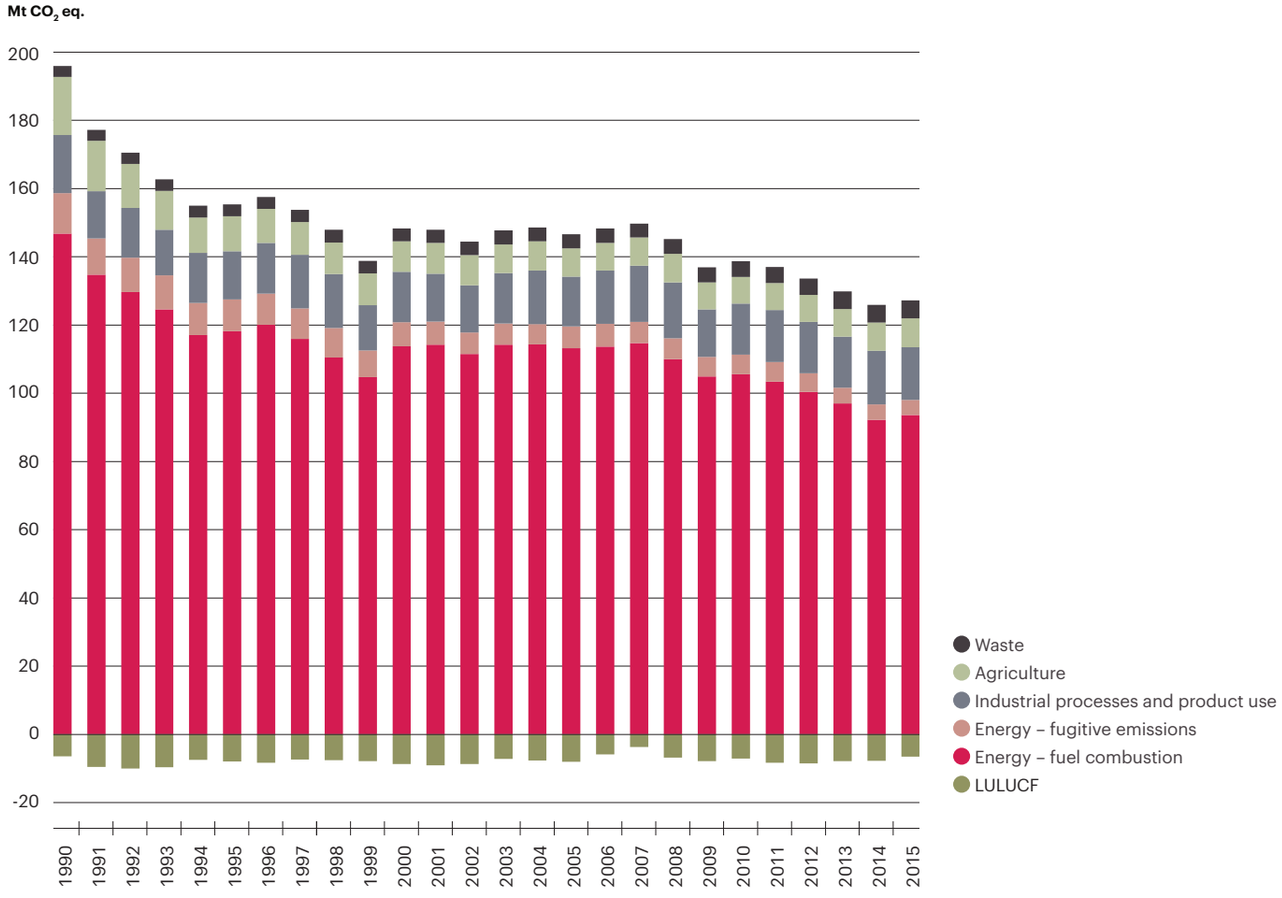
Last year-on-year change

[2] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Indicator assessment

Chart 1

Development of aggregated greenhouse gas emissions in the Czech Republic by sectors [Mt CO_2 eq.], 1990–2015

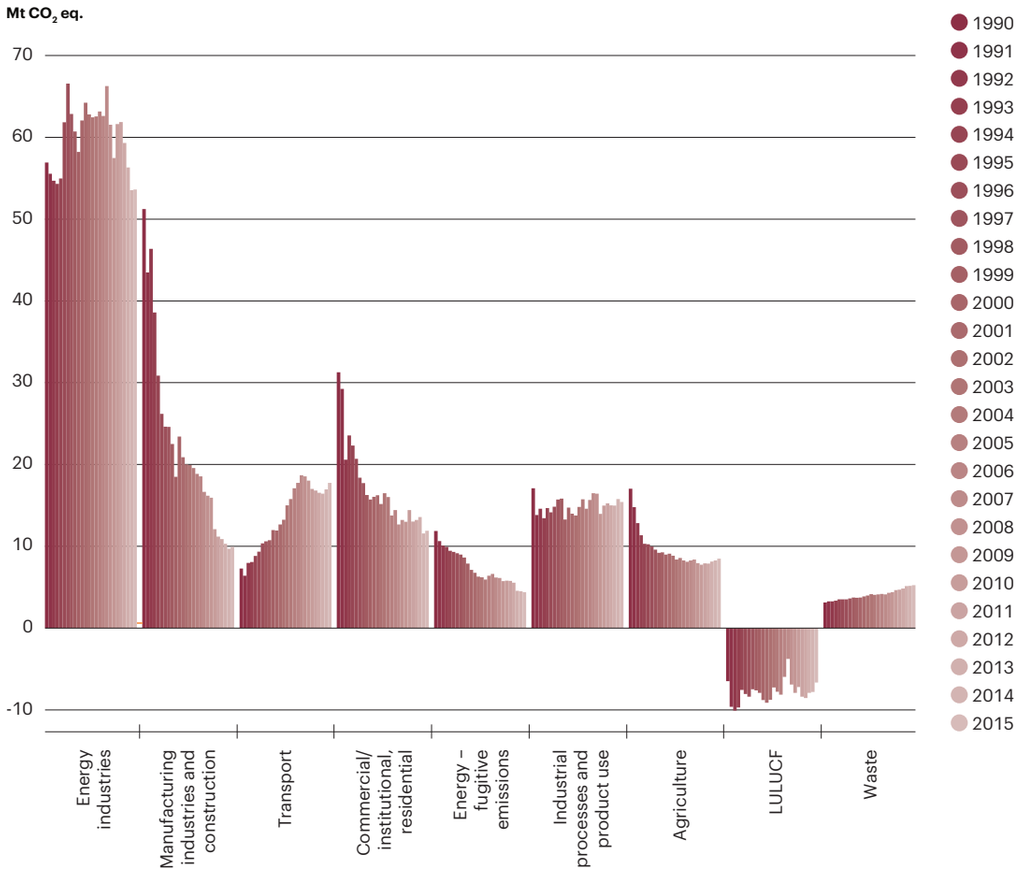


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

Chart 2

Trends in aggregate greenhouse gas emissions by major source categories and CRF sub-sectors of the category 1 – Energy [Mt CO_2 eq.], 1990–2015

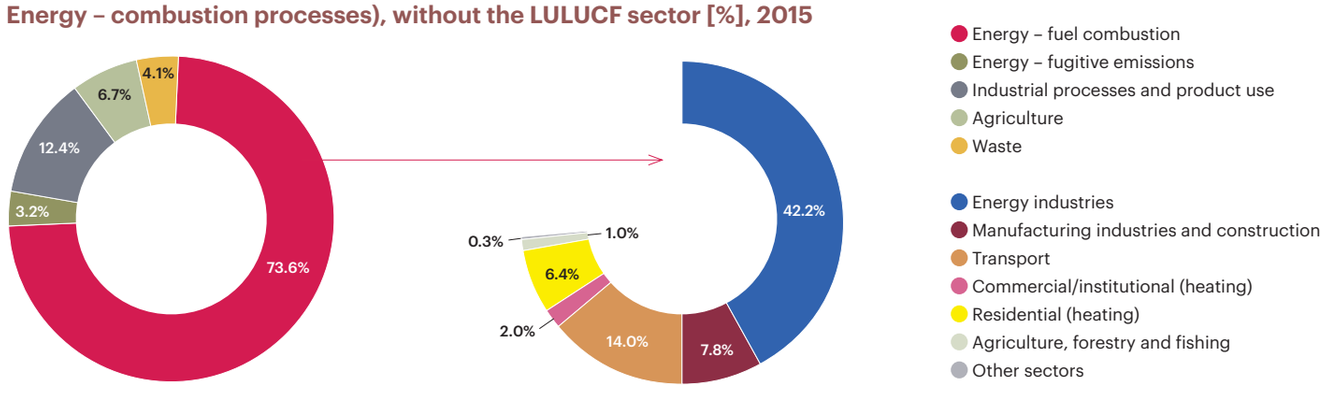


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

Chart 3

Structure of the aggregated greenhouse gas emissions by source categories (including the decomposition of category Energy – combustion processes), without the LULUCF sector [%], 2015

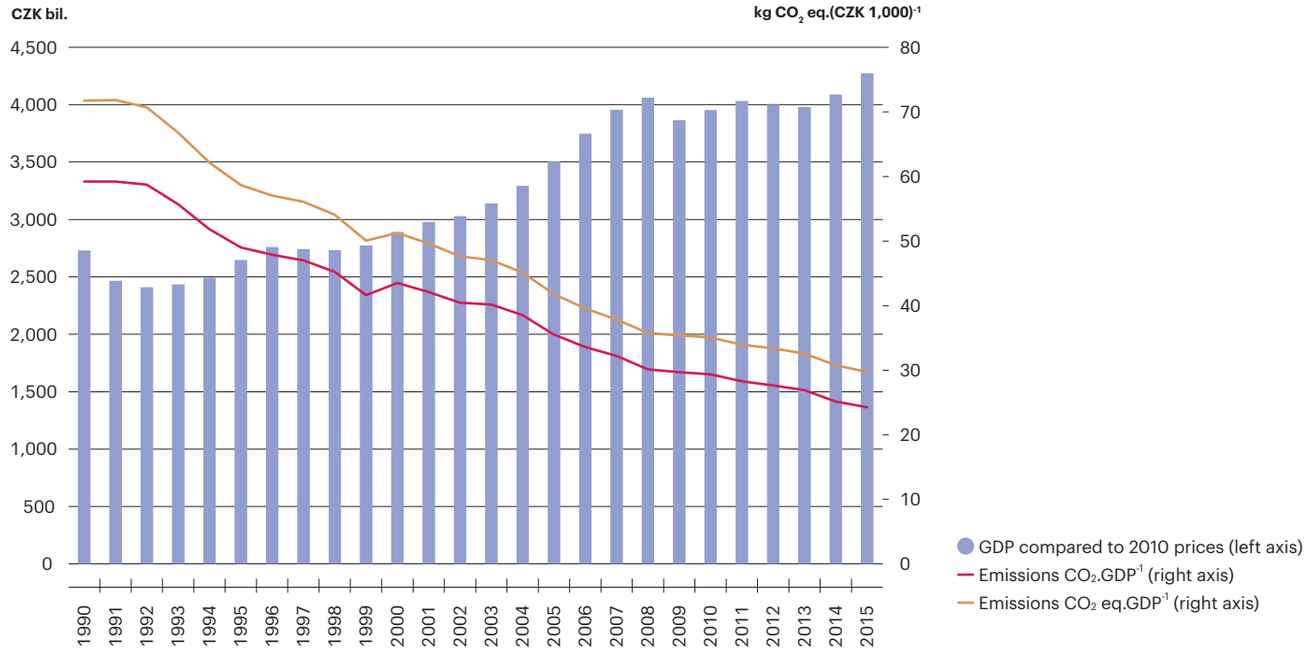


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

Chart 4

Evolution of the emission intensity of the economy of the Czech Republic [kg CO_2 eq.(CZK 1,000)$^{-1}$ compared to 2010 prices] and GDP [CZK bil. compared to 2010 prices], without the LULUCF sector and indirect CO_2, 1990–2015



Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute, Czech Statistical Office

Total aggregate greenhouse gas emissions in the Czech Republic in 2015 totalled 127.1 Mt CO_2 eq. (without LULUCF and indirect CO_2), which corresponds to a reduction by 35.1% against 1990. Year-on-year, emissions grew by 1.0%, representing an increase by 1.3 Mt CO_2 eq. compared to 2014 (Chart 1). At the beginning of the 1990s, in connection with the restructuring of the national economy, emissions declined significantly, after 2000, however, the trend of decreasing emissions is only gradual and accompanied with fluctuations affected by the performance fluctuations in the Czech economy. Since 2005, the baseline for the objectives of the **Climate Protection Policy in the Czech Republic**, aggregated emissions fell as of 2015 by 13.2% (19.4 Mt CO_2 eq.). The emission total in 2015 was below the trajectory of the scenarios prepared for the existing and additional measures, which indicates the attainability of the objectives of the Climate Protection Policy in the Czech Republic, the development of emissions, however, is closely linked to economic performance.

The greenhouse gas emissions in the period 1990–2015 were reduced to a large degree thanks to the decline in emissions from fossil fuel combustion in stationary sources as a result of the increased use of renewable energy and other low-emission energy sources. In the context of energy processes, emissions decreased most notably in the **manufacturing and construction sector** (Chart 2), the development of emissions reflected a change in the sectoral structure of industry and the modernization of technology reducing the energy intensity of industrial processes. In the period 1990–2015, emissions from this sector decreased to less than one fifth (by 80.6%), in the period 2005–2015 by 47.5%, i.e. by 8.9 Mt CO_2 eq.

Emissions from the **energy industry** in the period 1990–2015 fluctuated without a stronger trend, positive changes in the energy mix were offset by growth in energy consumption. In the period 2005–2015, however, emissions from the energy industry decreased by 15.1% (9.5 Mt CO_2 eq.), which significantly contributed to the reduction of the total emissions in that period. Also emissions from local **heating in households and commercial buildings** had a downward trend, the development of emissions was influenced by a decline in the share of solid fuels in the structure of fuels for heating, by the introduction of technologies with higher energy efficiency and by improving energy performance of buildings. At the same time, emissions from heating fluctuateed based on temperatures in the heating season, for that reason, greenhouse gas emissions grew by 2.8% in 2015 year-on-year. **Fugitive emissions** from the mining and transport of fuels are declining, mainly thanks to the phasing-out of coal mining.

Emissions from transport are growing, the dynamic growth of the transport sector outweighed at the end of the period 1990–2015 the effectiveness of environmental measures in the transport sector. In 2015, emissions from transport increased by 4.6% (0.8 Mt CO_2 eq.) to a level more than double compared to 1990, a temporary decline was registered only in the period of recession and subsequent stagnation of the economy in the years 2009–2012. Emissions from **industrial processes and product use** fluctuate without a stronger trend, according to the development of industrial production. F-gas emissions from the use of products replacing freons are growing significantly, during the period 2005–2015 they nearly quadrupled. Emissions from **agriculture** currently show an upward trend after a previous decline. Emissions **from waste** have been growing slightly in the long term, in the period 2005–2015 they increased by 27.5%, i.e. by 1.1 Mt CO_2 eq. The growth of emissions that are made up in about two-thirds of emissions from the landfill of solid waste is mostly generated by the growth of emissions from the disposal of biodegradable waste, which increased more than ten times during the period 2005–2015 by about 0.6 Mt CO_2 eq. In the **LULUCF sector**, carbon storage in biomass dominated over emissions during the entire period 1990–2015, in 2015 the removals decreased year-on-year by 14.9% to 6.6 Mt CO_2 eq.

The sector with the **highest share of emissions in total emissions of greenhouse gases** in 2015 was the energy industry (Chart 3), the share of combustion processes in the total emission balance amounted to 73.6%. The most important greenhouse gas in the Czech Republic is CO_2 with a share of 81.6% in total emissions in 2015, the proportion of CH_4 and N_2O reached 10.8% and 4.8% respectively. The shares of those gases are relatively stable in the time development, however, the proportion of F-gases significantly increases, in 2005 it made up 0.7%, in 2015 already 2.8%. The largest source of CH_4 emissions is waste (35.6% of total CH_4 emissions in 2015); the largest source of N_2O emissions is agriculture with a 73.1% share.

Emissions from industrial and energy-related enterprises falling under the **EU-ETS** decreased in the period 2005–2015 by 19.2% (by 15.8 Mt CO_2 eq.) to 66.6 Mt CO_2 eq. So those enterprises accounted for 63.9% of the total CO_2 emissions declared in the emission inventory. Installations in the EU-ETS significantly contribute to the reduction of emissions, in the period 2005–2015 they accounted for 81.4% in the total reduction of aggregated emissions. In 2016, however, the EU-ETS emissions rose by 1.3% in response to the continuing economic growth. The category of sources with the largest share in the total emissions in the EU-ETS are combustion processes (80.1% in 2015).

The **emission intensity** of the GDP generation in the Czech Republic is decreasing. The specific emissions per unit of GDP decreased in the period 1990–2015 to less than a half (by 58.5%). Since 2005 they decreased by 28.8% and in 2015 they decreased year-on-year by 3.4% to 29.7 kg CO_2 eq.$(CZK\ 1{,}000)^{-1}$ compared to 2010 prices (Chart 4). The development in the emission intensity is linked to a downward trend in energy and material intensity of the Czech economy.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

Climate system in the global context

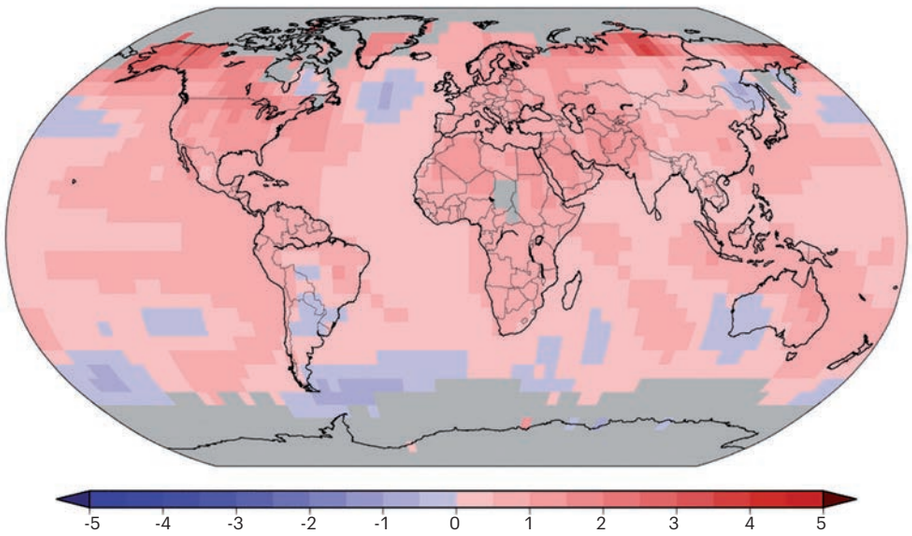
Key messages[3]

- Year 2016 was, from the global perspective, the hottest in the history of observation.
- The world ocean level increases and the extent of the Arctic and Antarctic glaciers decreases.
- The occurrence of hydrological extremes (i.e. droughts and floods) is growing.
- Greenhouse gas emissions in the EU28 decreased in the period of 1990–2015 by 23.7%.
- The greenhouse gas emissions per capita and per unit of GDP in the Czech Republic are above-average in the European context. The emission intensity of the Czech economy in 2015 was 70.0% higher than the EU28 average.

Indicator assessment

Figure 1

Distribution of the annual average air temperature expressed as deviation from the normal period 1981–2010 [°C], 2016

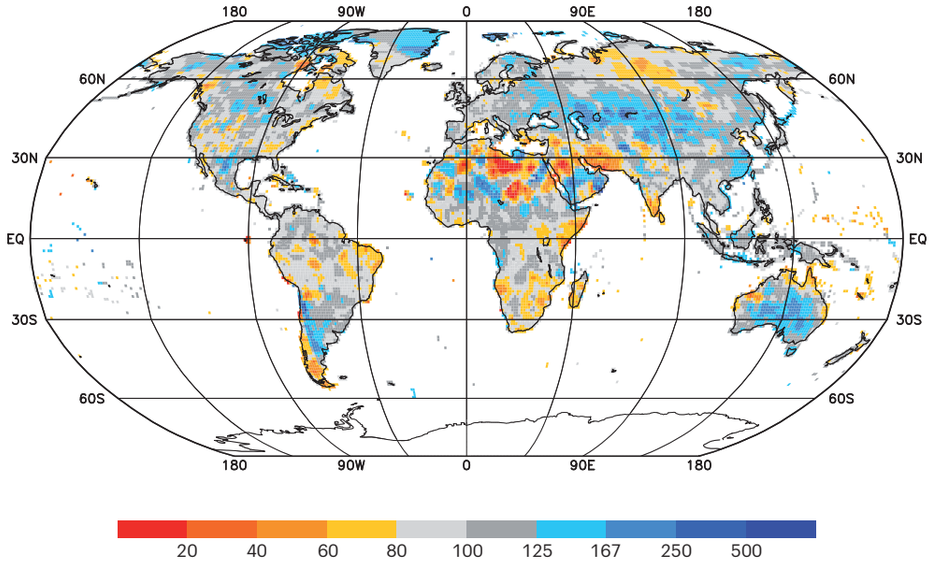


Source: National Centers for Environmental Information, NOAA

[3] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Figure 2

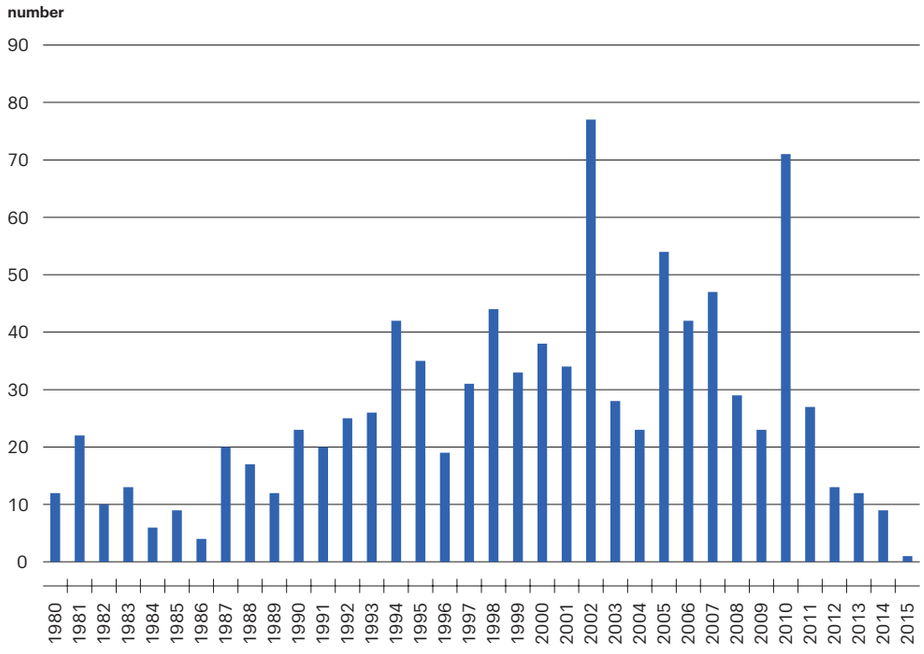
Annual rainfall expressed as a share to the average rainfall for the period 1951–2000 [%], 2016



Source: Global Precipitation Climatology Centre, Deutscher Wetterdienst (DWD)

Chart 1

Number of floods in the "very high" class of severity in Europe, 1980–2015

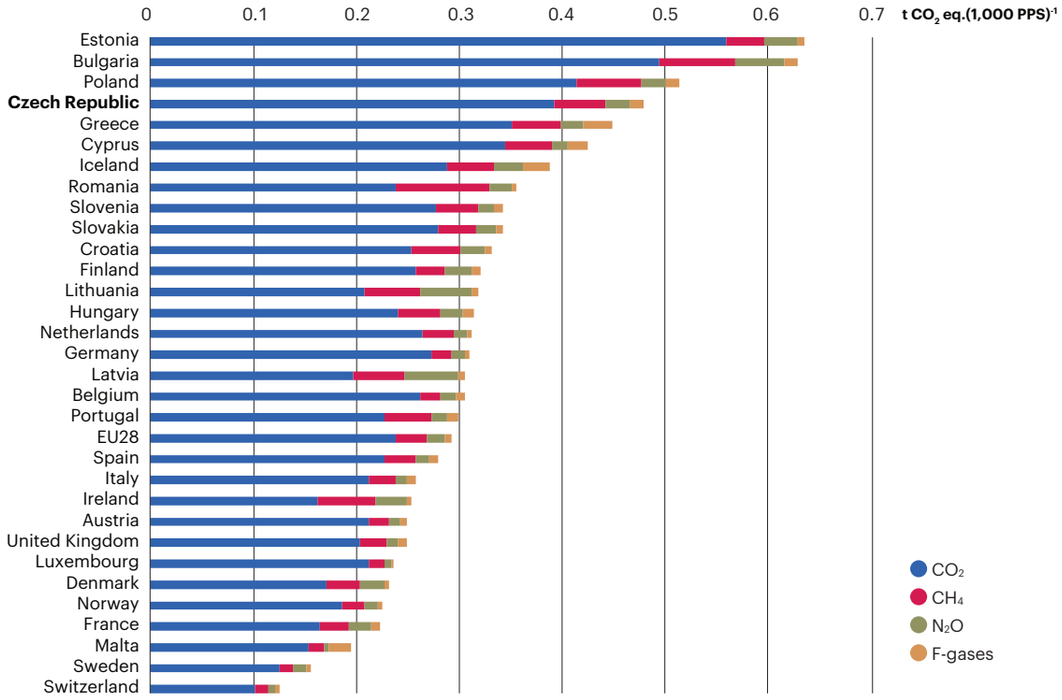


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Environment Agency

Chart 2

Emission intensity of GDP generation, without LULUCF sector [t CO_2 eq.(1,000 PPS)$^{-1}$], 2015



Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Environment Agency, Eurostat

The year 2016 was, according to the WMO Statement on the State of the Global Climate, the **warmest** year in the whole period of instrumental measurement carried out since approximately 1880. The global average annual temperature of the Earth's surface was 0.83 °C above the long-term average of 1961–1990, which is 14.0 °C, and higher by 0.52 °C in comparison with the period 1981–2010. This is the third year in a row, when the record global temperature was reached. That temperature increases by 0.1 to 0.2 °C per decade. Also the **level of the world ocean** was the highest ever in 2016. It is higher by 20 cm than at the beginning of the 20th century. The extent of the Arctic and Antarctic ice is reducing, the seasonal maximum of Arctic ice at 14.5 mil. km^2 was in 2016 the lowest since 1979, when the cryosphere monitoring started using satellites.

Average temperatures above the long-term mean (1961–1990) were recorded in 2016 in the vast majority of countries, exceptions were only in the central regions of Argentina and South-Western Australia (Figure 1). In the high latitudes of the northern hemisphere, average annual temperatures were recorded exceeding the long-term normals by 3 °C or more (e.g. in the areas of the North coast of Russia, Alaska and northwestern Canada). On Svalbard, the average annual temperature of – 0.1 °C meant a deviation of 6.5 °C above the long-term mean of 1961–1990 and the temperature record in the history of observation was achieved. The year 2016 was the warmest year on the North American continent, the second warmest in Africa and South America, and the third warmest in Europe.

Rainfall was regionally and seasonally significantly varied (Figure 2). Extreme drought hit the south of Africa, a very dry year was in the Amazonian lowlands, North-eastern Brazil and Central America. Conversely, the year with the highest precipitation in history was recorded in China, the Yangtze River was hit by the most extensive floods since 1999. In most of Western and Central Europe, the wet first half of the year contrasted with the dry second half. While in May and June, many areas of Western Europe have experienced a flood situation, July and August was dry, in France, it was the driest July and August in the history of observation. Also December was very dry, when less than 20% of the long-term normal precipitation fell on vast areas of the European continent.

One of the signs of climate change is **flooding**. The number of floods, the severity of which was evaluated as very high (Chart 1) using a combination of several criteria[4], varies widely in Europe between years. Years 2002 and 2010 were particularly significant, when floods hit also the Czech Republic and Europe recorded overall 77 or 71, respectively, floods of very high importance. Developments in the number of severe floods and greater frequency and extremity of droughts confirm the fact that one of the manifestations of climate change is the more common occurrence and significance of hydrological extremes.

Atmospheric **concentrations of greenhouse gases** have reached new highest levels, in 2015 the CO_2 concentrations increased by 144%, CH_4 by 256% and N_2O by 121% compared with the pre-industrial era (before 1750). Concentrations are rising despite the stagnation of emissions from fossil sources. Development of the climate contributes to the increase in the concentration of greenhouse gases connected with forest fires and reduced CO_2 removals in the biomass (due to drought, fires, etc.). The radiation effect of greenhouse gases increased in the period 1990–2015 by 37.0%, this increase was caused in 80% by CO_2 emissions. Global CO_2 emissions in 2015 were calculated at 36.3 Gt, the largest world producers of CO_2 emissions were China (28.2%), the USA (16.0%) and the EU28 (11.0%).

Total **aggregate greenhouse gas emissions** in the EU28 (without LULUCF and indirect CO_2) decreased in the period 1990–2015 by 23.7% (1,334.7 Mt CO_2 eq.) to 4,308.0 Mt CO_2 eq. The reduction of emissions during this period was most contributed to by the economically advanced countries with the highest proportion of total EU28 emissions (Germany, United Kingdom) in relative terms, however, the largest declines in the emissions were recorded in the new EU member countries (Latvia, Lithuania, Romania). The Czech Republic contributed to the total aggregated emissions of EU28 with 3.0% in 2015. Greenhouse gas emissions per capita in the Czech Republic (12.1 t CO_2 eq.capita^{-1}) were 42.6% above the average of the entire EU28 in 2015. The **emission intensity of the economy** of the Czech Republic ranks among the highest in the EU28 (Chart 2), it exceeded the European average in 2015 by 70.0%. The emission intensity of the individual countries depends on the share of emission-intensive sectors in the GDP generation and on the composition of the energy mix, lower emission intensity is reported by countries with the energy industry based on non-fossil energy sources, such as France and Austria.

[4] *It is a combination of the frequency of floods, the category of damage, the number of flood events during one flood situation and the severity class of the floods according to the Dartmouth flood observatory.*

Air quality

2

Air quality

The air is one of the fundamental components of the environment, the quality of which affects human health, natural ecosystems, and also the other components of the environment.

The concentrations of air pollutants are affected in particular by industrial and energy production, transport, local combustion heaters, but are also dependent on the weather conditions. Local factors are also of significant influence, in particular, the topography of the territory and cross-border transport of pollution.

The main air pollutants in the Czech Republic include particulate pollutants, distinguished as suspended particulate matter at the size fraction of PM_{10}, $PM_{2.5}$ and PM_1, sulphur dioxide (SO_2), nitrogen oxides (NO_x), carbon monoxide (CO), volatile organic compounds (VOCs), polycyclic aromatic hydrocarbons (PAHs), and ammonia (NH_3).

Suspended particulate matter with fraction PM_{10}, $PM_{2.5}$ and PM_1 belong among the most serious pollutants in relation to human health in the long term. The suspended particulates are bound to polycyclic aromatic hydrocarbons, expressed by benzo(a)pyrene. The severity of the exposure of the population to a mixture of suspended particulates depends on the concentration of suspended particles, their size, shape, and chemical composition. The effects of short-term increased daily concentrations of all suspended particulate matter of all PM fractions include the rise of general sickness and death rates, especially heart and blood vessels diseases, diseases of the respiratory system, and increase of infant mortality and worsened problems of asthmatics. Ultra-fine particles (size of 1–100 nm) can penetrate even into the blood stream, from where they can further get into all the organs. Moreover, carcinogenic effects have been proven for benzo(a)pyrene. Ground-level ozone is another substance that negatively affects human health and ecosystems. In humans, it harms the respiratory system and in particular irritates the respiratory tract, in the case of vegetation, the ground-level ozone negatively affects the assimilation organs of plants and affects their production capability. The high concentrations of NO_x and SO_2, VOCs and CO cause breathing problems, worsen asthma, and are associated with an increase in the overall, cardiovascular and respiratory mortality, they also negatively affect the nervous system. The impact of heavy metal emissions consists in their toxic, mutagenic, and carcinogenic properties and in their ability to accumulate in the individual environmental media and in living organisms.

References to current conceptual, strategic and legislative documents

7th Environmental Action Programme until 2020
- the achievement of a level of air quality that does not have significant negative impacts or poses a risk to human health and environment

European Commission's package of 18 December 2013 with the title "A Clean Air Programme for Europe"
- the achievement of the air quality in accordance with valid European legislation no later than before 2020 throughout the EU territory
- a significant reduction in emissions by 2030 from sources of pollution and thus achieving a decrease in the values of the background concentrations towards values recommended by the WHO

Directive 2001/81/EC of the European Parliament and of the Council on national emission ceilings for certain atmospheric pollutants (NECD)
- establishment of national emission ceilings for SO_2: 265 $kt.year^{-1}$
- establishment of national emission ceilings for NO_x: 286 $kt.year^{-1}$
- establishment of national emission ceilings for NH_3: 80 $kt.year^{-1}$
- establishment of national emission ceilings for VOC: 220 $kt.year^{-1}$

Directive of the European Parliament and of the Council (EU) 2016/2284 of 14 December 2016 to reduce national emissions of some air pollutants, amending Directive 2003/35/EC and repealing Directive 2001/81/EC

- commitments of Member States to reduce anthropogenic emissions of SO_2, NO_x, VOCs, NH_3 and $PM_{2.5}$ and the requirement for the preparation, adoption and implementation of national programmes for reducing air pollution, as well as the monitoring of emissions of the substances designated and of emissions of other pollutants

Directive of the European Parliament and of the Council of 2015/2193 of 25 November 2015 on the limitation of emissions of certain pollutants into the air from medium combustion plants
- establishment of rules for the reduction of emissions of SO_2, NO_x and TSP into the air from medium-sized combustion sources with the objective to reduce the amount of emissions into the air and reduce the possible risks arising from these emissions to human health and the environment

Directive of the European Parliament and of the Council 2010/75/EU of 24 November 2010 on industrial emissions (integrated pollution prevention and control)
- reducing industrial emissions of the EU on the basis of an integrated authorisation

Convention on Long-Range Transboundary Air Pollution (CLRTAP)
- prevention of the spread of transboundary air pollution on long distances

Protocol to Abate Acidification, Eutrophication and Ground-level Ozone of CLRTAP (The Gothenburg Protocol)
- reduction of the number of days with high ozone concentrations to a half and a subsequent reduction of the effects of ground-level ozone on human health
- establishment of new emission ceilings for the year 2020 set as a percentage reduction in emissions compared to the state in 2005: for VOC the emissions should be reduced by 18%, for NO_x by 35%, for SO_2 by 45%, for NH_3 by 7% and for $PM_{2.5}$ emissions by 17%

State Environmental Policy of the Czech Republic 2012–2020
- compliance with the national emission ceilings in force since 2010, and the reduction of the total emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x), ammonia (NH_3) and fine suspended particulate matter ($PM_{2.5}$) and volatile organic compounds (VOCs) by 2020 in line with the commitments of the Czech Republic
- improvement in air quality in places where limit values are exceeded and at the same time maintaining air quality in the territories where limit values are not being exceeded

Medium-term strategy (by 2020) to improve air quality in the Czech Republic
- the achievement of socially acceptable extent of the risks arising from air pollution to human health, ecosystems, and cultural and historical heritage in the whole territory of the Czech Republic
- from 2020 no exceedance of the values of the national emission ceilings laid down on the basis of NERP scenario with additional measures
- the progressive creation of conditions to meet future national commitments to reduce emissions as of 2025 and 2030
- not exceeding the air pollution limits throughout the territory of the Czech Republic by 2020 and at the same time maintaining and improving the air quality where concentrations of pollutants are currently below the values of the air pollution limits

National Emission Reduction Programme of the Czech Republic
- fulfilling the set not-to-exceed limits of national emissions as of 2020 for SO_2 (92 $kt.year^{-1}$), NO_x (143 $kt.year^{-1}$), NH_3 (64 $kt.year^{-1}$) and $PM_{2.5}$ (19 $kt.year^{-1}$) and VOC (129 $kt.year^{-1}$)
- reduction of the negative impact on ecosystems and vegetation and on the materials by way of compliance with the national emission reduction obligations and compliance with applicable pollution limits
- the achievement of socially acceptable extent of the risks arising from air pollution on human health
- reaching of the national exposure reduction target for suspended particulate matter $PM_{2.5}$
- the achievement and maintaining of air pollution limits in the period 2016–2020, and further reducing of the concentrations of pollutants
- the compliance with the target values of the burden by ground-level ozone to protect human health

Programmes to improve air quality for each zone and agglomeration
- the achievement of the air pollution limits throughout the territory of all zones and agglomerations for the polluting substances referred to in point 1 to 3 of annex 1 of the Act on the Air Protection by 2020
- measures to reduce emissions and to improve air quality at the national level

Act No. 201/2012 Coll., on air protection

- full adoption of air pollution limits provided for by the Directive 2008/50/EC of the European Parliament and of the Council on ambient air quality and cleaner air for Europe and by the Directive 2004/107/EC of the European Parliament and of the Council relating to arsenic, cadmium, mercury, nickel and polycyclic aromatic hydrocarbons in ambient air

Decree No. 330/2012 Coll. on the method to assess and evaluate the level of pollution, the extent of information provided to the public about the level of pollution and smog situations
- determination of the lower and upper limits for each pollutant for the assessment of pollution levels

Decree No. 415/2012 Coll., on the permissible level of pollution and its identification and on implementation of some other provisions of the Act on air protection
- setting the general emission limits, specific emission limits, methods of calculating the emission ceilings and the technical conditions of operation of stationary sources
- determination of the requirements on the quality of fuels

Operational Programme Environment 2014–2020
- reducing emissions from residential heating of households involved in the exposure of the population concentrations of pollutants (supports Exchange of non organic heat sources, the so-called pot subsidies)
- reducing emissions from stationary sources contributing to the population's exposure to excessive concentrations of pollutants
- improving the system of monitoring, evaluation and forecasting of air quality trends and the related meteorological aspects

4 | Emissions of pollutants

Key question

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

Key messages

The emission of air pollutants significantly decreased in the period 1990–2000. Emission reduction continued also after 2000, in the period 2000–2016, the greatest decline was in SO_2 emissions by 52.0%, NO_x by 46.0%, VOC emissions by 42.1%, total suspended particulates by 37.0%, CO emissions by 25.7% and emissions of NH_3 by 15.9%.
In 2016, SO_2 emissions decreased year-on-year by 12.8% and NO_x emissions by 4.4%. Total emissions of the individual pollutants are approximating the binding limits of national emissions from 2020.

TSP and VOC emission production stagnated in 2016, compared with the previous year.

In 2016, CO emissions production grew year-on-year by 4.9% and NH_3 emissions by 2.4%

Overall assessment of the trend

Change since 1990

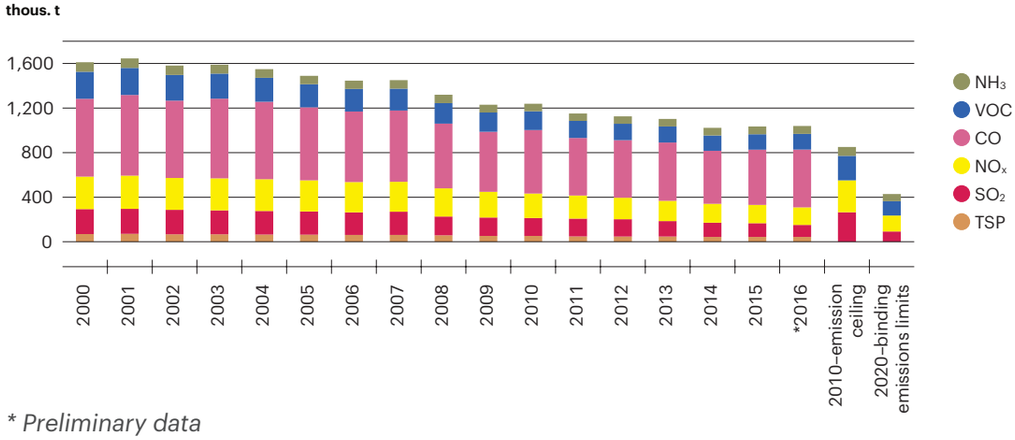
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

Development of total emissions of pollutants in the Czech Republic and the level of national emission ceilings for 2010 and the binding emissions limits from 2020 [thous. t], 2000–2016

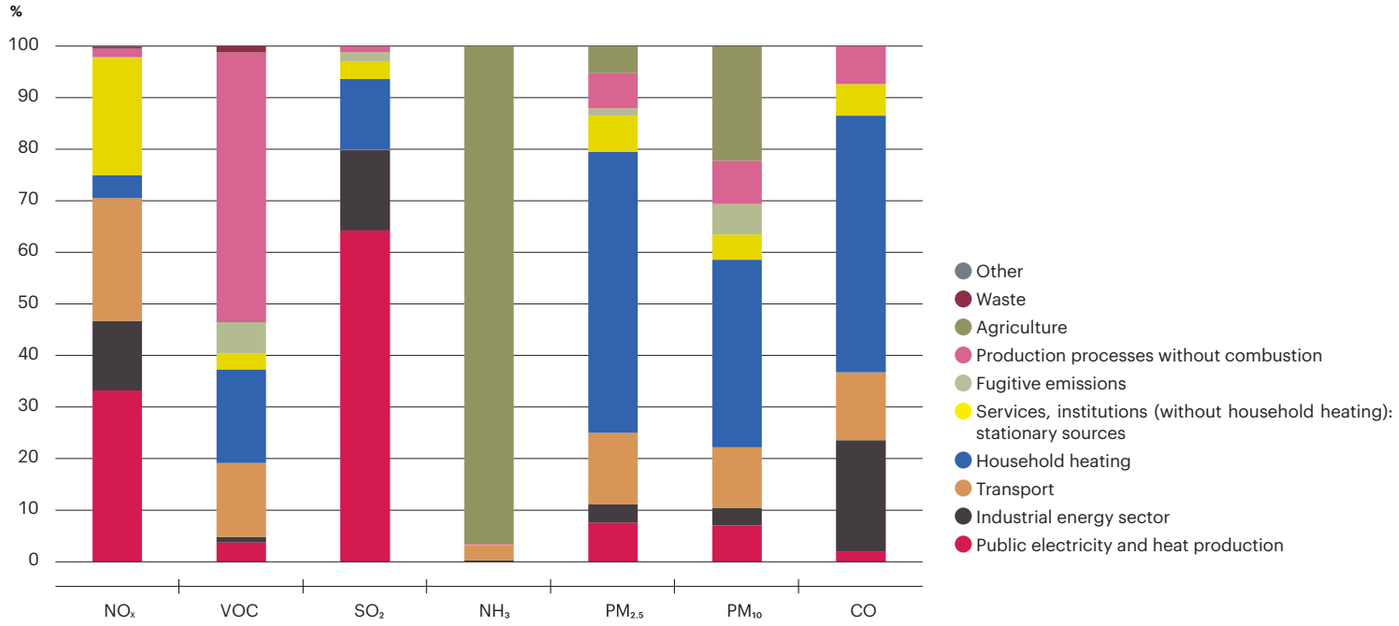


** Preliminary data*
The binding limits for the emissions of TSP and VOCs have not been established.
Emissions from the use of nitrogen fertilisers have been included in the NH_3 emission balance since 2008.
The emission inventory was corrected for the presented period 2000–2016 due to adjustments of emission factors.

Source: Czech Hydrometeorological Institute

Chart 2

Sources of emissions of pollutants in the Czech Republic [%], 2015



Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

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

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

In the period **2000–2016**, the trend of declining emissions of pollutants into the air continued, overall, the largest decreases occurred between 2000 and 2016 (Chart 1) in the case of SO_2 emissions by 52.0% to 107.2 thous. t^{-1}, NO_x emissions by 46.0% to 157.2 thous. $t.year^{-1}$, and also for VOC emissions by 42.1% to a total of 140.5 thous. $t.year^{-1}$. The least decrease occurred in emissions of NH_3, which fell only by 15.9% to a total of 71.4 thous. $t.year^{-1}$.

The fluctuations in emissions between years in the period 2000–2016 reflected the state of development of the national economy in each year, and the biggest change was therefore recorded between the years 2007–2008, and also between the years 2008–2009 due to a downturn of the national economy caused by economic crisis. In 2008, emissions of SO_2 decreased sharply year-on-year by 19.2% and CO by 9.0%, in 2009, the largest year-on-year decrease was seen in TSP emissions by 10.5% and NO_x emissions by 8.6%.

In 2016, however, the overall positive development halted. A year-on-year decline was observed only for emissions of SO_2 by 12.8% and NO_x emissions by 4.4%. TSP emissions stagnated year-on-year in 2016 at the level of 43.9 thous. $t.year^{-1}$. On the contrary, CO emissions grew by 4.9%, NH_3 emissions by 2.4% and VOC emissions by 1.1%.

Emissions of SO_2 and NO_x are steadily decreasing, in particular as a result of the introduction of technologies and manufacturing processes with the BAT, the use of fuels with a lower sulphur content and the reduction of the energy intensity of the economy. A significant role is currently played by the diversification of electricity production, i.e., the decrease in production of electricity in coal-fired power plants and, on the contrary, its increase in nuclear power plants and also the production of electricity from RES. A great influence is also the obligation to meet the legislative requirements of the transposition of Directive of the European Parliament and of the Council 2010/75/EU on industrial emissions into Czech legislation. An important negative factor affecting the production of SO_2 and NO_x emissions is, however, the long-term pro-export term

nature of electricity generation, especially in the case that most of the electricity is produced in steam plants for solid fuels. The long-term reduction of NO_x emissions is also associated with a decrease in these emissions from the transport sector, in particular as a result of a gradual modernisation and replacement of the vehicle fleet, leading to a decline in transportation emissions.

Stagnation in the emissions of NH_3 is associated in particular with the set agricultural policy of the Czech Republic and with the implementation of the Common Agricultural Policy of the EU. The reduction of emissions of NH_3 in the long term is, however, contributed to by the diminishing numbers of livestock, especially swine.

The development of VOC and CO emissions is associated with trends in industrial production, while CO emissions from industrial sources come from iron and steel plants in Ostrava and Třinec and their development thus corresponds to the volume of production of these devices. Developments in PM_{10}, $PM_{2.5}$, VOC and CO emissions also reflect the development of the meteorological conditions in the heating season in that year and, moreover, are significantly influenced by the type of fuel used in household combustion heaters. The decrease TSP presented also as PM_{10}, $PM_{2.5}$, was caused in the early 1990s by the application of end technology in coal power plants, at present, the emission development is influenced by growth of industrial production and construction.

The values of pollutant emissions in 2016 met the set emission ceilings for 2010. To achieve the binding emission limits from 2020 it is required to reduce the emissions of SO_2 by 16.6%, NO_x emissions by 10.0%, VOC emissions by 8.9% and NH_3 emissions by 11.6% (Chart 1).

The main source of emissions of pollutants into the air in 2015[1] was, in general, household heating, public electricity and heat production, and the industrial energy sector and transport. However, the representation of the individual sectors in the individual emissions of pollutants varies (Chart 2). In the case of NO_x, the main producer was the sector of public electricity and heat production (33.2%), followed by the transport sector (23.8%). The main producer of SO_2 emissions was public electricity and heat production (64.2%) and household heating (13.7%). In the case of the VOC emissions, the main source are manufacturing processes without combustion, especially the use of solvents, VOCs are also emitted by domestic heating. In the case of PM_{10}, $PM_{2.5}$ and CO emissions, the main source is local domestic heating (54.5%, 36.4% and 49.8% respectively) and also in the case of PM_{10}, $PM_{2.5}$ emissions it is transport (13.9% and 11.8% respectively), in the case of CO it is industrial energy (21.6%). NH_3 emissions originate mainly from the agricultural sector (96.5%).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[1] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

5 | Emissions of heavy metals

Key question

Is there success in reducing emissions of heavy metals that are toxic and dangerous for living organisms and the environment?

Key messages[2]

All monitored heavy metals emissions declined between 2005 and 2015, the most significant decline was observed in the nickel emission by 58.2% and lead by 47.9%.

Between 2014 and 2015, emissions of arsenic increased by 10.1% and emissions of copper by 2.4%.

Overall assessment of the trend

Change since 1990 N/A

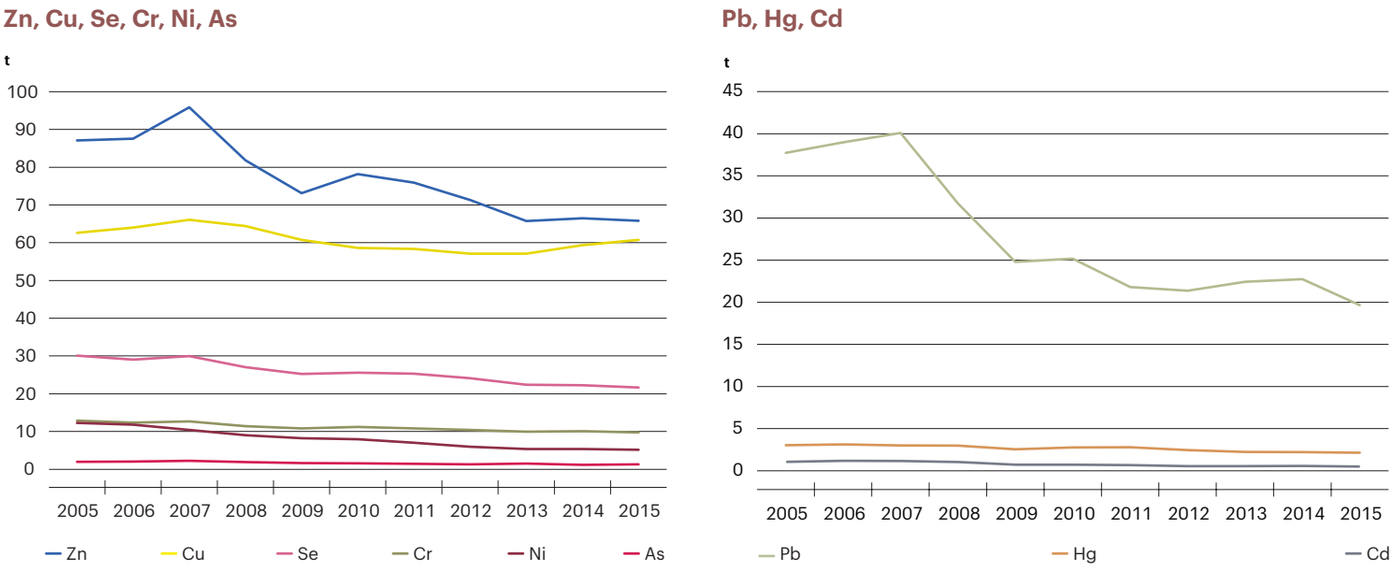
Change since 2005[3]

Last year-on-year change

Indicator assessment

Chart 1

Development of heavy metal emissions [t], 2005–2015



Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

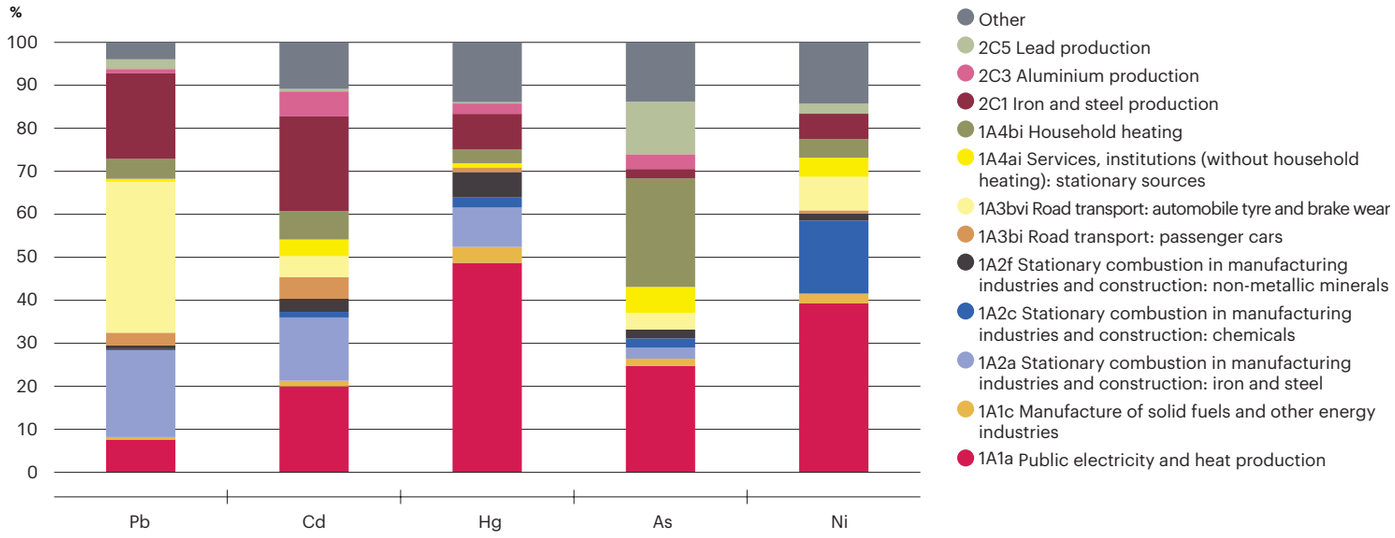
Source: Czech Hydrometeorological Institute

[2] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

[3] *Overall assessment of the trend postponed because of changes in the calculation methodology.*

Chart 2

Sources of selected emissions of heavy metals [%], 2015



Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

Heavy metals are metals with a specific weight greater than 4.5 g.cm^{-3}. They are bound in most fossil fuels from which they are released during the combustion process, at the same time they arise from technological processes of processing primary raw materials, in which they are naturally contained.

Emissions of heavy metals have been falling **since 2005** (Chart 1), in spite of the very unstable development between the years both due to the development of the economy (with an impact on the iron and steel production, the intensity of transport), and to the characteristic of the heating season and the quality of the processed material containing heavy metals.

Between the years 2005–2015, the greatest reductions were seen in emissions of nickel by 58.2% to a total of 5.1 t.year^{-1}, lead emissions by 47.9% to 19.6 t.year^{-1}, and also emissions of cadmium by 46.0% to 0.6 t.year^{-1}. On the contrary, the least reductions were seen in emissions of copper – by 3.0%, their development was rather stagnant over the entire period.

Between 2014–2015, most of the emissions also decreased, the largest decrease in production was observed in the case of lead by 13.6%, and cadmium by 9.8%. On the contrary, in the case of arsenic and copper, emissions rose year-on-year by 10.1% and by 2.4% respectively.

The main sources of heavy metal emissions in the Czech Republic in 2015 were, in general, automobile tyre and brake wear from road transport and the sector of public electricity and heat production.

For the individual metals, however, the representation of the different sources varies (Chart 2). **In lead** emissions, the dominant source is automobile tyre and brake wear from road transport (35.1%) and combustion processes in industry and construction (20.2%). For **cadmium**, the largest producer of emissions is public electricity and heat production (20.0%) and manufacture of iron and steel (14.7%). **Mercury** emissions are produced mainly by public electricity and heat production (48.7%). **Arsenic** emissions arise in particular as a product in household heating (25.3%), or also from the sector of public electricity and heat production (24.7%). **Nickel** emissions are generated the most by the sector of public electricity and heat production (39.3%) and also by combustion processes in industry and construction, or by the chemical industry.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

6 | Air quality in terms of human health protection

Key question

Are limit values that have been set for air pollutants in order to protect human health being met?

Key messages

In 2016, the limit values for benzene, arsenic, nickel, lead and cadmium were not exceeded in any of the monitored sites. The limit values for sulphur dioxide and carbon monoxide have not been exceeded. Year-on-year, there has been a decline in the number of stations, on which exceedance of the air pollution limit has been observed for suspended particulate matter PM_{10} and $PM_{2.5}$, and benzo(a)pyrene.
In 2016, no smog situation was announced for ground-level ozone. Compared to 2015, in 2016 the number of smog situations decreased for PM_{10} to 5, with a total duration of 387 hours.

Air pollution limits for suspended particulates PM_{10} a $PM_{2.5}$, benzo(a)pyrene and ground-level ozone have been exceeded repeatedly in the burdened localities of the Czech Republic in 2016. At four traffic-loaded locations, the annual limit value for NO_2 was exceeded (in Prague and Brno).

Overall assessment of the trend

Change since 1990

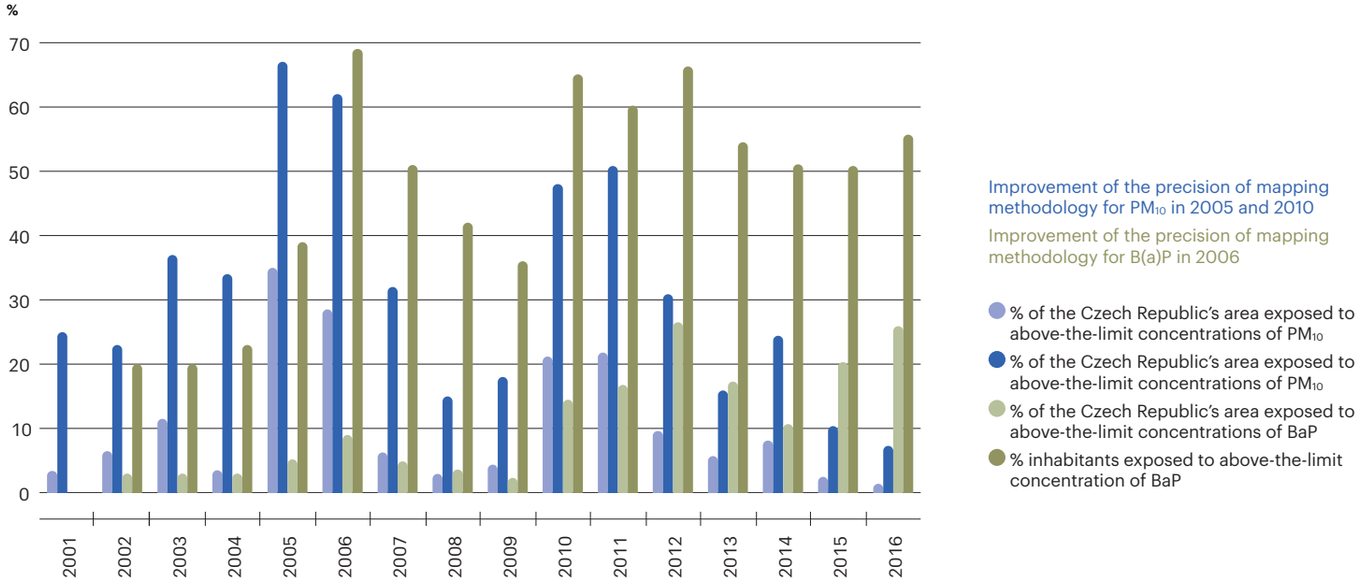
Change since 2005

Last year-on-year change

Indicator assessment

Chart 1

Percentage of the Czech Republic's area and population exposed to above-the-limit 24-hour concentrations of PM_{10} and above-the-limit annual concentrations of B(a)P [%], 2001–2016

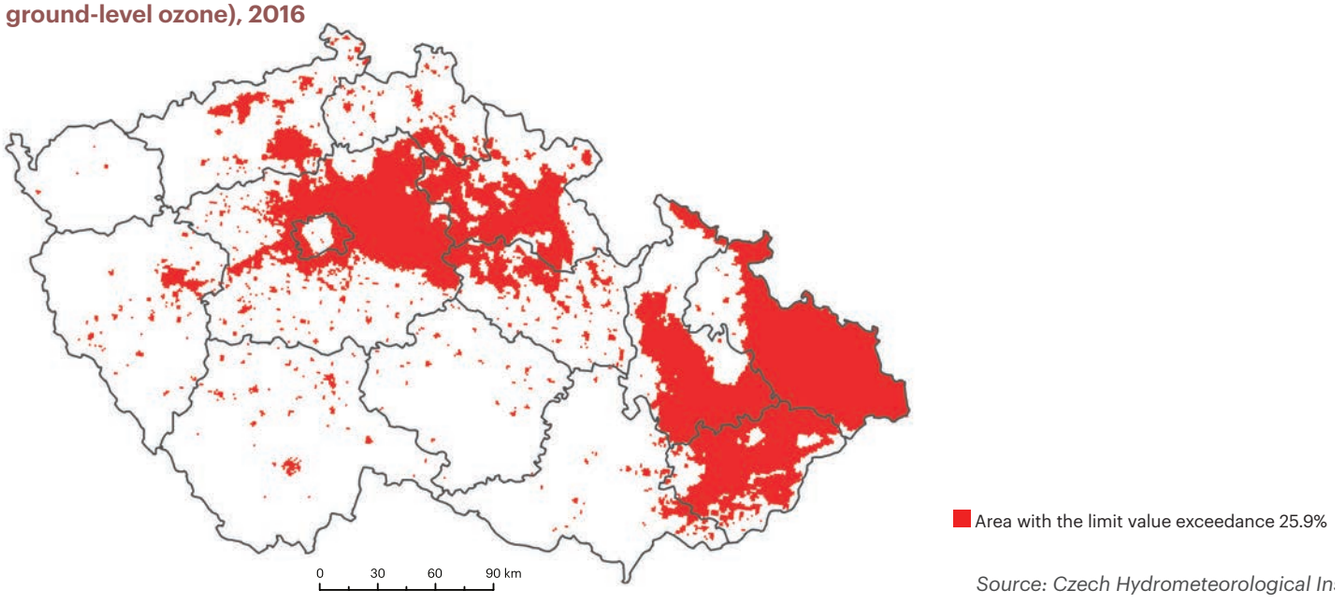


In 2005, a refinement of the mapping methodology was carried out and a model that combines the SYMOS model, the European EMEP model and the altitude data with the measured concentrations at rural background stations was first used in the construction of maps of PM_{10} concentration fields. In the year 2009, the methodology was refined again by applying the CAMx model. The SYMOS model includes emissions from primary sources. Secondary particulate matter and resuspended particulate matter that are not included in the emissions from primary sources, are taken into account within the EMEP and CAMx models. Between the years 2002–2007, the methodology for benzo(a)pyrene mapping, carried out since 2002, was gradually refined. In addition to the increase in the number of monitoring stations, a refinement in the mapping methodology was carried out in 2006. In 2006, a number of towns and villages were included in the territory with an exceeded B(a)P pollution limit as a result of a methodological change.

Source: Czech Hydrometeorological Institute

Figure 1

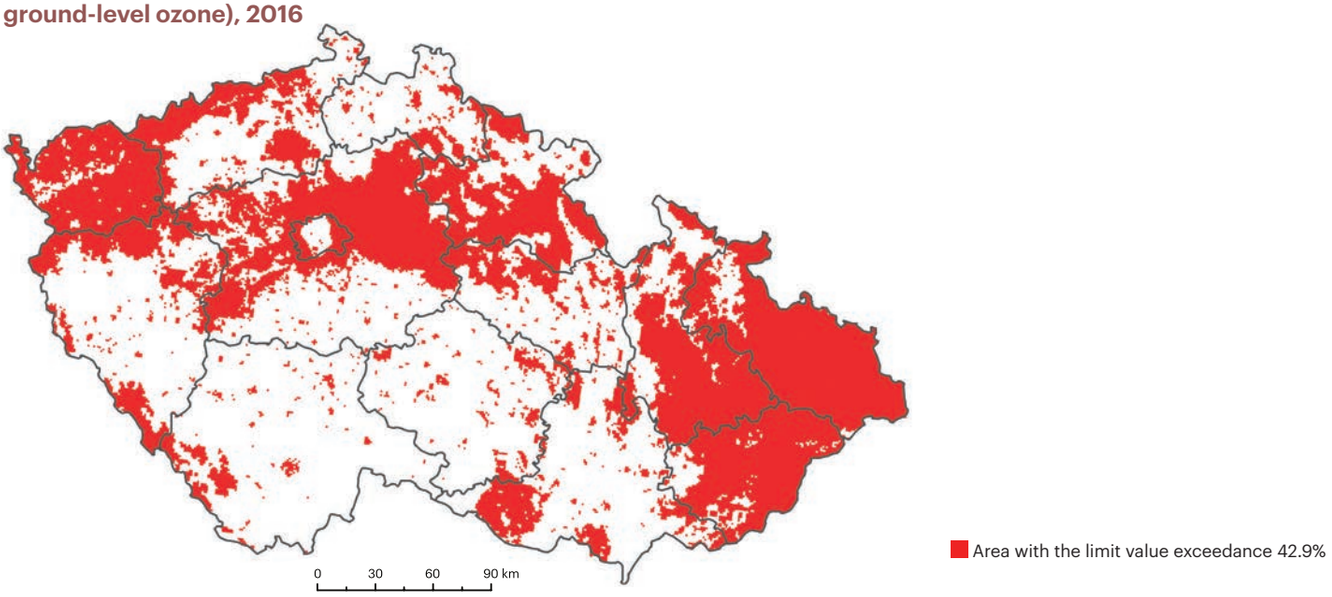
Areas within the Czech Republic where air pollution limit values for human health protection were exceeded (excluding ground-level ozone), 2016



Source: Czech Hydrometeorological Institute

Figure 2

Areas within the Czech Republic where air pollution limit values for human health protection were exceeded (including ground-level ozone), 2016



Source: Czech Hydrometeorological Institute

Table 1

Increase in the total annual mortality by "premature death" [an estimate of the number of premature deaths] – for the entire Czech Republic and the unburdened urban localities, 2010–2016

PM_{10} (75% representation of the $PM_{2.5}$ fraction)	2010	2011	2012	2013	2014	2015	2016
Estimated mean value for the Czech Republic	6,108	6,815	5,888	6,040	5,842	5,540	4,300
Estimated mean value for normal urban environment (*)	5,346	6,354	5,888	6,040	5,371	4,773	4,000

**Excluding stations extensively burdened by traffic and industry.*
The total mortality increase was calculated from the span of values measured in the Czech Republic and from the estimate of values in unburdened urban areas of the Czech Republic. The annual average of $PM_{10} \leq 13.3\ \mu g.m^{-3}$ for 75% representation of the $PM_{2.5}$ fractions) were evaluated as 0. The values of the total annual death rate in 2013 were taken from the Czech Statistical Office and "cleaned" – deaths caused by injury and those of people under 30 years were deducted.
The WHO recommendations were used for the conversion of the PM_{10} effects, taking the estimated mean value of representation of $PM_{2.5}$ fraction in the PM_{10} fraction for the Czech Republic to be 75%.
Accuracy of the estimate is in the order of hundreds of inhabitants.

Source: National Institute of Public Health

Table 2

Range of estimated values of individual carcinogenic risk (ILCR) for benzo(a)pyrene in evaluated types of sites with over 5,000 inhabitants* [number of cases per 100,000 inhabitants], 2010–2016

	2010		2011		2012		2013		2014		2015		2016	
Number of additional cases per 100,000 inhabitants	min	max	min	max	min	max	min	max	min	max	min	max	min	max
Cities (over 5,000 to 5 mil. inhabitants)	4.4	62.6	3.1	88.5	4.6	94.2	5.7	81.7	3.3	81.1	3.1	68.1	5.1	78.3
Sites without traffic and industrial burden	5.2	15.7	4.6	13.7	4.7	9.7	5.9	39.0	5.0	31.8	3.5	30.6	5.1	29.0
Sites with traffic burden	4.4	37.4	5.4	11.1	5.3	13.0	7.0	25.7	5.7	25.0	4.8	25.3	7.0	25.4
Industrial sites	14.8	62.6	15.7	88.5	9.8	98.8	11.0	81.7	13.8	81.1	8.2	68.1	9.1	78.3

** Concerns approximately 5 mil. inhabitants.*
For the purposes of health risk assessment, the data were processed in a form of span intervals for the Czech Republic, for all urban stations (about 5 mil. inhabitants in total) and for selected types of urban sites (housing sites without transport burden and urban transport burden). Due to lack of data, this procedure cannot be used to evaluate the burden on up to about 5 mil. inhabitants in small settlements (< 5,000 inhabitants).
B(a)P, which contributes with the highest share to the burden (its ILCR moves within the range of 10^{-4} to 10^{-3}), was selected as the indicator for the assessment.

Source: National Institute of Public Health

Despite the steady decline in pollutant emissions over the long term, the concentrations of pollutants in the air, especially of suspended particulate matter and benzo(a)pyrene, are not decreasing in the areas where in the previous years deterioration in air quality was identified and the development is accompanied by variations which are related mainly to the meteorological conditions. Air pollution limits were exceeded at the measuring stations in 2016 particularly in the context of the occurrence of degraded dispersion conditions, which tend to be associated with the inverted nature of the weather in the cold part of the year.

The **limit value for PM_{10} 24-hour concentration** (50 μg.m^{-3}, the maximum number of exceedances per calendar year is 35) was exceeded in 2016 at 23 stations out of the total of 145, i.e. at 15.9% stations. Year-on-year, there has been a decrease in exceedances, as in 2015, the limit value was exceeded on 23,4% of stations (at 29 stations out of a total of 124). The most exposed regions, in which stations were located that were exceeding the limit values, included mainly the Moravian-Silesian Region.

The **annual limit values for PM_{10}** (40 μg.m^{-3}) was exceeded in 2016 only at 1 station out of 152 stations, i.e. at 0.7% of the stations. As opposed to the previous year 2015, there has been a decrease in exceedances, as in 2015, the limit value was exceeded on 2.3% of stations (at 3 stations out of a total of 132). The exceedance was recorded at the station Ostrava-Radvanice Health Institute with a concentration of 41.0 μg.m^{-3}.

The **limit value for the 24-hour average concentration of PM_{10}** (Chart 1) was exceeded in 2016 at 1.4% of the territory (in 2015 at 2.5% of the territory). In 2016, 7.3% of the population in the Czech Republic was exposed to above-the-limit concentrations (in 2015 it was 10.4% of the population). The limit for the annual average concentration of PM_{10} was not exceeded in 2016 in the territory of the Czech Republic (in 2015, it was exceeded on 0.02% of the territory). The situation improved as opposed to 2015.

In 2016 in the entire territory of the Czech Republic there was a total of **5 smog situations** declared due to high suspended PM_{10} concentrations, with a total duration of 16 days and 3 hours (387 hours). No regulation was declared in 2016, since no regulatory threshold was exceeded as laid down in Annex 6 to Act No. 201/2012 Coll., on Air Protection. Compared to the previous evaluated year 2015, the number of declared smog situations decreased as well as the length of their duration (a total of 9 smog situations in 2015 with duration of 418 hours). In 2016, the smog situations were most often declared in the territory of the Ostrava/Karviná/Frýdek-Místek agglomeration, excluding the Třinec district (2 in total). Furthermore, a smog situation was announced in the Olomouc and Plzeň Regions and in the Třinec district. The announcement of the smog situations occurs in case of poor dispersion conditions due to the small air flow and the inverse of grading the ground the atmosphere. From the perspective of types of synoptic situations the inverse nature of weather arises most frequently in anti-cyclone situations.

The **annual limit value for $PM_{2.5}$** (25 μg.m^{-3}) was exceeded in 2016 at 10 stations from the total of 81, i.e. at 12.3% stations. Year-on-year, there has been a decrease in exceedances of the limit value, as in 2015, it was exceeded on 12,5% of stations (at 6 stations out of a total of 48). The limit value was exceeded in the Moravian-Silesian Region, but also at 1 station in the Ústí nad Labem Region.

No limit value has been set for the rate of air pollution in the case of **suspended particulate matter PM_1**, both in EU or Czech legislation. In 2014, PM_1 was measured in the Czech Republic at 9 locations, in 2015 at 11 locations, in 2016 already at 13 locations. The highest annual average concentrations were achieved in 2016 at the station Ostrava-Českobratrská (23.7 μg.m^{-3}), this site also reported the maximum 24-hour concentration (168.6 μg.m^{-3}). For fractions smaller than 1 μm, incremental data obtained from case studies and projects also exist, which point to increased and above-the-limit concentrations, especially in the Moravian-Silesian Region and Ústí nad Labem Region, where their main source are, in particular, road transport and local furnaces.

According to the estimate carried out by the State Health Institute, exposure to suspended particulate matter contributed to the **premature death rate of the population** in the range between units of percent to approximately 10% in the industrially burdened areas of Ostrava-Karviná in the period 2006–2016. This risk of exposure is not evenly distributed within the population, as it concerns sensitive population groups, particularly the elderly and chronically ill people. It can be estimated from these data that in the long-term (2006–2016) for the whole of the Czech Republic, the increase in overall mortality, contributed to by the exposure to PM_{10} fraction of suspended particulate matter (with estimated 75% representation of the $PM_{2.5}$ fraction), varies on average between 4 to more than 6 thous. people per year. In 2016, it was approximately 4.3 thous. people nationally, or roughly 4.0 thous. people in the typical urban environment, and it is clear that long-term exposure to suspended particulates, leading to premature mortality, is slightly decreasing (Table 1).

The **ground-level ozone** concentrations are influenced by the meteorological conditions (the intensity of sunlight, temperature, and the occurrence of rainfall) in the period from April to September when the highest concentrations are usually measured. In 2016, the limit value for the protection of human health, expressed as daily 8-hour mean concentrations (120 μg.m^{-3}), was exceeded at 22 stations out of a total of 75, i.e. at 29.3% of stations. Year-on-year, there has been an increase in exceedances of the limit value, as in 2015, it was exceeded on 22.2% of stations (at 16 stations out of a total of 72).

In 2016, the **limit value for ground-level ozone** for the protection of human health was exceeded in 18.5% of the Czech Republic's territory and 3.5% of the population were exposed to above-the-limit concentrations. In 2015, the limit value was exceeded on 26.8% of the territory of the Czech Republic, with 9.5% of the population, and thus the situation improved year-on-year.

In 2016, **no smog situation** was announced for ground-level ozone. As opposed to the previous evaluated year 2015 there was a significant change, as in 2015, due to high concentrations of ground-level ozone, 25 **smog situations** were declared with a total duration of 201 days and 9 hours (i.e. 2,457 hours in total).

As in 2015, in 2016 a number of towns and smaller settlements were classified as areas with exceeded **limit values for benzo(a)pyrene**. This concerned about 25.9% of the territory where 55.7% of the population live (Chart 1).

The **limit value** (1 ng.m^{-3}) for the annual average concentration of **B(a)P** was exceeded in 2016 at 31 stations out of a total of 44, i.e. at 70.5% of stations. Compared to 2015, the situation is worse because the number of exceedances of air pollution concentrations increased to 61.8% stations (21 out of 34 stations). Concentrations in excess of the limit values were measured at stations in the Moravian-Silesian, Central Bohemian, Ústí nad Labem Regions, but also in other Regions (e.g. the Plzeň, Hradec Králové Regions).

The total increase of the **individual lifelong risk of new cancer diseases** in urban localities of the Czech Republic with over 5 thous. inhabitants due to B(a)P has been stagnating in the long term; in 2016 it ranged from 5.1 to 9.1 occurrences of the disease per 100,000 inhabitants according to the type of urban localities. In localities with traffic load the impact of B(a)P emissions could lead to an increase in health risks by about 1 case per 100,000 inhabitants compared to the values measured in urban areas without major traffic and industrial pollution. In localities affected by large industrial sources, the value of the individual risk was higher than in other urban localities and in theory could represent an increase of up to 5 additional cases per 100,000 inhabitants (Table 2).

In 2016, the **annual limit value for NO_2** was exceeded at a total of 4 heavy-traffic locations (in Prague and Brno) out of a total of 96 stations, i.e. at 4.2% of the stations. In 2015, it was 2 locations out of a total of 93 (i.e. 2.2%). The annual limit values for

benzene, arsenic, nickel, cadmium and lead were not exceeded in 2016 at any station. At the same time, the limit values were not exceeded for hourly concentrations of SO_2 and NO_2, for 24-hour concentrations of SO_2 and for 8-hour mean concentration of CO.

The **map of areas** with exceedance of at least one air pollution limit value, excluding ground-level ozone,[4] provides comprehensive information on ambient air quality in the territory of the Czech Republic in 2016. In the reporting year, 25.9% of the territory of the Czech Republic (Figure 1) was marked that way, covering 55.7% of the population.

After the inclusion of ground-level ozone in 2016, 42.9% of the area of the Czech Republic (Figure 2) with around 58.9% of the population was defined as having exceeded the value of air pollution limit for at least 1 or more pollutants.

In settlements with a population of up to 10 thous. there is in the Czech Republic almost half of the population (in 2016 it was 48.2% of the population). Therefore, air pollution in the most affected small settlements can be comparable with the burden in large urban agglomerations. The reason behind the poor air quality in small settlements is a combination of several basic factors, which are representing the particular morphology of the territory, representing particularly the valley site with the appearance of a temperature inversion, the traffic burden of transit transport, especially in places without the existence of route suggestions help, and in the context of traffic fluidity, and residential heating by solid fuels. Local combustion heaters for domestic heating were in 2015 the source of 36.4% of all emissions of PM_{10} and 97.0% of B(a)P emissions. Moreover, where the local combustion heaters burn waste or other unauthorised fuel, they emit higher amounts of hazardous dioxins.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[4] *Act No. 201/2012 Coll., on air protection, Annex No. 1, section 1+2+3, exceedance of the air pollution limit value excluding ground-level ozone for at least one of the listed pollutants (SO_2, CO, PM_{10}, $PM_{2.5}$, NO_2, benzene, Pb, As, Cd, Ni, benzo(a)pyrene)*

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

Key question

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

Key messages

The limit values for annual or for winter average SO_2 concentration was not exceeded at any rural locality in 2016, and the annual limit value for annual average concentration of NO_x for the protection of ecosystems and vegetation was not exceeded either in 2016.

In 2016, the limit value for ozone for the protection of ecosystems and vegetation was exceeded at a total of 8 stations ranked as rural or suburban, and compared to 2015 the number of stations with an exceeded limit value increased.

Overall assessment of the trend

Change since 1990 N/A

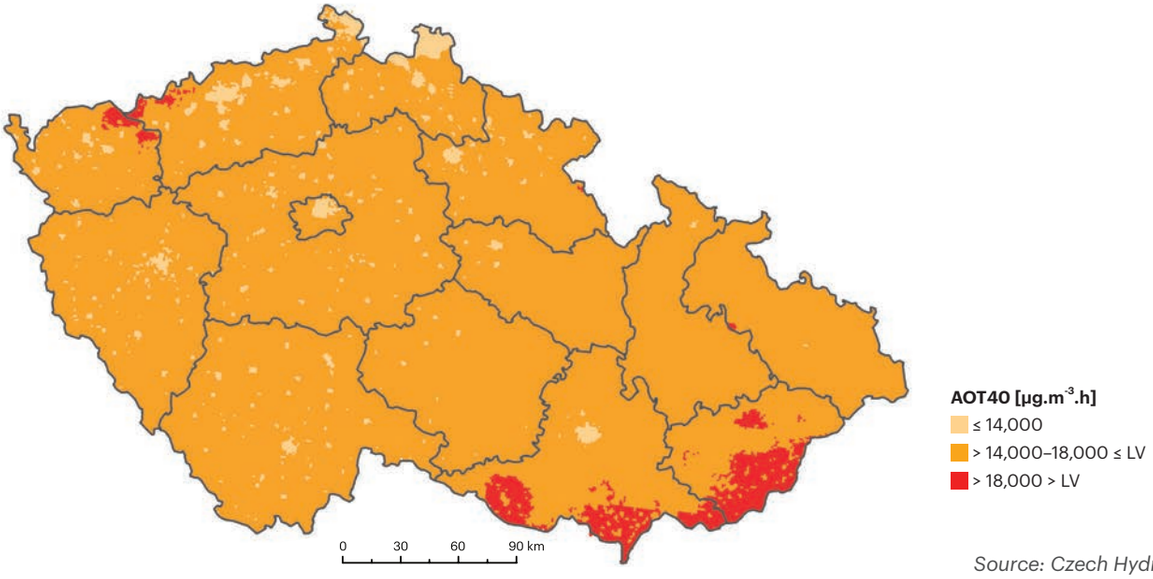
Change since 2000

Last year-on-year change

Indicator assessment

Figure 1

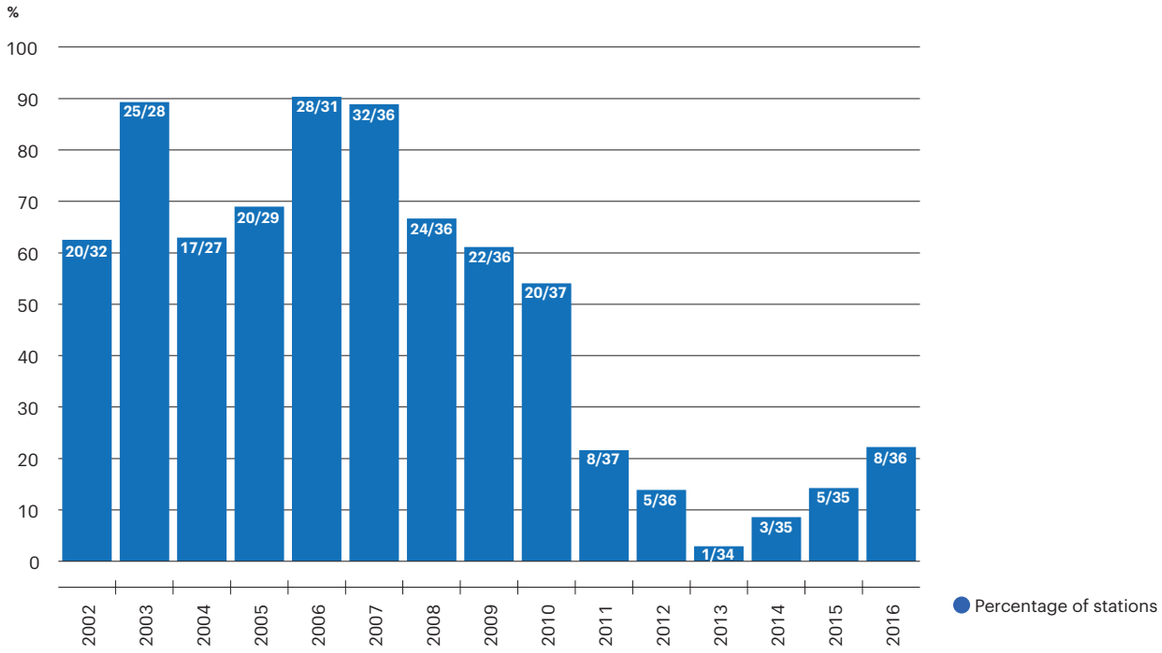
Field of AOT40 exposure index values, 5-year average [µg.m^{-3}.h], 2012–2016



Source: Czech Hydrometeorological Institute

Chart 1

Percentage of stations at which the limit values, expressed as AOT40 (5-year average) for the protection of vegetation, were exceeded [%], 2002–2016

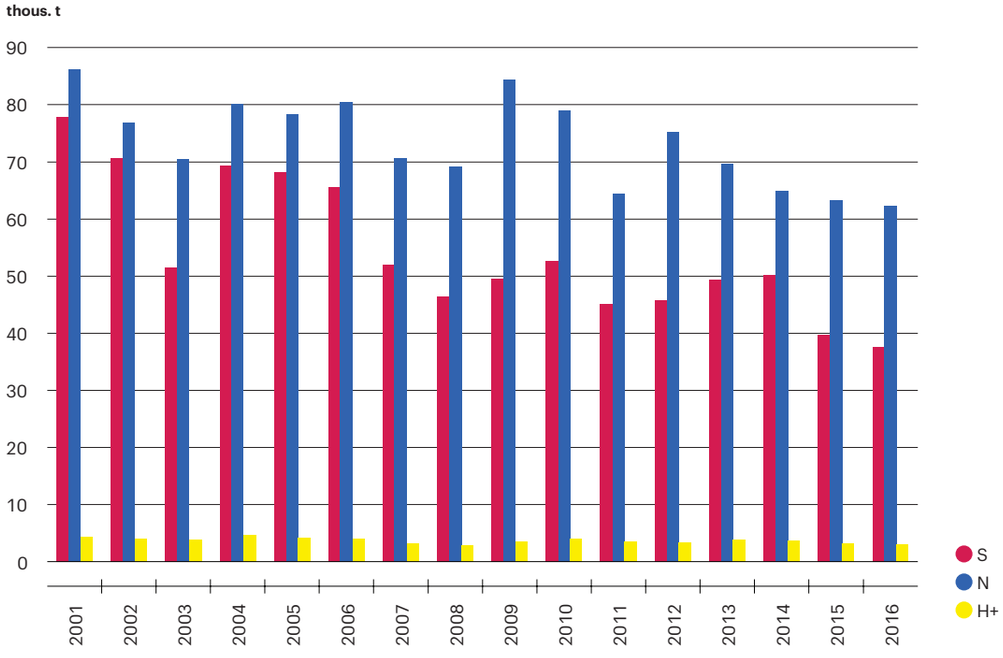


The number in the chart indicates the number of stations at which the limit value was exceeded (before the slash) out of the total number of stations (after the slash). These are rural and suburban stations for which the AOT40 calculation is relevant under the legislation

Source: Czech Hydrometeorological Institute

Chart 2

Trends in the total atmospheric deposition of sulphur, nitrogen and hydrogen ions in the Czech Republic [thous. t], 2001–2016



Source: Czech Hydrometeorological Institute

In 2016, the **ozone** (AOT40[5]) **limit value** for the protection of ecosystems and vegetation (period 2012–2016) was not exceeded in most of the territory of the Czech Republic (Figure 1). In comparison with the previous assessed period 2011–2015, the situation has not changed significantly.

The limit value for ozone for the protection of ecosystems and vegetation (18 000 $\mu g.m^{-3}$) was exceeded in 2016 at 8 stations out of a total of 36 rural and suburban stations (this is the average for the years 2012–2016). The highest values were measured at the station Štítná n. Vláří (21,105.8 $\mu g.m^{-3}.h$), where the highest concentrations have been measured in the long term. Compared to 2015 (average for the years 2011 to 2015), there was an increase in the number of sites where exceedance was recorded, because in 2015 the ozone limit value for the protection of ecosystems and vegetation was exceeded only at 5 of the total 35 stations (Chart 1).

Interannual changes in the values of the AOT40 exposure index are affected not only by ozone precursor emissions, but more particularly by the meteorological conditions (temperature, precipitation, solar radiation) in the period from May to July for which the indicator is calculated. Also for that reason, the highest concentrations of ozone and the most exceedances of the limit value were achieved in the years 2003, 2006 and 2015, which were characterised by favourable conditions for the formation of ground-level ozone.

The **limit value** for the annual average concentration of **SO_2** (20 $\mu g.m^{-3}$) for the protection of ecosystems and vegetation was not exceeded in 2016 at any one of the 19 stations classified as rural. Similarly, in 2016, none of the 18 stations classified as rural reported exceeded limit values for the winter, i.e. for the period October–March, average concentration of SO_2 (20 $\mu g.m^{-3}$) for the protection of ecosystems and vegetation. The highest annual average SO_2 concentration was measured in 2016 at the Krupka station (8.7 $\mu g.m^{-3}$), the highest winter average concentration of SO_2 was measured at the station of Věřňovice (12.5 $\mu g.m^{-3}$).

The **limit value** for the annual average concentration of **NO_x** (3 $\mu g.m^{-3}$) for the protection of ecosystems and vegetation was not exceeded in 2015 as well as in 2016 at any one of the 19 stations classified as rural. The highest annual average concentrations of NO_x were achieved at the site in Věřňovice (22.9 $\mu g.m^{-3}$).

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

In 2016, the total atmospheric deposition of **sulphur** amounted to a total of 37,662 t of sulphur for the total area of the Czech Republic and thus reached the lowest value since 2001. The total deposition of sulphur has its maximum in the Ore Mountains (Krušné hory) where the maximum values of the throughfall deposition of sulphur are also achieved. In the last decade, the value of the total **nitrogen** deposition remains in the range of 70,000–80,000 t per year as a result of the production of NO_x emissions. In 2016, the total deposition of nitrogen (oxidised + reduced forms) was 62,351 $t.year^{-1}.km^{-2}$ which is also the lowest value since 2001. In the case of total **hydrogen** ion deposition the value reported in 2016 was 2,987 $t.year^{-1}$ for the area of the Czech Republic, which is the lowest value since 2008.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[5] *For the purposes of the Act No. 201/2012, AOT40 means the sum of the differences between the hourly concentration greater than 80 $\mu g.m^{-3}$ (= 40 ppb) and the value 80 $\mu g.m^{-3}$ in the given period using only the hourly values measured every day between 08:00 and 20:00 CET, calculated from hourly values during the summer season (May 1–July 31).*

Air quality in the global context

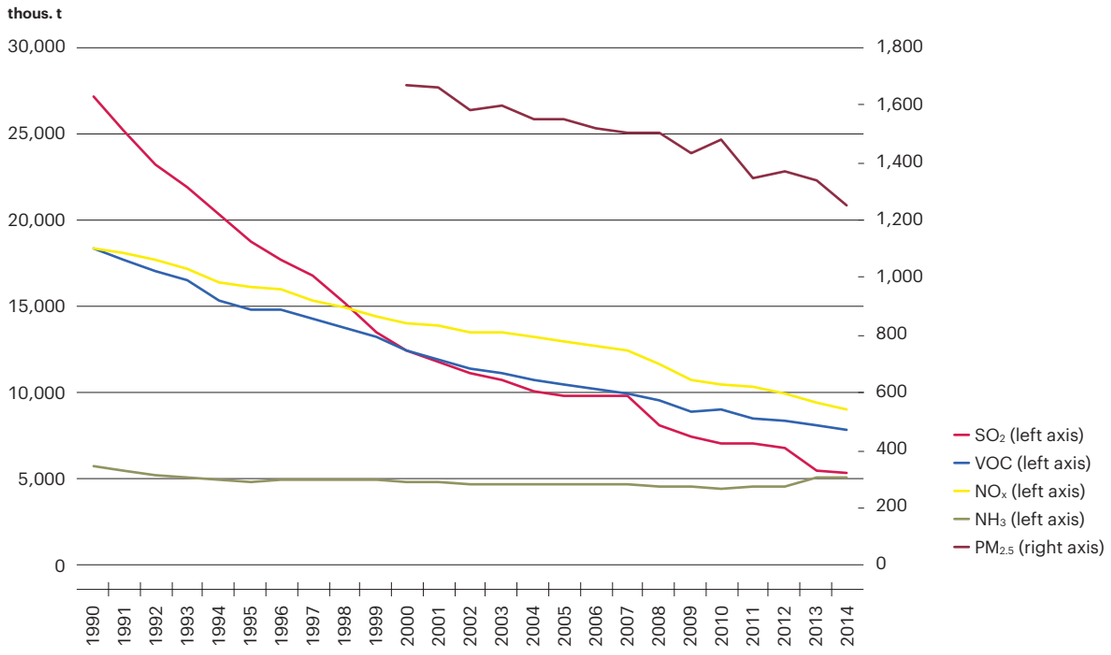
Key messages[6]

- Emissions of pollutants in the EEA33 countries have been decreasing since 1990, in the period 1990–2014 SO_2 emissions decreased by 80.5%, NO_x emissions decreased by 50.6%, VOC emissions by 57.0%, NH_3 emissions by 11.4% and emissions of $PM_{2.5}$ decreased by 25.2% since 2000.
- Lead emissions decreased between 1990 and 2014 by 91.7%, cadmium emissions by 66.3% and mercury emissions by 73.4%.
- Air quality is improving slightly in Europe.
- The limit value for the protection of ecosystems and vegetation for ground-level ozone in 2013 was exceeded in approximately 22% of the territory of European countries, especially in southern Europe.

Indicator assessment

Chart 1

Emissions of the main pollutants SO_2, NO_x, VOC, NH_3 in the EEA33 countries [thous. t], 1990–2014, and $PM_{2.5}$ in the EEA countries [thous. t], 2000–2014



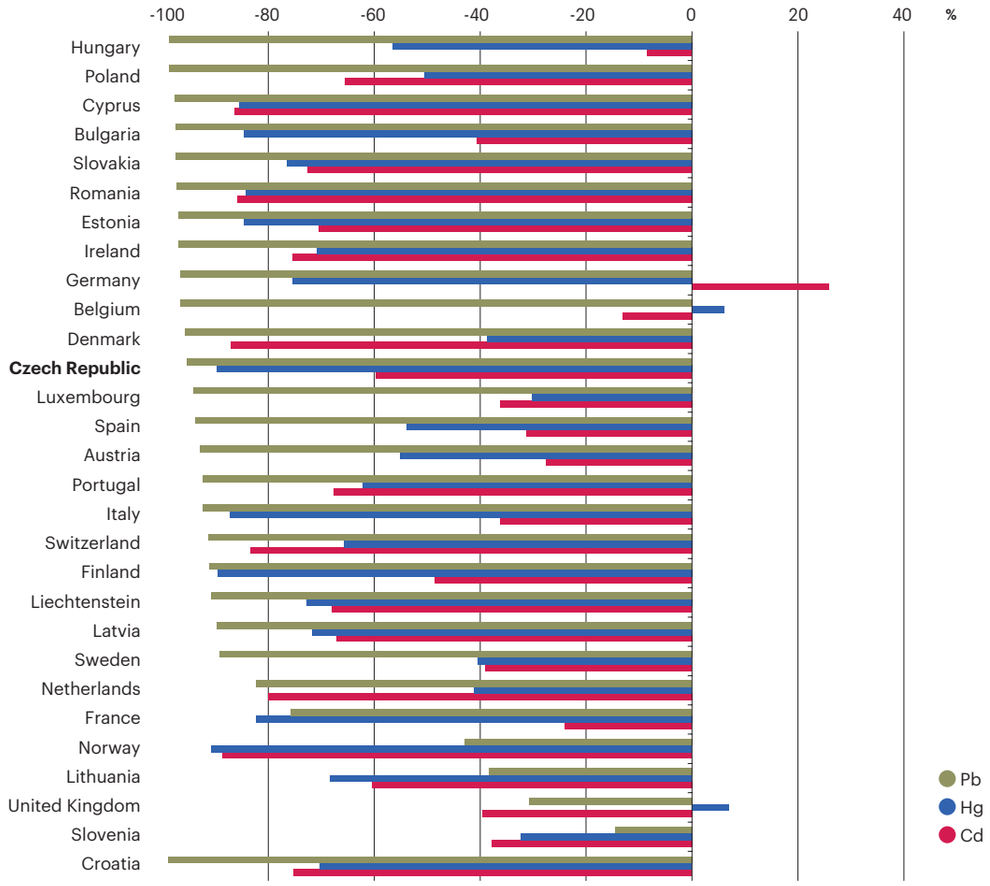
Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Environmental Agency

[6] *Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Chart 2

Development of heavy metal emissions in EEA33 countries [%], 1990–2014

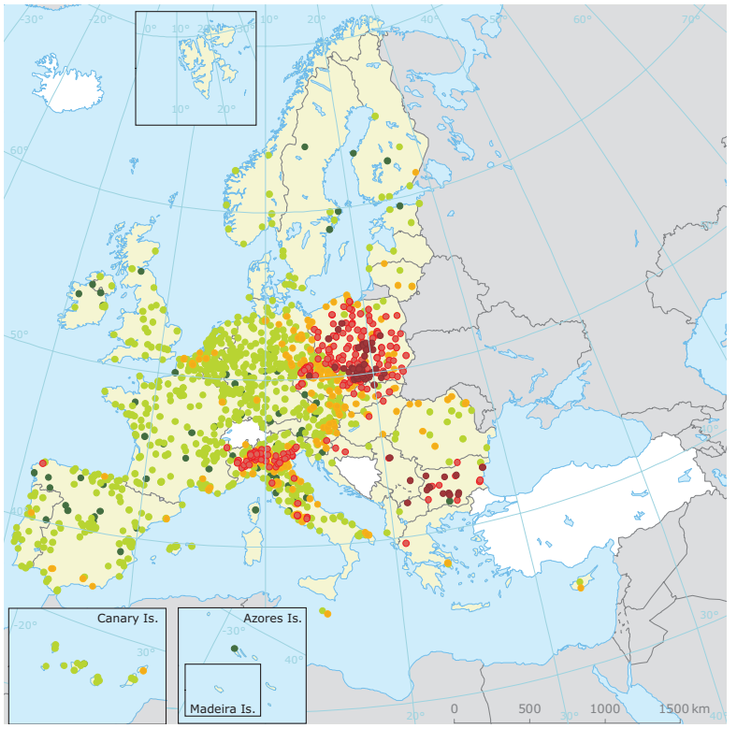


Data for Malta are not shown due to high uncertainty; data for Iceland, Greece and Turkey have not been reported. Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Environmental Agency

Figure 1

24-hour average PM_{10} concentration at background stations [µg.m^{-3}], 2014

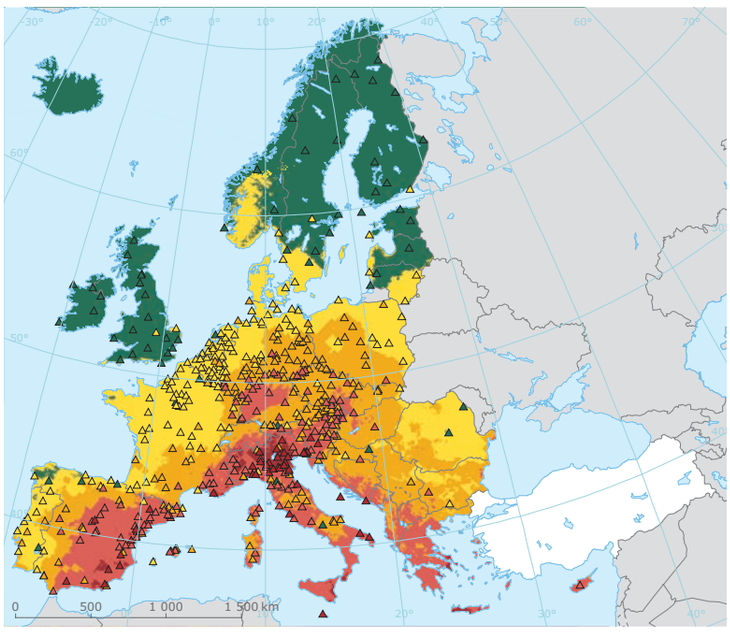


90.4 percentile of 24-hour average concentrations of PM_{10}, representing the 36th highest value of the exceedance.
Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Environmental Agency

Figure 2

Fields of the AOT40 index values in Europe [µg.m^{-3}.h], 2014



Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Environmental Agency

Pollutant emissions in Europe are declining (Chart 1), and all countries of the EU28 and EEA33 are approximating the emission ceilings specified in the NEC Directive and the Gothenburg Protocol. Emissions of SO_2 in 2014 in the EEA reached with 5.3 mil. t nearly 20% of the 1990 level and so represent the most significant decrease of all observed emissions of pollutants. NO_x emissions are also falling, and in 2014 they were with 9.1 mil. t at approximately 50% of the 1990 level. VOC emissions in 2014 amounted to 7.9 mil. t and compared to 1990 they decreased by 57.0%. NH_3 emissions were reduced between 1990 and 2014 only by 11.4%, however, their production is the lowest overall, with 5.1 mil. t. $PM_{2.5}$ emissions also decreased and in 2014 they were with 1.3 mil. t at about one quarter of the 2000 level. It appears, however, that roughly a third of the EEA33 countries will not be able to meet the set emission ceilings for $PM_{2.5}$ by 2020.

The emission ceilings for **heavy metals** are exceeded in Europe only locally, in areas with specific industrial production. Emissions of cadmium and mercury in 2014 fell to one third and one quarter respectively of the emission levels of 1990, lead emissions even to one tenth. The sharp reduction of emitted substances is mainly the result of a combination of introducing the best available techniques on the individual installations and implementing environmental legislation.

Air quality in Europe is gradually improving slightly also due to the decrease in the emission of pollutants. The most risky substances include suspended solids of PM_{10} and $PM_{2.5}$ fraction, ground-level ozone O_3 and polycyclic aromatic hydrocarbons expressed by benzo(a)pyrene. The level of exceeding the limit values changes between years, and is influenced by the developments of meteorological conditions, and by the current economic activity in the individual countries, especially industrial activities and transport outputs.

In 2014, roughly 16% of the urban population of EU28 average countries were exposed to above-the-limit 24-hour **PM_{10}** concentrations (50 $\mu g.m^{-3}$, 35-day exceedance, Figure 1). The level of exceedance changes between years, in 2013, roughly 17% of the urban population was exposed to those above-the-limit concentrations.

In 2014, about 8% of the EU28 urban population was exposed to above-the-limit annual concentrations of **$PM_{2.5}$** (25 $\mu g.m^{-3}$), in 2013, it was about 9% of the urban population.

In 2014, roughly 8% of the urban population was exposed to above-the-limit concentrations of ground-level ozone O_3, and it is the lowest value since 2000. In 2013, approximately 15% of urban population was exposed to above-the-limit concentrations. In the case of **O_3** concentrations, the most important role is played by the development of meteorological conditions in the warm part of the year.

About 17–24% of the EU28 urban population was exposed in 2014 to above-the-limit annual concentrations of **benzo(a)pyrene** (1 $ng.m^{-3}$), while in 2013 it was approximately 20–25% of the urban population.

A serious damage to vegetation in the long term presents the ground-level ozone, expressed as AOT40. The limit value for the **protection of vegetation for ground-level ozone** (18,000 $\mu g.m^{-3}.h$) was exceeded in 2014 on around 18% of the area of the EU28 countries, and on around 18% of the area of all European countries. The limit value was exceeded especially in southern and south-eastern Europe (Figure 2). The development of concentrations of ground-level ozone reported a significant year-on-year variability caused particularly by meteorological conditions during the growing season (May to July). In 2014, it was the lowest value since 2000.

Water management and water quality

3

Water management and water quality

Water is the basis of life on Earth, it is necessary for the functioning of ecosystems, the life of plants, animals and humans, and is also a key input for a number of industrial sectors and agriculture. It is important to pay attention to its quantity and quality. In order to keep sufficient quantity of water for living organisms in the aquatic ecosystems, it is necessary to monitor, in particular, water abstraction for human use, whether it is the use of water for drinking, or the use of water for agriculture, hydroelectricity etc. That is particularly important in the current period of climate change, with large swings in rainfall, leading to more frequent floods and droughts. To prevent both of these hydrological extremes, it is essential to increase water retention in the landscape. The amount of abstracted water affects the amount of discharged waste water – here, both the amount of discharged of waste water and the concentration of pollutants are important. Pollution of discharged water is intertwined with the availability of wastewater treatment and its effectiveness. The problem is, in particular, the still incomplete sewerage in smaller municipalities (under 2,000 population equivalent). Moreover, only a part of the wastewater treatment plants is equipped with the tertiary degree of treatment, and even that is not capable of 100-percent capture of all substances present in the wastewater (e.g. residues of medicinal products, in particular hormonal). The water quality is particularly important for the healthy functioning of ecosystems and the use of water as drinking, less so for its industrial or agricultural use. Water quality in watercourses is important not only for the organisms living in those ecosystems, but can affect also the surrounding ecosystems (e.g. floodplains). A problem may be the content of substances that are toxic in themselves (e.g. heavy metals), they can accumulate in sediments and organic tissues, and then enter the food chain. At the same time, however, a big issue to address is the content of nutrients (nitrogen, phosphorus, etc.), the increased amount of which leads to eutrophication of waters.

References to current conceptual, strategic and legislative documents

Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy (the Water Framework Directive)
- measures for focused decrease in the discharge, emissions and releases of priority pollutants
- the achievement of at least good water status and non-deterioration of their condition by 2015, with exceptions until 2027

Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources (Nitrates Directive)
- reduce and prevent water pollution by nitrates originating from agricultural sources

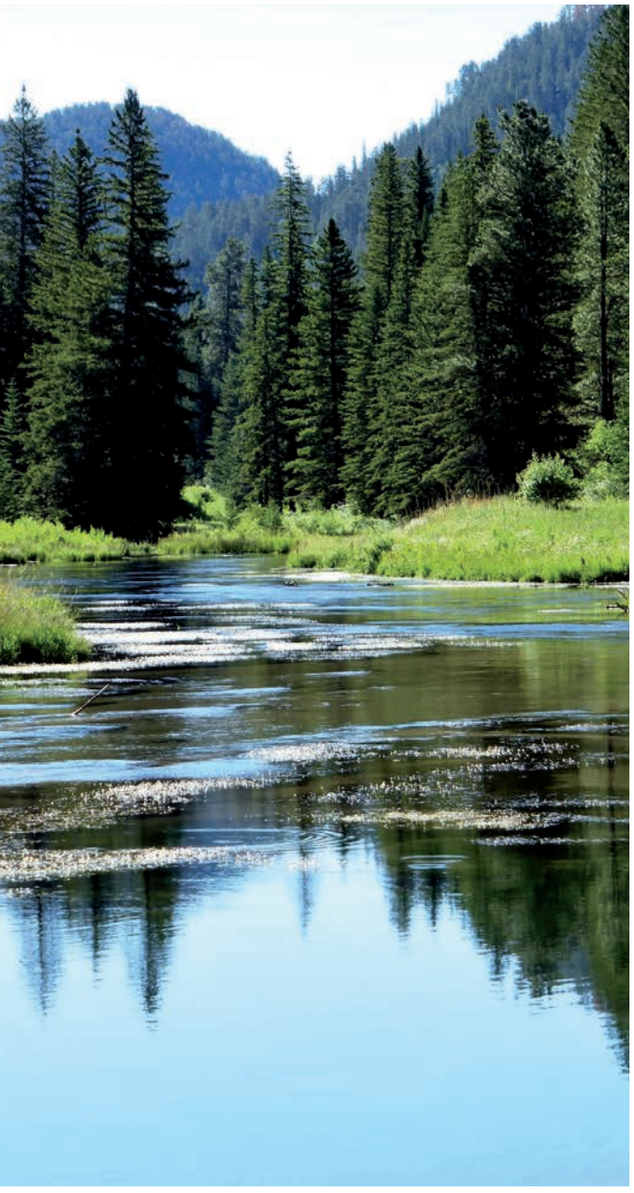
Directive 2006/11/EC of the European Parliament and of the Council on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community
- reduce and prevent water pollution by hazardous substances provided in the Annex to the Directive

Directive 2006/7/EC of the European Parliament and of the Council concerning the management of bathing water quality
- definition of the methods of monitoring and classification of bathing water quality

Directive of the European Parliament and of the Council 2013/39/EU, amending Directive 2000/60/EC and 2008/105/EC in respect of priority substances in the field of water policy
- protection of water against priority hazardous substances – achieving the obligations by the end of 2021 for the revised environmental quality standards of the existing priority substances and by the end of 2027 for the newly designated priority substances

Council Directive 91/271/EEC concerning urban waste water treatment
- obligation to connect communities over 2,000 PE to a WWTP

State environmental policy of the Czech Republic 2012–2020
- ensure prudent management of water in residential areas by supporting measures leading to the capture and subsequent use of rain water and non-drinking quality water on site



- completion of the construction and reconstruction of missing WWTPs in municipalities with over 2,000 PE, ensuring support the construction and reconstruction of WWTPs with sewerage in municipalities up to 2,000 PE
- achieving at least good ecological status or potential and good chemical status of surface water bodies, achieving good chemical and quantitative status of groundwater bodies

Strategy for Climate Change Adaptation in the conditions of the Czech Republic
- support for integrated planning in the field of water
- conceptual and legislative solutions to the management of long-term water shortages
- modifying the system of permitting the discharge of wastewater so that it puts maximum emphasis on the application of BAT (best available techniques)
- reducing the consumption of high-quality drinking water for purposes that do not require such a high quality

Strategy of the Ministry of Agriculture of the Czech Republic with a 2030 perspective
- creating the conditions for sustainable management of the limited water resources so that the requirements of the use of water resources are aligned with the requirements of water protection and at the same time with the implementation of measures to reduce the harmful effects of water caused by hydrological extremes, i.e. flood and drought

National action plan to decrease the use of pesticides in the Czech Republic
- preventive measures to reduce the occurrence of residues in surface and ground waters, with emphasis on the sources used or usable for supplying the population with drinking water

Development Plan for Water Supply and Sewerage systems of the Czech Republic
- the basic concept of the optimum development of the drinking water supply, drainage and disposal of waste water in the Czech Republic

Development Plans for Water Supply and Sewerage on the territory of Czech Republic regions
- the basic element of the planning in the field of water supply and sewerage systems
- the concept of addressing the drinking water supply and wastewater collection and treatment in the territorial units of the Czech Republic

Plans of the international river basin districts of the Elbe, Oder, Danube Rivers
- define the framework for the individual National river basin management plans

National river basin management plans
- support for connecting the residents in outlying areas of municipalities and residents of small villages to public water supply and sewerage systems
- accelerate renewal of leaking and outdated water supply networks and thereby reduce drinking water losses in water networks to 5,000 $l.km^{-1}.day^{-1}$ and reduce the number of piping system failures
- decrease pollution by hazardous substances, nutrients and organic substances and prevent their introduction from diffuse sources
- stopping or gradual elimination of emissions, discharges and releases of hazardous priority pollutants
- preventing or limiting the introduction of pollutants into groundwater
- preventing deterioration of the status of surface water bodies, achieving good status of water bodies using the set objectives

Plans for river sub-basins
• proposals for concrete measures for the gradual elimination of the most important water issues
• summary of the specific objective and program measures for the improvement of surface water and groundwater quality

Act No. 254/2001 Coll., on waters and on changes of some Acts (the Water Act)
• the protection of surface and groundwater, setting the conditions for the efficient use of water resources and to preserve and improve the quality of surface water and groundwater
• creating the conditions for reducing the adverse effects of floods and droughts
• ensuring the supply of drinking water and the protection of aquatic ecosystems and terrestrial ecosystems which depend directly on them

Operational Programme Environment 2014–2020
• ensure supply of drinking water in adequate quantity and quality (increase share of the population supplied by water from the public water supply systems to 94% by 2023)
• decrease the quantity of discharged pollution from municipal sources and decrease the introduction of pollutants to surface water and groundwater (for indicator P_{total} to 1,100 t by the year 2023 and for indicator COD_{Cr} to 39,100 t by the year 2023)
• increase the quantity of treated waste water to 321 mil. m^3 by the year 2023

8 | Water abstraction

Key question

Is water use in the Czech Republic sustainable, with regard to maintaining the availability of water sources in the future?

Key messages

Total water abstraction between the years 2000 and 2016 decreased by 9.4%. Year-on-year, the total water abstraction decreased in the sectors of water supply (605.6 mil. m^3 in 2016, i.e. 1.2% less than in 2015), industry (250.1 mil. m^3 in 2016, i.e. 4.5% less than in 2015) and agriculture (47.5 mil. m^3 in 2016, i.e. 12.6% less than in 2015).
Water consumption per capita supplied by water from a public water supply system, calculated out of the total quantity of produced water decreased by 1.7% and was 162.6 $l.person^{-1}.day^{-1}$.
The water loss in the pipe network continues to decline, in 2016 it amounted to 15.4%, which is 1.4 percentage points less than in 2015.

Total water abstraction increased year-on-year to 1,634.9 mil. m^3. Still, it is the second lowest value since 2000.
Consumption of water in households is no longer declining, in 2016 it amounted to 88.3 $l.person^{-1}.day^{-1}$, which was 0.4 l per person per day more than in 2015.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

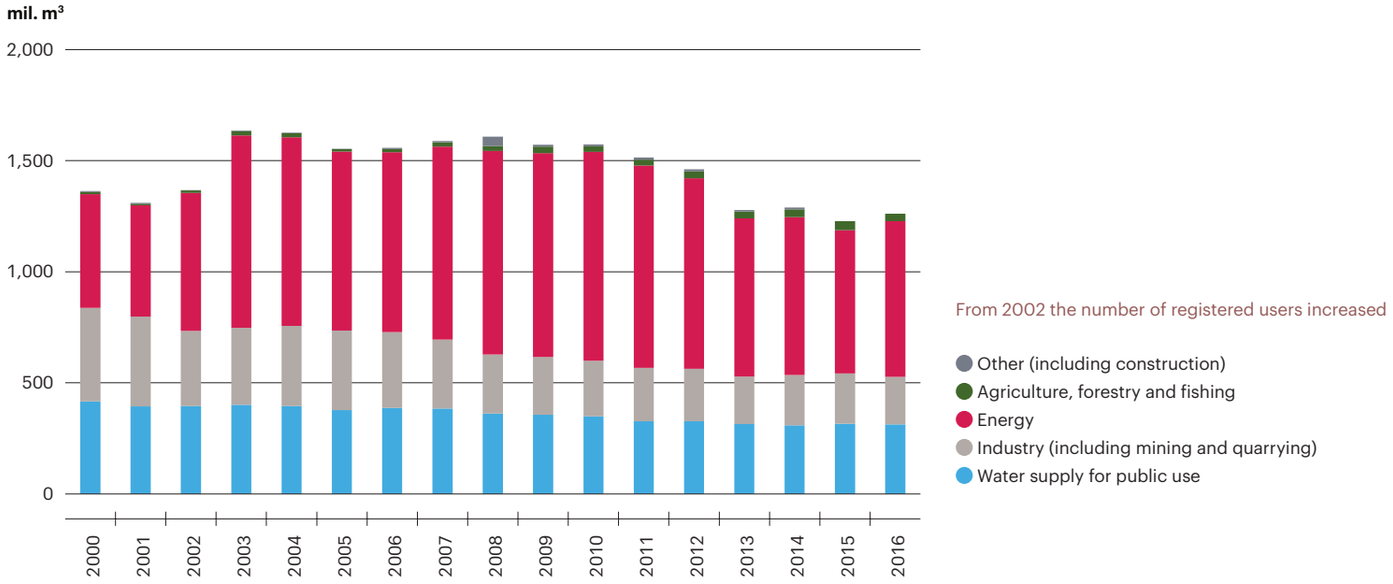
Total water abstraction by individual sectors in the Czech Republic [mil. m^3], 2000–2016

Until 2001, water abstraction exceeding 15,000 m^3 per year or 1,250 m^3 per month was registered. Since 2002, abstraction by users at over 6,000 m^3 per year or 500 m^3 per month has been registered – pursuant to Section 10 of Decree of the Ministry of Agriculture No. 431/2001 Coll.

Source: Ministry of Agriculture, Povodí state enterprises, T. G. Masaryk Water Research Institute, Czech Statistical Office

Chart 2

Surface water abstraction by individual sectors in the Czech Republic [mil. m^3], 2000–2016

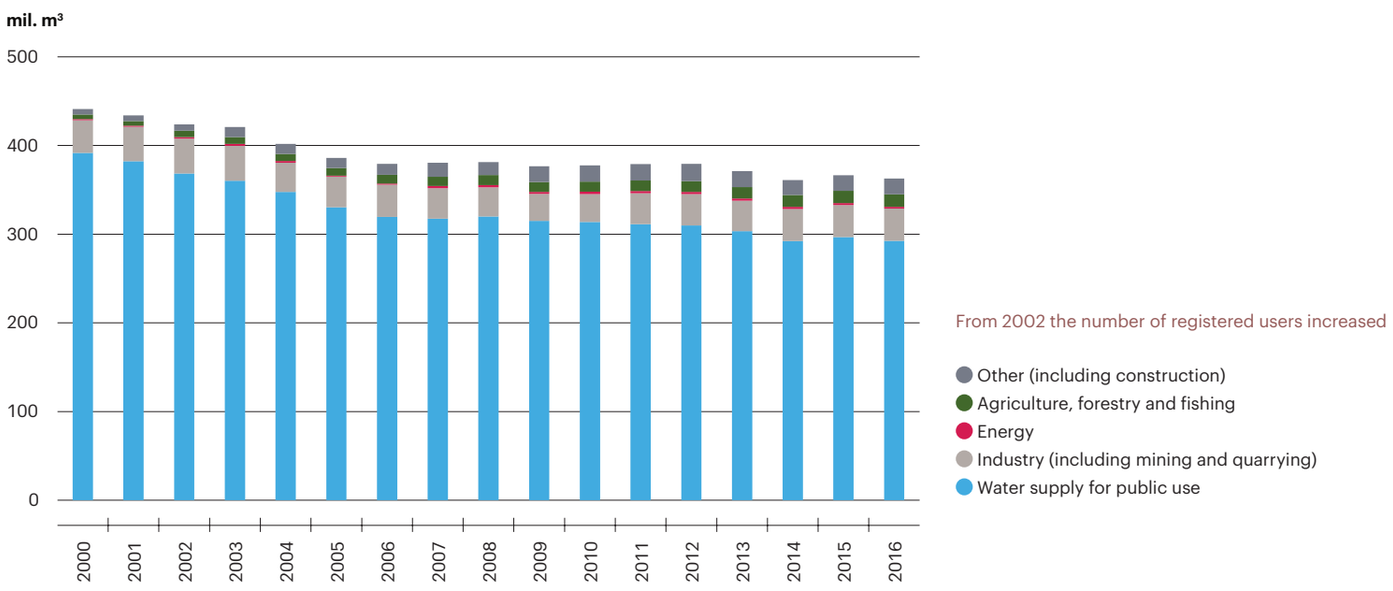


Until 2001, water abstraction exceeding 15,000 m^3 per year or 1,250 m^3 per month was registered. Since 2002, abstraction by users at over 6,000 m^3 per year or 500 m^3 per month has been registered – pursuant to Section 10 of Decree of the Ministry of Agriculture No. 431/2001 Coll.

Source: Ministry of Agriculture, Povodí state enterprises, T. G. Masaryk Water Research Institute, Czech Statistical Office

Chart 3

Groundwater abstraction by individual sectors in the Czech Republic [mil. m^3], 2000–2016

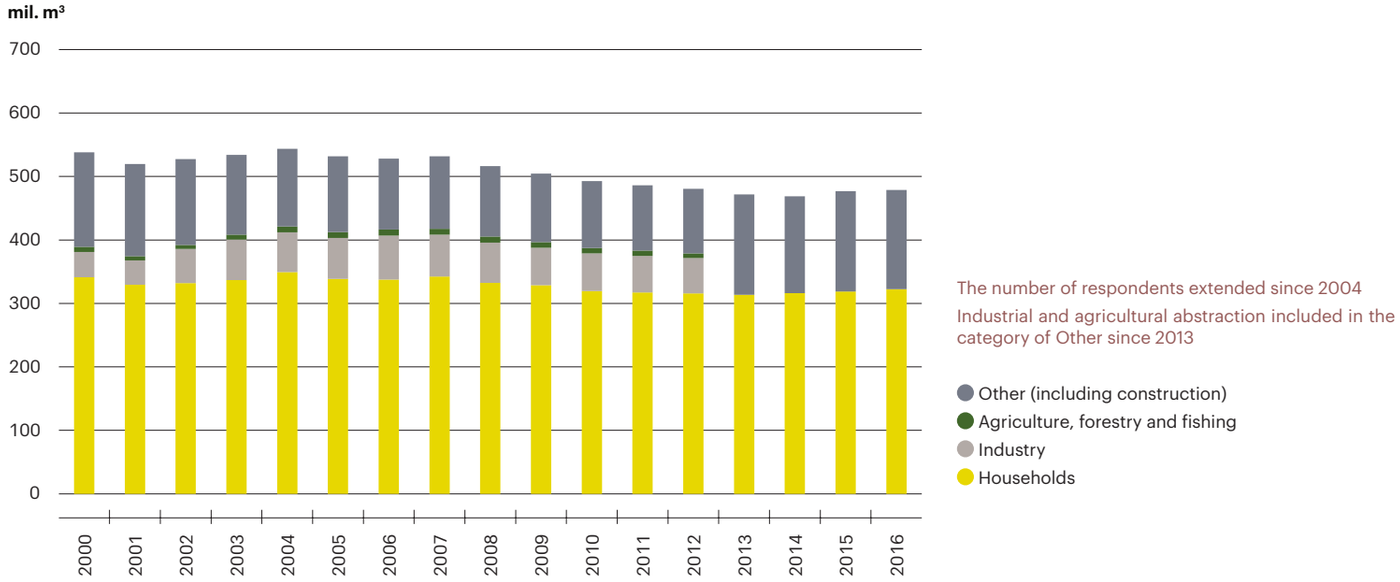


Until 2001, water abstraction exceeding 15,000 m^3 per year or 1,250 m^3 per month was registered. Since 2002, abstraction by users at over 6,000 m^3 per year or 500 m^3 per month has been registered – pursuant to Section 10 of Decree of the Ministry of Agriculture No. 431/2001 Coll.

Source: Ministry of Agriculture, Povodí state enterprises, T. G. Masaryk Water Research Institute, Czech Statistical Office

Chart 4

Use of drinking water from water supply systems for public use by individual consumer groups in the Czech Republic [mil. m^3], 2000–2016

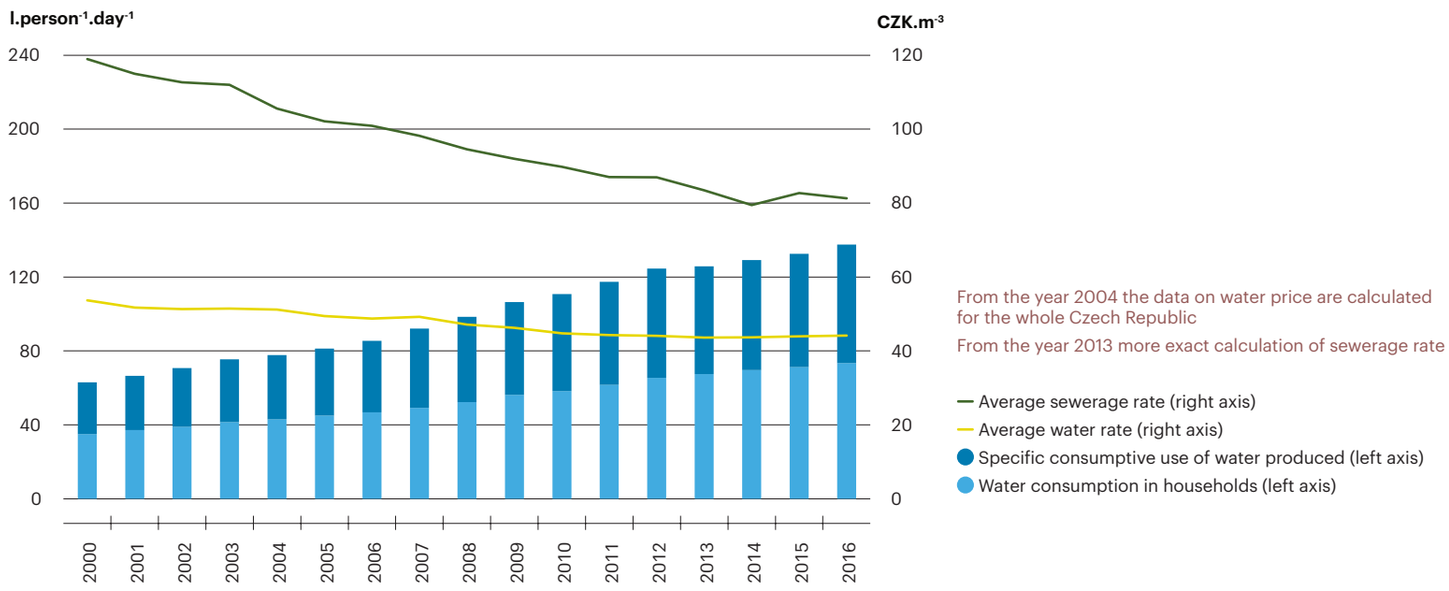


Until 2003, only data for the main operators are provided. In 2013, reporting of invoiced water was simplified (industrial and agricultural abstraction is included in the category "Other" which includes construction, services and other users connected to the public water supply systems).

Source: Czech Statistical Office

Chart 5

Water consumption in the Czech Republic [l.person^{-1}.day^{-1}] and the price of water [CZK.m^{-3}], 2000–2016



Until 2003, the water prices are provided for the main operators only. From the year 2004, the water prices are calculated for the entire Czech Republic. The water prices are provided without VAT. In 2013, the calculation of the sewerage rate was made more precise by including rain water discharges in the rate and also due to cooperation of the respondents. The resulting sewerage rate per m^3 from 2013 on is not fully comparable with the previous years.

Source: Czech Statistical Office

Abstraction of surface and groundwater reflects the development of the economy, development of the hydrometeorological conditions of the given year and the behaviour of households. Total abstraction of water (i.e. the sum of the abstractions of surface and groundwater, Chart 1) has been relatively stable since 2013, with a decrease in 2015 because of extreme drought. In 2016, the total abstraction was 1,634.9 mil. m^3, i.e. 2.0% more than in 2015. In 2016, the total abstraction decreased by 9.4% against 2000, and compared to 2003, when the total abstraction rose sharply in connection with a change of the abstraction limit that must be registered, it decreased by 20.5%. Surface water abstraction decreased by 6.7% against 2000, and by 22.2% against 2003. Groundwater abstraction decreased by 17.8% against 2000, and by 13.8% against 2003.

The highest water abstraction is made in the energy sector (43.0%, 702.4 mil. m^3 in 2016). Another important consumer are the water supply systems for public use. Their consumption is falling steadily only with minor variations as opposed to the fluctuating abstractions for the energy sector. In 2016, the water supply for public use abstracted 605.6 mil. m^3, which is 37.0% of total abstractions and the second lowest value since 2000. The third most important consumer of water is industry which abstracted 250.1 mil. m^3, i.e. 15.3% of the total abstractions. Abstraction of water for agriculture (47.5 mil. m^3) and the other sectors including construction (29.2 mil. m^3) forms only a minority of the total water abstraction (2.9% and 1.8% respectively).

Most of the abstractions are made from surface water (1,271.1 mil. m^3, i.e. 77.8% of the total abstractions), a smaller part from the groundwater (362.8 mil. m^3, 22.2%). When dividing the total abstractions into abstractions of surface and ground water (Chart 2, Chart 3), differences are noticeable in the representation of the individual economic sectors with regard to the source of the water abstracted.

Almost all of the **water abstraction for energy sector** (99.7%) is made from surface water. That water is used mainly for once-through cooling systems of steam turbines or for the operation of hydroelectric power plants. After the abstraction was reduced in 2015 because of unfavourable hydrometeorological conditions and the related abstraction restrictions, it increased year-on-year by 8.5% to 700.5 mil. m^3. The sharp rise in abstraction between the years 2002 and 2003 was caused by changing the scope of the reported data by starting water abstraction for cooling the nuclear power plant Temelín.

By contrast, **abstraction for water supply for public use** is largely made from ground water. The amount of 292.5 mil. m^3, i.e. 80.6% of groundwater abstraction was used for that due to the higher quality of groundwater, and hence lower need of treatment for the production of drinking water. Out of the surface water abstraction for public water supply, 24.6%, i.e. 313.1 mil. m^3 was used.

Water abstraction for the industry accounted for 16.8% of the abstraction from surface sources and 10.0% from groundwater sources. Water abstraction from underground sources has stagnated since 2014, the abstraction of water from surface sources shows a noticeable decrease year-on-year by 5.3% to 213.8 mil. m^3. The water abstraction for the industry is generally influenced by the economic development in the sectors with the highest abstraction (food, chemical and paper industry) and the introduction of new environment-friendly technologies of production, because of environmental and economic reasons.

Water abstraction for agriculture consists in the larger part of surface water, in 2016 it accounted for 2.6% of the abstraction (33.4 mil. m^3). The ground water abstracted for agriculture made up 3.9% (14.1 mil. m^3). The year-on-year fluctuations in abstraction for crop production depend on the temperatures and amount of

precipitation during the growing season, which manifested itself in the total volume of water abstracted for agriculture. After a decline in 2015, it returned in 2016 to a value similar to that of 2014 (47.5 mil. m^3 in 2016, 54.3 mil. m^3 in 2015, 48.5 mil. m^3 in 2014).

A significant part of the abstracted water is intended for the **production of drinking water**. In 2016, 585.4 mil. m^3 of water intended for consumption were produced. Drinking water invoiced to households and other customers accounted for 478.9 mil. m^3 (Chart 4). It increased insignificantly year-on-year by 0.4%. Households used 67.3% of the abstraction, year-on-year this increased by 1.1%. Water abstraction for industry decreased by 1.0%. In 2016, 10.0 mil. inhabitants of the Czech Republic, i.e. 94.4% of the population, were supplied with water from public water supply systems.

The **loss of drinking water in the water supply network**, which is caused by accidents and the age of the networks, declined quite significantly year-on-year, both in absolute terms (from 99,098,000 m^3 in 2015 to 90,069,000 m^3 in 2016) and in proportion to the total volume of produced water intended for consumption (16.8% in 2015 compared to 15.4% in 2016). With occasional variations, the positive trend of reducing water loss in the water supply network continues; in 2000 it accounted for 25.2%.

Water consumption per person supplied with water from the public water supply system, out of the total quantity of produced water, was 162.6 $l.person^{-1}.day^{-1}$, which is 1.7% less than in 2015 (Chart 5). Households consumed 88.3 $l.person^{-1}.day^{-1}$ in 2016. Since 2013, when the lowest value to date was recorded in the reference period (87.2 $l.person^{-1}.day^{-1}$), the trend of stagnation in consumption has continued.

In the long-term, **water and sewerage rates** continue to increase (Chart 5). In 2016, the average water rate was CZK 36.7 per m^3 and the sewerage rate was CZK 32.1 per m^3. The price increase is caused, inter alia, by inflation and repair of and also investment in the extensive water infrastructure renewal.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

9 | Waste water discharge

Key question

Are we successful in reducing the quantity of pollution discharged from point sources into surface waters?

Key messages

The volume of discharged phosphorus (P_{total}) decreased year-on-year by 6.4% to 1,058 t and of suspended solids by 5.2% to 9,417 t.

The total amount of waste water discharged in 2016, after a reduction in 2015, again approximated the level of 2014, with 1,700.8 mil. m^3. The increase between the years 2015 and 2016 was due, in the largest part, to agriculture (a change by 29.4% compared to 2015) and energy (a change by 12.0%).
The amount of organic pollution expressed by indicators BOD_5 and COD_{Cr} grew slightly year-on-year by 6.3% and 1.3% respectively. Also the volume of emitted nitrogen grew ($N_{inorg.}$) by 1.7%.

Overall assessment of the trend

Change since 1990

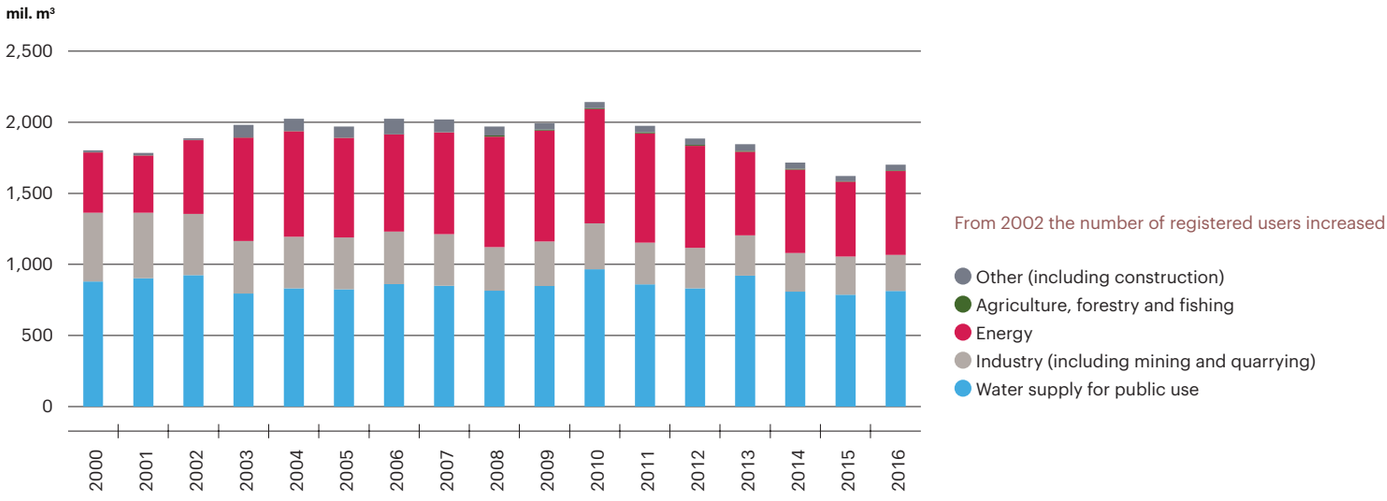
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

Quantity of waste water discharged into surface water in the Czech Republic [mil. m^3], 2000–2016

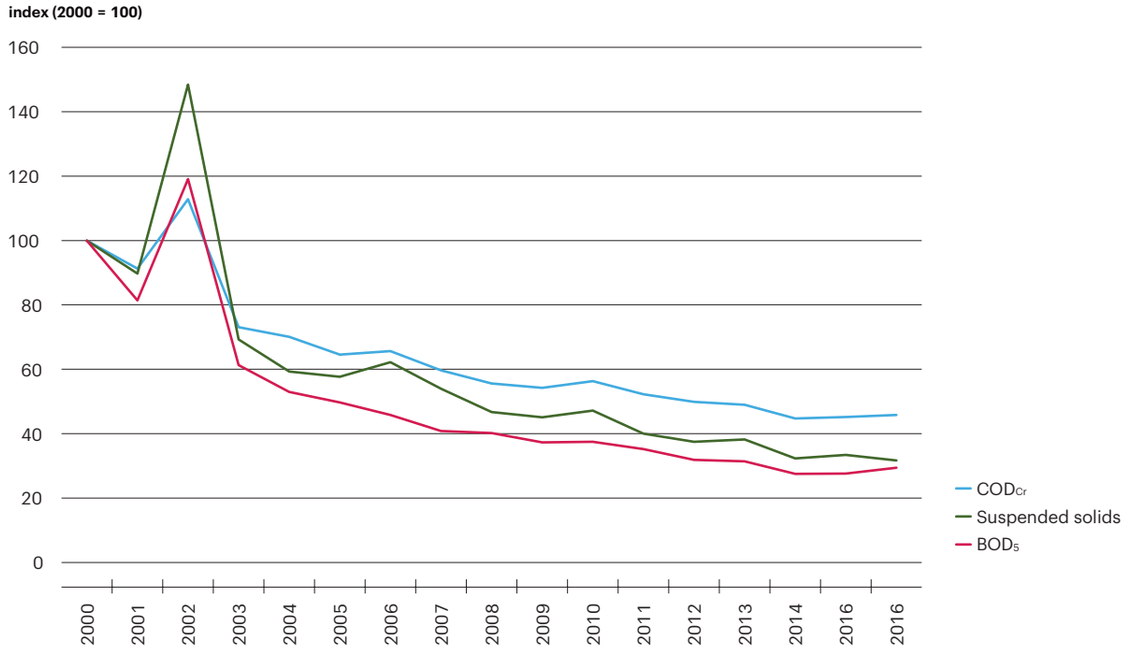


Until the year 2001 waste water and mine water discharges exceeding 15,000 m^3 per year or 1,250 m^3 per month were recorded. Since 2002, discharges exceeding 6,000 m^3 per year or 500 m^3 per month have been recorded – pursuant to Section 10 of Decree of the Ministry of Agriculture No. 431/2001 Coll.

Source: Ministry of Agriculture, Povodí state enterprises, T. G. Masaryk Water Research Institute, Czech Statistical Office

Chart 2

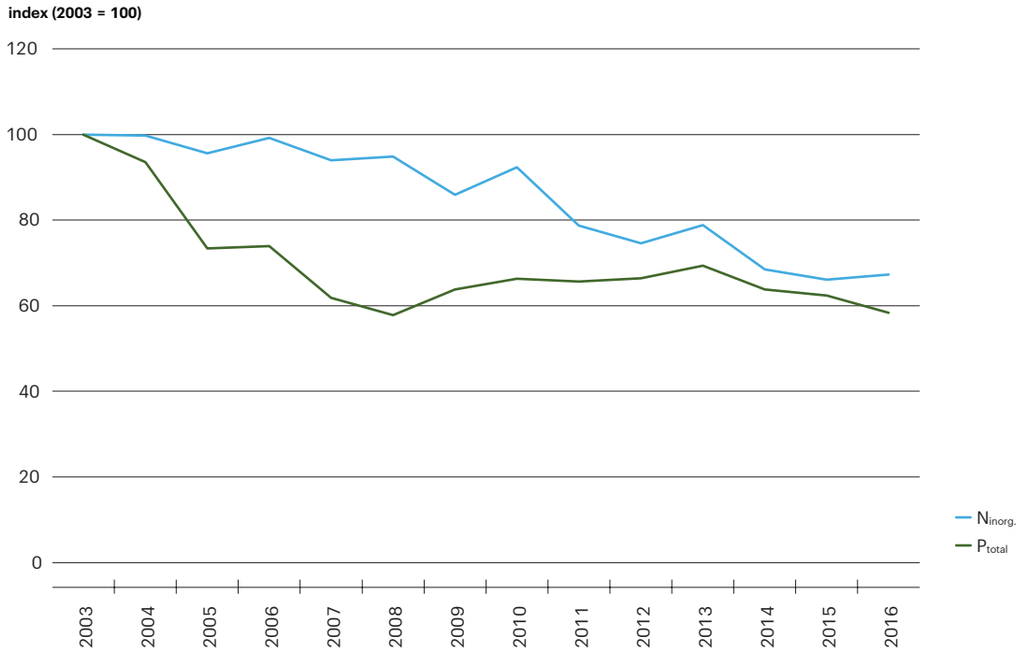
Relative representation of pollution discharged from point sources expressed in BOD_5, COD_{Cr} and suspended solids indicators in the Czech Republic [index, 2000 = 100], 2000–2016



Source: Ministry of Agriculture, Povodí state enterprises, T. G. Masaryk Water Research Institute, Czech Statistical Office

Chart 3

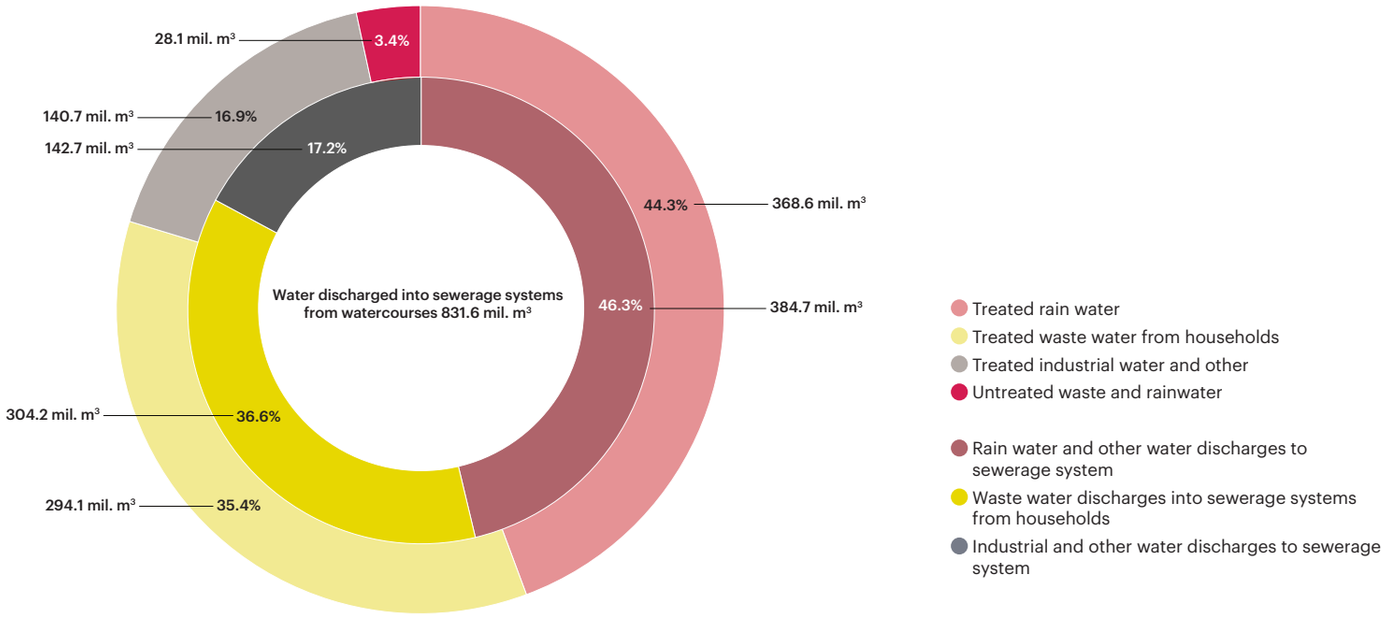
Relative representation of pollution discharged from point sources expressed in $N_{inorg.}$ and P_{total} indicators in the Czech Republic [index, 2003 = 100], 2003–2016



Source: Ministry of Agriculture, Povodí state enterprises, T. G. Masaryk Water Research Institute, Czech Statistical Office

Chart 4

Quantity of water discharged from sewerage systems into surface water in the Czech Republic [%, mil. m³], 2016



Source: Czech Statistical Office

The development in the **volume of discharged waste water** indicate several changes in the trend (Chart 1). The increase in 2002 and the two subsequent years was connected with a change in the limits of the registered quantity of discharged water and with the increase in discharges of waste water from the energy sector, which was due to the start of abstractions of cooling water for the Temelín nuclear power plant and the renewed increase in abstractions for the Mělník power plant. In 2010, discharge grew sharply due to higher rainfall, which increased the volume of disposed rainwater. From 2010, the volume of discharged water decreased each year until 2015. In 2016, the total volume of waste water discharged from point sources started to grow again to 1,700.8 m^3, which is 4.9% more than in 2015, but 0.9% less than in 2014 and 5.6% less than in 2000. It is therefore evident that the reduction in 2015 was due to an exceptional drought that year rather than to a changing long-term trend in the behaviour of waste water producers. This is confirmed by the fact that the greatest year-on-year increase (2015–2016) occurred in the agriculture sector (by 29.4%) and energy (by 12.0%), in which abstractions were significantly reduced in 2015.

In the overall perspective, the **structure of the waste water discharge** reflects the structure of customers. The largest proportion is held by the public sewerage (47.8%, i.e. 812.7 mil. m^3) and energy (34.7%, i.e. 590.4 mil. m^3). The discharge of municipal waste waters, which represent significant point sources of pollution (mainly organic), rose year-on-year by 3.5%. In contrast, the water discharged by energy sector consists almost exclusively of waste water from flow through cooling which influence the temperature and oxygen regime of water.

Another important source of pollution is the **industrial waste water** (14.9%, i.e. 253.9 mil. m^3), which is a source of not only organic pollution, but also of pollution by e.g. heavy metals and specific organic substances. Waste water discharges from the industry (including mining), compared with the previous assessed year 2015 decreased by 5.3%.

A specific pollutant of surface water is **agriculture**, representing a major source of pollution. The problem is primarily the non-point pollution caused by rinsing pollutants from agricultural land (sprays, medicines, fertilizers, etc.). This type of pollution is not generally recorded, but it significantly reflects in the resulting quality of surface and ground water, since it is a major source of nitrates, pesticides and causes acidification. By contrast, the volume of waste water discharged from point sources is recorded, in 2016, it represented 4.4 mil. m^3, which was 0.3% of the total volume of waste water.

In the "Other" category, where the construction industry is included, the volume of discharged water grew by 9.4% in 2016 compared to the previous year to the value of 39.5 mil. m^3.

Monitoring the **amount of pollution discharged in waste waters** is especially important because it greatly affects the quality of surface and underground water. The downward trend that was evident from 2000 to 2014 (except for the variation in 2002, which was due to an extreme flood situation), does not continue (Chart 2). Only suspended solids decreased year-on-year (9.4 thous. t, which is 5.2% less than in 2015). In contrast, BOD_5 and COD_{Cr} increased slightly year-on-year – BOD_5 by 6.3% to 5.6. t, COD_{Cr} by 1.3% to 37.4 t.

On the contrary, the amount of discharged nutrients has a more fluctuating trend in the longer perspective. Year-on-year, however, nitrogen ($N_{inorg.}$) increased in volume by 1.7% to 10.0 thous. t, while phosphorus (P_{total}) was reduced by 6.4% to 1.0 thous. t (Chart 3). In the longer term perspective, since 2003, the quantity of $N_{inorg.}$ has decreased by 32.7% and P_{total} even by 41.6%. The long-term decrease is influenced by the reduction of the quantity of phosphates used in detergents and in recent years especially by fact that the waste water treatment technology in the new and reconstructed WWTPs focuses on biological nitrogen removal or chemical phosphorus removal. The vast majority of waste water discharged into watercourses in the Czech Republic passes at least through a basic treatment (Chart 4).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[1] *Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.*

10 | Waste water treatment

Key question

How many Czech inhabitants are connected to the public sewerage systems and waste water treatment plants and what is the proportion of treated waste water?

Key messages

The proportion of population connected to a public sewerage system is still gradually increasing. In 2016, 84.7% of the population was connected to public sewerage systems, in 2015 it was 84.2%. The vast majority (96.0%) of the sewerage systems ends in a wastewater treatment plant. In 2000, 64.0% of the population was connected to a sewerage system with a WWTP, in 2016, it was 81.3% of the population.
The number of WWTPs is growing steadily, the proportion of tertiary treatment is increasing and the number of WWTPs with only mechanical treatment is shrinking. In 2016, a total of 2,554 WWTPs were operated in the Czech Republic, of which 1,382 with the tertiary phase of treatment and only 36 with the primary phase of treatment.
97.3% of waste water was treated (excluding rainwater).
In the reference year 2014[1], as compared with the reporting for 2012, the fulfilment improved of the requirements of Council Directive 91/271/EEC on urban waste water treatment, Articles 4 and 5.

However, 18.8% of the population is still not connected to a sewerage system ending in a WWTP. Although part of their waste water may be treated in a decentralised way, still it is a significant potential source of pollution of watercourses.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-on-year change

[1] *Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Indicator assessment

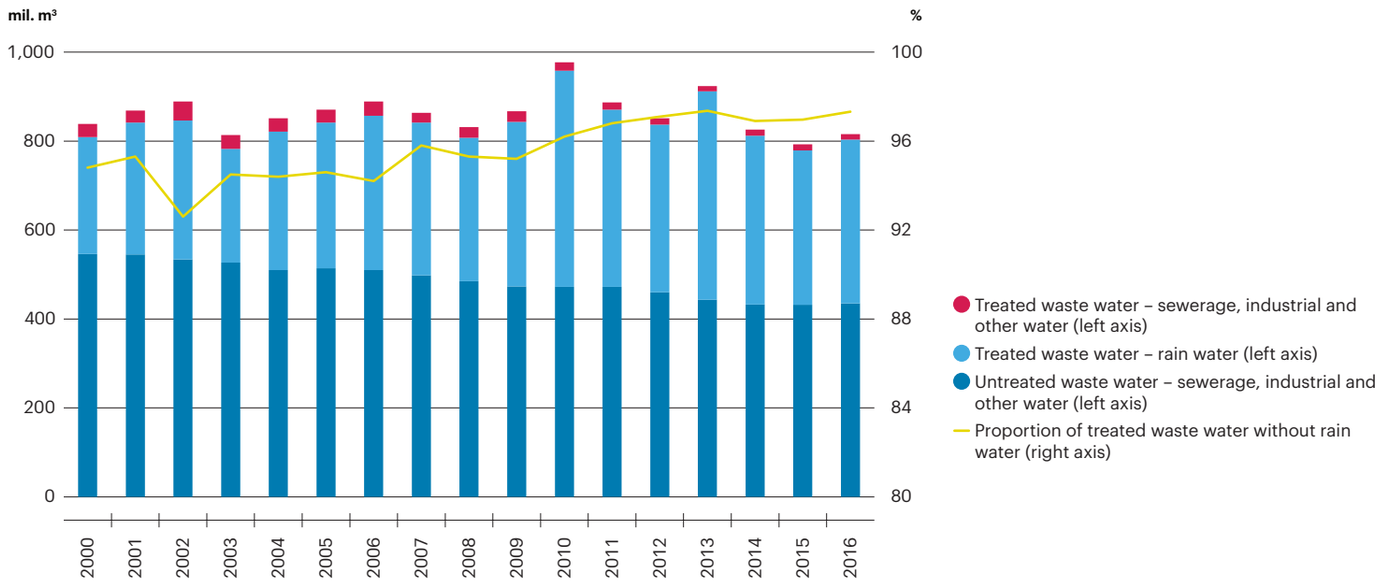
Chart 1

Proportion of the population connected to sewerage systems and to sewerage systems connected to WWTPs in the Czech Republic [%], 2000–2016

Source: Czech Statistical Office

Chart 2

Treatment of waste water discharged into sewerage systems in the Czech Republic [mil. m^3, %], 2000–2016

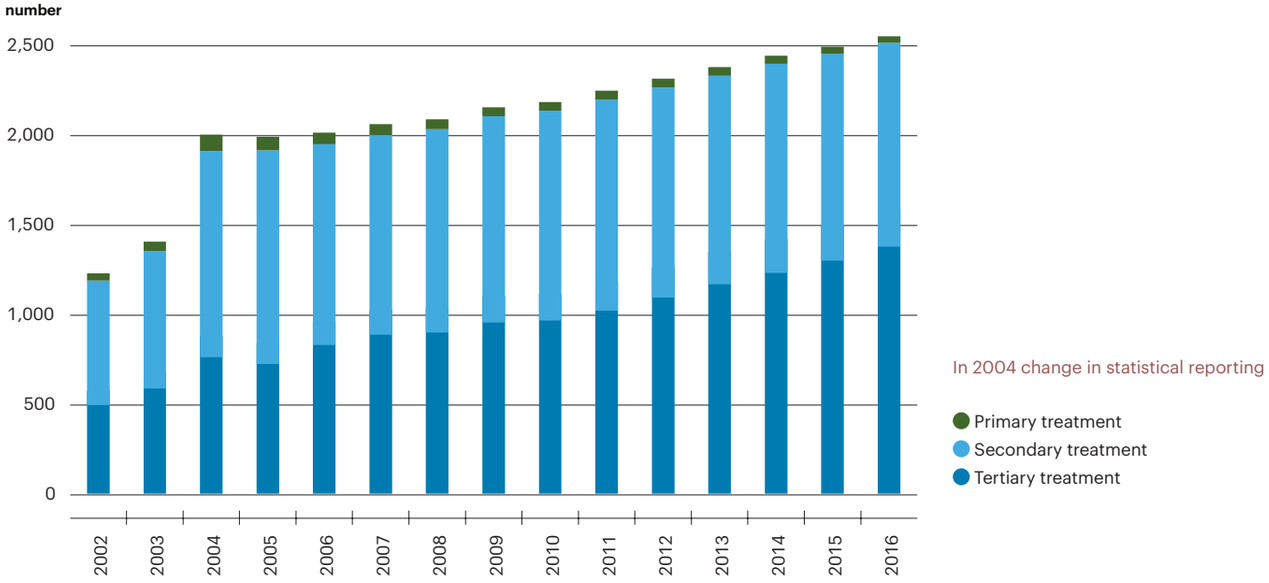


Until 2003 data are provided for the main operators of sewerage systems only. The number of respondents extended since 2004. The data series shown is impacted by changes in statistical reporting and the transformation of the former water supply and sewerage companies into the ownership of towns and communities.

Source: Czech Statistical Office

Chart 3

Waste water treatment plants according to treatment stages in the Czech Republic [number], 2002–2016

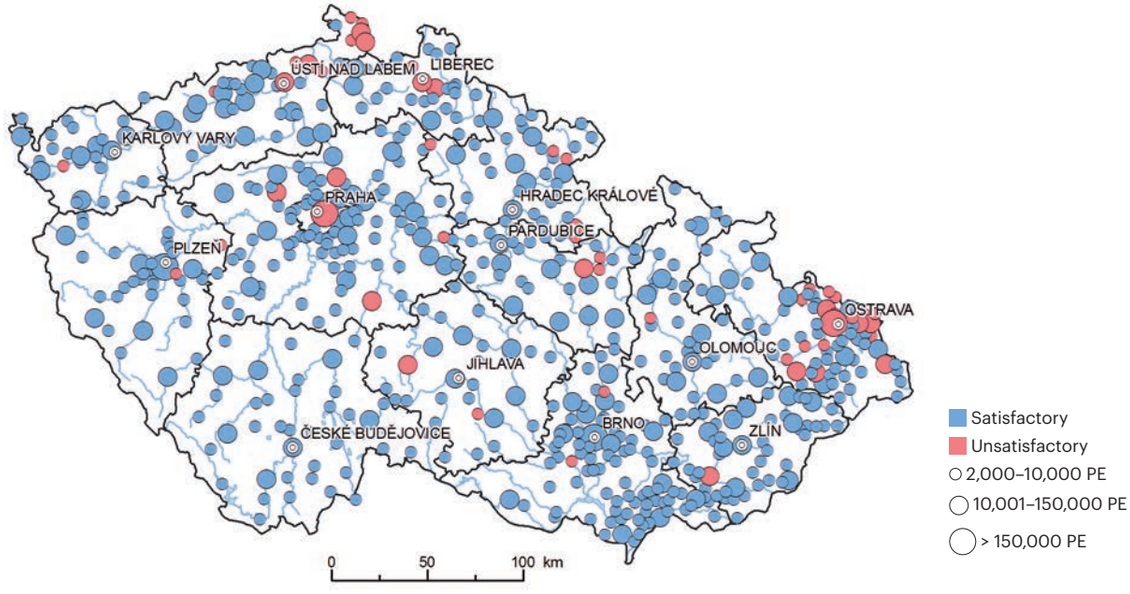


Primary treatment – mechanical WWTPs, secondary treatment – mechanical-biological WWTPs without nitrogen and phosphorus removal, tertiary treatment – mechanical/biological WWTPs with additional removal of nitrogen and/or phosphorus.

Source: Czech Statistical Office

Figure 1

Map of agglomerations in the Czech Republic according to their compliance with the requirements of Council Directive 91/271/EEC on urban waste water treatment, 2014



Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Urban Waste Water Treatment Directive

Proportion of the population connected to the sewer network rose year-on-year from 84.2% in 2015 to 84.7% in 2016 (Chart 1). The share of the population connected to sewerage with a WWTP in the same period increased from 80.8% to 81.3%. In 2000, the proportion of the population connected to a sewerage system with WWTP was 64.0%. The water infrastructure therefore slowly continues to develop. In contrast to the earlier period, when a significant factor was in particular the entry of the Czech Republic into the EU and the subsequent implementation of European legislation and absorption of European subsidies, this development is gradually reaching the limits given by the necessity to cover the smaller municipalities where less population is concentrated and where funding is lacking in the budget. Waste water produced by 18.8% of the population in 2016 was not directly discharged to sewerage systems with a WWTP, but was collected in sewerage systems without treatment plants, in sumps, septic tanks and other facilities, from where it was then transported for treatment or discharged without proper treatment directly into watercourses.

The **total volume of water discharged into the public sewerage systems**, which includes also rain water subject to discharge fees, has been stagnating since 2013. In 2016, it was 518.0 mil. m^3, the year-on-year increase was 2.4 mil. m^3 (0.5%). Also, the volume of water discharged to the public sewerage system without rain water has not changed much. In 2016, it was 446.9 mil. m^3 (from this volume, 434.9 mil. m^3 was treated and 12.0 mil. m^3 was untreated, Chart 2), which is 1.4 mil. m^3 (0.3%) more than in 2015. This amount represents almost half the volume in 1990 and a decrease of 22.4% compared to 2000.

Nevertheless, the **proportion of treated waste water** out of the water discharged into the sewerage systems was very satisfactory, in 2016 it amounted to 97.3%, whereas in 1990 it was only 75.0%. In the long-term perspective, the share has fluctuated since 2000 between 94 and 98% (Chart 2). A variation in 2002 was caused by limited operation of WWTPs affected by the flood. The WWTPs also treat a part of rain water not subject to discharge fees. Its quantity shows large annual fluctuations which correspond to the precipitation conditions of the given year. In 2016, when precipitation reached 95% of the long-term mean, 368.6 mil. m^3 were treated. This volume is 21.6 mil. m^3 higher than in 2015 and in comparison with the average of the years 2000 to 2015, it is slightly above average.

The **total number of WWTPs** for public use in the Czech Republic has more than doubled since 2002 to 2,554 (i.e. on average 1 WWTP per 4,136 inhabitants). Year-on-year, the number of WWTPs grew by 59, i.e. by 2.4% (Chart 3). Due to the construction and reconstruction of WWTPs, compared to 2015, the total number of WWTP with removal of nitrogen and/or phosphorus (tertiary treatment) increased by 78 WWTP in all agglomerations. There were only 36 WWTPs with only mechanical treatment in 2016, i.e. 1.4% of all WWTPs.

In the reference year 2014[2], there were 633 agglomerations with more than 2,000 population equivalent (PE), which are subject to **Council Directive 91/271/EEC on urban waste water treatment**. In comparison with the reporting for the year 2012, the fulfilment was improved of the requirements of Council Directive 91/271/EEC on urban waste water treatment in accordance, Article 4 (secondary treatment) and Article 5 (more stringent treatment). As of the reference year 2014, the Czech Republic failed to fulfil the requirements in 55 agglomerations (Figure 1). Article 4 was not met by 52 agglomerations due to free outlets of untreated waste water or small subsidiary WWTPs that did not meet requirements on the quality of discharged waste water, corresponding to the size of the agglomeration. Article 5 was not met by 3 agglomerations over 10,000 PE – Prague, Kladno and Pelhřimov. At the end of 2016, the unsatisfactory WWTP in Pelhřimov has been already renovated and it meets the requirements of the directive, the WWTP in Kladno should meet the limits after reconstruction. The problem remains to be the Central WWTP Prague that does not meet the requirements of the national and European legislation on the quality of discharged waste water, in particular in the indicator of total nitrogen.

The **average effectiveness of WWTPs** (the amount removed pollution) is very high in the Czech Republic. In terms of BOD_5 in 2016, the effectiveness was 98.3%, same as in 2015, for P_{total}, it improved year-on-year to 86.9%. Performance against the other indicators of WWTP effectiveness slightly deteriorated year-on-year. For suspended solids in 2016, the effectiveness was 97.1%, for COD_{Cr} 94.1%, and for N_{total} 78.0%. The results of the effectiveness of treating organic pollution are related to the completed reconstruction of most large WWTPs and the stabilized trend in produced pollution in the individual agglomerations.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[2] *Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.*

11 | Water quality

Key question

Is the quality of surface water and groundwater, which has an impact on aquatic organisms and the use of water, improving?

Key messages

As opposed to the year 2000, concentrations significantly decreased for $N\text{-}NH_4^+$ (by 64.2%), phosphorus (by 41.9%) and BOD_5 (by 24.6%).
In particular, the concentration of chlorophyll decreased year-on-year (by 19.1%).
The quality of bathing water has improved. In 2016, water in 138 locations was suitable for bathing (i.e., 53.5% compared to 44.6% in 2015) and water was unsuitable for bathing only in 7.8% (13.5% in 2015).

According to the cumulative assessment of the basic indicators monitored by CSN 75 7221 the quality of the watercourses in rivers of the Czech Republic is satisfactory, but still a big part of streams is assessed by class III (polluted water) and worse.
Contamination has been found in a number of samples of groundwater, especially ammonium ions (11.8% of the samples above the limit), and nitrates (10.6% of the samples above the limit). From among organic substances, in particular pesticides and their metabolites are problematic. The limit for the indicator "the sum of pesticides" was exceeded in 28.2% of the samples, the most problematic is chloridazon desphenyl, the limit of which was exceeded in 28.6% of the samples.

Overall assessment of the trend

Change since 1990

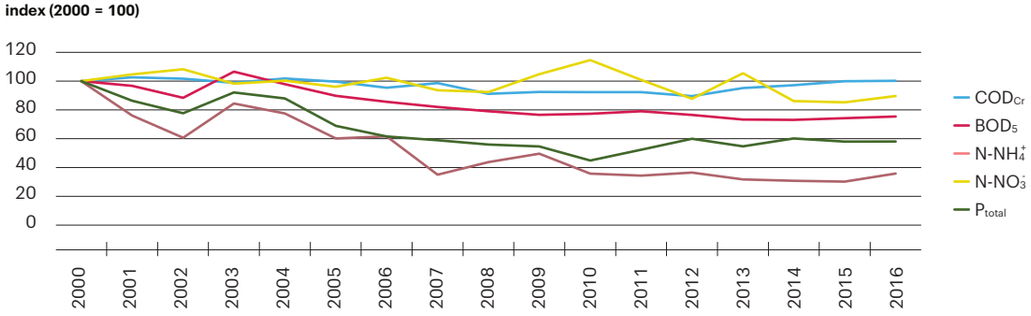
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

Development of concentrations of pollution indicators in watercourses [index, 2000 = 100], 2000–2016



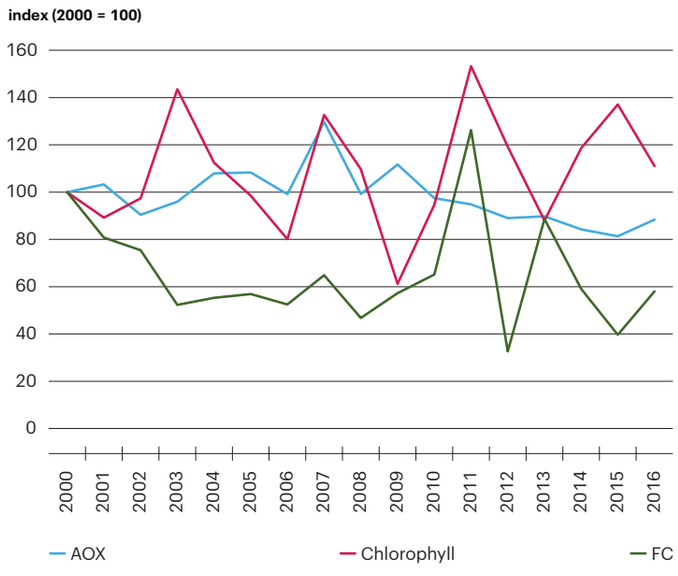
Indexes for the different parameters as of the selected baseline year were calculated on the basis of arithmetic averages for each year from the average annual values for 126 representative river profiles of category 5 and 6, i.e. the two most important. The number of stations varies for each year and each indicator depending on the availability of data. The quality of water in indicators BOD_5, COD_{Cr}, $N\text{-}NO_3^-$, $N\text{-}NH_4^+$, and P_{total} was evaluated at 107–126 stations, in 2016 at all 126 stations.

Source: Czech Hydrometeorological Institute, based on data of Povodí state enterprises

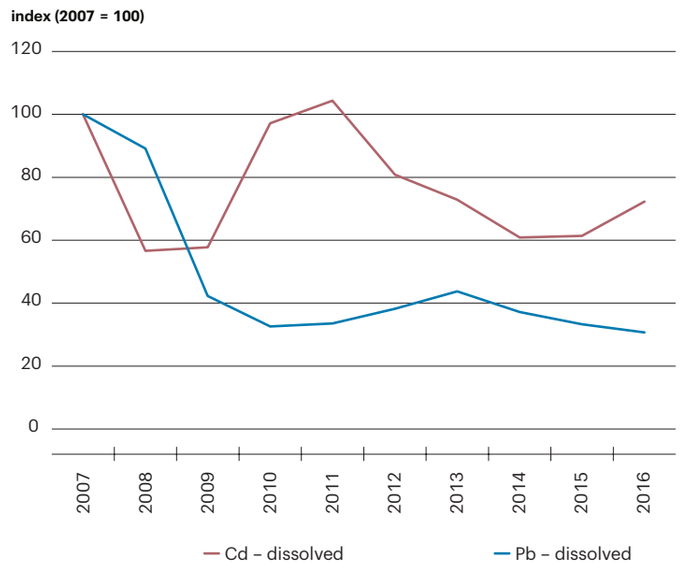
Chart 2

Development of concentrations of pollution indicators in watercourses, 2000–2016

AOX, chlorophyll, FC [index, 2000 = 100]



Cd, Pb [index, 2007 = 100]

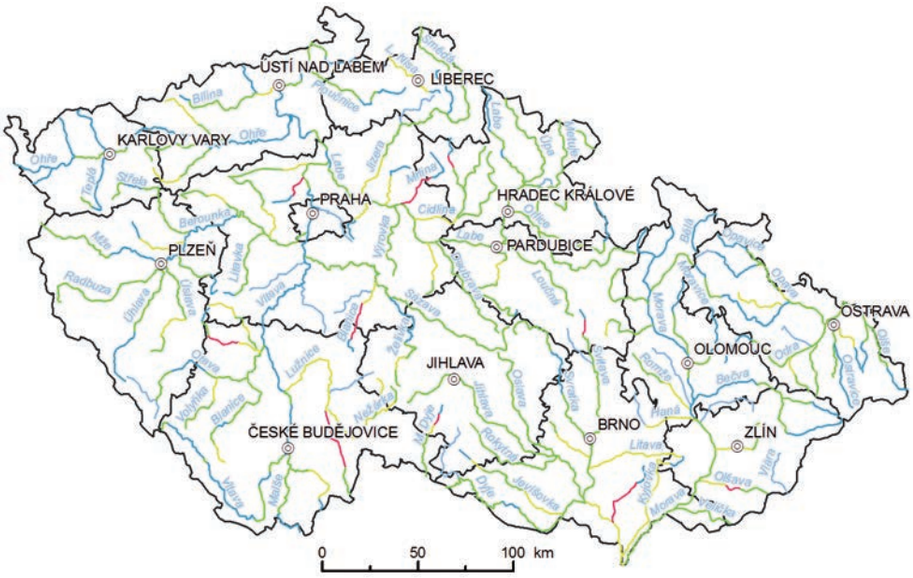


Indexes for the different parameters as of the selected baseline year were calculated on the basis of arithmetic averages for each year from the average annual values for 126 representative river profiles of category 5 and 6, i.e. the two most important. The number of stations varies for each year and each indicator depending on the availability of data. The quality of water in indicators AOX, FC and chlorophyll was evaluated in the period 2000–2016, dissolved Cd and Pb started to be measured in 2007. AOX was measured at 79–126 stations, in 2016 at 125 stations. Chlorophyll was measured at 40–126 stations, in 2016 at 126 stations. FC at 35–126 stations, in 2016 at 126 stations. Cd at 7–79 stations, in 2016 at 79 stations. Pb at 7–79 stations, in 2016 at 78 stations.

Source: Czech Hydrometeorological Institute, based on data of Povodí state enterprises

Figure 1

Water quality in watercourses in the Czech Republic, 2015–2016



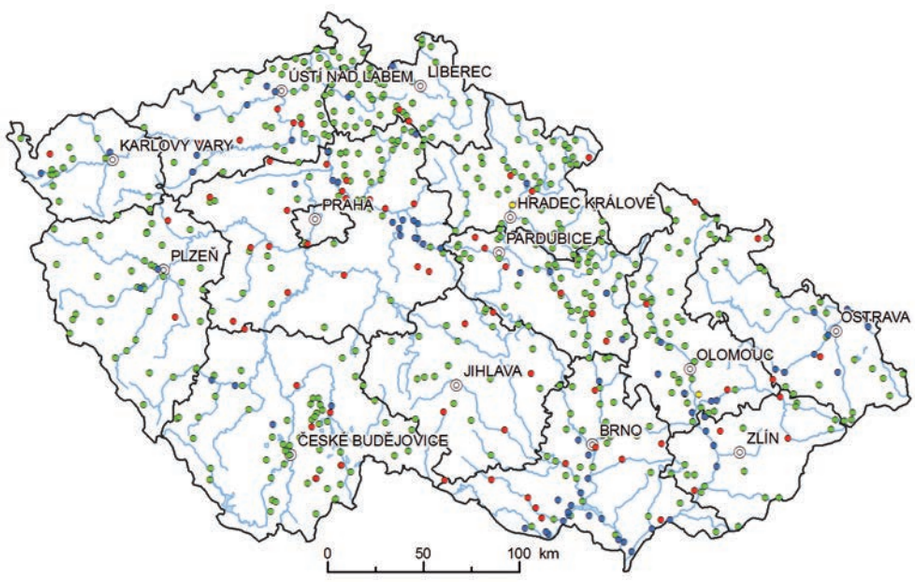
- Class I and II – unpolluted and slightly polluted water
- Class III – polluted water
- Class IV – heavily polluted water
- Class V – very heavily polluted water

A summary evaluation of indicators BOD_5, COD_{Cr}, $N\text{-}NH_4^+$, $N\text{-}NO_3^-$, P_{total}.

Source: T. G. Masaryk Water Research Institute

Figure 2

Concentration of nitrogen compounds in groundwater [mg.l^{-1}], 2016

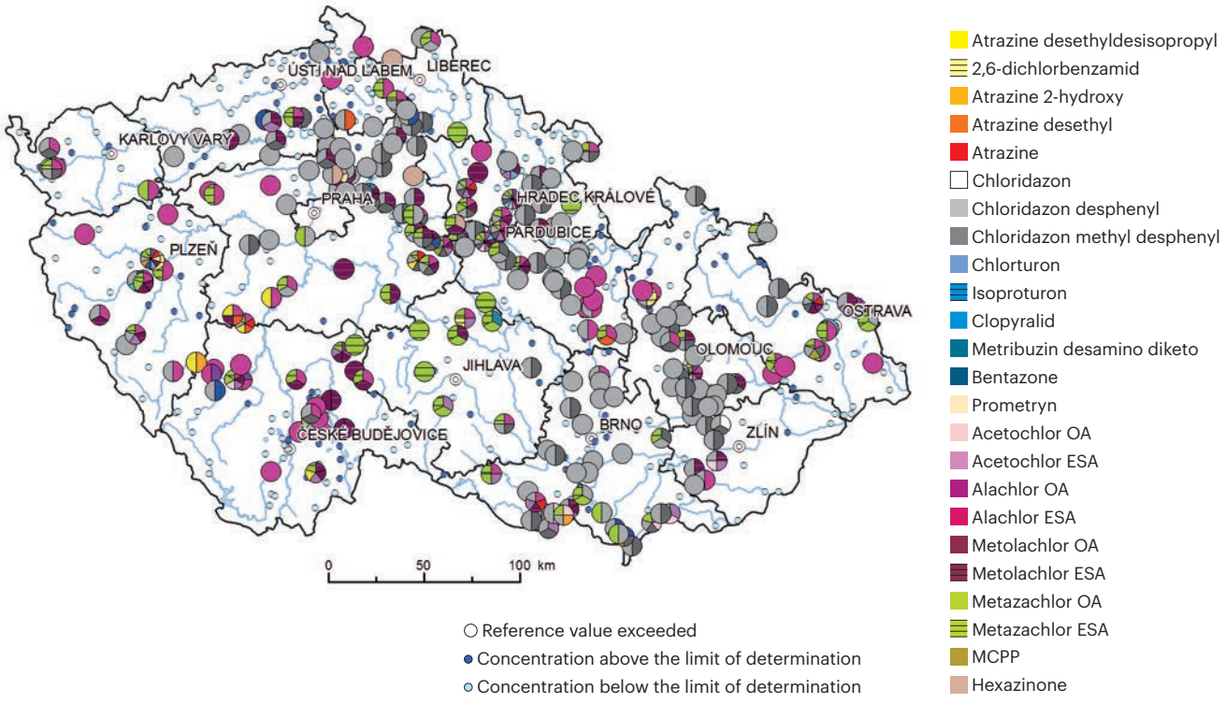


- Reference value of 0.5 mg.l^{-1} exceeded for nitrites
- Reference value of 0.5 mg.l^{-1} exceeded for ammonium ions
- Reference value of 50 mg.l^{-1} exceeded for nitrates
- Concentration up to the reference value

Source: Czech Hydrometeorological Institute

Figure 3

Concentration of pesticides in groundwater [μg.l^{-1}], 2016

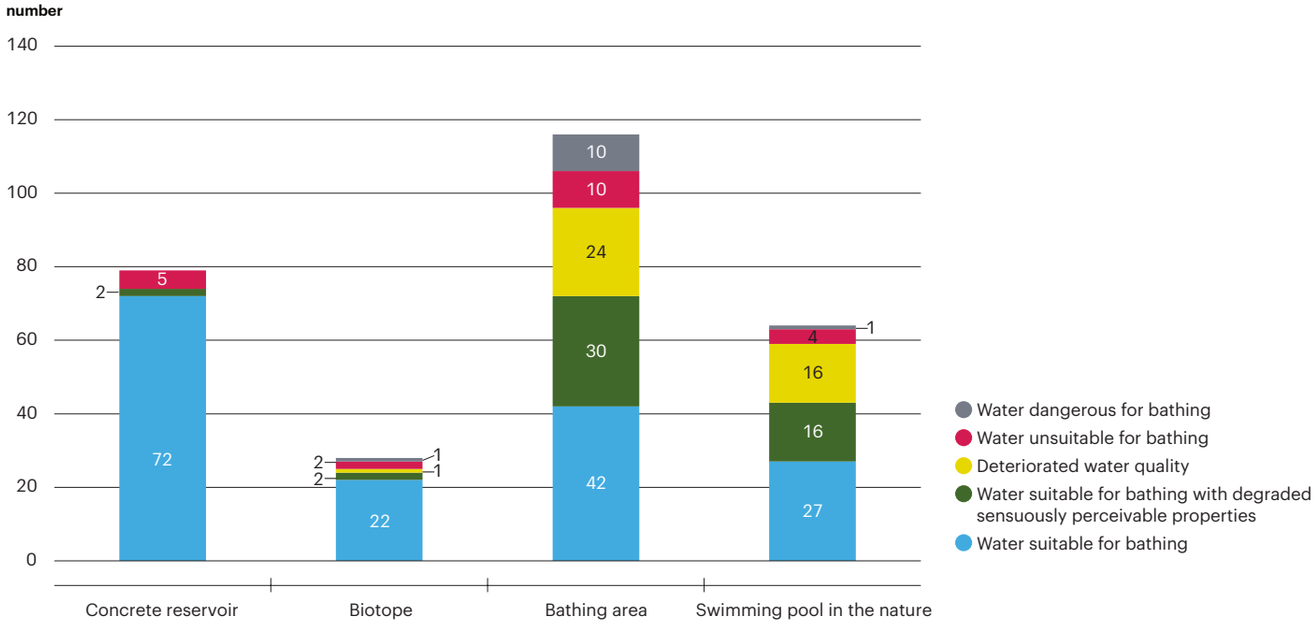


This shows the occurrence of pesticides in the Czech Republic that exceeded the reference values established for groundwater by Decree of Ministry of the Environment and Ministry of Agriculture No. 5/2011 Coll. at more than 1 monitoring object.

Source: Czech Hydrometeorological Institute

Chart 3

Quality of bathing waters in the monitored profiles according to type of sampling points [number], 2016



Source: National Institute of Public Health

To improve the quality of surface water and groundwater it is important to reduce the pollution emitted from point and diffuse sources. In the 1990s and at the beginning of the 21st century, the development of concentrations of the evaluated indicators[3] in the Czech Republic was mainly affected by changes associated with the amount of discharged waste water, access to wastewater treatment and the socio-economic and political development (industrial restructuring, higher living standards, accession to the EU). In recent years, the amount of discharged pollution from point sources no longer changes so dramatically and a significant role in the year-on-year fluctuations in the quality of surface waters is played in particular by meteorological conditions in the given year. In the regional context, the concentration of industrial activities, the existence of contaminated sites or the intensity of agricultural activities are important. At present, the diffuse nutrient pollution, pollution by substances difficult to remove from point source discharges and accidental pollution are now considered to be important sources of pollution of surface water and groundwater in the Czech Republic.

Water quality is monitored in the Czech Republic at 1,024 representative river profiles, the evaluation was made on 126 profiles from category 5 and 6, i.e. profiles with the widest scope of monitoring (Chart 1). In the period 2000–2016, the Czech Republic managed to successfully reduce watercourse pollution by $N\text{-}NH_4^+$ (decrease in average concentration by 64.2%) and P_{total} (decrease by 41.9%). The **average concentration** of ammoniacal nitrogen, which is the primary product of the decomposition of organic nitrogen compounds, a product of the metabolism of organisms and is present in sewerage and waste from agricultural production, reached the value of 0.177 $mg.l^{-1}$ in 2016. The cause of the decline is especially the more effective waste water treatment and a decrease in livestock production. The concentration of **total phosphorus** in 2016 reached the average value of 0.167 $mg.l^{-1}$. The reason for this positive long-term development is the fact that part of the phosphorus pollution originates from point sources that pass through treatment and whose volume decreases. The decline in phosphorus input was supported by restrictions in the use of phosphates in detergents[4]. A further reduction of the concentration of phosphorus in surface water is hampered by the lack of mandatory limits for phosphorus in WWTPs under 2,000 PE and the existence of the so-called diffuse pollution sources such as reliever chambers of the unified sewerage system and other unmonitored untreated waste water outlets. Part of phosphorus in surface waters comes from diffuse sources of pollution, mainly from erosion soil loss. In comparison with the diffuse nitrogen emissions, however, it is an insignificant effect. This type of pollution is difficult to remove, the solution is strict application of good agricultural practice, driven by principles of Good agricultural and environmental condition of land.

The **BOD_5** indicator decreased since 2000 by 24.6% to 2.882 $mg.l^{-1}$. $N\text{-}NO_3^-$ shows significant fluctuations, the value of the year 2016 is 10.3% lower than in 2000 and it reached 3.029 $mg.l^{-1}$. The mineral nitrogen fertilisers, the consumption of which has risen in recent years, are a major source of nitrogen, in addition to atmospheric deposition and municipal waste water. The COD_{Cr} indicator value fell during the period 2000–2016, but the value of the year 2016 is almost the same as in 2000, i.e. 20.200 $mg.l^{-1}$.

Other evaluated indicators in the period 2000–2016 were chlorophyll, fecal pollution and halogenated organic contaminants and since 2007 also dissolved toxic metals (Chart 2). The results of those indicators varied considerably over the monitored period. The largest decrease was achieved by Pb, between the years 2007 and 2016 it fell by 69.3% to 0.267 $\mu g.l^{-1}$. Lead affects the nervous system, it is especially dangerous in the case of long-term exposure. In the years 2007–2011, however, a relatively low number of samples (7–27) was evaluated; the decline between the years 2012–2016, when 66–78 samples were monitored, was 19.8%. A long-term trend cannot be evaluated for the other indicators. The average concentration of chlorophyll decreased year-on-year by 19.1% to 18.234 $\mu g.l^{-1}$. The chlorophyll concentration reflects the level of primary production of the aquatic environment (possibly eutrophication) and it reflects mainly the influence of the climate conditions (average temperatures and precipitation pattern during the year, respectively the growing season). The decline was influenced by more favourable meteorological conditions of 2016 compared to 2015, even though it is necessary to take into account the influence of local conditions, and the related differences between the measured profiles.

The concentration of **cadmium** increased year-on-year by 18.2% to 0.039 $\mu g.l^{-1}$. Cadmium shows a wide range of toxic effects, it is associated with carcinogenicity, and also has a significant ability to accumulate in the food chain. The average concentration of **AOX** also increased year-on-year by 8.4% to 22.037 $\mu g.l^{-1}$. This is a difficult to degrade pollution originating e.g.

[3] *Development of watercourse quality is assessed in the indicator on the basis of average annual concentrations of ten selected basic indicators of pollution for selected representative river profiles. Organic pollution is expressed as BOD_5 and COD_{Cr}, nutrients are represented by $N\text{-}NO_3^-$, $N\text{-}NH_4^+$ and P_{total}. Chlorophyll "a" was selected as a biological indicator, cadmium and lead as heavy metal indicators, adsorbable organohalogens (AOX) as general indicators, and thermotolerant (faecal) coliform bacteria (FC) represent the microbiological indicators.*

[4] *Detergents with higher phosphate concentration than 0.5% per weight were prohibited by Decree No. 78/2006 Coll.*

from the paper and chemical industry, such as chloroform or dioxins. The concentration of **thermotolerant coliform bacteria** (FC) primarily reflects the level of faecal pollution and also depends on the climatic conditions of the year (temperatures, precipitation). In 2016, the average concentration of FC was 54.141 CFU.ml^{-1} in watercourses of the Czech Republic, there was a year-on-year rise by 46.2%.

On the basis of comparison of **water quality maps** assembled according to a summary evaluation of the basic indicators monitored according to the Czech standard CSN 75 7221 continuously since the 1991–1992 period, the satisfactory water quality of watercourses in the Czech Republic is obvious, as well as the potential for further improvement (Figure 1). Most of the monitored watercourses were classified in the two-year period 2015–2016 as polluted in quality class III. Nevertheless, quality class V still occurs on some watercourses or their sections. In the long term, this applies to the Trkmanka River where intensive agricultural activity is manifested, and the section of the Lužnice River before its confluence with the Nežárka River. Furthermore, pollution class V was also recorded in the Blanice and Mrlina Rivers and in several short sections of other streams. In contrast, a considerable part of the Vltava River, but also the Ohře or Morava Rivers were classified as moderately polluted or unpolluted water (quality class I–II).

It is also important to monitor the **quality of groundwater**, which is assessed in the Czech Republic on the basis of Decree of Ministry of the Environment and Ministry of Agriculture No. 5/2011 Coll. The dominant indicators of groundwater pollution are ammonium ions, which were above the limit in 11.8% of samples, and nitrates which exceeded the limit in 10.6% of the samples (Figure 2). From among organic substances, mainly pesticides are problematic. In the numerous group of pesticides, the limits for groundwater are often exceeded not directly by the active components of pesticide preparations, but by the metabolites of pesticides. In line with the previous years, the substances that were also in 2016 most often in excess of the limit for underground water (reference value 0.1 µg.l^{-1}) in particular, were the metabolites of the herbicide chloridazon (herbicide used to treat sugar beet and fodder beet): chloridazon desphenyl (28.6% of samples over the limit), and chloridazon methyl desphenyl (12.8% of samples in excess), and metabolites of herbicides from the chloracetanilid group: alachlor ESA (13.1% of samples in excess), metazachlor ESA (11.3% of samples in excess), metolachlor ESA (9.1% of samples in excess), metazachlor OA and acetochlor ESA (4.7% and 4.5% of samples in excess), metolachlor OA (2.5% of samples in excess), acetochlor OA (1.8% of samples in excess), and alachlor OA (1.0% of samples in excess). Other frequently occurring substances are triazine pesticides, in particular metabolites of the herbicide atrazine such as 2-hydroxy, atrazine desethyl and atrazine desethyl desisopropyl (1.0%, 0.8% and 0.7% of samples over the limit). Out of other pesticides it is hexazinone (0.9%), bentazone (1.3%), 2.6-dichlorbenzamid-metabolite of the herbicide dichlobenil (0.8%), and clopyralid (0.5% of samples in excess). Excess concentrations of the various pesticides are reflected also in the increased number of 28.2% of samples in excess of the limit for indicator "sum of pesticides" with reference value 0.5 µg.l^{-1}. Other pesticides occur in excess concentrations only sporadically. Samples of groundwater with excess concentrations of pesticides were largely taken from shallow wells.

The main reason for groundwater contamination by pesticides and their metabolites in particular is intensive farming aimed at crop production. The cultivation of certain crops (rapeseed, beet, maize) represents, in terms of the pesticides used, a significant risk of contamination of groundwater and surface water. These are herbicides that are commonly used or were used in the past, and some are already banned (metazachlor, alachlor, metolachlor, acetochlor and atrazine). Unlike the herbicides used to treat cereals (chlorotoluron, isoproturon, MCPP), they contaminate groundwater to a greater extent[5]. Obviously, there is a direct correlation between the amount of pesticides used, and the possible pollution not only of groundwater but also surface water. It is necessary to take into account that the range of pesticides or active substances continues to change relatively fast, moreover, the no longer used (banned) pesticides persist in soil with a significant delay, in some cases for many years. At the same time, analytical methods for their identification and identification of their metabolites are being developed to significantly increase the sensitivity of the methods and the spectrum of the identifiable substances. In the analysed samples of water, therefore, many more substances are identified, and in an order of magnitude lower concentrations than it was common in the past.

One of the ways to reduce the pollution of water is to respect the principles of correct application of those substances and to strengthen research in the field of plant protection. Specific measures are embodied in the National Action Plan to reduce pesticide use in the Czech Republic.

[5] *Out of the listed pesticides, it is no longer allowed to use alachlor, acetochlor, atrazine, isoproturon and MCPP, see Commission Regulation (EU) No. 540/2011 of 21 October 2009 implementing Regulation of the European Parliament and of the Council (EC) No. 1107/2009 concerning the placing of plant protection products on the market and repealing Council Directives 79/117/EEC and 91/414/EEC.*

In addition to agricultural land, pesticides are used in substantial quantities also in the maintenance of greenery (forest management, maintenance of roads and railways, maintenance of parks, etc.).

In the Czech Republic, the **bathing water quality in open countryside** is systematically monitored and evaluated in five quality categories. According to the national assessment, 258 sites of bathing waters were monitored in the Czech Republic in 2016. The number of sites reported to the EU and assessed under Directive 2006/7/EC (until 2011 under Directive 76/160/EEC), was 154 sites in 2016. In the bathing season of 2016, 53.5% of bathing waters (i.e. 138 sites) were placed in the best category of quality according to the evaluation of the Czech Republic. The situation improved compared to 2015 when 44.6% of the sites were included in that category. On the contrary, there are fewer sites with impaired quality of water (40 sites, i.e. 15.5% in 2016, compared to 46 sites, i.e., 18.3% in 2015) and with water unsuitable for bathing (20 sites, i.e. 7.8% in 2016, compared to 34 sites, i.e. 13.5% in 2015). There is little change in the other categories compared to 2015, bathing prohibition was declared for 4.7% of the sites and water suitable for bathing with degraded sensory characteristics, i.e. the second best quality category, was established at 18.6% of the sites. According to the EU evaluation, 82.5% of bathing waters were placed in the best category of water quality and only 4 sites reached the limit for a bathing ban. Water quality sampling sites[6] can be divided according to their character into 4 types: concrete reservoirs, biotopes, bathing areas (includes ponds and reservoirs) and swimming pools in the nature (Chart 3). A higher quality of water in 2016 was recorded in concrete reservoirs and biotopes, which mostly met the highest quality, referred to as water suitable for bathing (72 sampling points, i.e. 91.1% for concrete reservoirs and 22 sampling points, i.e., 78.6% for biotopes). On the contrary, water dangerous for bathing was most frequently detected in bathing areas (in 10 cases, i.e. 8.6%).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[6] *At one bathing site, water quality may be monitored at multiple sampling points. The resulting evaluation of the area is reported as the most unfavourable value of the indicator of the overall assessment for all sampling points in the area.*

Water management and water quality in the global context

Key messages[7]

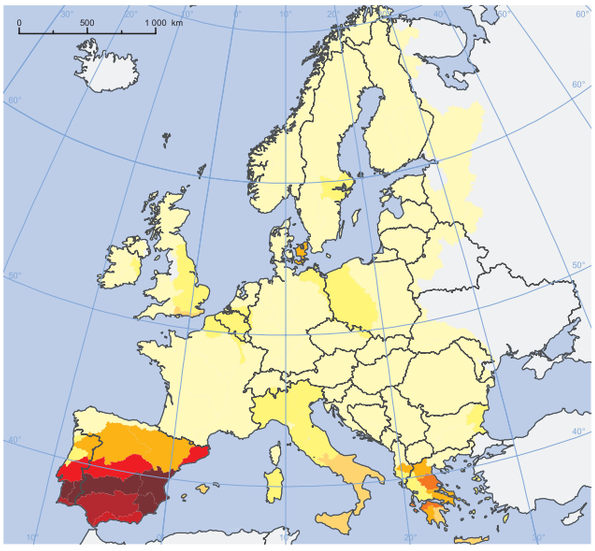
- Most European countries do not suffer from lack of water yet, the situation may worsen, however, due to climate change. The most favourable situation is in northern Europe. The water shortage in the most vulnerable countries in Europe in terms of water resources (mainly Spain and Portugal) occurs as a result of both unfavourable natural conditions and inefficient utilisation and increase in abstractions, primarily for agricultural production.
- Most European countries achieved in 2014 a high degree of compliance with Article 3 of Council Directive 91/271/EEC on urban waste water treatment, which relates to the availability of sewerage systems for urban waste water in agglomerations over 2,000 population equivalent. An average of 88% of wastewater within the European Union and approximately 96% in the Czech Republic were subject to the secondary treatment according to the Directive. The tertiary treatment of waste water in the so-called sensitive areas in the EU is greatly varied and depends both on the degree of technical development of WWTP as well as on the proportion of the sensitive areas of each country. The Czech Republic defined its entire territory as a sensitive area, reaching 94% compliance with the requirement for the tertiary level wastewater treatment.
- In terms of water quality, a significant decrease in the concentration of BOD_5 (by 52.7%) and orthophosphate (by 59.0%) has occurred in watercourses in the years 1993–2012, but a less significant decrease for nitrate (18.3%). In the long-term, the lowest concentration of pollutants is documented in the rivers of northern Europe. The most significant pollution by orthophosphate and BOD_5 is exhibited in the rivers of southeast Europe, for nitrate in the rivers of western Europe. In the European context, the pollution concentration expressed by these indicators (especially for phosphorus and nitrate) in the watercourses of the Czech Republic reaches above-average values.
- According to the EU evaluation of bathing water quality, in 2016, 85.5% of EU sites reached an excellent water quality, 8.4% a good quality, 2.4% an acceptable quality and 1.4% of the sites an unsatisfactory quality. The best results were achieved by the bathing waters of Luxembourg, Cyprus and Malta. In the Czech Republic, 82.5% of the sites had an excellent quality of water, 8.4% good quality, 1.3% acceptable quality and 0.6% of sites poor quality.

[7] *Data for the years 2013–2016 are not, due to the methodology of their reporting, available at the time of publication.*

Indicator assessment

Figure 1

Water scarcity in Europe expressed using the WEI index [%], summer 2014



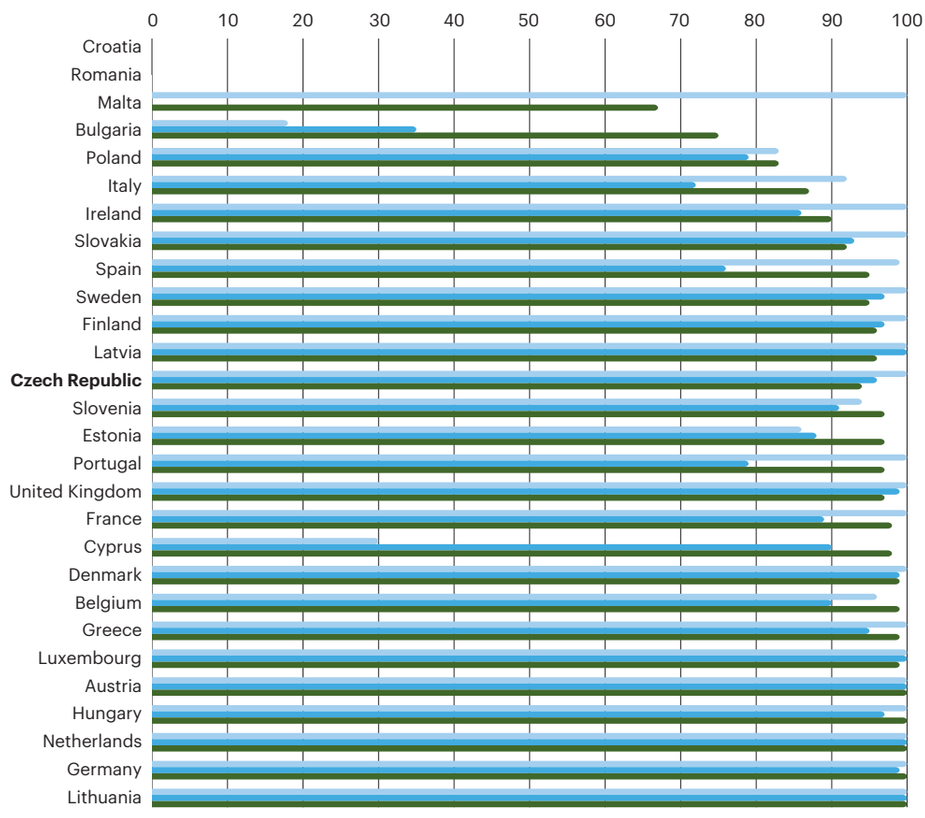
- < 5,0% without stress
- 5,1–10,0% without stress
- 10,1–15,0% without stress
- 15,1–20,0% without stress
- 20,1–25,0% water stress
- 25,1–30,0% water stress
- 30,1–35,0% water stress
- 35,1–40,0% water stress
- > 40,0 % extreme water stress
- No data available

Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Environment Agency

Chart 1

Compliance of EU countries with Article 3 (collecting), Article 4 (secondary treatment) and Article 5 (more stringent treatment) of Council Directive 91/271/EEC on urban waste water treatment [%], 2014



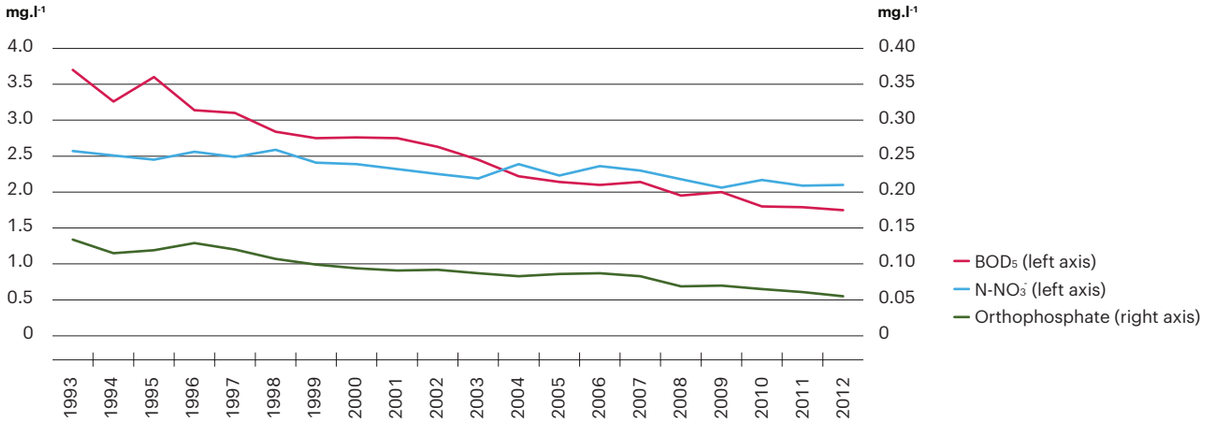
The results shown represent compliance of each Member State for the year 2014, as regards Article 3 (collecting), Article 4 (secondary treatment) and 5 (more stringent treatment) of Council Directive 91/271/EEC on urban waste water treatment. The classification of the Member States is such that the first mentioned are the countries with the lowest rates of compliance with Article 5 and the countries are sorted by increasing rates of compliance. A lower level of compliance referred to in Article 4 in comparison with the level of compliance in accordance with Article 5 is possible, since Article 5 refers only to sensitive areas.
Croatia and Romania did not provide data. Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.

- Article 3
- Article 4
- Article 5

Source: Urban Waste Water Treatment Directive

Chart 2

Development of concentrations of pollution indicators in European watercourses [mg.l^{-1}], 1993–2012

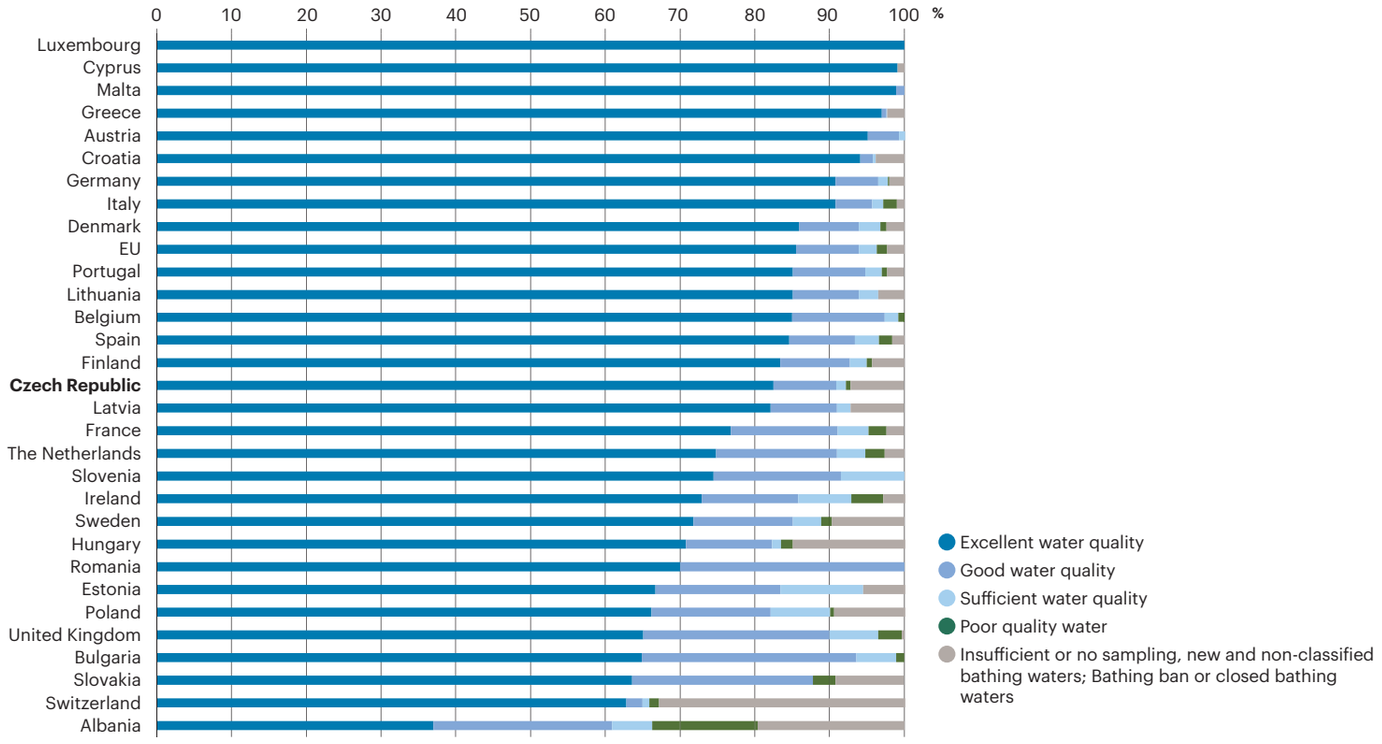


Concentrations are expressed as average values of BOD_5 from 539 stations, $N\text{-}NO_3^-$ from 1,059 stations and orthophosphate from 874 stations. In countries where BOD_5 was not monitored, BOD_7 has been converted into BOD_5 where $BOD_7 = 1.16\ BOD_5$. Nitrate concentration is expressed as nitrate nitrogen (Austria, Belgium, Bulgaria, Germany, Estonia, France, Latvia, Liechtenstein, Lithuania, Luxembourg, Norway, Poland, Slovakia, Slovenia, Switzerland), total oxidisable nitrogen (Denmark, Finland, Ireland, Sweden) and nitrate or oxidisable nitrogen (United Kingdom). Source of data is the database WISE-SoE Rivers (Version 14). Data for the years 2013–2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Environment Agency

Chart 3

Bathing water quality in EU Member States, Albania and Switzerland in each category according to the evaluation of the EU [%], 2016



Source: European Environment Agency

The **access to water sources** is heavily dependent on the geographical location and physical geographic conditions in the different countries. The most endangered countries of Europe, i.e. the countries with the highest index of WEI[8] (Figure 1) were during the summer of 2014 in particular Spain and Portugal, and to a lesser extent Greece and Macedonia. The water shortage in these areas occurs as a result of unfavourable natural conditions (climate, the character of the river network, geological conditions, etc.) as well as due to anthropogenic interventions in the water regime. In those countries, this means in particular uneconomical use of water for agricultural production. The agricultural sector there consumes approximately 80% of total water abstraction. That has a greater impact on the overall water balance in those regions than in countries with sufficient water resources. In countries with more favourable ratio of water abstractions to the volume of renewable water supplies, such as Northern countries, this condition is clearly influenced by the natural conditions (higher precipitation, river network density, number of lakes, water flow rate in streams). It is therefore desirable in the future both to utilise water resources more sparingly, and to support local agriculture, in particular in countries that manage with little or no irrigation.

Article 3 of **Council Directive 91/271/EEC on municipal waste water treatment** provides for Member States the obligation to ensure that all agglomerations above 2,000 population equivalent are equipped with sewerage systems for urban waste water. As of the reference year 2014, most Member States discharged a significant part of the waste water through the sewerage systems, the average rate of compliance reached 96% (Chart 1). However, there are still countries in which waste waters are discharged only partially and in a relatively high proportion the individual systems or other appropriate systems (IAS[9]) are used. The fulfilment of the requirements of the directive referred to in Article 3 for the Czech Republic was met for all reported agglomerations. Article 4 requires that municipal waste waters entering sewerage systems shall before discharge be subject to secondary treatment or other equivalent treatment. Within the EU, this degree of waste water treatment was applied on average to 88% of waste water, the Czech Republic achieved a 96% compliance with the requirements of Article 4 of the Directive. Article 5 concerns the treatment according to the more stringent requirements than laid down in Article 4 (tertiary treatment), especially in the so-called sensitive areas. The EU is currently identified as a sensitive area for almost 75% of the territory. Fifteen EU countries, including the Czech Republic, defined all its territory to be a sensitive area, and thirteen Member States defines as "sensitive" only certain water bodies. The Czech Republic reaches 94% compliance with Article 5 of the Directive, the EU average is 95%.

Concerning **water quality in watercourses** (Chart 2) it can be stated that in the period from 1993 to 2012 a significant decrease in organic pollution occurred in European watercourses: expressed in BOD_5, concentration decreased (by a total of 52.7%), and expressed in phosphorus (indicator orthophosphate) concentration decreased (by a total of 59.0%). This positive development is mainly due to the introduction of European and national legislation, aimed primarily at municipal waste water treatment, and the introduction of phosphate-free detergents on the market. The decreasing trend in nitrate concentration over the period 1993–2012 was slower (by of 18.3%). The decrease was mainly due to the improvements in waste water treatment and the applications of tools to reduce agricultural inputs of nitrogen. However, diffuse pollution from agriculture remains a significant stressor in more than 40% of Europe's water bodies. In the long-term, low concentration of pollutants is recorded in the rivers of northern Europe, where the treatment of waste water is at a very good level and moreover, the rivers flow through less populated or mountainous areas. The most significant pollution by BOD_5 and orthophosphate can be found in the watercourses of southeast Europe. Orthophosphate pollution is a problem also in the Czech Republic. The highest level of nitrate pollution, similar to that in the Czech Republic, is also present in the rivers in the densely populated and intensively farmed West Europe.

In European countries the **quality of the water at the sites also intended for bathing**[10] is monitored each year. In the season of 2016, bathing sites in all countries of the EU28 and also in Albania and Switzerland, were assessed under this Directive (Chart 3). In the bathing season of 2016, a total of 21,575 bathing waters were monitored, which is 7 sites less than in 2015. 68.8% of the cases were coastal sites and 31.2% of the sites was inland. In Luxembourg, Austria, Slovenia, Romania and Malta, all the evaluated sites reached at least sufficient water quality. In eight Member States from EU28, more than 90% of the evaluated sites had excellent water quality (Luxembourg, Cyprus, Malta, Greece, Austria, Croatia, Germany and Italy). Overall, in the EU28 the highest category was reached in 85.5% of bathing waters (in 2015 it was 84.4%), in the Czech Republic it was 82.5%. In contrast, the poor quality of water was reached in 2016 by a total of 316 monitored sites, which is 1.5% of the total, and 0.3 percentage points less than in 2015. The highest share was recorded in Ireland (4.3%), the United Kingdom (3.2%), the Netherlands (2.6%) and France (2.4%). A high proportion of sites with poor quality of water was also recorded in Albania (14.1%), where, however, the situation significantly improved against 2015, when 39.7% of the monitored bathing waters were classified in that quality class. In the Czech Republic in 2016, only one site had poor quality water.

[8] *The WEI Index expresses water shortage and describes what pressure is exerted by the total water abstraction on water sources (calculated as a ratio of total water abstraction to the quantity of renewable water reserves). It thus specifies countries that have, given their resources, high abstraction and are therefore prone to water shortage (water stress). The WEI warning threshold that separates regions with sufficient water resources and regions lacking them is the value of approximately 20%. Severe water shortage may occur when the value of the WEI exceeds 40%.*

[9] *Individual systems or other compliant systems that achieve the same level of protection for the environment as the sewerage systems.*

[10] *Based on the Directive 2006/7/EC of the European Parliament and of the Council concerning the management of bathing water quality as of 15 February 2006.*

4 Nature and landscape

Nature and landscape

The character of the landscape is the result of interaction between natural and anthropogenic factors. The use of the landscape subsequently affects the biodiversity of species, the condition of habitats, populations and ecosystems in a given environment. The state of nature and landscape is then reflected in the different types of ecosystem services and the ability of ecosystems to provide such services in the long term.

Environmentally valuable territories, which are mainly near-natural habitats (mainly forests, meadows, etc.), hold water in the landscape, prevent soil erosion, increase the ecological stability of the landscape and maintain or increase the level of biodiversity. By contrast, the vast areas of arable land or built-up areas do not fulfil those functions. Another serious problem affecting the state of nature and landscape is the fragmentation of the landscape and the reduction of its permeability, in particular by the development of liner transport infrastructure and suburban development of urban agglomerations. The landscape fragmentation means disintegration of comprehensive parts of the landscape into smaller areas which lose their original quality and ecosystem linkages. At the same time, barriers are formed in the countryside that limit or prevent the migration of animals and plants. All this leads to a loss of genetic diversity and reduced viability of populations and ecosystems.

The negative effects on nature and landscape can be reduced by well-considered interventions, mainly responsible spatial planning.

Changes of nature and landscape are slow and take a long time, and it is not possible to acquire data for their monitoring through automated technical means. The evaluation of the changes is only possible in the long term, following a non-periodical updating of data. The exception is the periodic (six-year period) updating of data on the status of species of Community importance, mainly species of birds, and natural habitats occurring in the territory of the EU Member States.

References to current conceptual, strategic and legislative documents

Convention on Biological Diversity
- conservation and halting the loss of biological diversity
- access to genetic resources and fair and equitable sharing of benefits arising from their utilization

European Landscape Convention
- support of landscape protection, management and planning and organization of European cooperation in this area

Council Directive No. 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the so-called Habitat Directive)
- ensuring biodiversity through the protection of natural habitats and wild fauna and flora species in the territories of member states
- maintaining or restoring a favourable status from the viewpoint of the protection of natural habitats and wild fauna and flora species
- creating the all-European Natura 2000 system comprising Sites of Community Importance and Special Protection Areas

Directive No. 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy
- gradual removal of transverse obstacles restricting the aquatic organisms' migration and of the reduction of the burden on aquatic environments in all EU member states

Directive No. 2009147/EC of the European Parliament and of the Council on the conservation of wild birds
- creating and declaring Special Protection Areas, which together with Sites of Community Importance form the Natura 2000 system

Renewed EU Sustainable Development Strategy
• ensuring the Earth's ability to sustain life in all its diversity

EU Biodiversity Strategy to 2020
• halting the loss of biodiversity and degradation of ecosystem services in the European Union by 2020
• determining the share of biotopes and species in respect whereof a favourable or improving situation must be achieved

Regulation (EU) No. 1143/2014 of the European Parliament and of the Council on the prevention and management of the introduction and spread of invasive alien species
• determining the essential rules with respect to the most problematic invasive species from the viewpoint of the EU

Thematic strategy for soil protection
• to provide for sustainable use of land

State environmental policy of the Czech Republic 2012–2020
• ensuring the protection and care of the most valuable parts of nature and landscape, preventing the loss of indigenous species, and eliminating negative impacts of non-indigenous invasive species on biological diversity

Rural Development Programme 2014–2020
• restoring, preserving and enhancing ecosystems dependent on the agricultural sector through agro-environmental measures
• ensuring investments for competitiveness and innovation of agricultural undertakings
• support for diversification of economic activities in the rural space in order to create new jobs

State Nature Conservation and Landscape Protection Programme of the Czech Republic
• maintaining numerous enough populations of indigenous wild fauna and flora species and minimizing risks when introducing new invasive and non-indigenous species
• securing the protection of soil as an irreplaceable and non-renewable natural resource
• reversing the negative trend of decreasing area of agricultural land
• preservation or restoration of grasslands

National Biodiversity Strategy of the Czech Republic
• protection and conservation of ecosystems and natural habitats, including maintaining and restoring viable populations of species in their natural environment

Biodiversity Action Plan
• halting the loss of biodiversity by 2010

Strategy on Adaptation to Climate Change in the Czech Republic
• ensuring a thorough and coherent planning of land use with a long term perspective, taking into account the protection of biodiversity and ensuring the key ecosystem services including the retention of water in the landscape

Spatial Development Policy of the Czech Republic, as amended by the Update no. 1
• economical use of built-up areas, provision of the protection of undeveloped areas (especially agricultural and forest land) and preservation of public greenery
• the placement development projects that may significantly affect the character of the landscape, to the least possible conflicting sites and the follow-up support of the compensatory measures

The concept of clearing of river network of the Czech Republic, 2014 update
• determining the supranational and national priorities of progressive bi-directional making passable the transverse obstacles including a timetable for implementation of the plan with regard to capacity possibilities and financial resources
• determining the principles of the protection of current migratory permeability of watercourses and improving conditions for living organisms in flowing waters
• definition of significant watercourses in terms of migration or sections of watercourses on two levels Above-regional priority habitat biocorridors with international relevance and National priority sections of watercourses in terms of territorial and species protection

Act No. 114/1992 Coll., on nature and landscape protection
- maintaining and restoring the natural balance in the landscape
- protecting the diversity of life forms, natural values and beauties
- prudent management of natural resources

Act No. 334/1992 Coll. on the protection of the agricultural land resources
protection of the agricultural land resources as an irreplaceable means of production and environmental component
- setting the principles of soil protection policy, fines and the process of exclusion from the resources

Operational Programme Environment 2014–2020
- measures to protect endangered plant and animal species and control and removal of the populations of invasive plant and animal species
- measures to conserve and improve the natural conditions in forests in the specially protected areas and Natura 2000 sites, defined regional and supra-regional biocentres of territorial systems of ecological stability
- support for natural overflowing in floodplain areas, revitalization of watercourses and wetlands, building and restoration of retention spaces

12 | Land use

Key question

What is the state and development of land use in the Czech Republic?

Key messages

In 2016, the acreage of permanent grassland in the agricultural land resources grew to 12.7% of the country's territory and the acreage of arable land was reduced to 37.6% of the territory. The forested area is growing slightly, in 2016 it made up 33.9% of the territory.

The total acreage of the agricultural land resources in the Czech Republic in the period 2000–2016 decreased by 1.5%. In particular, agricultural land is shrinking in favour of built-up and other areas. The size of those areas increased by 4.1% from the year 2000 to 2016.

Overall assessment of the trend

Change since 1990

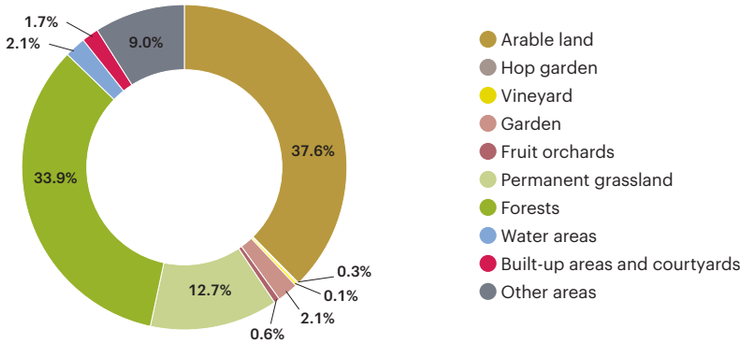
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

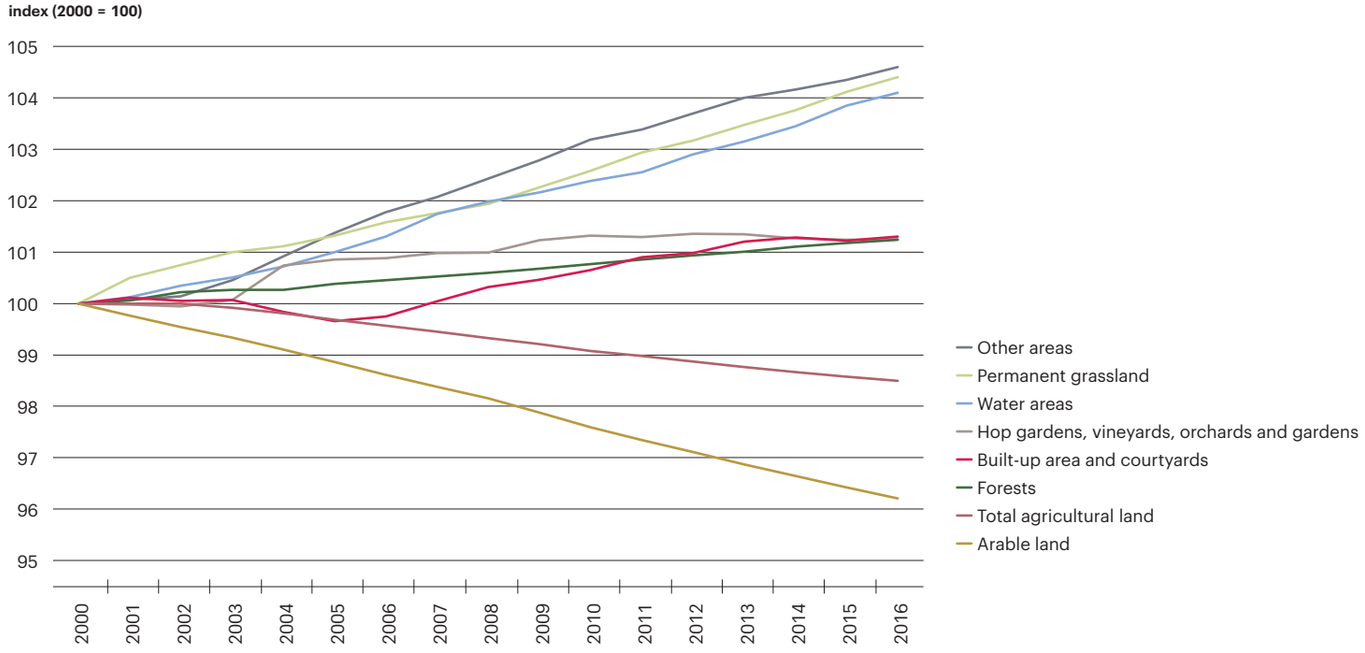
Land use in the Czech Republic [%], 2016



Source: Czech Office for Surveying, Mapping and Cadastre

Chart 2

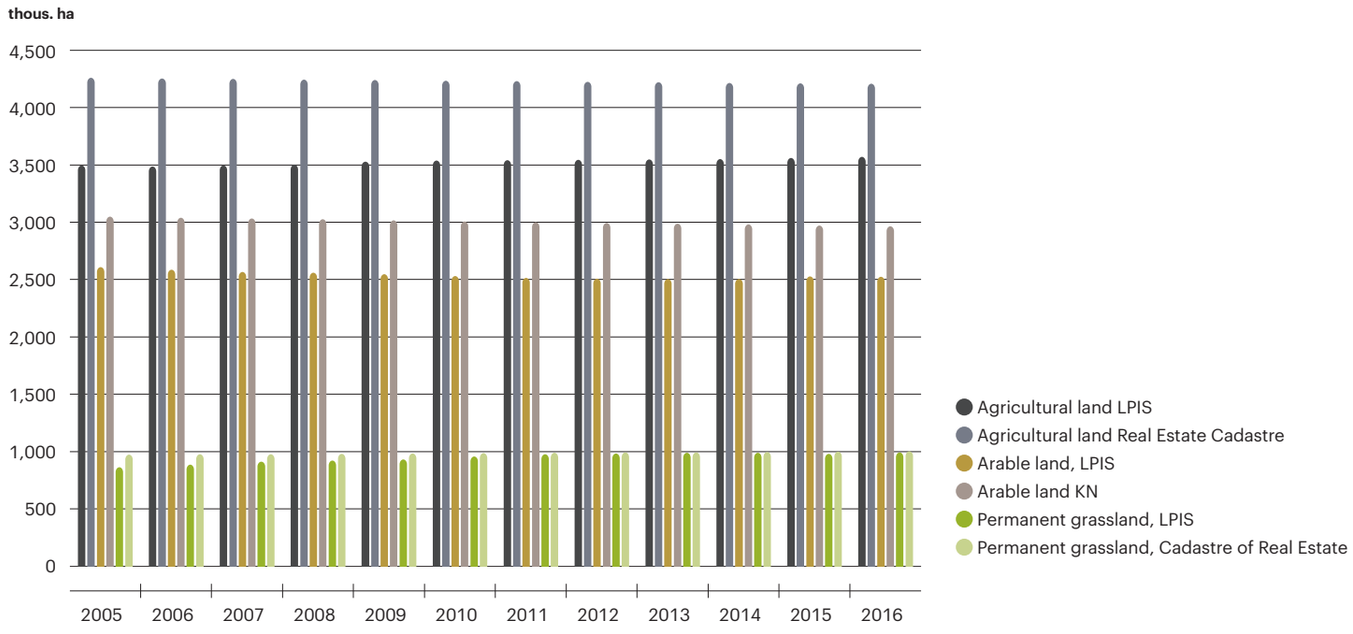
Land use development in the Czech Republic [index, 2000 = 100], 2000–2016



Source: Czech Office for Surveying, Mapping and Cadastre

Chart 3

Development of agricultural land area and its main categories recorded in LPIS (public agricultural land register) and in the Real Estate Cadastre [thous. ha], 2005–2016

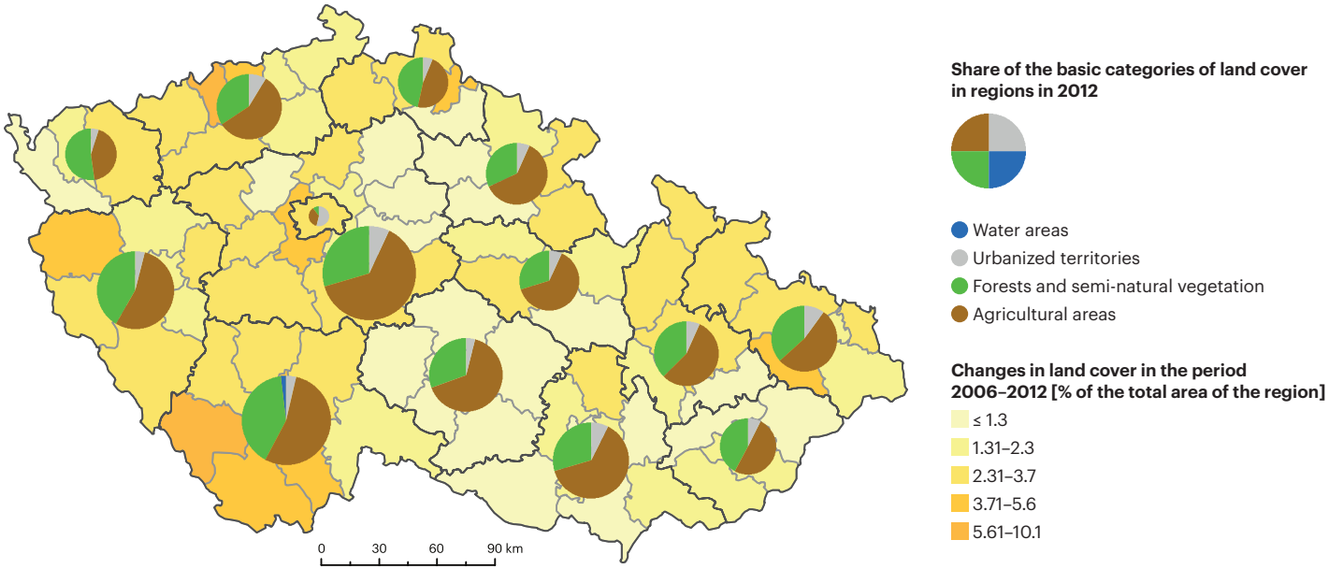


In 2015, the categorisation has changed in registering agricultural land in LPIS. To maintain the homogeneity of the time series, the data for arable land are set out from 2015 as the sum of acreage of standard arable land and fallow land, the data for permanent crop are the sum of acreage of permanent grassland and grassland.

Source: Czech Office for Surveying, Mapping and Cadastre, Ministry of Agriculture of the Czech Republic

Figure 1

Basic categories of land cover in the regions of the Czech Republic in 2012 and changes in land cover in the period 2006–2012 according to the CORINE Land Cover database [%]



Data for the years 2013–2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: CENIA, European Environment Agency

The structure of land use in the Czech Republic is characterised by a higher percentage of forests (33.9% in 2016, Chart 1), and a high rate of ploughed agricultural land, which reached 70.7% in 2016. The acreage of the agricultural land resources in the Czech Republic's land resources accounted for 53.4% in 2016.

A clear long-term trends in the use of the territory of the Czech Republic in the period 2000–2016 are the decrease in the acreage of arable land (Chart 2) by 116.8 thous. ha (3.8%), and an increase in the area of permanent grassland which grew in the period 2000–2016 by 42.3 thous. ha (4.4%) largely at the expense of arable land. This development, supported by the subsidy policy of the State and the application of the principles of the Common Agricultural Policy, is positive from the perspective of environmental protection and biodiversity. The decrease in acreage of arable land and the increase in areas of permanent grassland help to reduce soil erosion and support biodiversity.

The total area of agricultural land has been slightly decreasing, according to the Cadastre of Real Estate; in the period 2000–2016 it decreased by 64.4 thous. ha (1.5%) in total, in the year-on-year comparison of 2015 and 2016 by 3.6 thous. ha (0.1%). The loss of agricultural land was both due to the conversion of farmland to built-up and other areas, in the period 2000–2016 this was 32.9 thous. ha (i.e., 4.1%), and as a result of the gradual growth of the area of forests and bodies of water. The growth rate of water areas increased after 2010, in the period 2000–2016 water areas expanded by 6.5 thous. ha (4.0%), and took up 2.1% of the Czech Republic territory. The growth of water areas was caused by flooding, among others, of former mining areas in the Karlovy Vary and Ústí nad Labem Regions.

The most important process causing the loss of arable land was also in 2016 its conversion to permanent grassland. Out of the total loss of arable land (in 2016 it was 7.7 thous. ha) a total of about 4.2 thous. ha was converted to permanent grassland, of which about 0.6 thous. ha in the South Bohemian Region. The expansion of built-up and other areas has caused the loss of arable land by further 2.4 thous. ha, the most in the Regions of Central Bohemia and South Moravia (together approx. 830.0 ha). The loss of arable land in 2016 was also caused by its transformation to forest land (598.0 ha) and to bodies of water (240.1 ha). Increases of arable land in 2016 amounted to a total of 1.4 thous. ha; new arable land was created mostly on previous permanent grassland (932.5 ha), other areas (171.0 ha) and fruit orchards (150.0 ha). As a result of those changes,

the area of arable land in 2016 in the total balance decreased year-on-year by 6.4 thous. ha, i.e. 0.2%, in contrast, the area of permanent grassland grew by 2.8 thous. ha, i.e. 0.3%.

The area of **built-up and other areas** increased year-on-year (2015–2016) by 1.8 thous. ha (0.2%) to 842.9 thous. ha, which represents 10.7% of the territory of the Czech Republic. The growth rate of urban and other areas, which was the largest in the years 2005–2010, slowly decreases. In the context of other areas, the acreage of roads is increasing (overall in 2015 by 1.2 thous. ha, i.e. 0.5%) and public green areas (by 893.0 ha, i.e. 2.2%). On the contrary, the extent of mining areas declined (year-on-year by 721.0 ha, i.e. 2.1%), the rate of the decline decreased compared to 2015. The land take of the agricultural land resources in favour of anthropogenic areas (mainly transport infrastructure), therefore continues, and downward momentum of the growth of other areas is caused particularly by the attenuation of surface mining. The growth of public green areas can be evaluated positively, in particular with regard to the environment of cities and their adaptation to climate change.

According to the data of the **public land registry LPIS** (Land Parcel Identification System), 45.3% of the territory of the Czech Republic was used for agricultural purposes in 2016, which is by approximately 637.3 thous. ha less than the area of the agricultural land resources registered in the Cadastre of Real Estate (Chart 3). Categories of agricultural land with the highest proportion in LPIS is arable land (69.8% in 2016) and permanent grassland (27.8%) and thus for other categories fall only 2.5% of the total acreage of agricultural land in LPIS. In the period 2005–2016, the total area of land registered in the LPIS (unlike the Cadastre of Real Estate) was slowly increasing (by 76.8 thous. ha, i.e. by 2.1%), mainly as a result of the growth of registered areas of permanent grassland by 130.7 thous. ha (15.2%), while the recorded acreage of arable land decreased by 84.7 thous. ha, i.e. by 3.2%.

Based on the data from the **CORINE Land Cover** from 2012, the highest share of agricultural land is in the total territory of the Vysočina Region (65.1%) and in the Central Bohemian Region (62.9%, Figure 1), the most forested regions, according to the CORINE Land Cover data, are the Karlovy Vary Region (51.8%) and in the Liberec Region (46.4%). The highest proportion of urbanised territories is in the region of the City of Prague (54.3%); followed by the Moravian-Silesian Region (9.8%). In the period 2006–2012 there were the biggest changes in land cover in the Prachatice district (land cover changed on 10.0% of the territory) in the context of deforestation in the Šumava National Park, and in the Most district (8.4% changes), where mining areas are gradually shrinking. Overall, the land cover changes more in the border mountainous, wooded areas and also in urban areas, and by contrast, it is relatively stable in areas with intensive agriculture in the Central Bohemian Region (district of Nymburk, 0.5% changes), South Moravian Region (Vyškov, 0.6% changes) and in Vysočina Region (Žďár nad Sázavou, 0.7% changes).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

13 | Landscape fragmentation

Key question

Is the process of landscape fragmentation being slowed down?

Key messages

Although the decline in unfragmented areas is slowing down, the landscape fragmentation process still continues. For the period 2000–2010[1] the surface area of unfragmented landscape decreased by 5.2% and in 2010 it represented 63.4% of the total area of the Czech Republic. The rivers in the Czech Republic registered more than 6,600 transverse objects greater than 1 m, and in 2016 there were a total of 758 weirs, which may adversely affect aquatic ecosystems.

Overall assessment of the trend

Change since 1990

Change since 2000

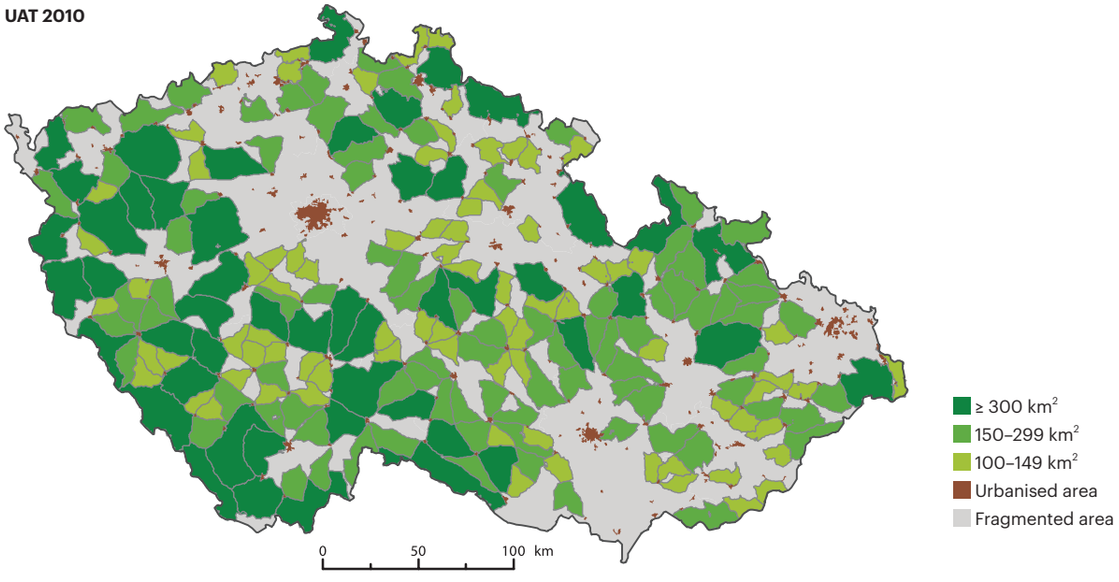
Last year-on-year change

Indicator assessment

Figure 1

Landscape fragmentation due to transport in the Czech Republic, 2010

UAT 2010



Assessed using UAT polygons. UAT (Unfragmented Areas by Traffic) is a method of determining the so-called unfragmented areas by traffic, i.e. areas which are delimited by roads with traffic intensity higher than 1,000 vehicles per 24 hours or multi-track railways. UAT is defined in areas greater than 100 km².
Data for the years 2011–2016 are not, due to the methodology of their reporting, available at the time of publication.

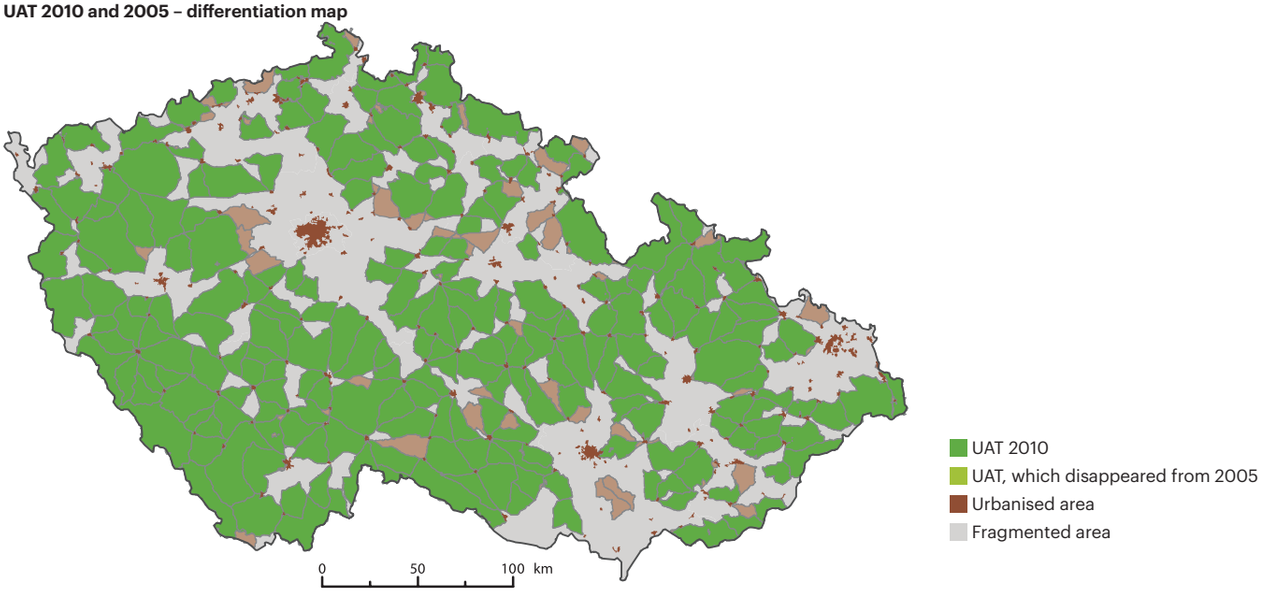
Source: Evernia

[1] *Data for the years 2011–2016 are not, due to the methology of their reporting, available at the time of publication.*

Figure 2

Dynamics of landscape fragmentation due to transport in the Czech Republic between 2005 and 2010

UAT 2010 and 2005 – differentiation map



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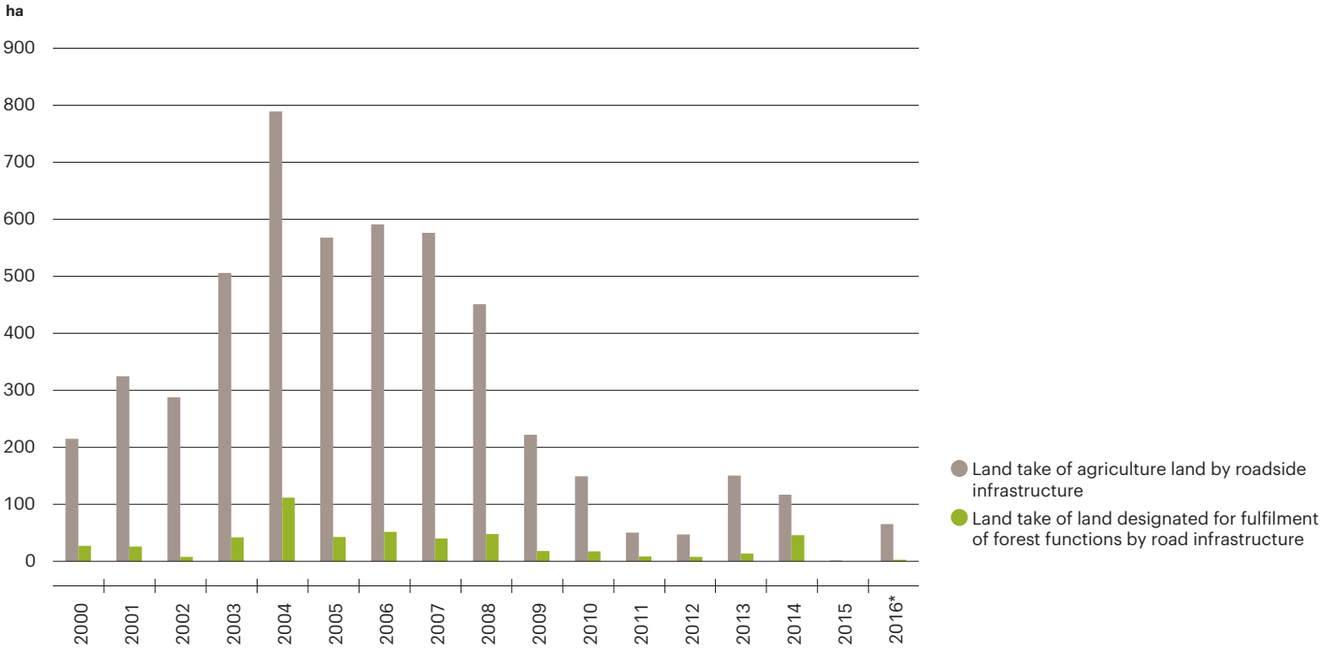
Data for the years 2011–2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Evernia

Chart 1

Development of land take of the agriculture land and of land designated for fulfilment of forest functions due to road infrastructure in the Czech Republic [ha], 2000–2016

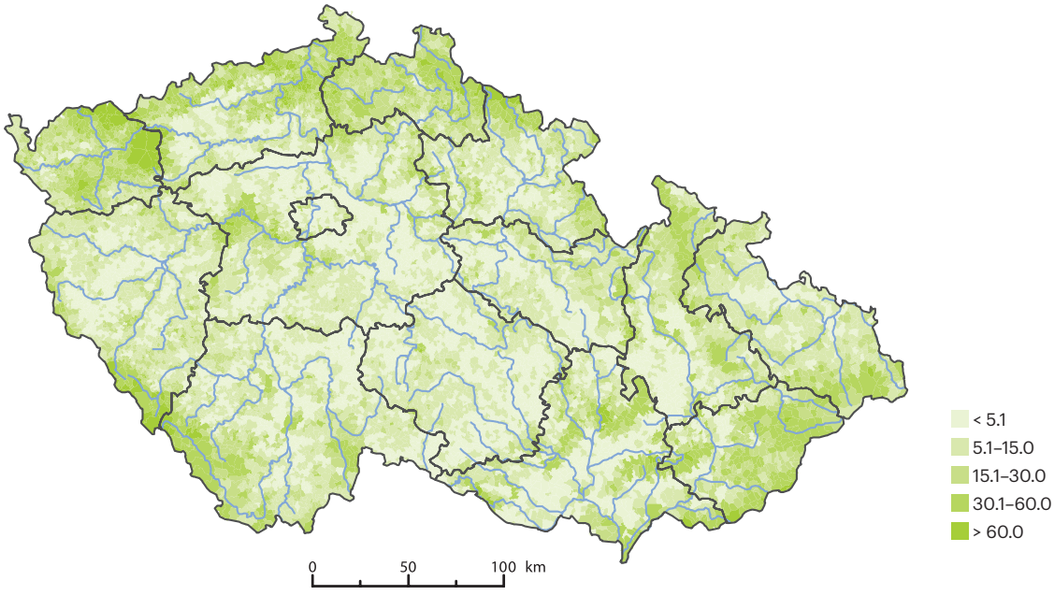


The methodology of reporting the take-overs of agriculture land and of land designated for fulfilment of forest functions is annually affected by temporary take-ups of such land which are associated with the construction of transport infrastructure.
** Preliminary data.*

Source: Transport Research Centre

Figure 3

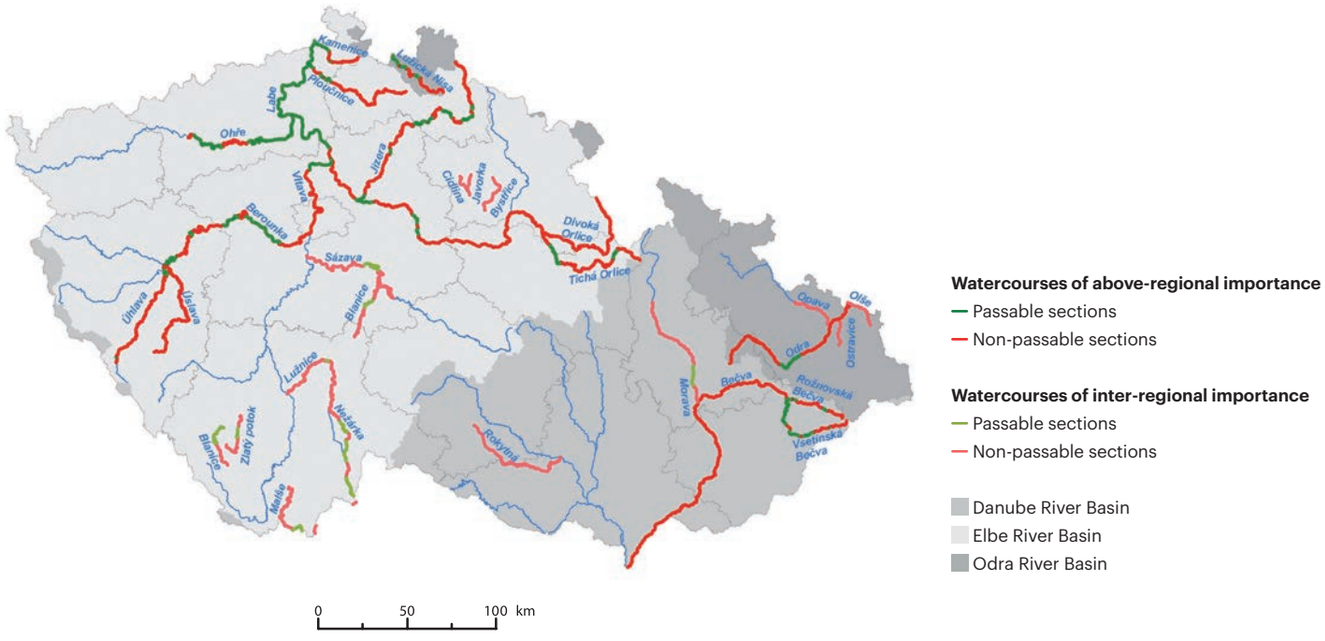
Proportion of natural biotopes in the area of cadastral areas in the Czech Republic [%], 2016



Source: Nature Conservation Agency of the Czech Republic

Figure 4

Current status of the migration permeability defined in the migration-significant watercourses in the Czech Republic, 2014



Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Nature Conservation Agency of the Czech Republic

During the period 2000–2010, the area of unfragmented landscape decreased from 54,000 km^2 (68.6% of the total area of the Czech Republic) to 50 thous. km^2 in 2010 and therefore covered 63.4% of the total area of the Czech Republic (Figure 1, Figure 2). The rate of decline, compared with the previous five-year period (2000–2005), decreased in the last assessed 2.4% years to 2040, but even though the fragmentation of the landscape in the Czech Republic still continues and according to the forecasts it can be expected that the proportion of unfragmented landscape in the year 2040 will achieve only 53%.

The highest **fragmentation of the landscape** in the Czech Republic is recorded in the Central Bohemian, South-Moravian and Moravian-Silesian Regions (Figure 1) that belong at the same time among regions with the highest loss of unfragmented areas for the period 2005–2010 (Figure 2). The high increase in fragmentation is caused by the scattered expansion of built-up areas as a result of the continuing urbanisation taking place mainly in urban agglomerations and also due to the development of transport infrastructure, especially the construction of urban ring roads, express roads and motorways. On the contrary, the Plzeň Region and the South Bohemian Region have the greatest area of unfragmented areas, as the more diverse topography and large-scale protected areas result in a lower population density and thus less need for transport services.

In the years 2000–2016, approximately 5,109 ha of agricultural land and approximately 509 ha of forest land were taken for the construction of transport infrastructure in the Czech Republic (Chart 1). The most significant decrease in agricultural land in the period 2000–2016 occurred in the Central Bohemian and South Bohemia Regions, in particular, due to the continuing preparation and construction of motorways D1 and D3; in the Central Bohemian Region, the **agricultural land take** is also closely related with the construction of the Prague ring road connecting the motorways D1 and D5. Between the years 2015–2016, an increased amount of agricultural land was taken in the Central Bohemian, Liberec and Olomouc Regions. The forest land was taken in the period 2015–2016 only in the Liberec Region.

Transport infrastructure represents a serious and often insurmountable obstacle to many important species of animals. The solution is an appropriate construction of migration objects, underpasses and overpasses (ecoducts) for animal migration. In the Czech Republic, there are 23 ecoducts registered, which are regularly checked for traces indicating the presence of animals. However, continuous monitoring of functionality is not carried out.

The ecological stability of the landscape can be evaluated according to the quantity of natural biotopes. The average proportion of the area of natural biotopes in the cadastral area in the whole of the Czech Republic is 13.4%. Areas with extremely degraded natural structures are found in the most intensively agriculturally exploited regions of the Czech Republic and in municipal agglomerations; on the other hand, **natural and near-natural landscape** is found mainly in mountain ranges alongside the border, and basically consistent with the SPA (Figure 3).

Watercourses and their flood plains represent a specific migration route, which different communities and animal and plant populations are bound to. Based on the reconstruction of historical sites, the occurrence of the 12 species of fish, which migrate between the sea and the river environment, was documented in the Czech Republic. Of them there are currently in the territory of the Czech Republic recorded only 2 species European eel (Anguilla Anguilla) and Atlantic salmon (Salmo salar). On watercourses of different order in the territory of the Czech Republic, there are reservoirs larger than 50 ha and more than 6,600 transverse objects higher than 1 m, while the number of lower migration barriers is not exactly known and will be an order of magnitude higher. Other influences that cause the fragmentation of water courses are afflux and water accumulation, modifications of water courses (anti-flood measures), water abstractions and pollution.

At important watercourses managed by the state enterprises Povodí (i.e. river basins), a total of 758 weirs were recorded in 2016, of which 196 are managed by state enterprise Povodí Labe, 343 by state enterprise Povodí Vltavy, 44 by state enterprise Povodí Ohře, 174 by state enterprise Povodí Moravy, 82 by state enterprise Povodí Odry.

In order to maintain and strengthen the populations relying on **migration** and to fulfil the Concept of Making the Czech River Network Passable, an increasing number of construction designs of fish passes has been prepared since 2010. In 2016, a total of 28[2] of these projects were prepared and 11 were implemented.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[2] *Upcoming fish passes are projects that are consulted with the Nature Conservation Agency of the Czech Republic. Nature Conservation Agency of the Czech Republic, however, offers no information as to whether these projects are ready for implementation and whether they are being implemented. This information is provided only in such fish pass projects, which are submitted within the Operational Programme Environment.*

14 | Nature protection

Key question

How and to what extent are the nature and landscape protected and how it is dealt with species protection in the Czech Republic?

Key messages

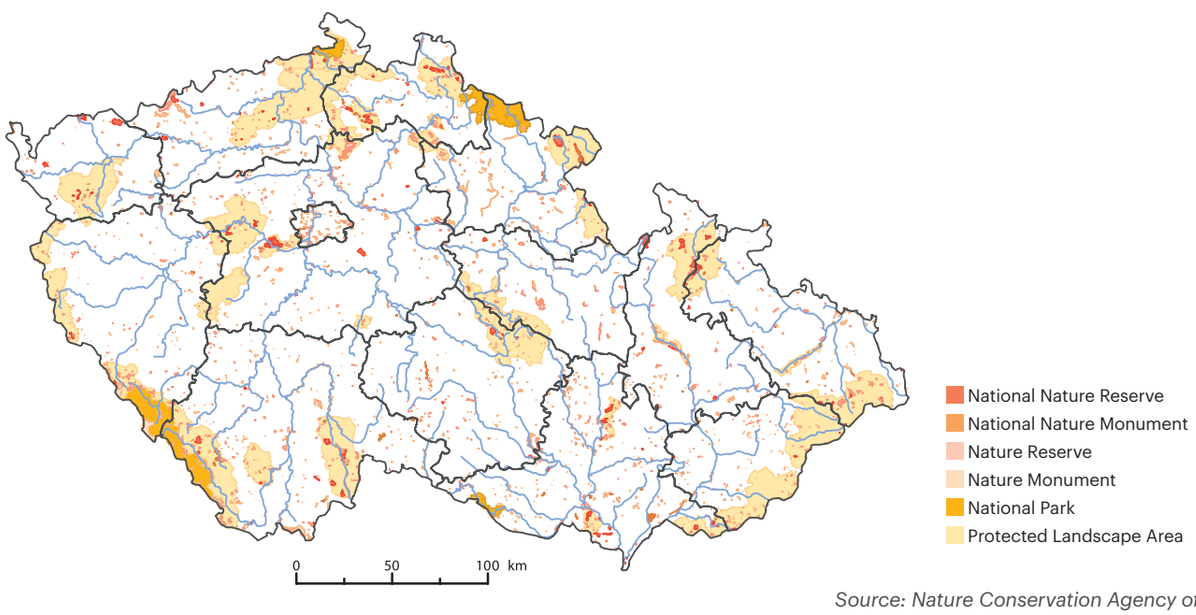
In 2016, 16.7% of the Czech Republic's area was protected by means of specially protected areas, the number and size of small-scale specially protected areas is growing. Through the Natura 2000, 14.1% of the Czech Republic's area was protected in 2016.

In 2016, there were only 8 rescue programmes implemented for the most endangered specially protected species.

Indicator assessment

Figure 1

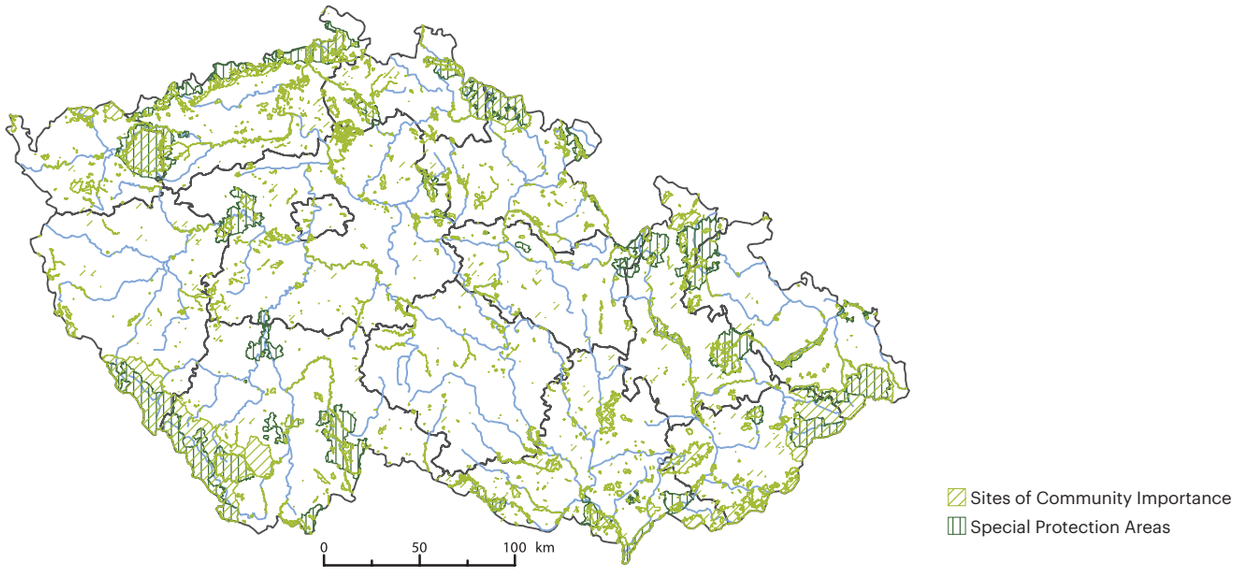
Large-size and small-size specially protected areas in the Czech Republic, 2016



Source: Nature Conservation Agency of the Czech Republic

Figure 2

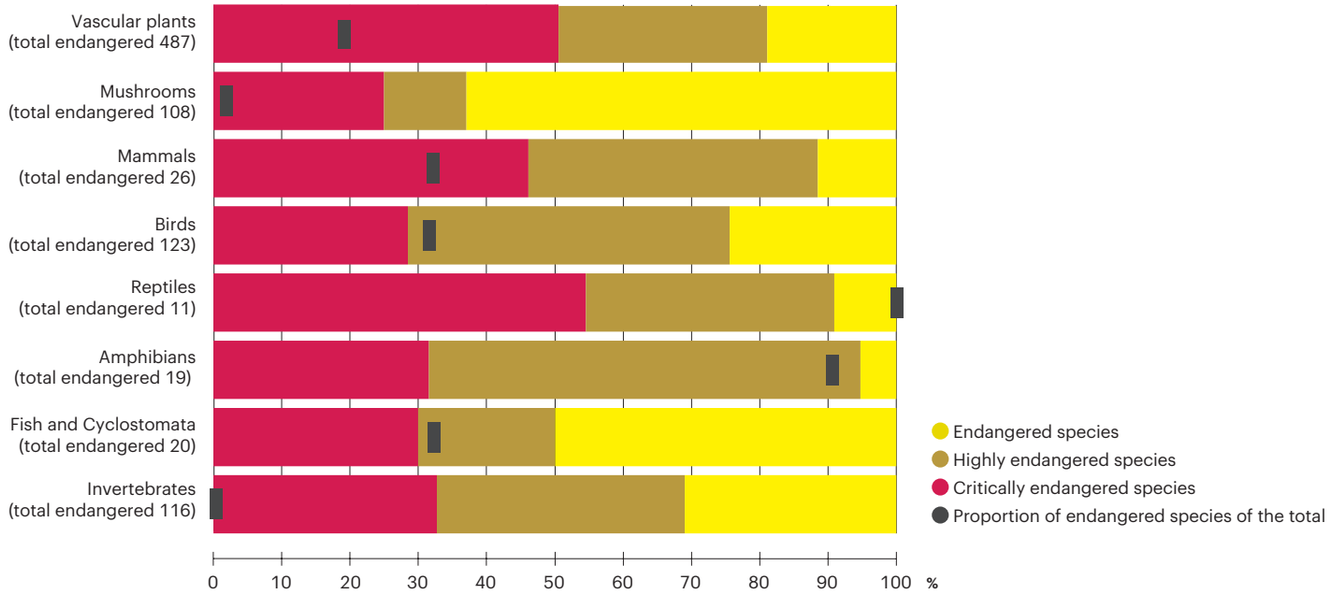
Natura 2000 sites, 2016



Source: Nature Conservation Agency of the Czech Republic

Chart 1

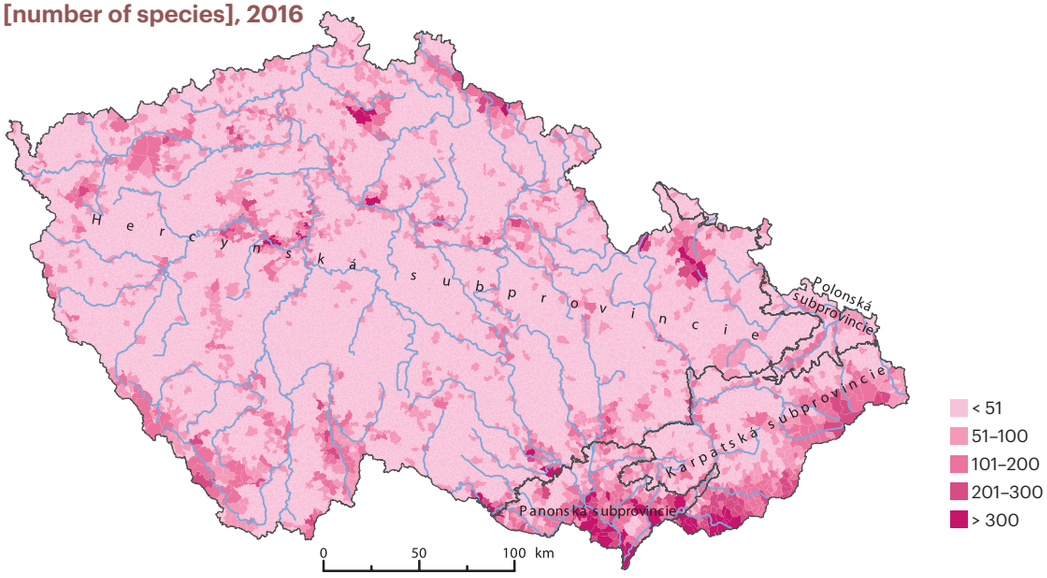
Endangered plant and animal species by categories and their share of the total number of species of the particular taxon in the Czech Republic [number, %], 2016



Source: Nature Conservation Agency of the Czech Republic

Figure 3

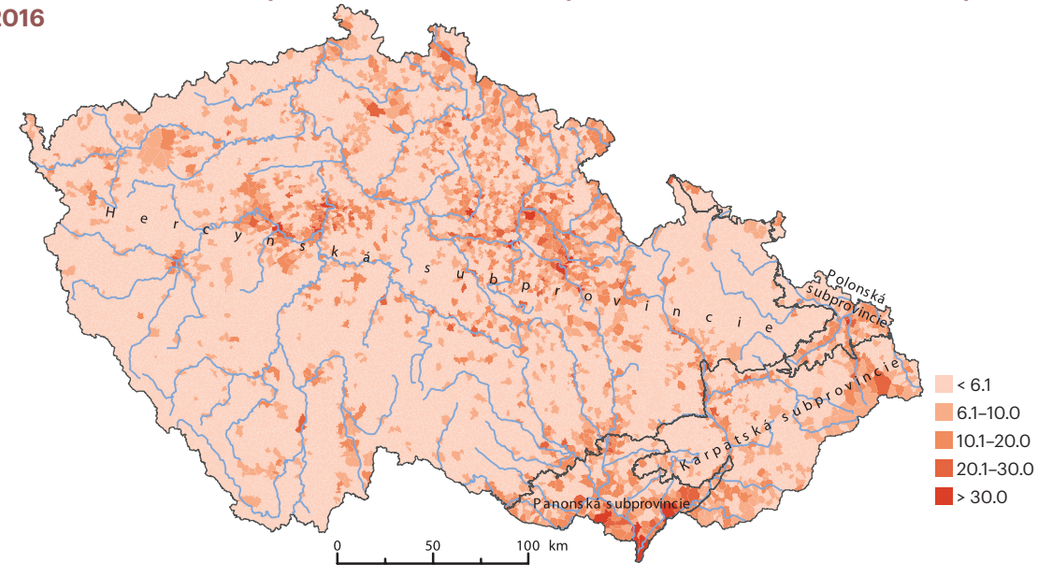
Occurrence of the endangered species of flora and fauna of the red lists by the cadastral area in the Czech Republic [number of species], 2016



Source: Nature Conservation Agency of the Czech Republic

Figure 4

Occurrence of invasive species of flora and fauna by the cadastral area in the Czech Republic [number of invasive species], 2016



Source: Nature Conservation Agency of the Czech Republic

The aggregate area of **large-size specially protected areas** (which include National Parks and Protected Landscape Areas) in 2016 was 1,254.8 thous. ha, i.e. 15.9% of the Czech Republic's territory (Figure 1). The National Parks conserve the most valuable areas with preserved natural phenomena and a high potential of self-regulation processes. There are altogether 4 National Parks in the Czech Republic, namely Krkonoše Mountains (declared in 1963), Podyjí/Dyje River Basin (1991), Šumava Mountains (1991), and České Švýcarsko/Bohemian Switzerland (declared in 2000). There are 26 Protected Landscape Areas in the territory of the Czech Republic, the purpose of which is to preserve a specific use of a piece of landscape with a typical relief, which led to the

formation of a harmonic landscape in the past. **Small-scale specially protected areas**, which include national nature reserves (NNR), nature reserves (NR), national nature monuments (NNM), and nature monuments (NM), occupied in 2016 the area of 116.2 thous. ha, i.e. 1.5% of the territory of the Czech Republic. However, nearly a third of the small-size specially protected areas are located within a protected landscape area or a national park. The most frequent changes occur in this category, the reason being the declaration of new areas, predominantly for the purpose of protecting sites of Community importance. In 2016, 24 small-scale specially protected areas were re-declared or newly declared with a total acreage of 1,813 ha.

The **Natura 2000 system** is a system of protected areas of Community importance, which is being built in the territory of EU member states. It comprises two types of protected areas – **bird areas (Special Protection Areas) and sites of Community importance**. As of 2016, the territory of the Czech Republic included 41 bird areas (Figure 2) the aggregate area of which was 703.4 thous. ha, i.e. 8.9% of the Czech Republic's territory. There were a total of 1,112 sites of Community importance (Figure 2) in 2016 (1,075 in 2015) and occupied an area of 795,107 ha (785,576 ha in 2015), i.e. 10.1% of the territory of the Czech Republic. The increase of number of sites and their territory is caused by adoption of an amendment to the national list of Sites of Community Importance which was published in 2016. The amendment supplemented the national list with 50 new Sites of Community and replenish 70 existing Sites of Community Importance with new nature conservation. Due to mutual overlap of bird areas (Special Protection Areas) and sites of Community importance, the area of the Natura 2000 occupied a total of 14.1% of the territory of the Czech Republic.

The territories protected through large-scale and small-scale specially protected areas and the territory protected by Natura 2000 are significantly overlapping and thus the total area of protected areas in the Czech Republic accounted in 2016 for 23.0% of the territory of the Czech Republic.

General protection of the territory is provided through the territorial system of ecological stability, significant landscape elements (by law – forests, alluvial flats, wetlands, other water elements etc., or declared by the relevant nature conservation authorities) and through other tools.

As there are many fauna and flora species in the Czech Republic the state of which is critically endangered, it is necessary to adopt active protection measures and coordinate their protection. To this end, the Ministry of the Environment has implemented, in accordance with Section 52 of Act No. 114/1992 Coll., **rescue programmes**[3]; these represent a set of measures aimed at increasing the population of the species in question above the extinction level. In 2016, the rescue programmes were implemented for 4 plant species: marsh angelica/Angelica palustris; Dianthus arenarius subsp. bohemicus; whitestem pondweed/Potamogeton praelongus Wulfen; Gentianella praecox subsp. bohemica) and for 4 animal species: freshwater pearl mussel/Margaritifera margaritifera; Aesculapian snake/Zamenis longissimus; European ground squirrel/Spermophilus citellus and the Eurasian otter/Lutra lutra. The funding spent on rescue projects amounted to CZK 4,715 thous., of which CZK 481 thous. on rescue programmes focused on plants and CZK 4,234 thous. on rescue programmes focused on animals.

In 2016, records were kept of a total of 487 **endangered species** of higher vascular plants, 108 species of mushrooms, 26 species of mammals, 123 species of birds, 11 species of reptiles, 19 species of amphibians, 20 species of fish and Cyclostomata and 116 species of invertebrates. According to the degree of risk is divided into endangered, highly endangered and **critically endangered species** (Chart 1). The highest proportion of the total number of the endangered species, in the case of reptiles (100%, that is, all species occurring in the territory of the Czech Republic, fall into at least one of the categories of threat) and amphibians (90.5%). This proportion is the lowest for fungal species (1.8%) and invertebrates (0.3%).

According to the **red lists of the Czech Republic**, 2,643 plant species, including fungi, and 5,554 animal species, of which 175 vertebrates and 5,379 invertebrates, are endangered. The red lists are divided into seven categories, three of which determine the degree of threat (critically endangered – C1, endangered – C2, vulnerable – C3). Category C1 critically endangered includes 900 species of plants and 1,477 species of animals (57 vertebrates and 1,420 invertebrates), category C2 includes 841 species of plants and 1,756 animal species (50 vertebrates and 1,706 invertebrates), category C3 includes 722 plant species and 2,312 species of animals (68 vertebrates and 2,185 invertebrates). In the Czech Republic, the red list species are most commonly located in the specially protected areas and along watercourses. The largest number of species can be found in the south of the Carpathian and Pannonian subprovince (Figure 3).

One of the factors endangering populations of plant and animal species and their biocenoses and the state of ecosystems is the proliferation of **geographically non-indigenous species**. Of the total number of 1,454 non-indigenous plant species which occur or have been recorded in the territory of the Czech Republic, 61 are regarded invasive. The most dangerous

[3] *See www.zachranneprogramy.cz for more details.*

invasive plant species[4] include, for example: giant hogweed/Heracleum mantegazzianum; knotweeds/Reynoutriae Japanese, Sachalin and Czech; bobby tops/Impatiens glandulifera; big-leaved lupine/Lupinus polyphyllus; or ailanthus/Ailanthus altissima. As to animals[5], 278 non-indigenous species have been documented so far, 113 of them invasive. Insofar as their impacts on biological diversity are concerned, the most dangerous ones include American mink/Mustela vison; North American raccoon/Procyon lotor; Cervus nippon; a number of fish species (e.g. Pseudorasbora parva; goldfish/Carassius auratus etc.); or North American crayfish species (Eastern crayfish/Orconectes limosus and signal crayfish/Pacifastacus leniusculus) that spread crayfish plague. The highest number of invasive species on the territory of the Czech Republic is found along large towns, watercourses and roads (Figure 4) that create easily permeable corridors for the penetration and spread of these species.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[4] *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.*

[5] *Šefrová H., Laštůvka Z. (2005): Catalogue of alien animal species in the Czech Republic. Acta Universitatis Agriculturae et Silviculturae Mendelianae Brunensis 53: 151–170. doi: 10.11118/actaun200553040151.*

15 | State of animal and plant species of Community importance in 2006 and 2012

Key question

What is the state and development of natural habitat types of Community importance[6] in the territory of the Czech Republic?

Key messages[7]

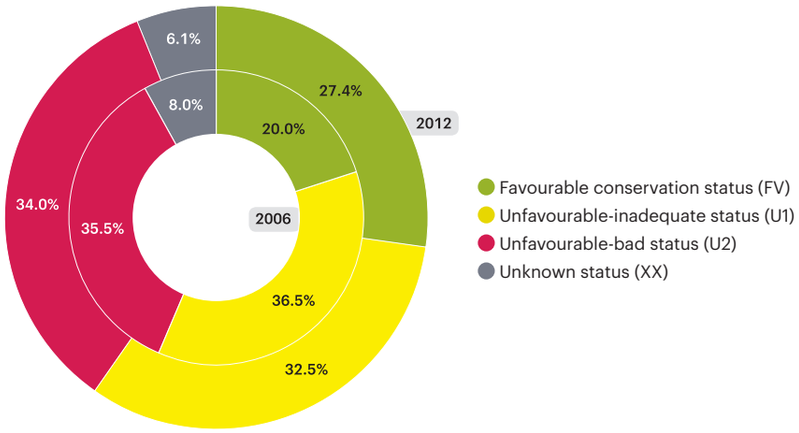
A comparison of results of the assessments made in 2006 and 2012 shows an overall improvement of the state of plant and animal species of Community importance. In 2007–2012, 25.3% of animal and plant species of Community importance were marked as species in a favourable state in terms of protection, as opposed to years 2000–2006, when it was only 18.9% of all species.

A significant proportion of animal and plant species of Community importance was, based on the results of the 2006 assessment (total 36.7% of the species) as well as from 2012 (37.0%) in terms of the protection marked in an unfavourable-inadequate status, 31.5% of major animals and plants species, in the years 2007–2012 was assessed to be in unfavourable-bad state.

Indicator assessment

Chart 1

State of animal species of Community importance in the Czech Republic [%], 2000–2006, 2007–2012



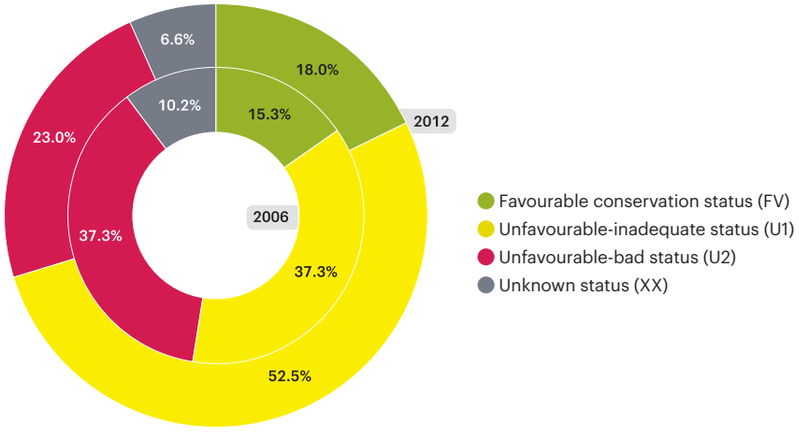
Source: Nature Conservation Agency of the Czech Republic

[6] *Species of Community interest ("species of European importance") include species found in European territories of member states of the European Community which are endangered, vulnerable, rare or endemic and which are defined in relevant legislation of the European Community. The indicator does not assess all species, but only those stipulated in the "Habitat Directive" (Council Directive No. 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora). From the viewpoint of the Habitat Directive, bird species are not considered species of Community importance, as they have, in accordance with the Bird Directive (Directive No. 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds), a very specific position and an independent assessment system. The state of animal and plant species of Community importance is also indicative of the overall state of all species in the territory of the Czech Republic, although the indicator deals only with species of Community importance. For an approximate assessment as the one indicated above, the set of species of Community importance is in fact a set of indication species on which the maximum possible amount of information is collected. There is no other similarly extensive group of different species that undergoes a similar assessment.*

[7] *The evaluation of the status of animals and plants species of Community importance is based on Council Directive 92/43/EEC of 21 May 1992 on the protection of natural habitats and of wild fauna and flora, which requires the EU Member States to submit every six years the assessment report on the state of conservation of individual phenomena. The evaluation reports have been submitted for the period 2000–2006 and 2007–2012, the period 2013–2018 will follow.*

Chart 2

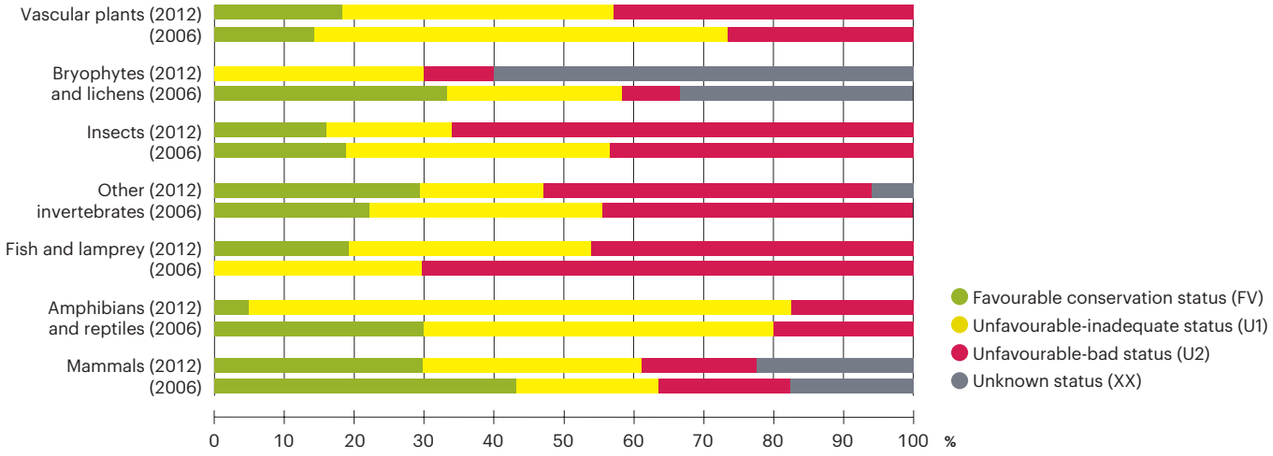
State of plant species of Community importance in the Czech Republic [%], 2000–2006, 2007–2012



Source: Nature Conservation Agency of the Czech Republic

Chart 3

State of animal and plant species of Community importance in the Czech Republic according to taxonomic groups [%], 2000–2006, 2007–2012



Source: Nature Conservation Agency of the Czech Republic

The **overall status** of each species, which is determined separately for each of the two biogeographic regions which the Czech Republic is divided into, i.e. continental, occupying most of the Czech Republic's territory, and Pannonian in south-eastern Moravia, consists of four sub-parameters – area, population, habitat and anticipated development. If any of the four sub-parameters is assessed as unfavourable, the overall status of the species in question is also assessed as unfavourable. The indicator reflects the state of biodiversity in the Czech Republic[8], where an increasing number of species of organisms fall into one of endangered categories according to criteria of the International Union for Conservation of Nature (IUCN). It shows, in particular, relative shares of the total assessment of species (defined in Council Directive No. 92/43/EEC on the conservation of natural habitats and of wild fauna and flora) according to a standardized scale.

About a third of **animal species of Community importance** in the Czech Republic is evaluated as unfavourable-bad, another third as unfavourable-inadequate (Chart 1). Species included in those categories are likely to occur at more or less disturbed

[8] *The state of animal and plant species of Community importance is also indicative of the overall state of all species in the territory of the Czech Republic, although the indicator deals only with species of Community importance.*

habitats. It is rather difficult to document any direct link to the habitat type. The most endangered species include species found in natural watercourses (which have been adversely affected by stream regulations and changes in watercourse dynamics), species associated with old and decaying wood (which is present in small quantities in forests of the Czech Republic) and, in particular, groups of species tied to a fine mosaic of landscape elements (butterflies, amphibians and reptiles). According to the 2007–2012 monitoring programme data, the status of 27.4% animal species found in the Czech Republic is assessed as favourable, with mammals having the highest share. Species of Community importance included in the assessment also contain some new species found in the territory of the Czech Republic in the previous six-year period (e.g. golden jackal/Canis aureus, several species of bats, Balkan goldenring dragonfly/Cordulegaster heros, Orthotrichum rogeri moss, Notothylas orbicularis hornwort).

Only 18.0% of **plant species of Community importance** found in the territory of the Czech Republic are in a favourable status. The status of 52.5% of plant species is rated as unfavourable-inadequate, while plant species in an unfavourable-bad status account for 23.0%, and their habitats are probably more or less in disarray (Chart 2).

A comparison of results of the **2006 and 2012** assessments indicates an overall improvement. The percentages of unfavourable assessments and unknown statuses decreased between the years being monitored (Chart 1, Chart 2).

However, it must be noted that the improvement of the assessments is based more on methodological factors rather than on the actual status of affairs, as the status of animal and plant species was rarely improved by active measures. The favourable status of species generally reflects a favourable situation of biotopes or species, which are even spreading in some cases.

Indicator assessment according to taxonomic groups

Sub-indicators of **animal** species of Community importance for taxonomic groups of monitored animals – mammals, amphibians and reptiles, fish and lampreys, other invertebrates and insects (Chart 3) – have been defined in a way similar to the overall indicator. The Habitat Directive does not regard birds as species of Community importance; under the Birds Directive, their position is quite specific, and birds are therefore not subject to evaluation according to European evaluation reports.

Based on results of the monitoring between 2007 and 2012, fish and lampreys have a significantly worse rating (Chart 3), with 70.4% of their species falling into the unfavourable-bad category. The most important factors endangering these species include inappropriate stream regulation measures and water pollution. More than 40% of insects and other invertebrates are in an unfavourable-bad status. Insofar as these groups are concerned, there exist many species associated with the endangered biotopes mentioned above, from structurally (in terms of age and quantity of species) rich forests, solitary trees and heterogeneously managed non-forest habitats to largely unaltered aquatic habitats.

This is mainly due to a different approach to the selection of species classified as species important for the European Community. The highest proportion of favourably assessed species – 43.2% – us shown by mammals, due to the inclusion of a higher number of species which are endangered mainly in Western (i.e. considerably more urbanized and fragmented) Europe.

A comparison of the two sets of **monitoring data** indicates a positive change. Between the two assessments, the proportion of unfavourable-bad rated categories of insects and other invertebrates decreased significantly, the proportion of favourable-rated category of mammals and amphibians and reptiles grew. The only group the state of which worsened between the assessments are fish and lampreys (Chart 3).

Similarly, sub-indicators of **plant species** for taxonomic groups of monitored plants – vascular plants and non-vascular species – bryophytes and lichens (Chart 3) have been defined as well. In the case of bryophytes and lichens, the fact that the group has only been studied to a limited extent has the greatest effect (a high proportion of the "unknown" category), in spite of the fact that this category declined substantially between the two evaluations (from 60.0% to 33.3%). At the same time, the proportion of non-vascular plant species falling into the favourable category increased from 0 to 33.3%, which fact, however, may be attributable to a greater quantity of collected data. Concerning the vascular plant species that have a long history of research, a significant decrease of species falling into the unfavourable-bad category in favour of the better-rated unfavourable-inadequate category was obvious between the two assessments (Chart 3).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

16 | State of natural habitats of Community importance in 2006 and 2012

Key question

What is the state and development of natural habitat types of Community importance[9] in the territory of the Czech Republic?

Key messages[10]

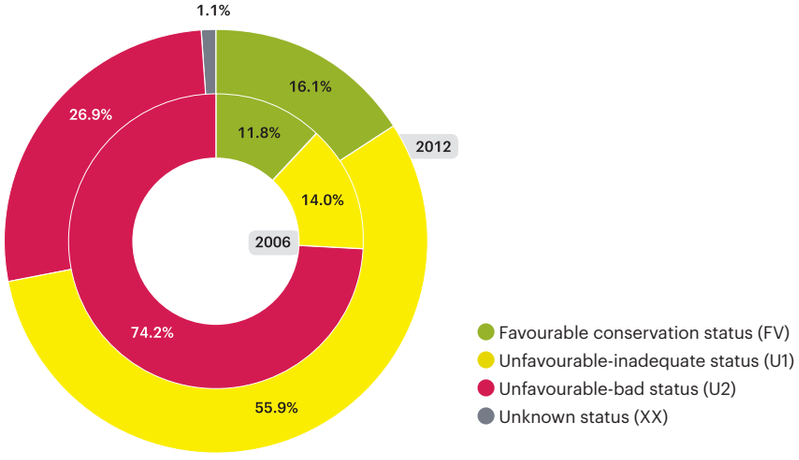
A comparison of results for the 2000–2006 and 2007–2012 periods indicates an improvement of the state of natural habitat types of Community importance in the Czech Republic. The proportion of habitats rated as unfavourable-bad decreased from 74.2% to 26.9%, and the proportion of habitats rated as favourable grew from 11.8% to 16.1%. The significant improvement is attributable to a changed methodology in one of the parameters entering into the assessment.

Between 2007 and 2012, more than a half of natural habitat types of Community importance in the Czech Republic were rated as unfavourable-inadequate, 26.9% as unfavourable-bad.

Indicator assessment

Chart 1

State of natural habitats of Community importance in the Czech Republic [%], 2000–2006, 2007–2012



Source: Nature Conservation Agency of the Czech Republic

[9] *Natural habitat types of European Community interest ("European habitats") are natural habitats found in European territories of European Community member states that are in danger of disappearance in their natural range, have a small natural range following their regression or by reason of their intrinsically restricted area, or present outstanding examples of typical characteristics of one or more of the biogeographical regions defined in European Community legislation. In the Czech Republic, there are altogether 60 natural habitat types which are subject to assessment and which are mapped and interpreted using finer units, so-called biotopes, at the national level.*

[10] *The evaluation of the status of habitats of Community importance is based on Council Directive 92/43/EEC of 21 May 1992 on the protection of natural habitats and of wild fauna and flora, which requires the EU Member States to submit every six years the assessment report on the state of conservation of individual phenomena. The evaluation reports have been submitted for the period 2000–2006 and 2007–2012, the period 2013–2018 will follow.*

Chart 2

State of natural habitat types of Community importance in the Czech Republic according to individual formation group [%], 2000–2006, 2007–2012

Source: Nature Conservation Agency of the Czech Republic

The state of natural habitat types of Community importance can also help assess the overall state of natural biotopes in the Czech Republic, even though the indicator deals only with natural habitats of Community importance[11].

Determining the overall state of each natural habitat type, which is defined separately for each of the two biogeographic regions which the Czech Republic is divided into, i.e. the continental region, which occupies most of its territory, and the Pannonian region in south-eastern Moravia, means considering four sub-parameters – current size, potential area, structure and function, and future outlooks. If any of the parameters is assessed as unfavourable, the overall status of the habitat is also assessed as unfavourable.

Between 2000 and 2006, the area, size and future outlooks were mostly assessed as favourable or unfavourable-inadequate. However, the quality of structure and function is much worse, since these mainly concern the biological value of the habitat and thus also its ability to resist external pressures. The total number of habitats assessed between 2000 and 2006 was 93 – totally 11.8% of them rated as being in a favourable status, 14.0% being in a unfavourable-inadequate status, and 74.2% being in an unfavourable-bad status. Between 2007 and 2012, the situation improved; the total number of habitats included in the assessment was likewise 93. Compared to the previous period, the share of unfavourably rated sites dropped to 26.9%. On the other hand, the percentage of favourably rated habitats rose to 16.1% (Chart 1).

Between 2000 and 2006, the Czech Republic's habitats falling into the unfavourable category included mainly those which were not very large (juniper pasturelands, coastal and halophytic habitats) and forests. On the other hand, heaths, rocky habitats, peatlands and fens generally received the most favourable assessment (Chart 2). As to the 2007–2012, the unfavourable category again included small coastal and halophytic habitats, while the habitats that received the most favourable rating included heathlands and temperate zone shrubs. There was an improvement between the two monitored

[11] *A similar assessment of the state of natural habitats cannot be applied at the national level, where such an indicator does not exist.*

periods; the percentage of unfavourably rated habitats of coastal and continental sand dunes dropped by a half. A similar change for the better occurred with respect to forests, rocky habitats and caves, and also natural and semi-natural grassland formations (Chart 2).

However, it must be noted that that the improvement is based more on methodological factors rather than on the actual state of affairs. Only a few habitats owe their improvement to active measures. The favourable situation generally reflects the favourable status of biotopes, but is in many cases based on a larger amount of collected data.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

17 | Indicator of common bird species

Key question

What progress has been made in stopping the decrease in the number of farmland bird species and woodland bird species?

Key messages

Since 1982, the population levels of common bird species in the Czech Republic have continued to decline, and in overall, between the years 1982–2016 they decreased by 5.4%. The abundance of populations of woodland bird species decreased by 14.9% in total and numbers of populations of the birds in the agricultural landscape dropped by 33.5%. The trend indicates that the state of landscape and biodiversity in the Czech Republic has been worsening.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

Development of the common farmland bird species indicator, the common woodland bird species indicator and the overall indicator of all common bird species in the Czech Republic [index, 1982 = 100], 1982–2016

The actual indicators are, in accordance with the methodology used across Europe, calculated as the geometric mean of the indices of abundance of each species in each year, which is then smoothed by the algorithm TrendSpotter. This procedure reduces the display of fluctuations in the individual years caused, for example, by the weather and leads to greater clarity of the existing trend. However, the smoothing affects the numerical value of the index in the different years.

Source: Unified Bird Census Programme (Czech Society for Ornithology/ORNIS)

Development trends of bird populations reflect changes in the use of landscape and overall changes of ecosystems, while the effect of climatic changes is less significant[12]. Since 1982, the numbers of populations of common bird species in the Czech Republic have dropped by 5.4%, whereas the numbers of populations of farmland bird species have dropped by 33.5% and the numbers of populations of woodland bird species by 14.9%. It is also reasonable to assume that the number of bird species had been dropping even before 1982, when the monitoring programme started.

Principal causes of the dramatic decline of the **abundance of farmland bird species** include continuously increasing intensification of agricultural production and concurrent abandoning of less fertile agricultural land.

They gradually become grown with undesirable natural seeding woody species and changes spontaneously to a forest mostly composed of softwoods, which does not provide suitable conditions for the birds of the open (field) of the landscape. A temporary improvement occurred after the change of the political system in 1989, when the intensity of agricultural production temporarily dropped; farmland bird species reacted immediately by increasing their populations[13]. The economic consolidation of the agricultural sector brought yet another steep decline which has been continuing at varying rates until now. The further deterioration of the development occurred after the change in the method of financing of agriculture after the entry of the Czech Republic to the EU in 2004, mainly due to the application of the common agricultural policy of the EU. Roughly since 2012, further loss in the size of population has been slowing down. The effect of financial tools that have hitherto been used to mitigate adverse impacts of agriculture on nature (e.g. agro-environmental programmes) is obviously insufficient[14].

The **abundance of forest species** has been evenly decreasing without significant fluctuations throughout the monitoring period since 1982 (100%) to the level of 85.1% in 2010 and has remained at that level up to 2016. The abundance of strictly woodland species (biotope specialists) has been dropping, being replaced by more widespread species with a broader ecological valence[15]. Bird communities are thus being unified and differences in the composition of avifauna of initially distinctly different ecosystems are gradually disappearing. Rare and narrowly specialized species are becoming even rarer and biodiversity at the local or regional level is reduced. Causes of the above trend have not yet been studied in the Czech Republic.

The factor that has been increasingly affecting the composition of bird species in the Czech Republic roughly since the mid-1990s is a climatic change. It is the reason why Nordic species have been disappearing from Central Europe, while the number of thermophilic species, hitherto found mainly in southern Europe, has shown a slight increase[16]. As a result of the phenomenon outlined above, the Czech Republic can expect another decline of the abundance of bird species[17], because the area with the highest diversity of bird species, which the Czech Republic is currently a part of, will be moving northeast.

On the basis of population trends of **common bird species**, it is clear that the decline in biodiversity is thus measured in the Czech Republic is continuing. In 2016, the abundance is down to 94.6% of the 1982 level, and unless nature protection measures are adopted across all sectors of human activities, this trend will most likely continue in the near future as well[18].

Although the protection and conservation measures that have been implemented so far, which include, in particular, agro-environmental measures in the framework of agricultural subsidies, more considerate forestry management practices, as well as general protection of nature and bird species under the Conservation of Nature and Landscape Act, probably help slow down the negative trend, they are unable to halt it, not to speak of its reversal into a positive trend. In spite of

[12] *Reif J., Škorpilová J., Vermouzek Z. & Šťastný K., 2014: Population changes of common breeding birds in the Czech Republic from 1982 to 2013: an analysis using multispecies indicators. Sylvia 50: 41–65*

[13] *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, doi: 10.1111/j. 1474-919x. 2008.00829. x.*

[14] *Vermouzek Z., 2014: Indicator of farmland bird species for 2014. A study for the Ministry of Agriculture of the Czech Republic. Czech Society for Ornithology, unpubl., 46pp.*

[15] *Reif J., Škorpilová J., Vermouzek Z. & Šťastný K., 2014: Population changes of common breeding birds in the Czech Republic from 1982 to 2013: an analysis using multispecies indicators. Sylvia 50: 41–65*

[16] *Reif J., Voříšek P., Šťastný K., Koschová M. & Bejček V., 2008b: The impact of climate change on long-term population trends of birds in a central European country. Animal Conservation doi:10.1111/j.1469-1795.2008.00200.x.*

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

[18] *Voříšek P., Klvaňová A., Brinke T., Cepák J., Flousek J., Hora J., Reif J., Šťastný K. & Vermouzek Z., 2009: State of the birds of the Czech Republic 2009. Sylvia 45: 1–38.*

partial conservation successes, which concern mainly rare and scant species[19], the current state of affairs and near-future outlooks are unsatisfactory. System changes will be necessary in the years to come, particularly in the agricultural sector, where the relation between the intensity of agricultural exploitation and the decline of biodiversity has already been known for some time. Efficient conservation of biodiversity of forests will require, as the first step, the commissioning of detailed analyses which would describe causes of the present state, and plan appropriate protection and the appropriate conservation measures accordingly.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[19] *Voříšek P., Reif J., Šťastný K. & Bejček V., 2008: How effective can be the national law in protecting birds? A case study from the Czech Republic. Folia Zool. 57(3): 221–230. Voříšek P., Klvaňová A., Brinke T., Cepák J., Flousek J., Hora J., Reif J., Šťastný K. & Vermouzek Z., 2009: State of the birds of the Czech Republic 2009. Sylvia 45: 1–38. Inger R., Gregory R., Duffy J. P., Stott I., Voříšek P. & Gaston K. J., 2014: Common European birds are declining rapidly while less abundant species' numbers are rising. Ecology letters 2014, doi: 10.1111/ele.12387.*

Nature and landscape in the global context

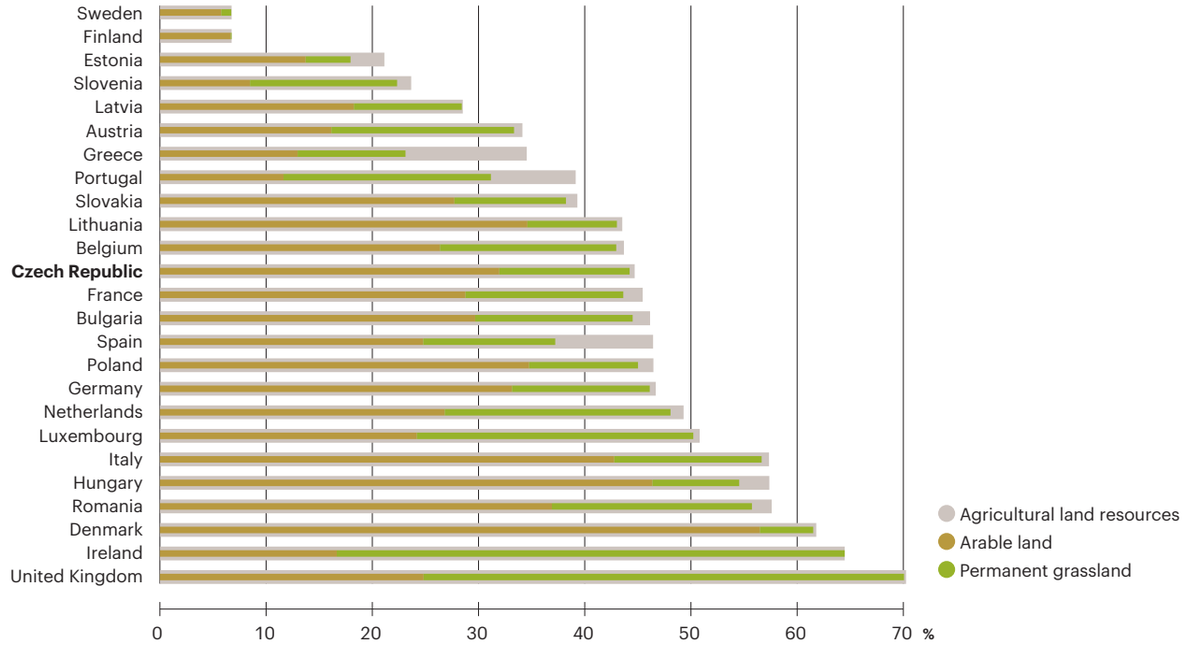
Key messages[20]

- In 2013, agricultural land occupied a total of 41.9% of the whole EU28 territory. The character of farming along with urbanization and transport infrastructure significantly affect the fragmentation of the landscape.
- Between 2007 and 2012, only about 23% of animal and plant species of Community importance and approximately 16% of habitats of Community importance were assessed as being in a favourable status. In the Czech Republic, in the same period the corresponding figures were approximately 25% of animal and plant species of Community importance and roughly 16% of habitats of Community importance.
- Between 1990 and 2013, the populations of common bird species, woodland bird species and farmland bird species dropped by approximately 14%, 8% and 34%, respectively.
- Between 1990 and 2013, the populations of grassland butterflies showed a significant decline of about 30%.

Indicator assessment

Chart 1

Proportion of agricultural land, arable land and permanent grassland [%], 2013



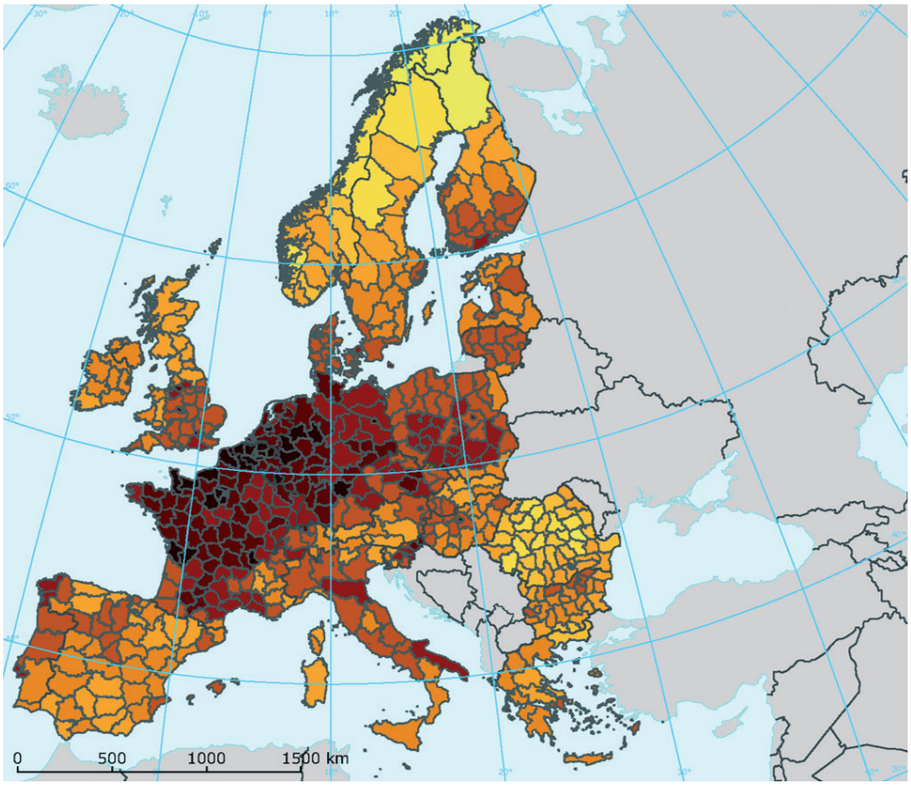
Data for the years 2014–2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

[20] *Data for the years 2014–2016 are not, due to the methodology of their reporting, available at the time of publication.*

Figure 1

Landscape fragmentation by NUTS regions, 2009



Landscape fragmentation by NUTS regions
Number of patches per 1,000 km²

- < 0.10
- 0.11–0.25
- 0.26–0.50
- 0.51–1.00
- 1.01–5.00
- 5.01–10.00
- 10.01–25.00
- 25.01–50.00
- 50.01–100.00
- > 100
- Outside data coverage

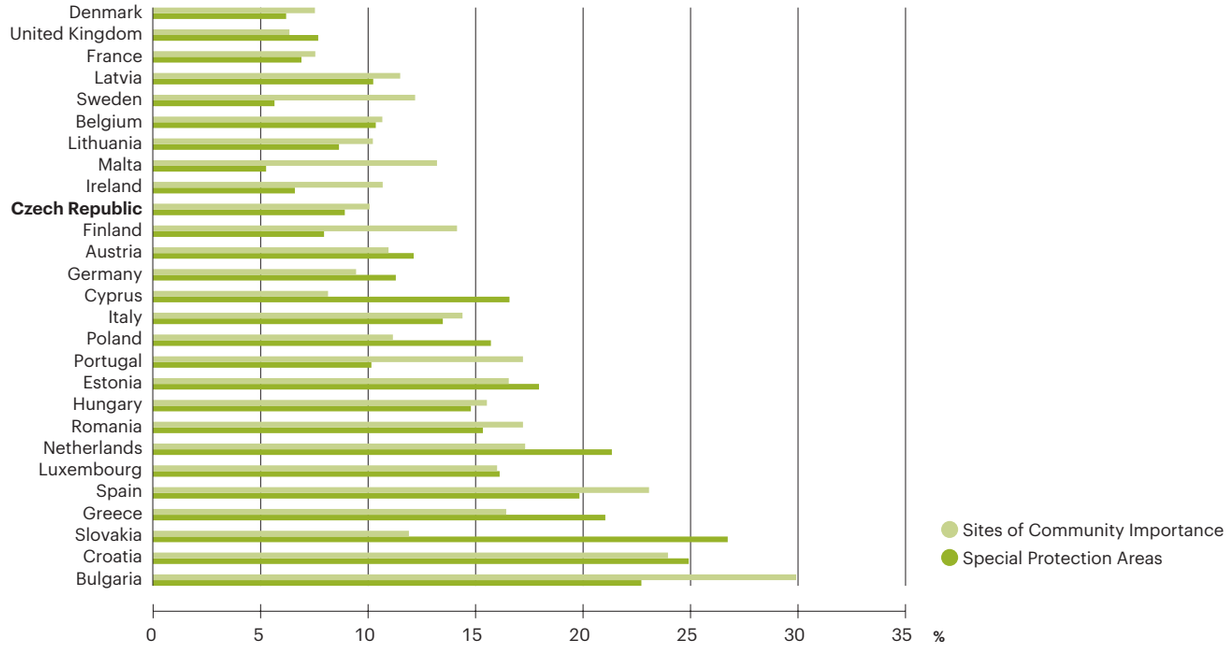
The "Effective mesh density" method is based on the number of meshes per 1,000 km². The smaller the size of meshes (i.e. greater number per 1,000 km²), the higher the landscape fragmentation. There are three categories of regions: heavily urbanized (with the population density higher than 100 inhabitants per 1 km²), ex-urban (semi-rural) and remote/rural. In urbanized regions, the number of meshes is higher than 100 per 1,000 km² and they are in average 40 times more fragmented than the extra-urban regions.

Data for the years 2010–2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Environment Agency

Chart 2

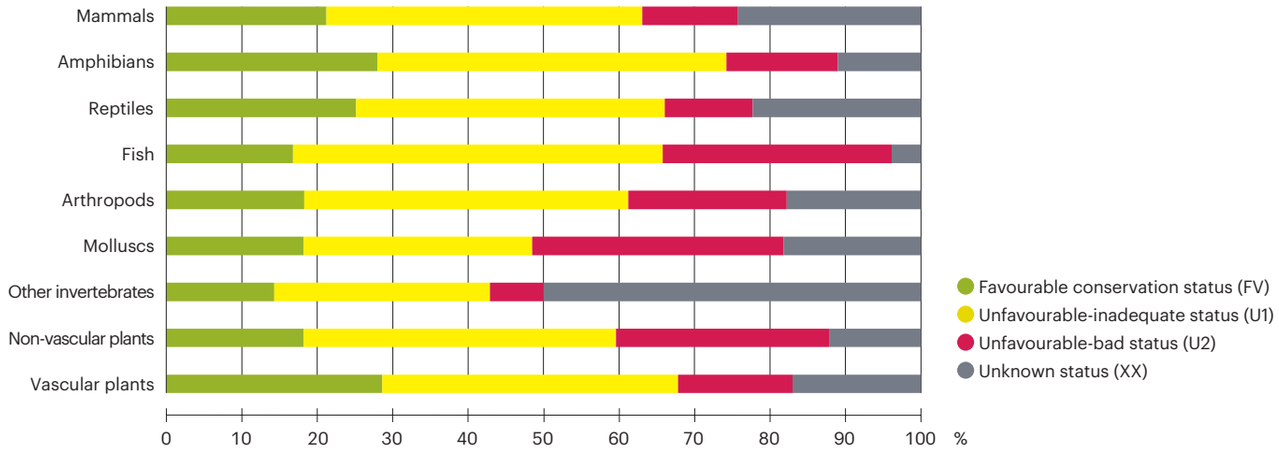
Share of sites of Community importance and Special Protection Areas in the surface area of EU28 [%], 2016



Source: European Environment Agency

Chart 3

State of animal and plant species of Community importance in EU25 according to taxonomic groups [%], 2007–2012

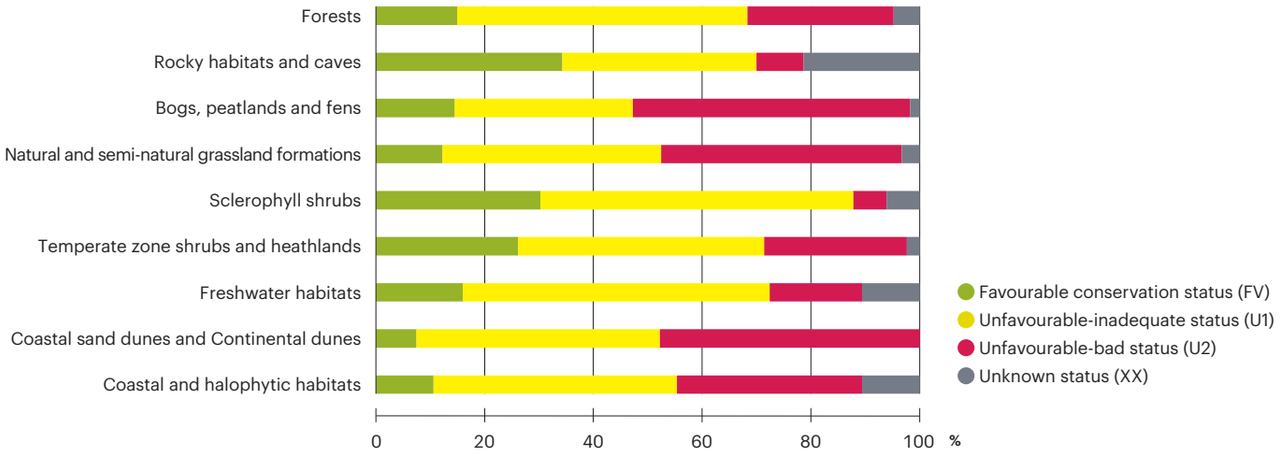


Data for the years 2013–2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: ETC/BD

Chart 4

State of natural habitats of Community importance in EU25 according to taxonomic groups [%], 2007–2012

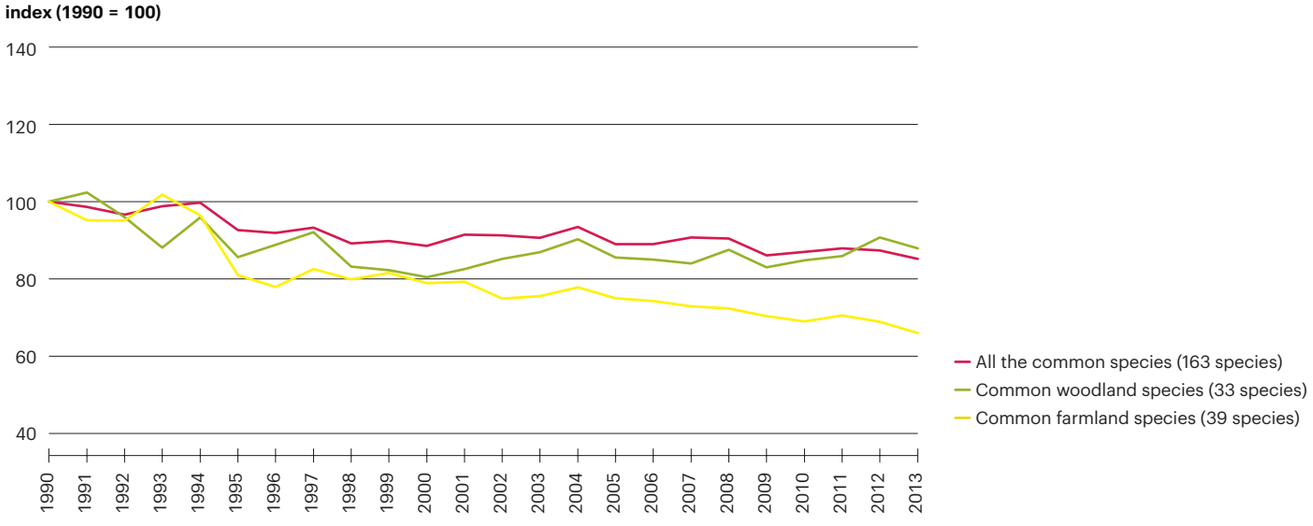


Data for the years 2013–2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: ETC/BD

Chart 5

Development of the common farmland bird species indicator, the common woodland bird species indicator and the overall indicator of all common bird species in Europe [index, 1990 = 100], 1990–2013

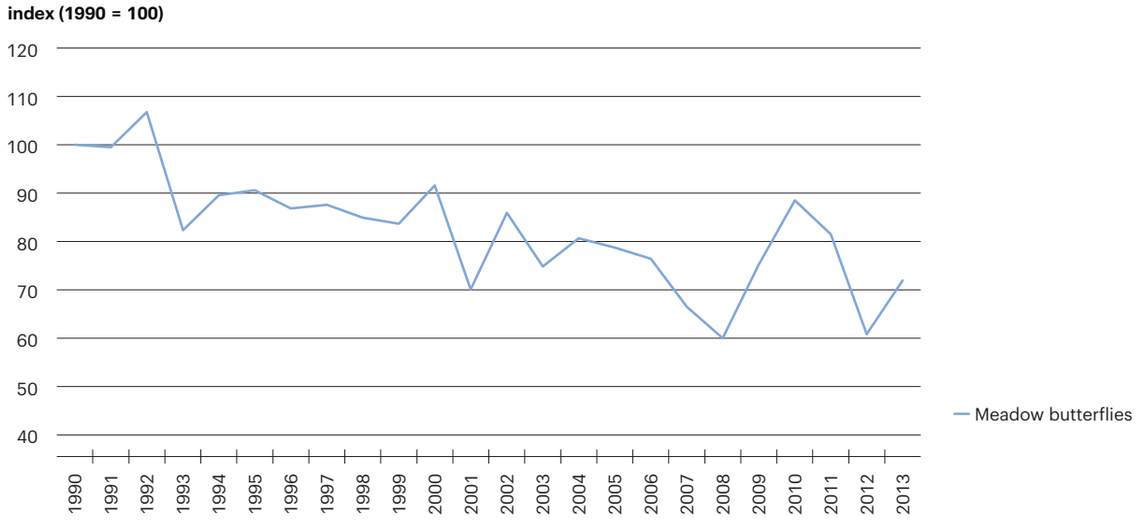


Data for the years 2014–2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Environment Agency

Chart 6

Development of the indicator of grassland butterflies in Europe [index, 1990 = 100], 1990–2013



Data for the years 2014–2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Environment Agency

The character of the landscape is in many cases the result of **land use** by humans, in particular for agriculture and settlement development. In 2013, agricultural land occupied a total of 41.9% of the EU28 territory, the share of agricultural land in the total territory of individual countries varies considerably, which is caused by a wide range of natural and socio-economic conditions within the European region. The highest shares of agricultural land are in the United Kingdom and Ireland (Chart 1), where the majority of agricultural land is covered by permanent grassland. On the contrary, Finland and Sweden have a very small share of agricultural land on the total area, since around 70% of the territory of the country is covered by forests. The share of agricultural land in the total land resources of the Czech Republic is slightly above average compared with the EU28 (44.6% in 2013). Most of the agricultural land in the Czech Republic is occupied by arable land (71.1%) which is intensively cultivated which causes a higher environmental burden than farming on permanent grassland. The share of man-made surfaces (built-up areas, roads, etc.) in the total surface area of the EU is the highest in the Benelux countries (about 12–14%). Water areas occupy the largest share of the total area in the Netherlands (10.6%) and in Finland and Sweden (9.7% and 8.5%).

The land use by humans often leads to splitting large landscape units to smaller areas, or fragments, that are losing their original qualities and ecosystem links. **Landscape fragmentation** in Europe is affected especially by transport infrastructure and by the degree of urbanization; but the specifics of agricultural land use, which are subject to the natural conditions of the individual states, also significantly contribute to it. Given the above factors, Luxembourg, Belgium and the Netherlands belong among the most fragmented countries, followed by the Czech Republic with a slightly lower share (Figure 1). On the other hand, Norway, Sweden and Romania are countries with the lowest fragmentation in Europe (Figure 1).

The area of **Natura 2000** sites in 2016 covered 804.7 thous. km^2 of the European territory[21], i.e. 17.7% of the territory. The States with the highest proportion of Natura 2000 areas include Slovenia with 37.1% of the territory and Bulgaria with 34.4% of the territory. The Czech Republic with a share of 14.1% ranks 19th. States with the lowest share of Natura 2000 areas are the United Kingdom (8.5%) and Denmark (9.7%), Chart 2.

The **loss of ecosystem linkages** and original qualities of habitats is the most manifested on the state of natural habitats and the species of plants and animals bound to them. Between 2007 and 2012, only 23.1% of all plant and animal species of Community importance found in the territory of EU25 were assessed as being in a favourable status (Chart 3); the percentages

[21] *Natura 2000 areas include only areas on the mainland, not areas above the sea and the ocean.*

of **animal and plant species of Community importance** falling into the unfavourable-bad and unfavourable-inadequate categories were 18.2% and 41.7%, respectively. From the European perspective (as well as from that of the Czech Republic), the most endangered groups included fish, molluscs and arthropods (animals) and non-vascular plants.

Between 2007 and 2012, 16.4% of **natural habitat types of Community importance** found in the territory of EU25 were assessed as being in a favourable status; the percentages of natural habitat types of Community importance falling into the unfavourable-inadequate and unfavourable-bad categories were 46.8% and 30.1%, respectively. According to results of the assessment, the most endangered habitat types include coastal sand dunes and continental dunes (of which only 7.5% fall into the favourable category), and coastal and halophytic habitats (Chart 4). As to the Czech Republic, the most endangered habitat types are forests, coastal and halophytic habitats (none of which was rated as being in a favourable status), and also freshwater habitats (of which only 7.1% fall into the favourable category). On the other hand, the best-rated habitats between 2007 and 2012 are rocky habitats and caves (of which 34.3% were assessed as being in a favourable status).

The downward trend in abundance of **all common species of birds and common forest bird species** is gradually levelling out, still, since 1990, the abundance of all common species of birds reduced by 14%, and of common forest species of birds by 8%. The decline of the abundance of common farmland bird species between 1990 and 2013 was even more significant – almost 34% (Chart 5). The development of bird populations in the Czech Republic is therefore consistent with the European trend (see the indicator of common bird species). However, there had been a substantial decline of all populations even before 1990. The dropping abundance of **common farmland bird species**, particularly in the beginning of the monitored period, is related to increasing intensification of agricultural production and concurrent abandoning of agricultural land in regions not so suitable for agricultural production.

The dramatic decline of biodiversity of grassland formations is indicated by an overall decline of populations of **grassland butterflies**, the population of which has decreased by some 30% between 1990 and 2013 (Chart 6). The main reason is a changed use of landscape, including agricultural intensification and unification of agricultural processes and, on the other hand, abandonment of agricultural exploitation of land, particularly in mountainous or waterlogged regions of eastern and southern Europe.

5 Forests

Forests

The importance of forest stands is determined by their ability to fulfil productive functions (in particular, the production of wood, or other products) and non-productive functions (prevention of erosion, support of the appropriate water regime, the impact on air quality, regulation of floods and droughts, the sanitary-hygiene function, recreational and aesthetic function). Good health of forests is essential for both types of those functions, and it is therefore necessary to take care of the health of forests, not only in the interest of keeping their values, but also in the interests of the health of human society that is affected by forest ecosystems. Although in the past, the non-productive functions of forest were more neglected and there were interventions that have negatively affected the health of forests until the present (forest amelioration, the planting of single-aged monocultures, etc.), there is an effort to regulate the impacts by measures that return the forest into its more natural form.

Near-natural methods of management in forests (planting of improving and stabilizing species, natural regeneration, reducing the numbers of cloven-hoofed game, etc.) are the efforts to ensure the ability of the forest to perform also the non-economic functions of the forest. The result of responsible management of forests, in particular, is strengthened ecological stability, which is important for example in reducing the impacts of extreme weather events and climate change.

Measures to improve the ecological stability of the forest are numerous. One of them is an effort to achieve a more natural species composition of forests and even representation of age classes. Even-aged monocultures that are the result of uniform planting of stands (mostly spruce and pine), resist poorly in long-term biotic and abiotic factors, are often in poor health, and therefore are no longer able to all perform all their functions in a satisfactory manner.

References to current conceptual, strategic and legislative documents

EU Forest Strategy for the period 2013–2020
- promoting the balance of various forest functions to meet demand and provide vital ecosystem services
- promoting forestry and the entire value chain based on forestry as a competitive and viable contributor to bioeconomy

ICP Forests Programme
- evaluating and monitoring the impact of atmospheric pollution on forests

National forestry programme for the period up to 2013[1] (2008)
- improving the health and protection of forests by limiting clear cutting, support and introduction of more nature-friendly forest management methods, promoting natural regeneration and closer to natural species composition
- develop monitoring of forests

State environmental policy of the Czech Republic 2012–2020
- support of sustainable and friendly ways of forest management
- adaptation measures against the negative impacts of climate change in the context of forestry
- improvement of the species and spatial composition of forests – support of increasing the share of improving and stabilizing species in the regeneration of forests and afforestation
- the update of the National Forestry Programme after 2013
- keeping the current proportion of state owned forests with nature-friendly forms of preference management while respecting competitiveness

State forest policy principles (2012)
- conserving forest and forest land for future generations
- increasing biodiversity in forest ecosystems and their ecological integrity and stability

[1] *The content of this programme is still current and the implementation of a series of proposed measures took place also in 2016.*

State Nature Conservation and Landscape Protection Programme of the Czech Republic (1998, 2009)
- increasing the species diversity of forest stands to approximate natural species composition
- increasing the structural diversity of the forest and the share of naturally regenerated and genetically suitable stand species
- strengthening of the non-productive functions of forest ecosystems

Strategy of the Ministry of Agriculture of the Czech Republic with a 2030 perspective
- sustainable management of forests with a continuous improvement of their condition
- ensuring the awareness-raising and information activities concerning the importance of sustainable forest management
- ensuring the competitiveness of the value chain based on forestry

National Biodiversity Strategy of the Czech Republic (2016)
- specification of current problems of forest ecosystems restoration in areas previously (mainly in the past) exposed to elevated emission stress
- processing the concept of further mitigation impact procedure of negative processes on forest biodiversity

Strategy on Adaptation to Climate Change in the Czech Republic 2015
- the use of natural processes and growing space and species varied forest stands
- the change of preferences of the species and ecotypes of forest tree species

Act No. 289/1995 Coll., on forests and on amending some Acts
- determination of prerequisites for the preservation of the forest, care for the forest and the regeneration of the forest as a national wealth
- support for sustainable management in forests of the Czech Republic

Operational Programme Environment 2014–2020
- improvement of the species, age and spatial structure of forests

18 | Health condition of forests

Key question

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

Key messages

The damage to forest stands in the Czech Republic expressed as a percentage of defoliation[2] still remains at a high level, and does not proceed as fast as in the past. This is the response of forests to the improved ambient air conditions in the past two decades; the long-term effort to change the species composition of the forest stands also positively influences the health of the stands.

In the category of older stands (60 years of age and older) the sum of the defoliation classes 2–4 for conifers was 74.8% and for deciduous trees it was 41.9%. In younger stands (up to 59 years of age), the situation is more favourable, in the case of conifers 25.7% of stands dropped to class 2 and 4, and for deciduous trees it was 22.4%. After the improvement in the second half of the 1990s, it is possible to track the dynamics of oscillating defoliation after the year 2000, which meant in 2016 a mild year-on-year deterioration in all categories, except for younger deciduous trees.

Overall assessment of the trend

Change since 1990

Change since 2000

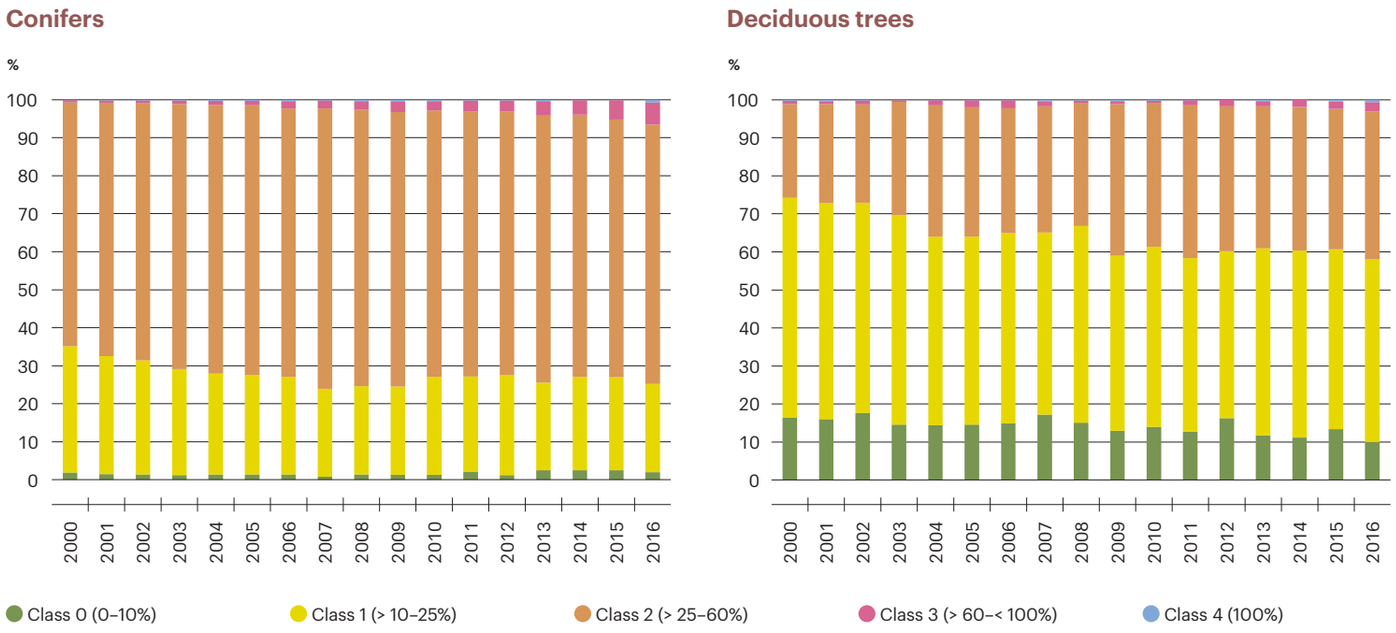
Last year-on-year change

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

Indicator assessment

Chart 1

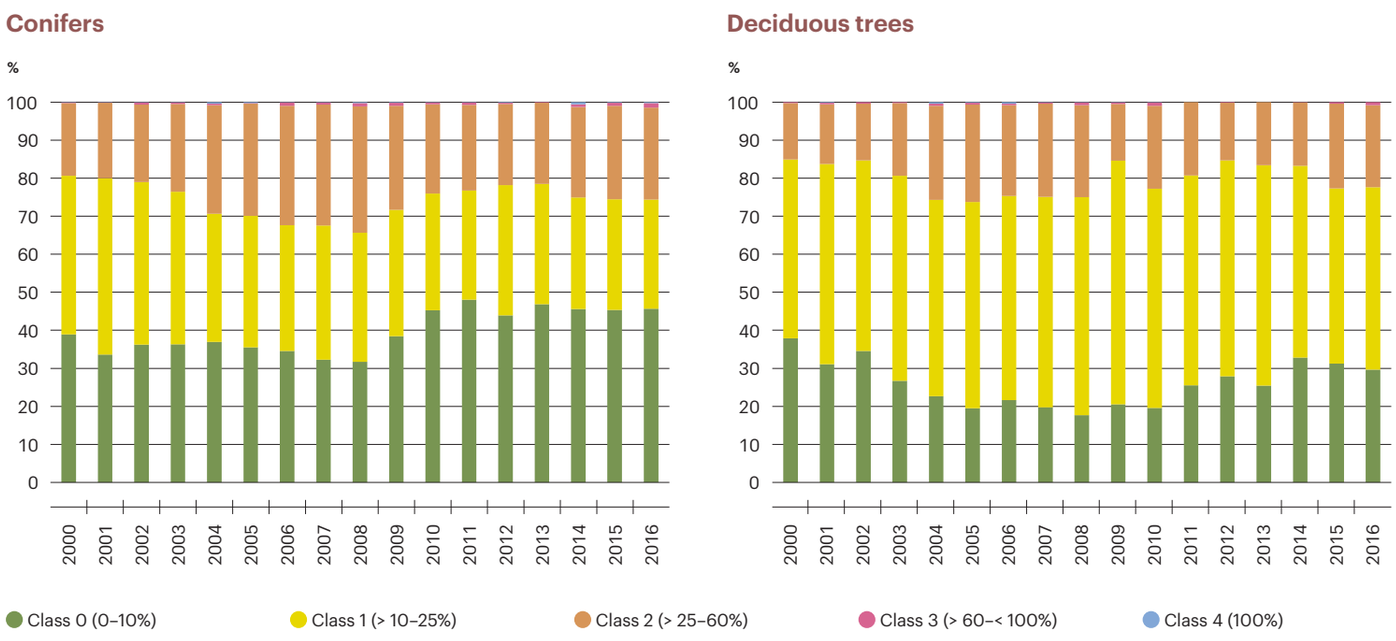
Defoliation of older conifers and deciduous trees (60 years of age and older) in the Czech Republic according to classes [%], 2000–2016



Source: Forestry and Game Management Research Institute, public research institution

Chart 2

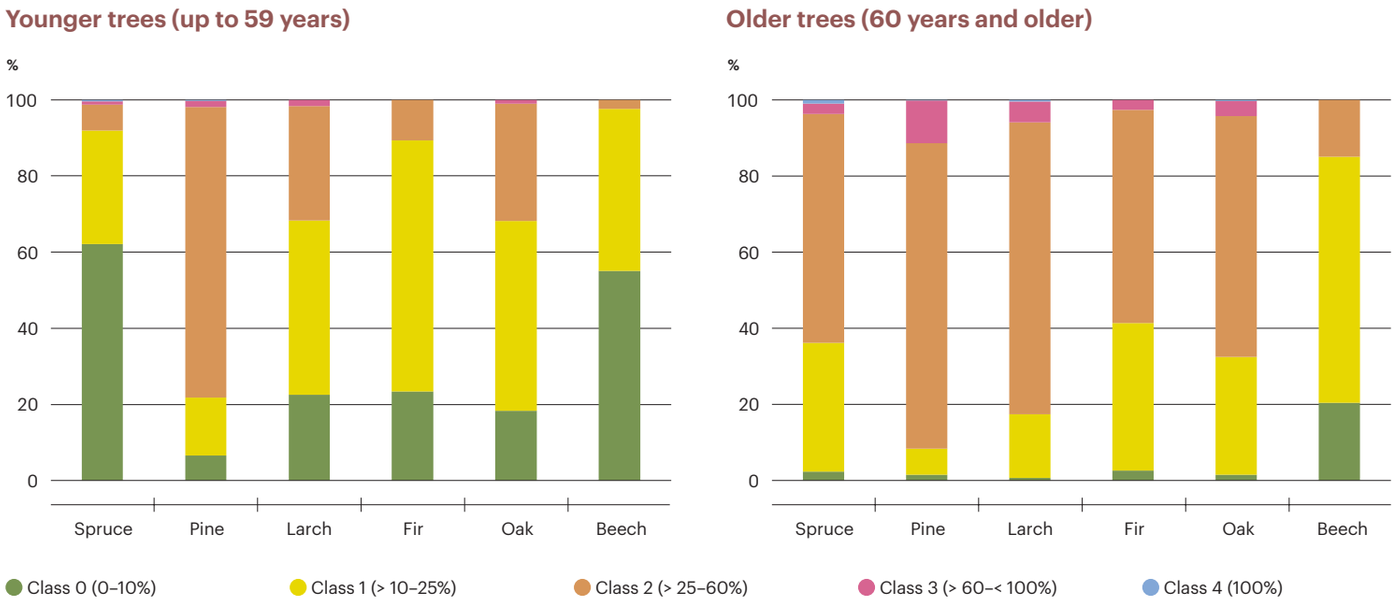
Defoliation of younger conifers and deciduous trees (up to 59 years of age) in the Czech Republic according to classes [%], 2000–2016



Source: Forestry and Game Management Research Institute, public research institution

Chart 3

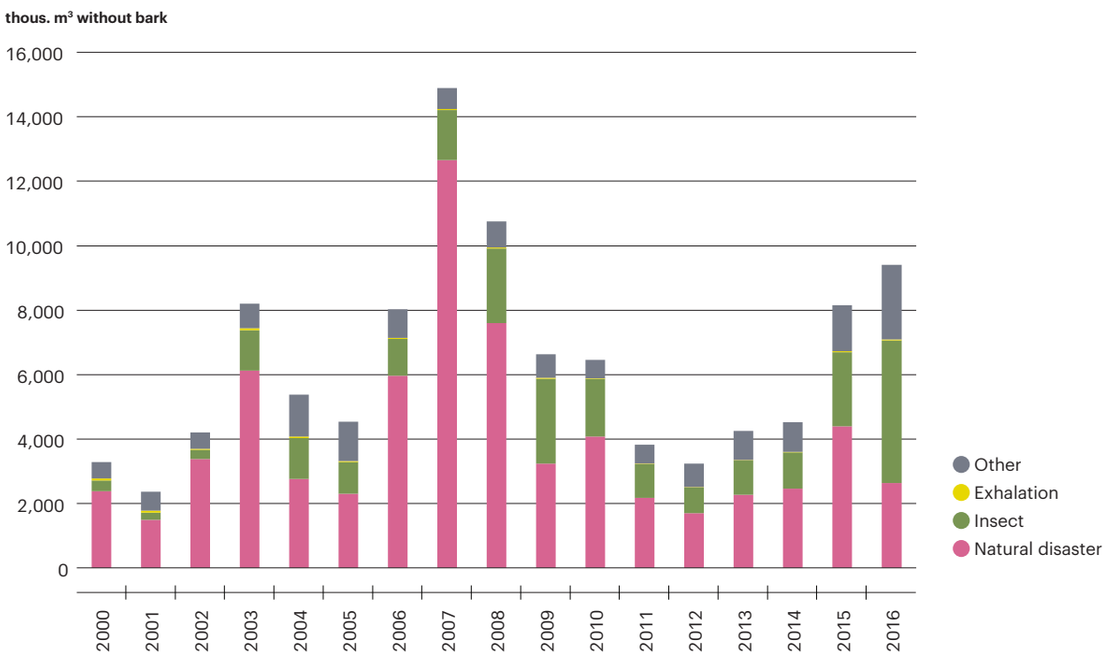
Defoliation of basic tree species in the Czech Republic, according to classes [%], 2016



Source: Forestry and Game Management Research Institute, public research institution

Chart 4

Salvage felling by causes in the Czech Republic [thous. m³ without bark], 2000–2016



Source: Czech Statistical Office

Forest damage is caused not only by natural agents, but also by the increasing influence of air pollution load on the environment. It is divided into the primary damage (direct damage to the trees by the action of pollutants on their assimilatory organs) and secondary (indirect, chronic damage, caused by environmental factors, e.g. soil acidification, climate change etc.). The assessment of the health status of the coniferous and deciduous stands is divided into two categories according to their age – older (60 years of age

and older) and younger (up to 59 years of age). The health of trees is expressed by the percentage of defoliation, defined as a relative loss of assimilation capacity in the tree crown compared to a healthy tree growing in identical vegetation and habitat conditions. The defoliation values are divided into five basic classes (0–4), of which classes 2–4 characterise significantly damaged trees.

In the case of **older stands** there was a significant increase in defoliation observed during the 1980s, and in the 1st half of the 1990s. After a period of stabilisation, which is attributed to the reaction of the forests to positive changes in the environment, especially the reduction of ambient air pollution. From the beginning of the 21st century, however, a deterioration can be seen again (Chart 1), demonstrated both on coniferous and deciduous trees. It was mainly the period between the years 2007–2009, when the consequences of the Kyrill hurricane affected the state of health of the stands. After the state improved in 2010, the situation of conifers in the defoliation class 2 to 4 is stagnant, their share still exceeds 70% in the long term – in 2016 it was 74.8% (in 2015 it was 73.0%). In the case of deciduous trees there is a prevailing tendency of increasing the percentage of classes 2 through 4. In 2000, a total of 25.8% of stands was in the mentioned classes, in 2005 it was 36.0% and in 2010 already 38.6%. Between 2015 and 2016, the percentage of defoliation grew from 39.3% to 41.9%. The deciduous trees are generally more resistant to defoliation due to the complete annual renewal of the assimilation system.

In the **evaluation of individual wood species** aged 60 years of age and older, the value of defoliation in the sum of the classes 2 to 4 is the highest for pine from among conifers – in 2016 it was 91.6%, for larch (82.6%) and spruce (63.8%). Among the deciduous trees, a significant degree of defoliation is apparent for oak, in total for 67.6% of the evaluated trees in class 2 to 4 in 2016 (Chart 3).

The poor health of the older forests is the result of the intense ambient air pollution stress on the forest ecosystems in recent decades. Since 1989, the situation of air pollution has been significantly improved due to reducing the amount of emitted substances. It was contributed to by the installation of emission control equipment on the sources of air pollution, changing of the fuel base and the application of emission limits stipulated for each source. Forest stands, however, respond to changes with a considerable delay, moreover, the air pollution burden still continues, even if its intensity is demonstrably lower. Also the chemical composition of air pollution has changed. The older forests have been significantly affected by poor air quality since the early stages of growth. Many of these forests are also characterised by inappropriate species composition, therefore their health status remains unsatisfactory.

In **younger stands (up to 59 years of age)**, the level of defoliation is lower (Chart 2) due to the fact that younger forests have better vitality and ability to withstand adverse environmental conditions. A significant reason is also the lower environmental stress than in the past. After 2000, however, it is also possible to observe for these crops a health deterioration that is characterised by increasing the proportion of tree species in class 2 to 4 at the expense of the classes 0 and 1 (conifers in the period 2000–2008 from 19.4% to 34.3%, deciduous trees from 15.1% to 25.0%). The change in trend can be observed after 2008, when in both categories of species the proportion of class 2 to 4 decreases. In the years 2014 and 2015, however, an increase was recorded again and subsequent stagnation between 2015 and 2016.

In the **evaluation of individual tree species** up to the age of 59 years, in the case of conifers there is the least favourable situation repeatedly for pine, which is sensitive to drought, temperature extremes and sudden weather changes. In 2016 for classes 2 to 4 the value of defoliation was 78.2% (year-to-year increase by 3.1% p.p.). A more favourable status, compared to older stands, is observed in the case of spruce (only 8.0% in class 2 to 4). In the deciduous stands of the younger age category, the higher degree of defoliation applies mainly to oak, with 31.8% (Chart 3), the year-to-year decrease was a substantial 7.8 p.p.

A direct consequence of the poor health of forests is their reduced ability to resist environmental stress. The most significant factors in the long term, inducing the need for salvage felling (Chart 4), are abiotic factors (climate factors such as wind, frost, snow, drought; or exhalations) and biotic factors (mainly attacks by insects, humans and nibbling by animals).

The **share of salvage felling**, caused by abiotic influences does not have a clear trend, since it is subject to unpredictable extreme meteorological events. In 2016, the amount of salvage felling was 9,399 thous. m^3 without bark (4 527 thous. m^3 without bark in 2014; 8 153 thous. m^3 without bark in 2015). The year-to-year increase is caused by droughts, windbreaks and the subsequent attack by bark beetle. Damage by insects, which is the second most common cause of salvage felling, is usually strongly intertwined with the previous action of natural factors. Stands damaged e.g. by drought or wind are much more susceptible to attack by insects but also fungal diseases. In the Czech Republic, of the biotic factors, the most damage is caused by the bark beetle.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

19 | Species composition and age structure of forests

Key question

Is the unsatisfactory species composition and age structure of the forests in the Czech Republic changing?

Key messages

The proportion of deciduous trees in the total forest area of the Czech Republic gradually increases, in 2016 it accounted for 26.7% of the total forest area. In the long-term, it is possible to observe the evolution towards a positive change in the species composition, towards a more natural (and more stable) composition of forest stands. However, this process is very slow and requires many years of intense effort.

In the Czech Republic, the age structure of forests is not uniform. In the long term the area of old forest stands (over 120 years) increases. This phenomenon, which is from the economic perspective assessed negatively, may on the other hand have a positive effect in the context of the biodiversity conservation.
The proportion of fir, which is an important part of the natural forest ecosystem and which contributes significantly to maintaining forest stability, has been stable in the total forest area about 1%) even though its share in artificial planting is 5%.

Overall assessment of the trend

Change since 1990

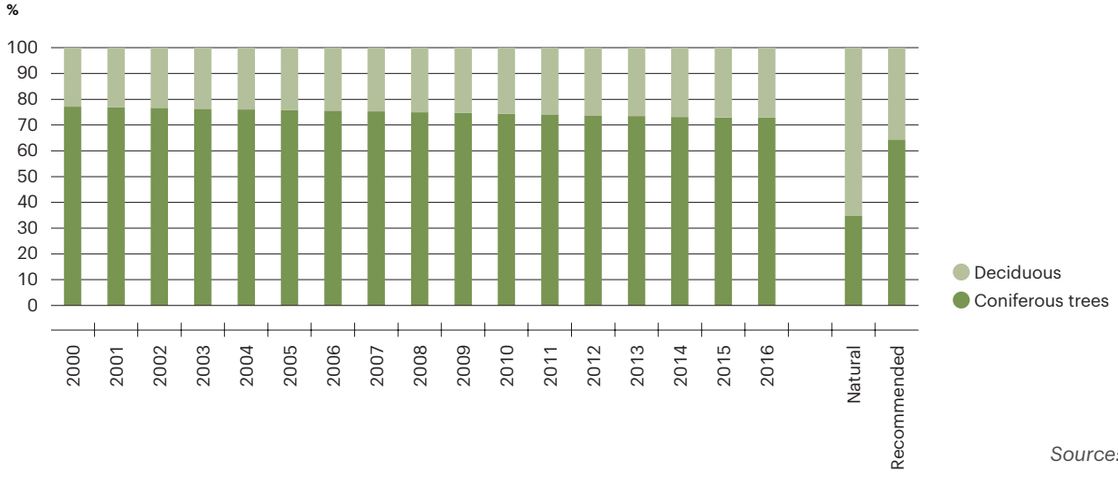
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

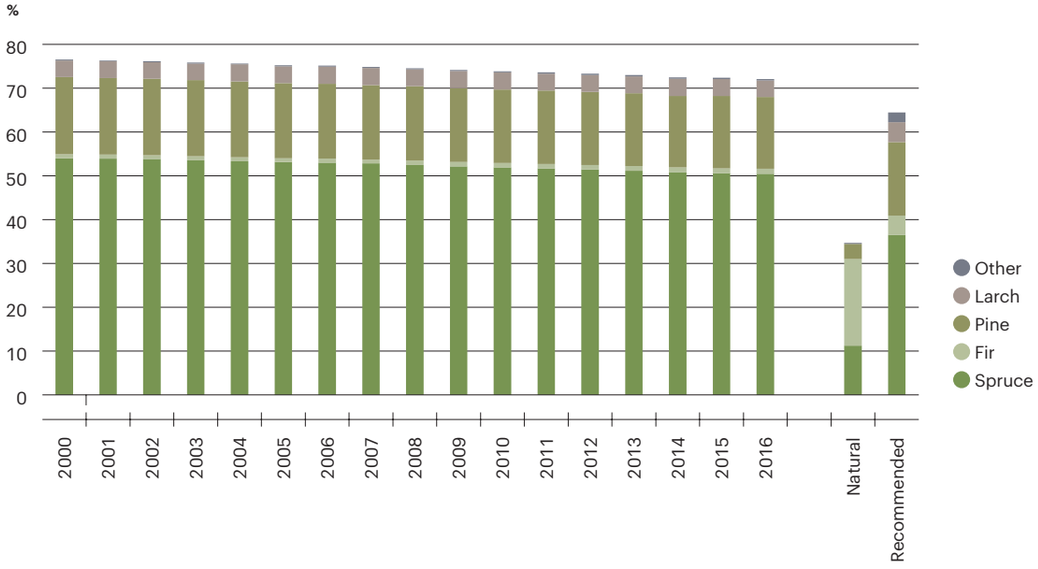
Development of the proportions of coniferous and deciduous stands in total forest area of the Czech Republic, reconstructed natural and recommended composition [%], 2000–2016



Source: Forest Management Institute

Chart 2

Development of species composition of coniferous stands in the Czech Republic, reconstructed natural and recommended composition [%], 2000–2016

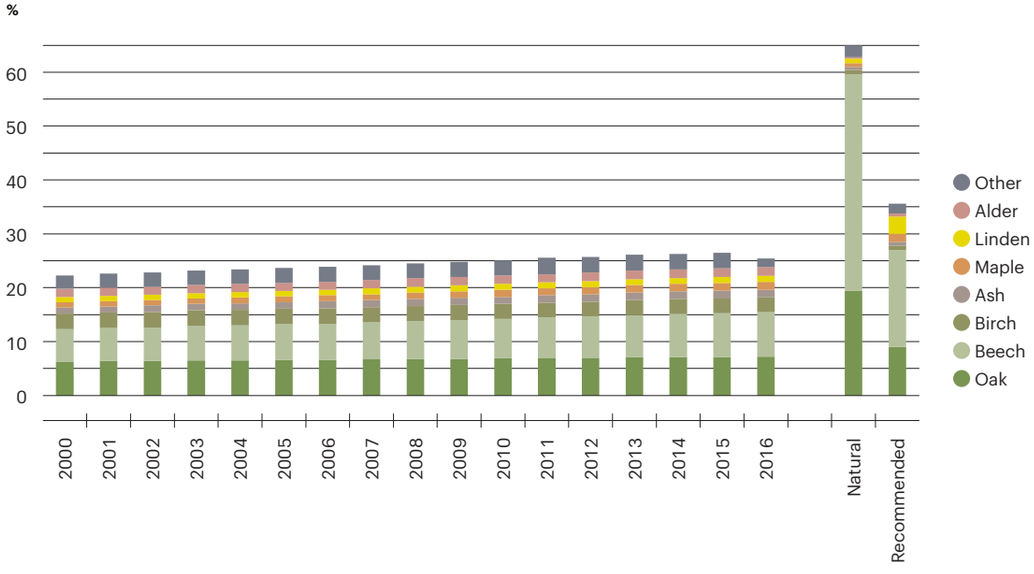


Larch occurs naturally only on a very limited area in the Czech Republic, to the east of the Hrubý Jeseník range, therefore, it is not included in the natural forest composition. Its natural occurence covers mountain ranges of Central Europe – the Alps and Carpathian Mountains and their foothills.

Source: Forest Management Institute

Chart 3

Development of species composition of deciduous stands in the Czech Republic, reconstructed natural and recommended composition [%], 2000–2016

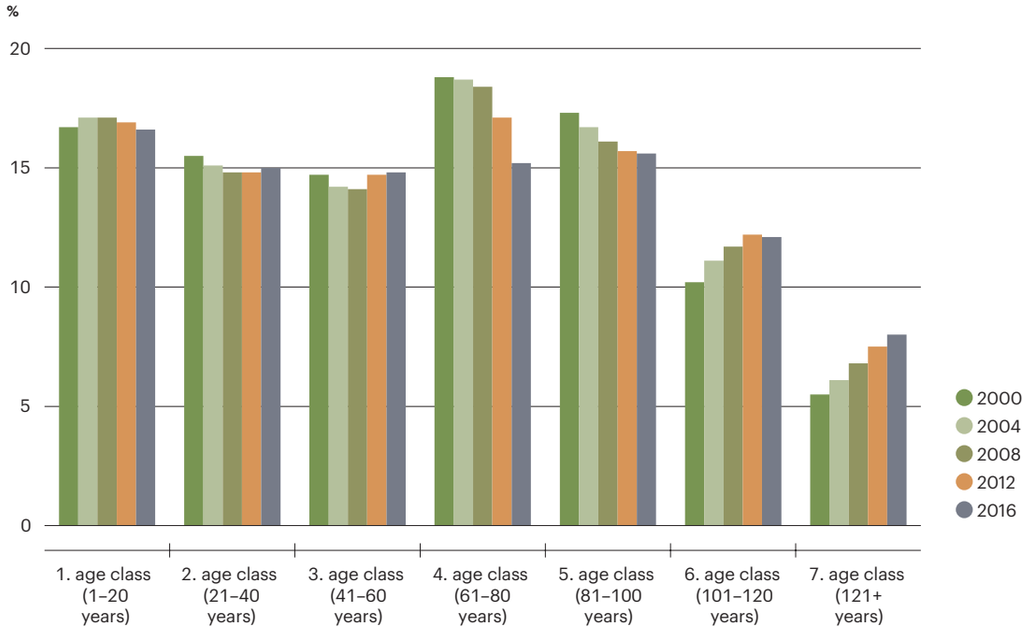


Wood species ash, maple, linden, alder have been monitored only since 2011, therefore, they are not included in the previous years.

Source: Forest Management Institute

Chart 4

Development of the age structure of forest stands in the Czech Republic [%], 2000, 2004, 2008, 2012, 2016



Source: Forest Management Institute

The **current composition of the forests of the Czech Republic** significantly differs from the reconstructed natural and recommended[3] (Chart 1, Chart 2, Chart 3), due to the widespread planting of spruce and pine monocultures in the past. These even-aged monocultures of conifers, often of unsuitable ecotype, decrease biodiversity and are much more susceptible to damage from biotic and abiotic factors. In contrast, the **natural species composition of forests** in the Czech Republic corresponding to the natural conditions of the habitat is the basis for the overall stability of the forest. According to this composition, in lower altitudes there should be a natural occurrence of oak and hornbeam forests, and with the increasing altitude they gradually move in beech and fir, and in the highest altitudes change to spruce forests.

The **recommended composition** is then a compromise between the above compositions of forests, taking into account the economic interests, the non-productive functions of forests, and recently also the knowledge related to the adaptation to climate changes. This composition anticipates the reduction in the **proportion of coniferous trees** (Chart 1) from the current roughly 72% (in 2016 it was 72.1%) to 64.4% (in the case of spruce from 50.5% to 36.5%). Simultaneously, it anticipates an increase in the proportion of fir from the current 1.1% to 4.4% (Chart 2) and also a significant increase in the **proportion of deciduous trees**, especially of beech from the current 8% (in 2016 it was 8.3%) to the targeted 18.0%, and also of oak and linden. On the other hand, it envisages a reduction in the proportion of birch, elm and alder (Chart 3).

In the last decades is there is a clear focused change of species composition towards more natural (and stable) structure of forest stands by applying deciduous tree species rather than conifers (Chart 1). The overall proportion of deciduous stands on a total area of forests since 2000 increased from 22.3% to 26.7% in 2016 (Chart 1). On the other hand, the proportion of coniferous trees in the total forest area of the Czech Republic decreased from 76.5% in the year 2000 to 72.3% in the year 2016. The growth of young forest stands remains a problem, mainly as a result of foraging in areas with excessive stock of split hoofed game.

The **proportion of spruce** in the total forest area in the long-term steadily decreases, between the years 2000–2016 it decreased from 54.0% to 50.5% (Chart 2). An important part of the natural forest ecosystem is fir, which contributes significantly to maintaining the stability of the forest. The **proportion of fir**, which is among the trees consolidating and draining soil, on the

[3] *The reconstructed structure is close to the climax composition before human influence on the forest. The recommended composition of the forest is a universally optimised compromise between the natural composition and composition optimal from contemporary economic perspective.*

total area of forests is consistently around 1% (in 2016 it formed 1.1%), even though its share in reforestation steadily rises (currently about 5%). The failure of the efforts to increase the proportion of fir is mainly attributed to the extensive damage caused by split hoofed game.

The **share of beech** trees in the composition of forests is increasing, between 2000 and 2016 it has increased from 6.0% to 8.3% of the total area of forests. The increase, although slower, was recorded also in oak, which since 2000 has increased from 6.3% to 7.2% in 2016 (Chart 3).

The **age structure of forests in the Czech Republic** is not uniform (Chart 4). The approximation of the actual age structure to the so-called normal status[4] is very slow. Area of stands under the age of 60 years is below normal, in the long term each 1st to 3rd age class of should be around 18%, which is currently not reached in any of the classes. However, between the years 2015 and 2016, a slight approximation to the normal age structure occurred in all three of the aforementioned age classes. In 2016, the 1st age class recorded 16.6%, the 2nd class 15.0%, and the 3rd class 14.8% of the forested land area. The reason for this unfavourable status is the increase in forest areas in the late 19th and the first half of the 20th century, mostly afforested by monocultures.

On the other hand, since 1990, the proportion of areas of older to overaged stands of the 6th and 7th age class has been rising continuously. In the year 2016, the 6th age class recorded 12.1%, same as in 2015, and the 7th class 8.0% (7.8% in 2015) of the forested land area. This increase may have been caused, in addition to the changes in the management of protection forests and special purpose forests, also by the postponing of renewal of economically unattractive, poor quality or poorly accessible forests. This trend, which in economic terms poses the risk of losses, may on the other hand be perceived as positive in terms of biodiversity conservation. Forest stands of higher age in fact represent favourable environment for species associated with ecosystems with high proportion of dead wood.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[4] *Such spatial arrangement of age classes in a normal forest is considered as normal, which best complies with the conditions of forest cultivation, protection of forest and wood felling.*

20 | Responsible forest management

Key question

Does forest management develop in accordance with the principles of sustainable development and the nature of nature-friendly farming methods?

Key messages

Between the years 2015 and 2016, the total area of forests increased by 1,380.7 ha (between the years 2014 and 2015 it was by 2,238 ha). At the same time, the area of forest stands which are certified in accordance with the principles of sustainable management of forests according to PEFC and FSC increased from 68.8% to 69.2% (67.2% pursuant to PEFC and 2.0% pursuant to FSC).

The shares of artificially regenerated conifers and deciduous trees have been slightly approximating the recommended composition of the forest, thanks to reducing the proportion of coniferous trees in favour of deciduous trees. Artificially established stands consisted in 2016 in 59.6% of conifers, however, they also represented 90.4% of harvested trees, which strengthened the proportional representation of deciduous trees.
A growing trend of natural forest regeneration stopped in the period 2007–2013 and since 2014 its share in the total afforestation has been decreasing.
The total forest stock has been increasing over the long term.

The long-term problem is the browsing by cloven-hoofed game, which causes significant damage especially in the regenerated stands.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

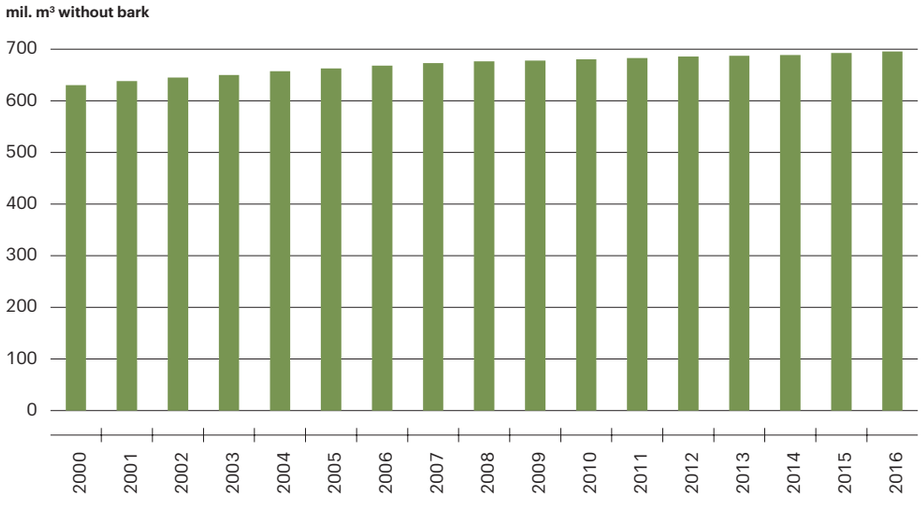
Forest renewal in the Czech Republic [thous. ha], 2000–2016

Since 2002, due to changes in the methodology the natural regeneration includes also the recovery under the trees (originally only a renewal of bare areas was included).

Source: Czech Statistical Office

Chart 2

Standing tree volumes development in the Czech Republic [mil. m^3 without bark], 2000–2016



Source: Forest Management Institute, Czech Statistical Office

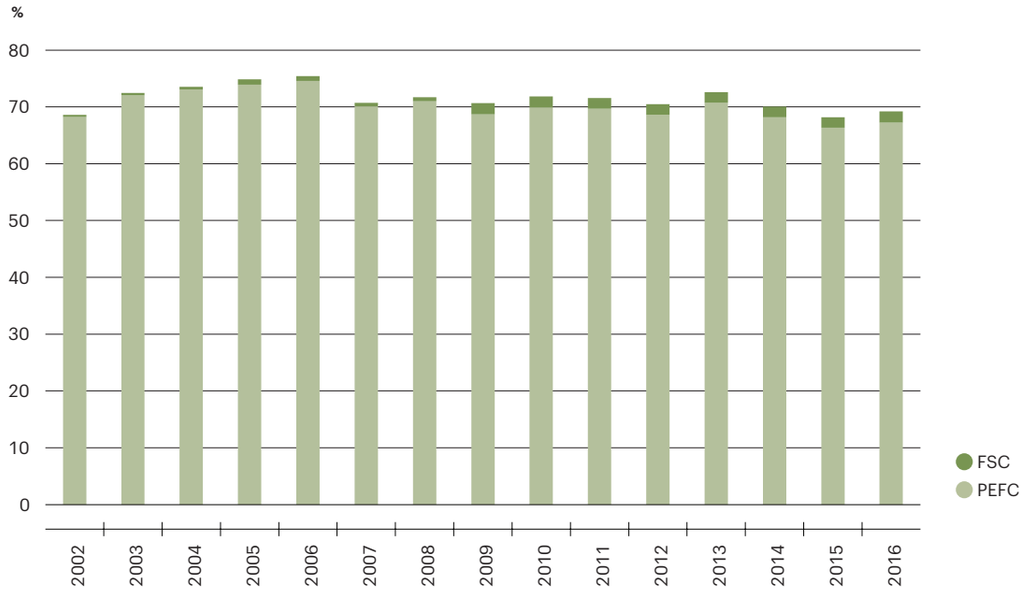
Chart 3

Comparison of wood felling and total average growth increment in the Czech Republic [mil. m^3 without bark], 2000–2016

Source: Czech Statistical Office

Chart 4

Development of the proportion of PEFC and FSC certified forests in the total forest area in Czech Republic [%], 2002–2016



Source: FSC Czech Republic, PEFC Czech Republic

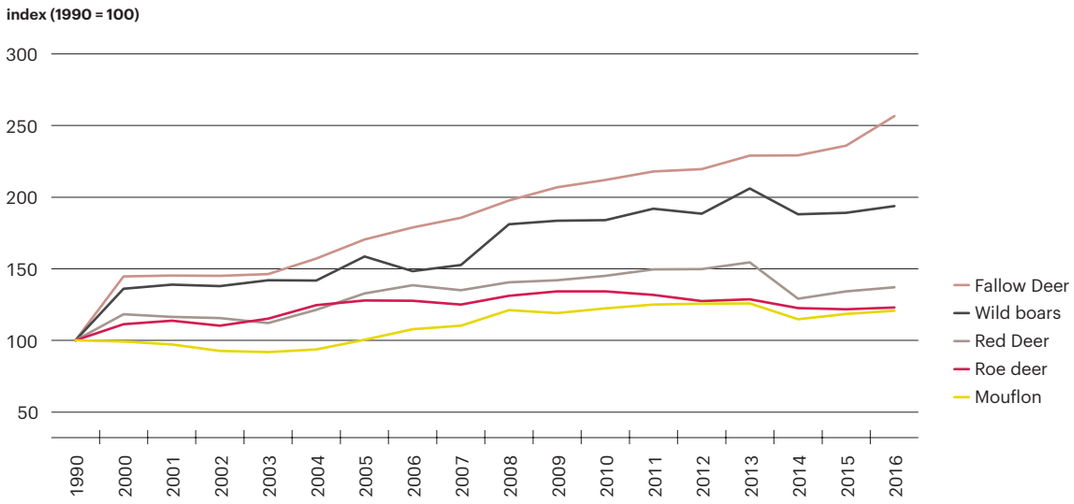
Chart 5

Proportions of the forest categories in the Czech Republic's total forest area [%], 2000–2016

Source: Forest Management Institute

Chart 6

Spring stocks of game (selected species) in the Czech Republic [index, 1990 = 100], 1990–2016



Balance at 31 March of that year.

Source: Czech Statistical Office

Since 2000, the shares of artificially regenerated conifers and deciduous trees have been slightly approximating the recommended composition of the forest, thanks to reducing the proportion of coniferous trees in favour of deciduous trees. The higher proportional representation of deciduous trees in 2016 was caused by the increased proportion of artificially regenerated deciduous trees (40.4%, in the year 2015 it was 38.5%, Chart 1), and at the same time by a high proportion of harvested conifers (90.4%). After the increase in the areas and the mutual representation of naturally regenerated stands between the years 2007–2013, in the subsequent period there was a decline in natural regeneration – the proportion of the total area of reforestation dropped from 23% in 2013 to 19% in 2016. At present the area, at which the **natural regeneration** takes place, accounts for 4,813 ha (compared to 6,112 ha in 2013).

The total standing wood stock has been increasing constantly (Chart 2). In 2016, the standing tree stock amounted to 695.8 mil. m^3. The increase in the total standing stock is fixed. In addition to the normal growth increment, the growing share of older stands and the modest growth in stand tree density also contribute to this development.

Part of the growing stock is unavailable for **felling** (felling is restricted in the special purpose forests and in the protection forests, in reservations, and in the first zones of national parks it is almost impossible). The total volume of production is in the long term lower than the **mean annual increment** (Chart 3). The mean annual increment, which expresses the production capacity of forest habitats, is a crucial indicator in assessing the principle of balance and sustainability of felling. After the year 2000 the total production exceeded the total average growth increment only twice, in 2006 and 2007, mainly as a result of processing of wood damaged by the Kyrill hurricane and the subsequent bark beetle calamity (in 2007 salvage felling accounted for 80.5% of the total felling).

In the long term the **total logged volum**e has been greater than 15 mil. m^3 without bark, from 2012, continued to grow from 15.1 mil. m^3 to 16.2 mil. m^3 in 2015 and 17.6 mil. m^3 in 2016. The proportion of salvage (calamity) felling in the total felling in 2016 accounted for 53.3% (50.4% in 2015), which represents a significant increase compared to the previous period, when it ranged between 20–30% of the total felling. Among the main causes of this change can be the impact of droughts, windbreaks and subsequent infection by bark beetle. The mean annual increment over the period since 2003 has been stable between 17–18 mil. m^3 without bark, and in 2016 it was 17.9 mil. m^3 without bark.

The area of forests certified in accordance with the principles of the **PEFC** (Programme for the Endorsement of Forest Certification Schemes) and **FSC** (Forest Stewardship Council)[5], i.e. sustainably managed forests, peaked in 2006 (75.4% of the total forest area in the Czech Republic, of which 74.6% according to PEFC and 0.8% according to FSC). In 2007, however, this area has declined to a level of about 70%, where it remained until 2015, when, in particular, due to the reduction of areas of forests certified according to PEFC, there was a further decrease to the total of 68.2% forests (66.3% according to PEFC and 1.9% according to FSC). In 2016, the area of certified forests slightly increased to 69.2% (67.2% according to PEFC, 2.0% according to FSC, Chart 4). Forest certification in the Czech Republic developed particularly after 2000, when in addition to sustainable forest management, there was an effort to inform consumers about the origin and environmental qualities of the wood. The reason for the decline of awarded certificates in recent years is that the certification process is demanding and forest owners do not see the added value of these certificates.

According to their prevailing features forests are classified into **categories of production forests, protection forests, or special purpose forests** (Chart 5). In the long-term there is a gradual decline proportion of forests categorised as production forests, from 76.7% of the total area of the forests in 2000 to 74.4% in 2016, and on the other hand the proportion of special purpose forests in the same period increased from 19.8% to 23.6%. The permanent decrease in the area of protection forests in the relative immutability of natural conditions suggests, that the current possibilities of classifying forests into the protective category are not fully utilised. Their share in 2016 accounted for 2.1%, while in the year 2014 it was 2.6% and in 2000 even 3.5%.

The priority is the **reducing and maintaining the numbers of cloven-hoofed game and wild boar** in hunting grounds, particularly with regard to the damage caused by wild boars on crops and land, and foraging by cloven-hoofed game in newly established forest growths. In addition to the foraging of young trees, which hinders the natural regeneration, the overgrowth of game has a negative impact on the entire forest ecosystem. The reason for this is mainly an overgrowth of reduced natural regulation, or its complete absence. After a short improvement in 2014, the number of the monitored game was again increased in 2015 and 2016, with the exception of roe deer whose numbers show a long-term decrease from 2010 (Chart 6), yet they are still high. In order to reduce the damage caused by wild animals on agricultural and forest property, the plans for breeding and hunting, and their supervision based on the approval with the hunting holder, must be carefully prepared every year in accordance with the relevant provisions of the Act No. 449/2001 Coll., on game management, so that the number of cloven-hoofed game and wild boars range between minimum and standardised populations. At the same time, it is necessary to change the system of farming in order to allow more efficient reduction in the states of wild boar and at the same time conditions for small animals and other animals are improved, linked to the agricultural landscape.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[5] *Forest certification under the PEFC and FSC systems is one of the forest management processes which aim at sustainable forest management in the Czech Republic and strive to improve all forest functions in favour of the human environment. Through the certificate, the forest owner declares a commitment to manage the forest pursuant to the given criteria. In terms of international recognition, both systems are considered equal.*

Forests in the global context

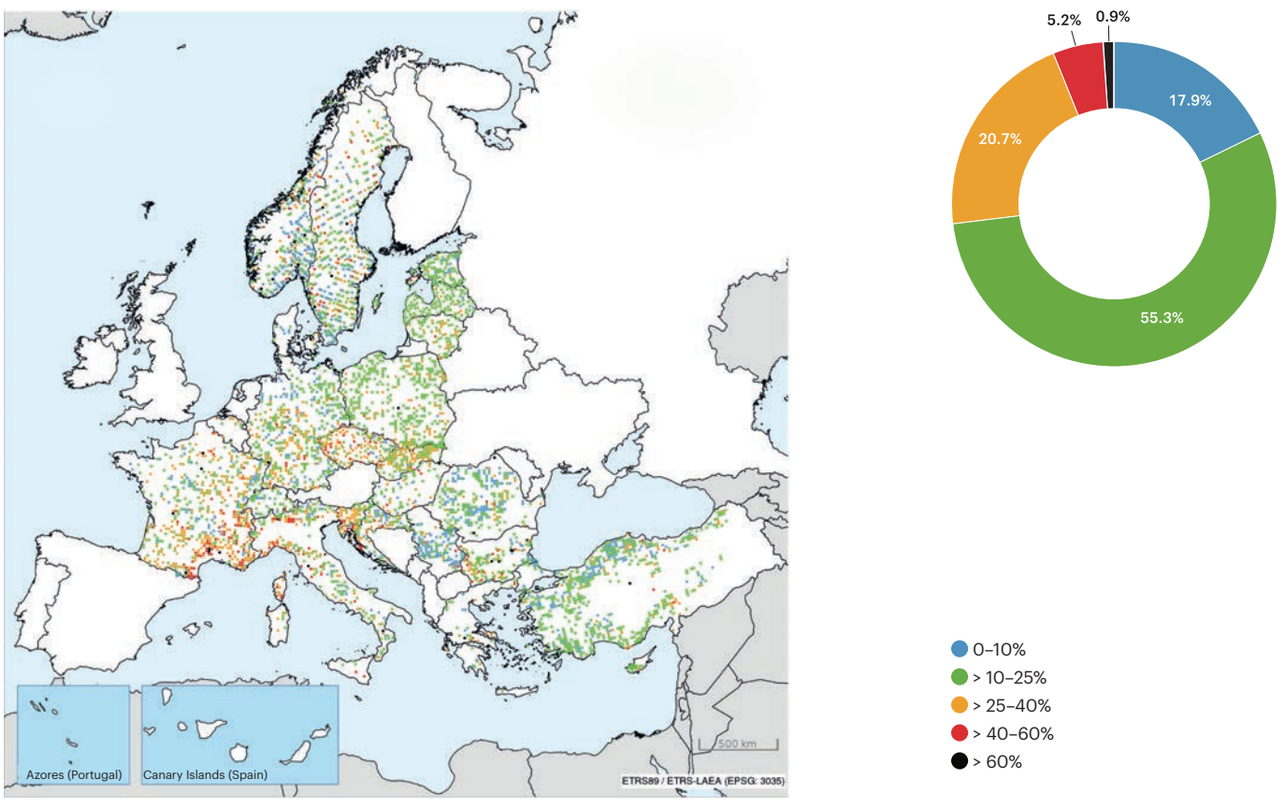
Key messages[6]

- The general situation in forest stands in Europe may be considered as satisfactory, there is no systematic imbalance in the sense of favouring production over biodiversity, or vice versa. The total area of forest stands, as well as the total standing stock, are growing.
- Forests face an increasing pressure caused by human activities. The health condition of forest stands in Europe is also not satisfactory. In 2015, for a total of 23.3% of assessed stands, the defoliation rate exceeded 25% and the stands were thus classified as damaged or dead. The Czech Republic is in this respect among the areas with higher levels of defoliation. In Central Europe, including the Czech Republic, the age and species composition of the stands remain a problem.

Indicator assessment

Figure 1

Defoliation on the main monitoring sites of all tree species [%], 2016

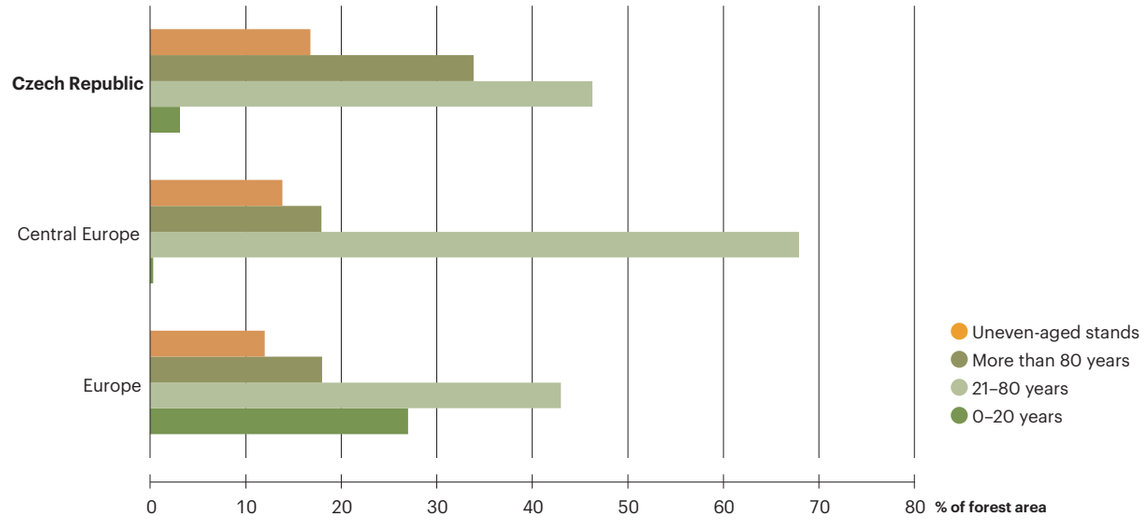


Source: ICP Forests

[6] *Data for the years 2011–2016 are not, due to the methodology of their reporting, available at the time of publication.*

Chart 1

Age structure of forest stands [% of the area of the forest], 2010

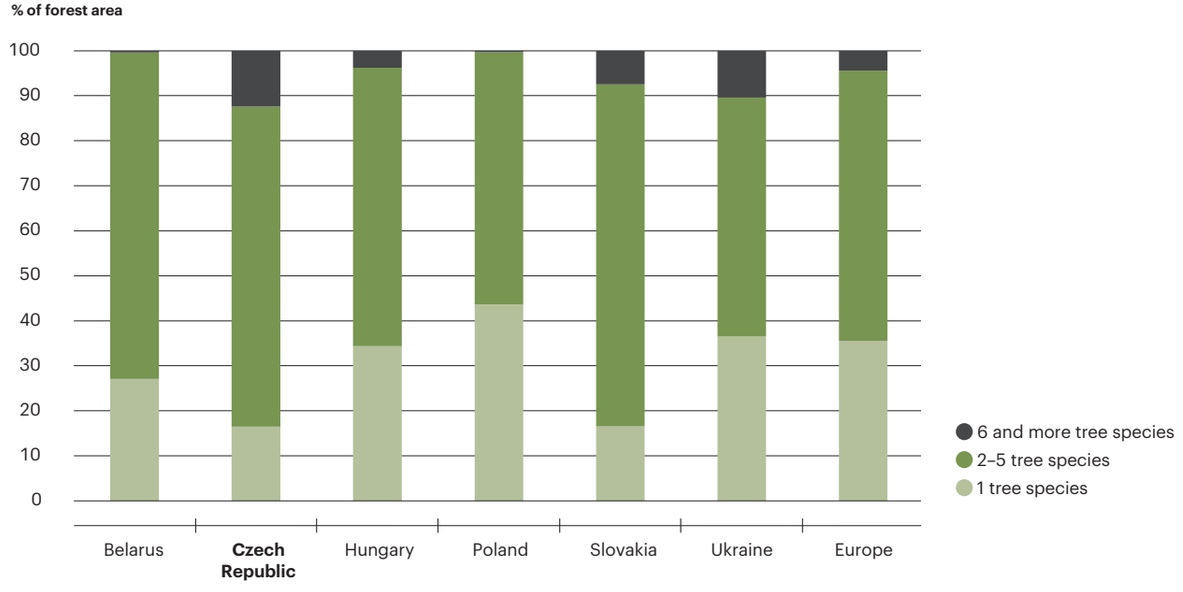


Data for the years 2011–2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: State of Europe's Forests 2011

Chart 2

Species composition of forest stands in selected countries [% of the area of the forest], 2010

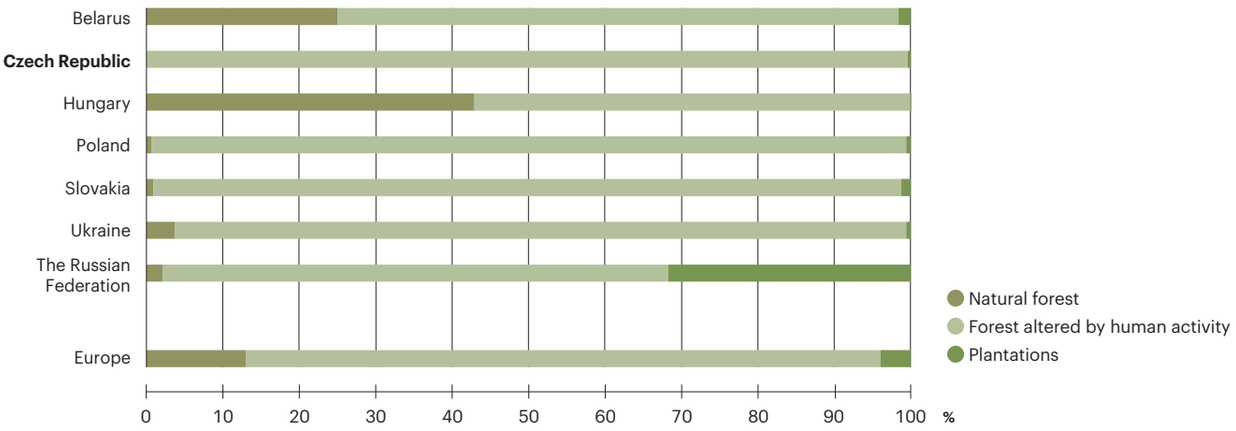


Data for the years 2011–2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: State of Europe's Forests 2015

Chart 3

Proportion of forests affected by humans in selected countries [% of area], 2015

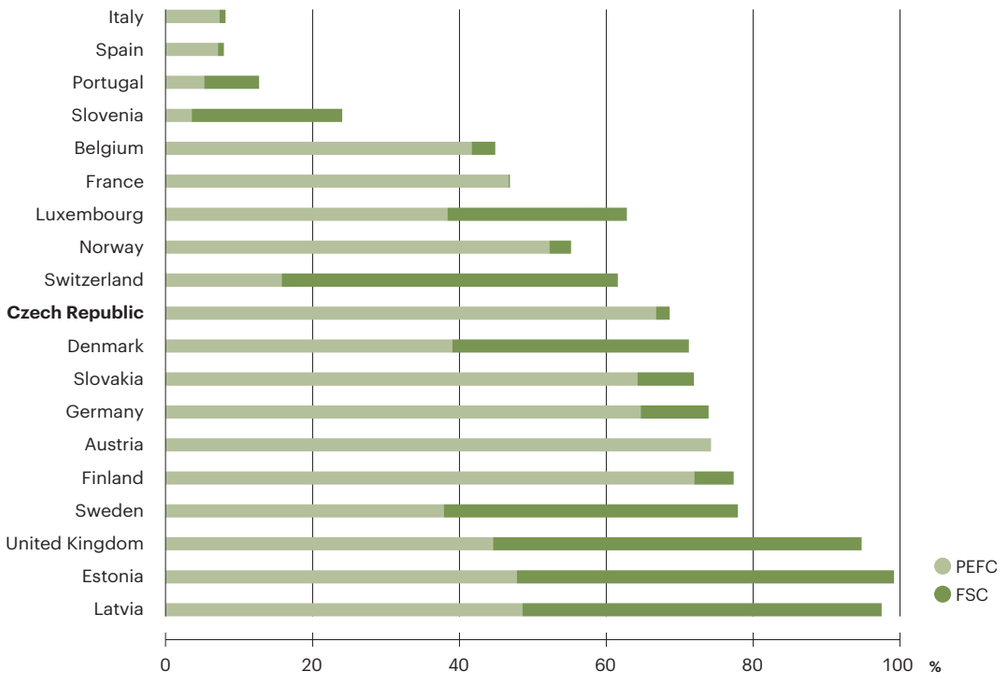


A forest modified by humans differs from a natural forest usually in its species composition, which has been affected by human activities, e.g. artificial regeneration.
Plantations are forest stands established with the intention to obtain the largest possible volume of wood in a short time (10–60 years). Wood from forest plantations is most commonly used for the production of paper, cellulose, chipboard, or as firewood.
Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: State of Europe's Forests 2015

Chart 4

Proportion of PEFC and FSC certified forests in the total forest area in selected EU countries [%], 2016



Source: PEFC Czech Republic, FSC Czech Republic

Forests in Europe are facing increasing pressures caused by human activities that pose a risk for both the vitality of forest soils, as well as the health status of the forests.

On the European territory, 76.4% of the forests are in the category of low defoliation damage (0–25%) and 3.2% of the forests in the highest category of damage (over 60%). The forests with the significant damage are mainly located in the Central and Southern Europe, notably in southern and south-eastern France, northern Italy, the Czech Republic, the Slovak Republic, or Croatia (Figure 1). There are many reasons as defoliation is the result of a complex set of factors and is influenced by short-term factors (pest outbreaks, diseases, damage by frost, wind and other weather conditions), along with long-term factors (inappropriate age and species composition of vegetation, soil acidification, long-term exposure to atmospheric pollution and others).

The high degree of **defoliation** generally indicates a decrease in the resistance of forests to various environmental influences. This is a worrying finding, especially in relation to the predicted more frequent extreme weather events and the fact that in the long-term the efforts to significantly reduce nitrogen deposition have been unsuccessful.

In the Czech Republic, in comparison with the European **average age structure**, the percentage of stands older than 80 years is significantly higher (33.8% in the Czech Republic, 18.0% in Europe), and also the area of all-aged stands is smaller (Chart 1). The current situation is a result of historical development. Intensive forest management and in particular the trend of planting monocultural stands in the 20th century and the late 19th century have led to an entirely unsatisfactory age and species composition of forest stands in comparison with the natural composition. Changing the unfavourable conditions, which forest management faces in the Czech Republic, given the length of the life cycle of forest trees, will be a long-term process. On the other hand, it is clear that in comparison with the average of the Central European region[6], concerning biodiversity, conservation and non-production functions, the proportion of trees older than 80 years and uneven-aged stands, the situation in the Czech Republic is significantly better than in the other countries (Chart 1).

Species composition of forest stands the Czech Republic compared with the European average is very positive (Chart 2). The proportion of monocultures is lower by almost a half (16.5% in the Czech Republic, 32.0% in Europe). When comparing the area of stands with more than 6 tree species, the situation in the Czech Republic is also favourable. The area of these stands is much higher than the European average (12.4% in the Czech Republic and 4.0% in Europe).

However, the European average also includes specific forest ecosystems that naturally consist of only one or two species (e.g. Nordic pine forests, subalpine spruce forests), while in the Czech Republic monocultures, due to the natural conditions, should not virtually exist.

In the Czech Republic, the situation regarding the area of **monocultures** and mixed forests, is better in comparison with the countries of Central Europe. The overall trend towards a mixed species composition of European forests is, in comparison with the year 1990, positive. Similar to the age structure, a significant change in species composition may be realized only in the long-term.

Species and age composition, that is natural for the habitat conditions, is the basis for the stability of forest ecosystems. In Europe, the share of natural forests is 4.0% of the total area of forests, in the Czech Republic it is 0.38%. This low level is caused by the long-term management in European and Czech forests, which were easily accessible for man in the past. The highest degree of natural forests can be found in the Russian Federation, where the share of natural forests ranges around 32%.

The proportion of the areas of **PEFC and FSC certified forests** in the total area of forest in selected EU Member States is the highest in Estonia (99.2%), Latvia (97.5%) and the United Kingdom (94.8%). In contrast, the smallest proportion is in Spain (7.9%) and Italy (8.1%). The Czech Republic belongs to the European average with 68.6%, mainly due to the high proportion of forests certified according to PEFC (Chart 4). On the other hand, however, the Czech Republic belongs to the States with the lowest share of forests certified by FSC (1.9%), less is only in Italy (0.9%), Spain (0.8%), France (0.2%) and Austria (0.01%).

[6] *The evaluation of Central Europe included data from the following countries: Belarus, the Czech Republic, Hungary, Poland, Slovakia, Ukraine. Region Europe comprises all European countries except the Russian Federation.*

6 Land and agriculture

Land and agriculture

A prerequisite for life on Earth is not only water and sunlight, but also land that serves as a living environment for most terrestrial organisms, including humans. Land is a dynamic and ever-evolving live system which performs many ecosystem functions and services. These include mediation of circulation of substances, exchange of thermal energy in the system earth – air, infiltration, accumulation and transport of water. But land is most often seen as a source of livelihood and space for farming and construction.

Construction and inappropriate management are factors that threaten the qualitative properties and the amount of land the most. Inappropriate crop rotation practices and the use of heavy vehicles caused a higher level of erosion and compaction of the soil. The consequence is a reduced ability to absorb water, accelerated surface run-off, siltation of water sources, reduced depth of topsoil or limitation of plant development. Also incorrect practices in conventional farming, using mineral fertilizers and plant protection products in excessive quantities, often lead to the pollution of groundwater and surface water, the decline in biodiversity of soil micro-organisms, and thus the quality of the soil. Similarly this applies to other chemical substances that enter the soil from landfills, old environmental burdens, through emissions or discharges of waste water into the soil and in industrial accidents. Soil contamination may subsequently, through bioaccumulation in the food chain, have a negative impact on related ecosystems and the quality of food.

From the environmental point of view, it is therefore important to monitor the development of organic farming. That does not burden soil with mineral fertilizers, or other chemical plant protection products. It has a positive effect on the quality of soil as well as on the quality of produced food, on the health and welfare of livestock and indirectly also on the human health. Organic farming contributes significantly to the protection of surface water and groundwater, has a beneficial effect on soil microorganisms, increases biodiversity and ecological stability of the landscape, including the anti-erosion effect. It contributes positively to the sustainable development of rural areas and maintains the character of the landscape preserving it by not applying the conventional farming approaches, such as creating large land units with monoculture crops.

References to current conceptual, strategic and legislative documents

Common Agricultural Policy 2014–2020
- measures to protect the environment – e.g. crop diversification, maintenance of permanent grassland and the creation of ecologically focused regions

EU Strategy on Adaptation to Climate Change from April 2013
- minimizing the negative impacts of climate change on agriculture
- improving resilience of agricultural and forest ecosystems

United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, particularly in Africa
- measures against desertification and to mitigate the effects of drought in the drought-affected countries

European Action Plan for Organic Food and Farming
- promoting organic farming through rural development, organic food market and strengthening of research

Directive 2009/128/EC of the European Parliament and of the Council establishing a framework for Community action to achieve the sustainable use of pesticides
- conditions for the use of plant protection products

Council Directive 91/676/EEC concerning the protection of waters against pollution caused by nitrates from agricultural sources (Nitrates Directive)
- requirements for management in vulnerable zones (subsidies check in the Cross Compliance system)

Action programme of the Nitrates Directive for the period 2012–2016
- a set of mandatory measures to be met by farmers in vulnerable areas

Regulation (EU) No. 1307/2013 of the European Parliament and of the Council establishing rules for direct payments to farmers under support schemes within the framework of the common agricultural policy and repealing Council Regulation (EC) No. 637/2008 and Council Regulation (EC) No. 73/2009
- payment of support includes, among other things, the additional support per hectare for observing agricultural practices which have a beneficial effect on the climate and the environment
- comply with the standards for agricultural and environmental status of soil established by the Member State and pursuing objectives to prevent soil erosion, maintain soil structure and keep organic matter in soil

State Environmental Policy of the Czech Republic 2012–2020
- reduction of permanent grabs of agricultural land
- reducing the risk of agricultural land, forest land and rock erosion
- limiting and controlling contamination and other degradation of soil and rocks caused by human activities
- remediation of contaminated areas, including old environmental burdens
- restoration of the landscape water regime by implementing erosion control measures in the landscape

Strategy on Adaptation to Climate Change in the Czech Republic
- stopping soil degradation caused by excessive erosion, depletion of nutrients, loss of organic matter and compaction
- support for organic agriculture

Strategy of the Ministry of Agriculture of the Czech Republic with a 2030 perspective
- support for the competitiveness and sustainability of the Czech agriculture, food industry, forestry and water management
- support for reasonable food self-sufficiency
- application of sustainable management of natural resources
- improving soil conservation at a time of climate change with regard to sustainable management and to comprehensive development and creation of landscape

National strategic Rural Development Plan of the Czech Republic for the period 2014–2020
- support of friendly farming methods, including organic farming
- restoration, conservation and increase in biodiversity, development of agricultural areas with high natural value and the improvement of the status of the European landscape
- better water management, including the management of fertilisers and pesticides
- prevention of soil erosion and improved soil management

Action Plan of the Czech Republic for the Development of Organic Farming in the years 2016–2020
- increasing the share of income from the production in the total income of organic farms against aid (improvement against the current state)
- increasing the proportion of Czech organic food to 60% in the organic food market
- achieving 3% proportion of organic food in total food and drink consumption
- increasing the real contribution of organic farming to the environment and animal welfare = reaching 15% share of organically farmed land in the total agricultural land in the Czech Republic
- achieving at least 20% proportion of arable land in the total area of organically farmed land
- securing financing for research and consultancy in organic farming at an extent corresponding to the proportion of organic farming areas in the total farmland (15%)
- ensuring non-productive functions of organic agriculture, which contribute to the restoration and stability of natural processes in the soil

National action plan to decrease the use of pesticides in the Czech Republic
- limiting risks resulting from the use of plant protection products
- optimising the use of plant protection products without limiting the scope of agricultural production and the quality of plant products

National Emission Reduction Programme of the Czech Republic
- reduction of ammonia emissions from fertiliser applications to arable land and livestock production beyond the minimum requirements of Good agricultural practice

Updated National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants for the period 2012–2017
- removal of old environmental burdens contaminated by POPs

Act No. 252/1997 Coll., on agriculture, as amended
- creating the prerequisites for the promotion of non-productive functions of agriculture that contribute to the protection of the environment components such as the soil, water and air, and to the maintenance of populated and cultural landscape
- creating conditions for the implementation of the common agricultural policy and rural development policy of the European Union
- creating conditions for the development of diverse economic activities and improving the quality of life in rural areas and for the development of villages

Act No. 156/1998 Coll., on fertilisers, soil conditioners, herbal medicines and substrates and agrochemical testing of agricultural soils – the Fertilisers Act (as amended)
- the use of fertilisers, auxiliary chemicals, modified sludge and sediments

Act No. 254/2001 Coll., on waters and on changes of some Acts (the Water Act) as amended
- implementation of the Nitrate Directive into national legislation

Government Regulation No. 262/2012 Coll., on designation of vulnerable zones and action programme, as amended
- the designation of vulnerable zones and establishing an action programme for these areas
- the determination of the resulting Good agricultural practice

Government Regulation No. 75/2015 Coll., on conditions for the implementation of agro-environment-climate measures and amending Government Decree No. 79/2007 Coll., on conditions for the implementation of agro-environment measures, as amended
- the maximum limit values of the content of monitored heavy metals, which can be contained in a soil sample

Operational Programme Environment 2014–2020
- finalization of the inventory of old environmental burdens (the target value for the year 2023 is 10 thous. of registered contaminated sites)
- implementation of remediation of the most seriously contaminated sites on the basis of risk analysis results (the target values for the year 2023 are 1.5 mil. m^3 of excavated or pumped contaminated material and 500 thous. m^2 of remediated sites in the Czech Republic)

21 | Risk of soil erosion and slope instabilities

Key question

How big is the proportion of agricultural land threatened by erosion what is the area of landslides in the Czech Republic?

Key messages

On the Czech Republic's territory, 56.7% of agricultural land is potentially threatened with water erosion[1], of that 17.8% with extreme erosion. Wind erosion is a threat for 18.3% of agricultural land. Since 2015, the vulnerability of soil to water erosion has increased by almost 10 percentage points[2], and for wind erosion by less than 1 p.p. The framework method of management to prevent further erosion is recommended for 53.8% of the evaluated area of agricultural land. The remaining area of agricultural land (46.2%) can be managed without restrictions.
On the mapped territory[3], the area of active landslides was 4.0 thous. ha.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-on-year change

[1] *Potential vulnerability of agricultural land to water erosion expressed as a long-term average soil loss G higher than 2.1 t.ha^{-1}.year^{-1}.*

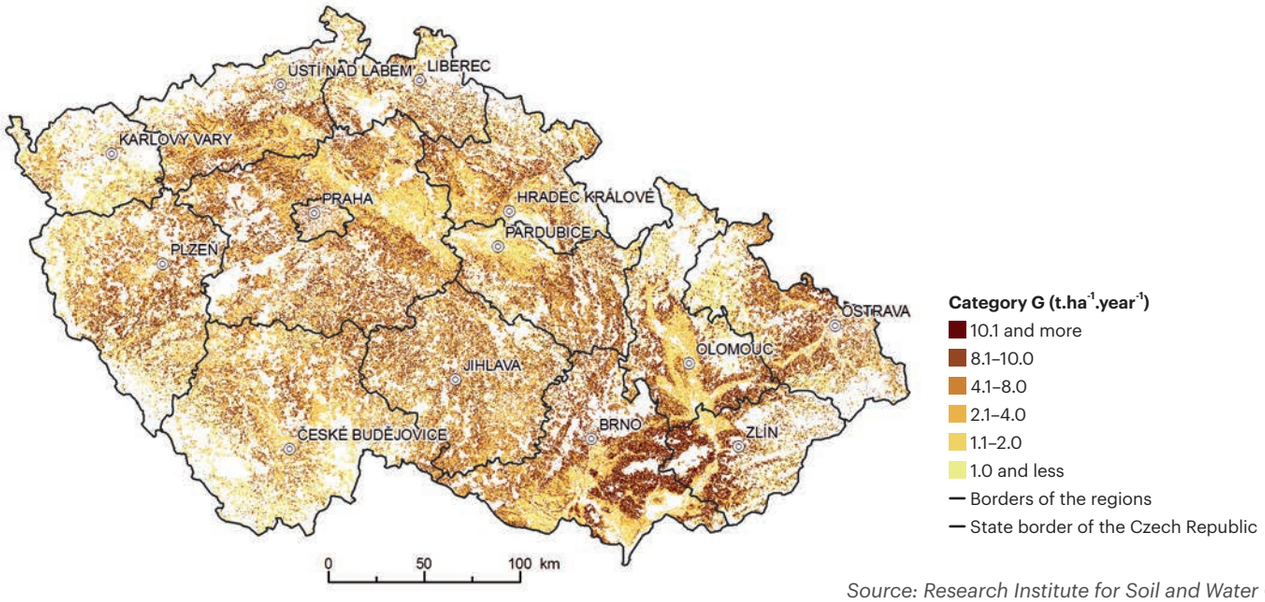
[2] *The jump in the area threatened with water erosion between the years 2015 and 2016 is caused by the change in the settings for the parameter of erosion effect of rain, expressed depending on kinetic energy and intensity of erosion-risk rains – the R factor. In 2015, the constant 40 MJ.ha^{-1}.cm.h^{-1} was used for the R factor. In 2016, the value of R factor was refined, a regionalised R factor is used.*

[3] *At present, due to the high complexity, only 14% of the territory of the Czech Republic is mapped.*

Indicator assessment

Figure 1

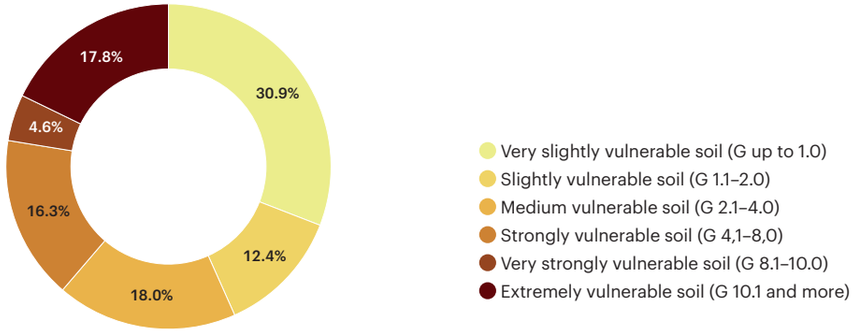
Potential vulnerability of agricultural land to water erosion expressed as a long-term average soil loss G in the Czech Republic [t.ha^{-1}.year^{-1}], 2016



Source: Research Institute for Soil and Water Conservation

Chart 1

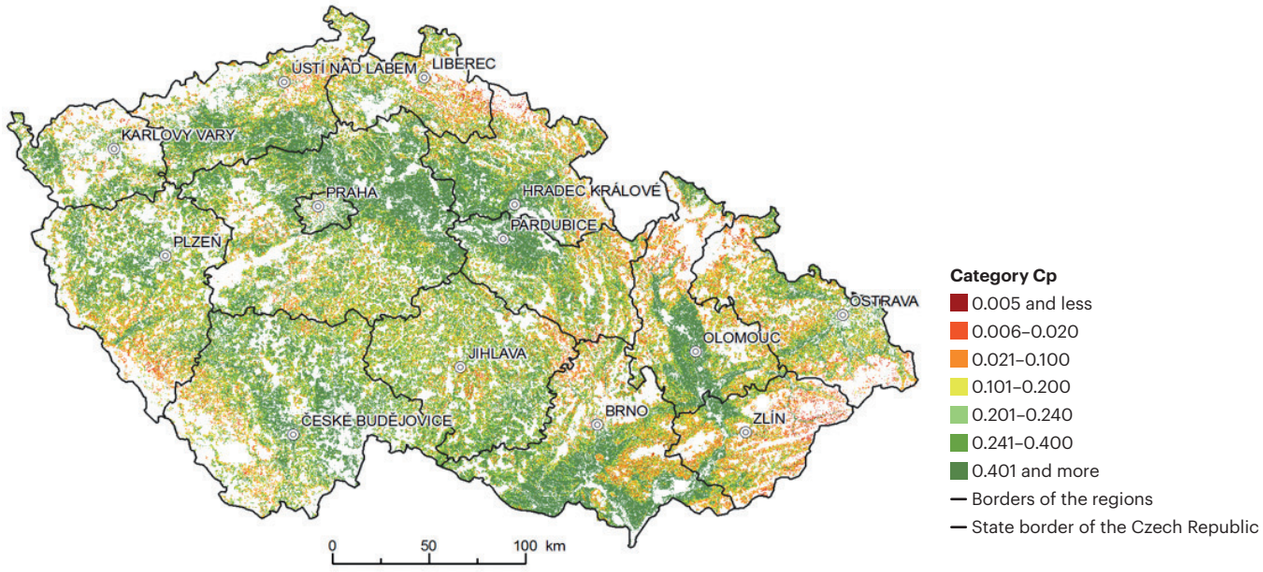
Potential vulnerability of agricultural land to water erosion expressed as a long-term average soil loss G in the Czech Republic [% of agricultural land resources], 2016



Source: Research Institute for Soil and Water Conservation

Figure 2

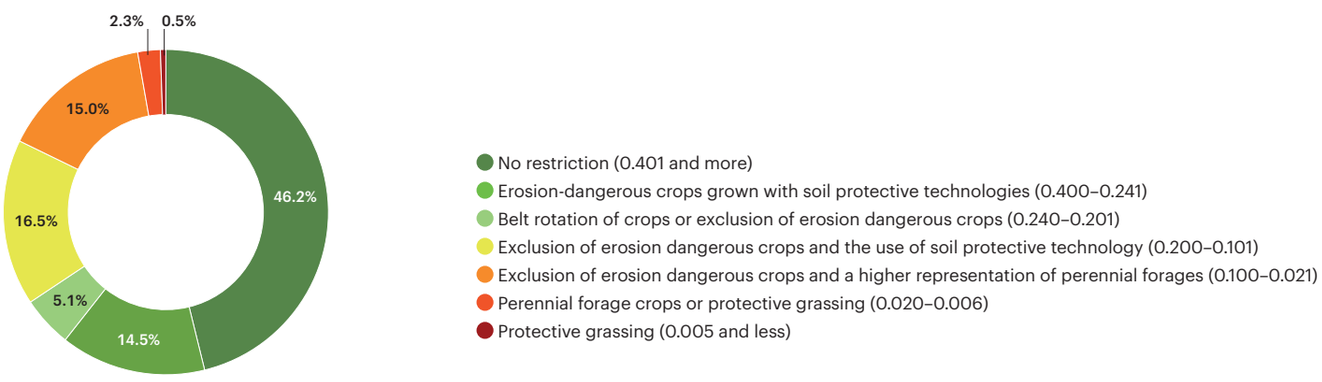
Vulnerability of agricultural land to water erosion expressed as the maximum admissible values of the protective vegetation influence factor (Cp) in the Czech Republic, 2016



Source: Research Institute for Soil and Water Conservation

Chart 2

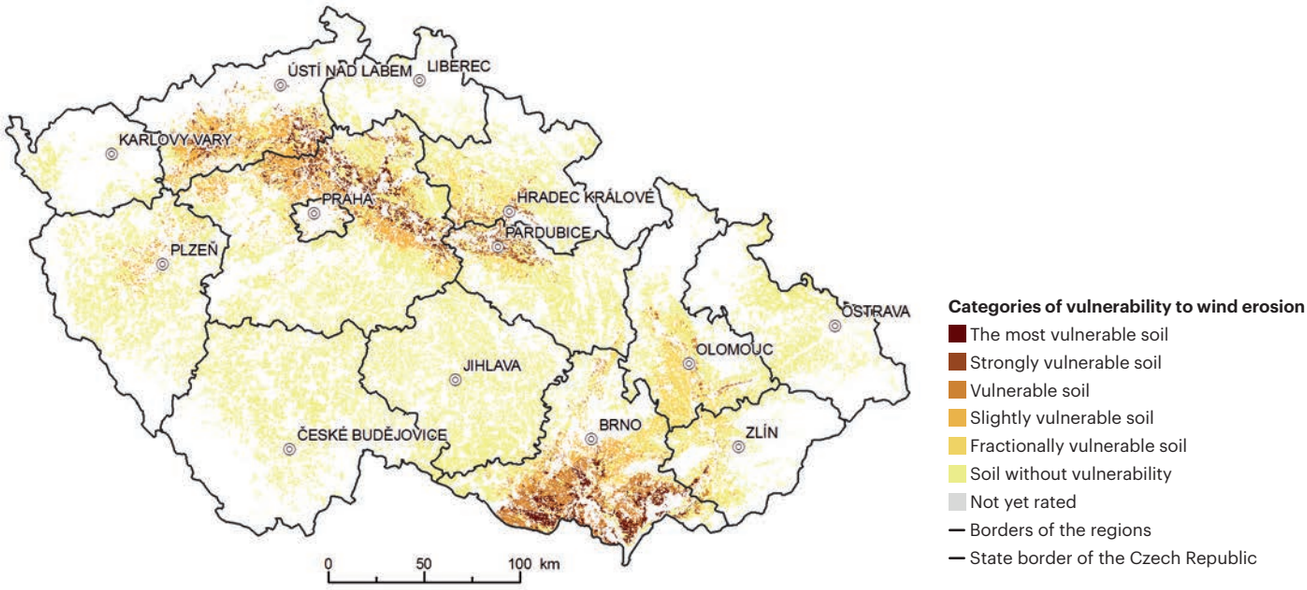
Vulnerability of agricultural land to water erosion expressed as the product of the maximum tolerable values of the protective vegetation influence factor (Cp) times the erosion control measures factor (Pp) in the Czech Republic [% of agricultural land resources], 2016



Source: Research Institute for Soil and Water Conservation

Figure 3

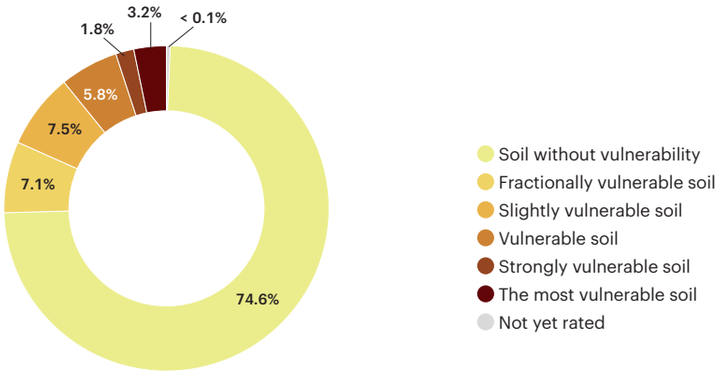
Potential vulnerability of agricultural land to wind erosion in the Czech Republic, 2016



Source: Research Institute for Soil and Water Conservation

Chart 3

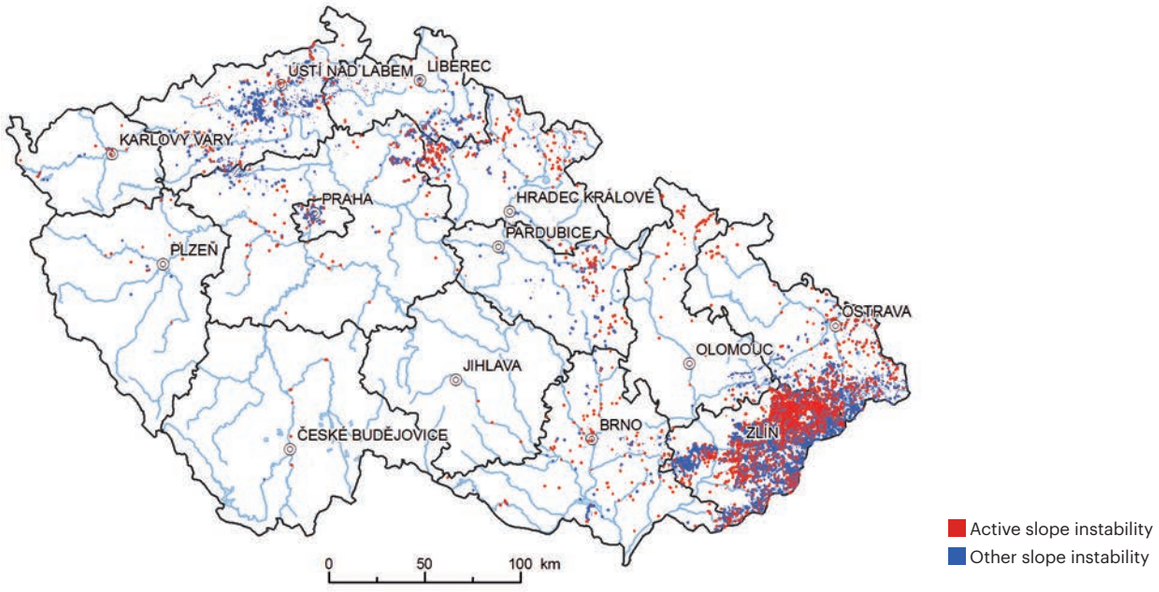
Potential vulnerability of agricultural land to wind erosion in the Czech Republic [% of agricultural land resources], 2016



Source: Research Institute for Soil and Water Conservation

Figure 4

Landslides and other dangerous slope instabilities on the territory of the Czech Republic, 2015



Source: Czech Geological Survey

Erosion in natural conditions is a gradually ongoing process compensated by weathering of substrate and formation of new soil. Human influences have accelerated this process considerably, in the case of the cultivation of erosion-risk crops (e.g. corn) up to thousand times. Such high erosion rate cannot be compensated by the very slow soil-forming processes (it is estimated that the period needed to form 1 cm layer of soil in the climatic conditions of the Czech Republic (and Central Europe) is around 100 years). The excessive loss of soil particles due to erosion may **reduce the depth of the topsoil**, or destroy the entire topsoil layer. On heavily eroded soils, the yields per ha are reduced by up to 75% and land prices are reduced by up to 50%. In addition to growing erosion-risk crops, erosion is accelerated also by massive land consolidation, monoculture cultivation, the removal of landscape elements, the absence of grassed strips or terraces, land management regardless of the slope of the land, etc.

Soil in the climatic conditions of the Czech Republic is threatened mainly by water and wind erosion. **Water erosion** threatens mainly the upper (the most fertile) part of land (topsoil) by washing away soil particles and depositing them in other places, so-called soil loss. The loss of soil particles causes clogging and soiling of reservoirs, which produces turbidity of surface water and worsens conditions for aquatic organisms. Water erosion threatens the most the areas with the most valuable soil (Polabí and Moravské úvaly, Figure 1), where the largest proportion of land with most vulnerable soil can be found. The proportion of land potentially vulnerable to long-term average soil loss (G)[4] greater than 2.1 $t.ha^{-1}.year^{-1}$ (i.e., above the lower limit of medium threatened soil) was 56.7% of the acreage of agricultural land in 2016 (Chart 1). Since 2015, the area of soil potentially endangered with long-term average soil loss increased by 9.7 percentage points (i.e., by 404,997.7 ha). In 2016, 17.8% of agricultural land was exposed to extreme water erosion (G higher than 10.1 $t.ha^{-1}.year^{-1}$), in 2015 it was 11.4%.

The level of water erosion threat for a territory can be expressed using the maximum admissible value of the protective vegetation influence factor Cp[5] (Figure 2). This value is used as the basis for specifying the type of a suitable framework method of farming (Chart 2), in which the excess loss of soil particles is not yet manifested. In 2016, it was possible to grow

[4] *The calculation of the average long-term soil loss (G) is based on the universal soil loss equation (USLE): $G = R \times K \times L \times S \times C \times P$ [$t.ha^{-1}.year^{-1}$]. Inputs into the equation include the following factors: rainfall and runoff erosivity factor adjusted for regional climate according to public land register database (R), soil erodibility factor (K), slope length factor (L), slope steepness factor (S), cover-management factor adjusted for regional climate (C) and the support practices factor (P).*

[5] *The calculation of Cp is based on the Universal Soil Loss Equation (USLE), expressed in the form: $Cp = Gp / (R \times K \times L \times S \times P)$. Inputs into the equation include the following factors: maximum permissible average annual loss of soil preserving soil functions and fertility relative to the depth of the soil (Gp), rainfall and runoff erosivity factor adjusted for regional climate according to public land register database (R), soil erodibility factor (K), slope length factor (L), slope steepness factor (S) and cover-management factor adjusted for regional climate (P). Cp are divided into 5 groups. The value is limited and its potentional exceeding should be eliminated by anti-erosion measures (Pp).*

erosion-risk crops on 65.8% of the area, of that on 46.2% without restriction and on 14.5% with soil-protective technology. On 5.1% of the area, the cultivation of erosion-risk plants was conditioned by strip cropping. The exclusion of erosion-risk crops was recommended on 31.5% of the territory. Of that, on 16.5% of the area, the recommendation included using **soil-protection technologies** and on 15.0% a higher representation of perennial forage. On the remaining 2.8% of the territory, it was recommended cultivating perennial forage crops or protective grassing. The types of framework management are recommended according to the standards of good agricultural and environmental condition that ensure the management is in agreement with environmental protection.

The effect of **wind erosion** on agricultural land is very similar to that of water erosion, also its causes are similar (outsize plots with one type of crop, missing windbreaks – alleys, game refuges, etc.). With regard to the current trends in land management it may be assumed that in the future the danger of wind erosion will increase. Wind erosion[6] potentially threatened 18.3% of agricultural land in 2016 (18.0% in 2015), of which 3.2% in the category of most vulnerable land. The categories of soils without risk covered 74.6% of the area.

Other factors threatening the agricultural land include the sealing or **compaction of soil**. Compaction of soil is the result of intensive farming, soil compression by repeated rides of heavy vehicles (mainly tractors, harvesters). Compacted soil loses its ability to absorb water, which leads to higher vulnerability to water erosion and higher acidification of soils. In 2016, compaction threatened over 33% of agricultural land, out of which 16.3% in the category of high vulnerability and 16.8% in the category of upper-middle vulnerability. About 70% of those soils is threatened by the so-called technology compaction (rides of heavy machinery) and the remaining 30% is threatened by genetic compaction (given by the natural characteristics of the soil).

Serious direct and indirect damage may also be caused by some of the geodynamic processes, in particular the slope instability. **Slope instabilities** can be of natural or anthropogenic origin, but are distinguished by the speed of movement, forming 4 basic groups: a creep (movement in the order of millimeters to centimeters per year), a slump (movement in the order of meters per day), a flow (movement in the order of meters per hour) and a fall (movement in the order of meters per second). In the Czech Republic, the behaviour of the slopes is affected mainly by extreme situations, the type of rock, the improper structures set up and also management in the landscape. Landslides most commonly affect large areas of the Czech Republic in the Outer Western Carpathians, Bohemian Central Uplands and the area around the River Ohře (Figure 4). In 2016, the registry of slope instabilities of the Czech Republic registered 18,345 objects of slope instabilities (17,787 in 2015). The area of landslides amounted to 71,337.8 ha (66,282.9 ha in 2015), of which 4.0 thous. ha consisted of **active landslides**, which are considered the most serious source of risk[7]. The long-term increase in the area of slope instabilities can be evaluated both in the context of increasing intensity of extreme weather events due to climate change, and in the context of mapping the phenomenon in the territory of the Czech Republic.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[6] *The methodology for establishing the potential vulnerability of agricultural land to wind erosion was used. From the data on soil environmental quality units, the data on climatic regions (the sum of daily temperatures above 10 °C, average rainfall certainty for the growing period, probability of dry vegetation periods, average annual temperature, annual precipitation), and information on the main soil units (genetic soil type, soil-forming substrate, grain size, skeletal characteristics, rate of hydromorfism). The final evaluation is expressed by the product of the climate region factor and the main soil unit factor.*

[7] *At present, due to the high complexity, only 14% of the territory of the Czech Republic is mapped.*

22 | Contaminated sites

Key question

How many contaminated sites are registered in the Czech Republic and what is the progress of their remediation?

Key messages

Remedial actions recorded in the Evidence System of Contaminated Sites over the period 2010–2016 include finalized remediation of 295 contaminated sites, 45 other remedial actions were completed in an unsatisfactory condition. From the Operational Programme Environment, financing was approved for 27 projects in 2016 for the implementation of the investigation work and risk analysis, the total costs represented CZK 234.0 mil.[8]

The incremental Evidence System of Contaminated Sites database currently contains 4,927 sites, of which 2,483 sites are up-to-date. In the land use planning analytical materials used for regional planning 9,307 contaminated and potentially contaminated sites are registered.

Despite the clear benefits and the amount of works already completed on the territory of the Czech Republic, there is still a large number of contaminated sites where the extent of risks to the environment and human health is not known.

Overall assessment of the trend

Change since 1990 N/A

Change since 2000

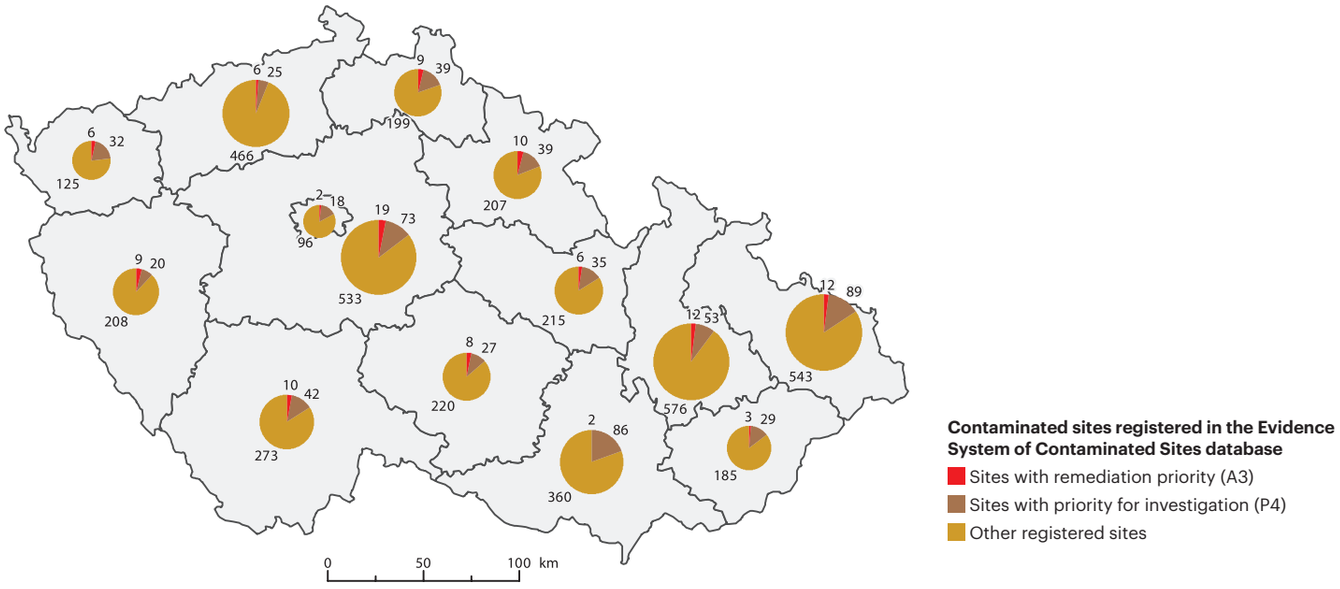
Last year-on-year change

[8] *These costs do not include two financially significant projects which were not finally appraised by the selection committee of the managing authority at the time of publication.*

Indicator assessment

Figure 1

Number of contaminated sites registered in Evidence System of Contaminated Sites in the Czech Republic, 2016

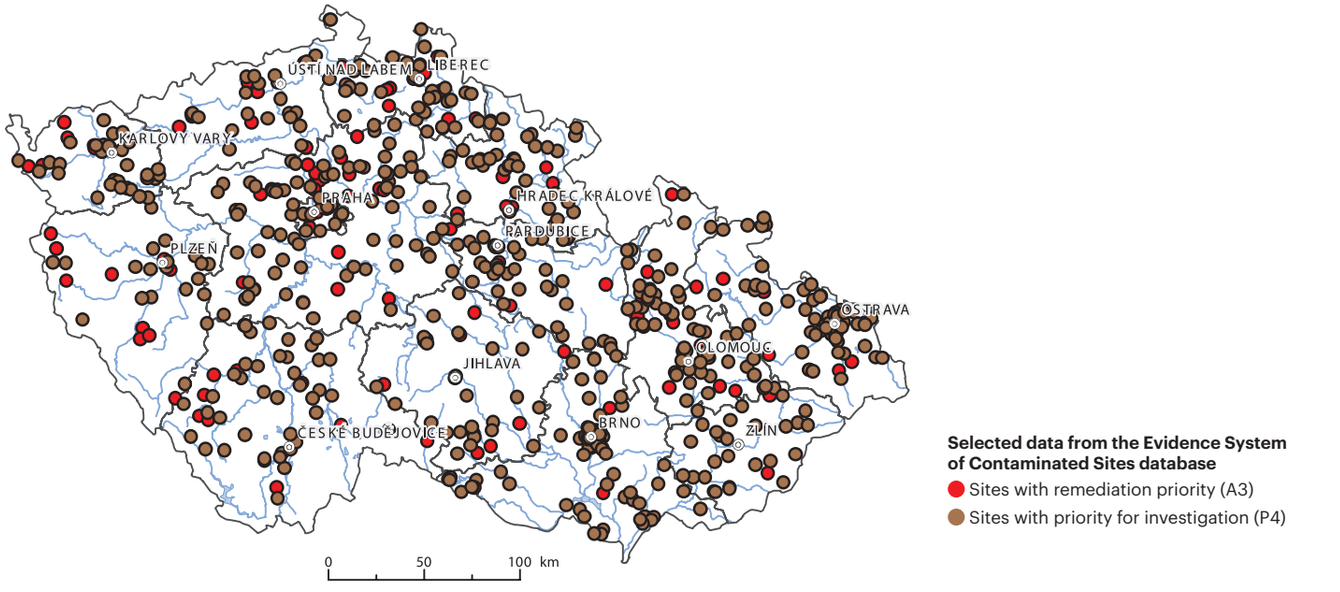


Sites with remediation priority (A3) and sites with priority for investigation (P4) have been determined according to the valid Methodological Guideline of the Ministry of the Environment No. 1/2011.

Source: Ministry of the Environment

Figure 2

Locations of contaminated sites with priority for remediation and for investigation, registered in Evidence System of Contaminated Sites in the Czech Republic, 2016

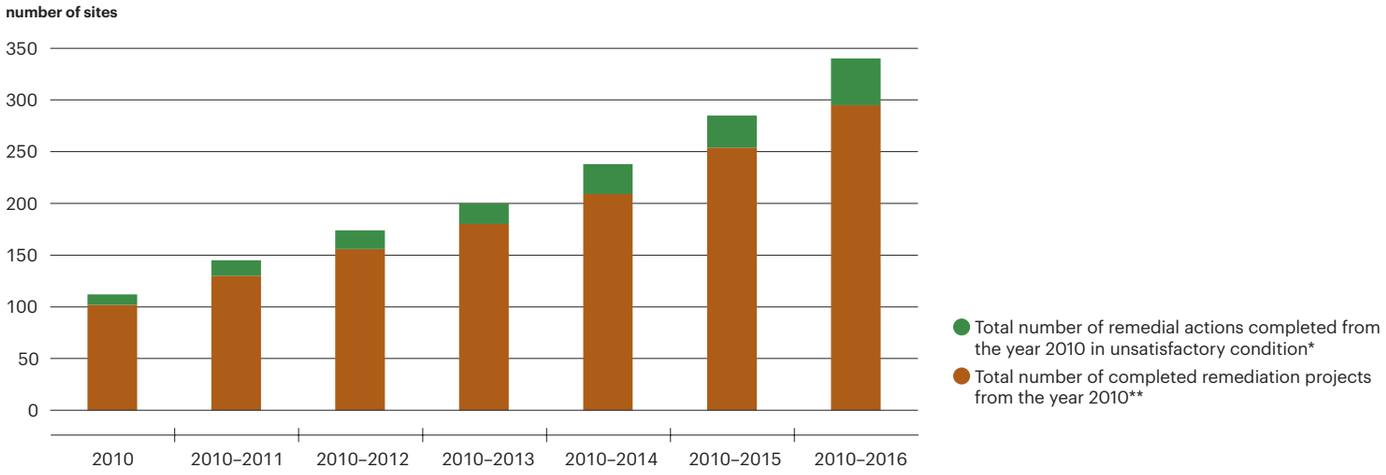


Sites with remediation priority (A3) and sites with priority for investigation (P4) have been determined according to the valid Methodological Guideline of the Ministry of the Environment No. 1/2011.

Source: Ministry of the Environment

Chart 1

Number of contaminated sites with completed remediation registered in Evidence System of Contaminated Sites in the Czech Republic, cumulative for the period 2010–2016



** Remediation was terminated for other reasons (e.g. lack of financial resources, unanticipated extent of contamination, newly identified circumstances, etc.).*
*** Remediation may be registered as completed also when post-remediation monitoring continues.*
Data for the whole period have been recalculated and adjusted due to changes to the methodology of their reporting.

Source: Ministry of the Environment

Contaminated sites represent a severe contamination of the rock environment, groundwater or surface water, soil or building structures, which occurred due to negligent handling of dangerous substances in the past (before 1989) and which endangers the health of humans and the environment. The extensive occurrence of contaminated sites in the Czech Republic is one of the remnants of many years of governance of the previous regimes, when environmental protection and the use of harmful substances in industrial and other production were at low level.

To record information about contaminated and potentially contaminated sites, the Czech Republic has operated since 2005 a database called **Evidence System of Contaminated Sites**, originally it was Evidence System of Old Environmental Burdens formed in 1996. This is an incremental database recording the existence of contaminated sites and their status, which is publicly accessible. The Evidence System of Contaminated Sites database has not been filled with systematic inventory data, but is formed by incrementally adding sites, because the issue of old environmental burdens remediation is not regulated by any law and there is no unified approach to this issue. For those reasons, the Evidence System of Contaminated Sites database does not provide an overview of the total number of contaminated or potentially contaminated sites in the Czech Republic. Therefore, in the years 2009–2012 the first phase of the National Inventory of Contaminated Sites was implemented. Within its framework, the methodology tools for inventorying maximum number of contaminated or potentially contaminated sites were developed. A pilot survey using new methodologies on 10% of the territory of the Czech Republic has registered nearly 1,000 sites, of which a third turned out to have been already registered in the Evidence System of Contaminated Sites.

Total **number of contaminated sites** in the Czech Republic is not known but is estimated approximately at 10,000 contaminated sites. In the land use planning analytical materials used for spatial planning, 9,307 sites are registered, including those, which are registered in the Evidence System of Contaminated Sites. The Evidence System of Contaminated Sites database contained 4,927 sites in 2016, of which 2,483 (50,4% of sites) are sites with up-to-date records and the remaining 2,444 sites in the Evidence System of Contaminated Sites database have not yet been updated. Most of the contaminated sites registered in Evidence System of Contaminated Sites are located in the Moravian-Silesian, Olomouc and Central Bohemian regions. These are mostly former industrial facilities, landfills, fuel stations, etc. (Figure 1 and 2).

Remediation of the contaminated sites should contribute to reducing health risks by removing the most hazardous contaminants from groundwater and rock environment and also has benefits for the revitalization of the landscape as a whole,

for the restoration of the state of the environment and regeneration of natural relationships in the ecosystems. Remedial interventions started before 1989 or immediately after were mostly carried out randomly without deeper economic priority analysis of the interventions, and that as a result of the economic interests of investors on the sites or in response to an acute threat to water resources, environment or public health. The systematic removal of the contaminated sites started on a larger extent after the year 1990. For some of them, especially within the framework of the privatization, the state accepted the liability.

At present, the need for remedial action (e.g. remediation) in the area of old environmental burdens is evaluated on the basis of an elaborated risk analysis, according to the relevant methodical guideline of the Ministry of the Environment No. 1/2011[9] which proves the potential of an adverse effect on the health of people or sensitive ecosystems near the contaminated site. The remediation of contaminated sites in the Czech Republic in predominantly **financed from three main sources**. The first source are the so-called "Environmental Agreements"[10], which provide Ministry of Finance of the Czech Republic funding towards contaminated sites incurred before privatisation of the former state enterprises, where the state assumed the liabilities associated with their existence in the 2nd privatisation wave. The second major source of funding are the financial sources of the individual ministries, state enterprises, etc. The third source of funds are European funds withdrawn through operational programmes, in particular the Operational Programme Environment. In that programme, it is possible to apply for financing in the case of an old environmental burden where pollution originator or successor in title is not known, or the originator has ceased without a successor. Under the 2nd call for intervention area 3.4, respectively the 36th call of the Operational Programme Environment 2014–2020 (April–June 2016), there were 27 projects on investigation work and risk analysis approved for financing, with total costs of CZK 234.0 mil.[11] and the financial requirement for the provision of subsidy from the Cohesion Fund was CZK 189.4 mil. For comparison, in the 1st call for intervention area 3.4, respectively the 7th call of the Operational Programme Environment 2014–2020 (September–November 2015), 23 projects on investigation work and risk analysis were approved for financing, with total costs of CZK 717.6 mil. and the financial requirement for grants from the Cohesion Fund was CZK 610.0 mil.

The number of contaminated sites with **completed remediation** in the Czech Republic may be, at least in part, evaluated on the basis of the data stored in the Evidence System of Contaminated Sites database (Chart 1), which does not include information on remediation projects of the regions, State Environmental Fund of the Czech Republic, other ministries and does not record even private entity projects, and therefore is not complete. In the period 2010–2016 remediation of 295 contaminated sites was completed, and another 45 remedial actions were completed in an unsatisfactory condition (e.g. because of lack of financial resources, unanticipated extent of contamination, newly identified circumstances, etc.). The largest number of completed remediation of contaminated sites was recorded in 2010. In 2016, remediation was completed on 41 sites and 14 other remedial actions have been completed in an unsatisfactory condition. Despite the undoubted benefits and the substantial extent of already implemented remedial actions, still a large number (in the order of thous.) of contaminated sites remain in the Czech Republic, where the extent of the risks to the environment and human health is not known, or the risks are so serious that it is essential to pay increased attention to them and to try to focus more financial resources in their remediation. Only by doing so, the number of old environmental burdens in the Czech Republic can be reduced, thus limiting even more any further potential contamination.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

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[9] *Ministry of the Environment (2011): Methodical guideline Risk analysis of contaminated territories*

[10] *In cases of national enterprises where the "Environmental Agreement" was not conclude as part of the privatization project, the buyer received a discount on the purchase price to cover the elimination of contamination. In these case of contaminated sites, the buyer became the successor of the originator of contamination.*

[11] *These costs do not include two financially significant projects which were not finally appraised by the selection committee of the managing authority at the time of publication.*

23 | Consumption of fertilisers and plant protection products

Key question

Is the amount of agrochemicals used in agriculture reducing?

Key messages

The consumption of livestock manure slightly decreased by 4% to 69.2 kg.ha^{-1}.
The consumption of plant protection products in 2016 remained at a similar level to 2015, it slightly increased by 0.5%.
The consumption of lime substances that enhance the production capability of the soil decreased by 9.5% to 258.0 thous. t.

The growing trend of consumption of mineral fertilisers continues. Compared to 2015, the consumption grew further in 2016 by 2.9% to 141.1 kg of pure nutrients.ha^{-1}.

Overall assessment of the trend

Change since 1990

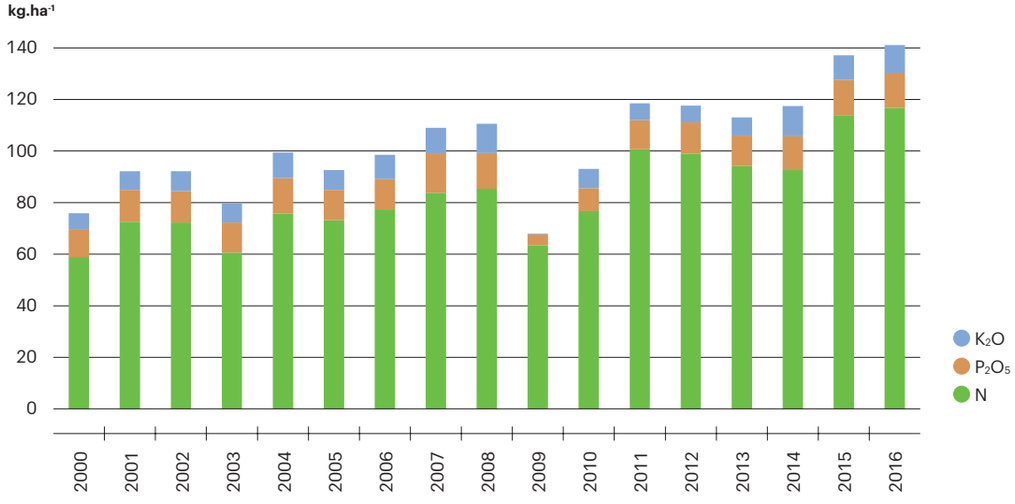
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

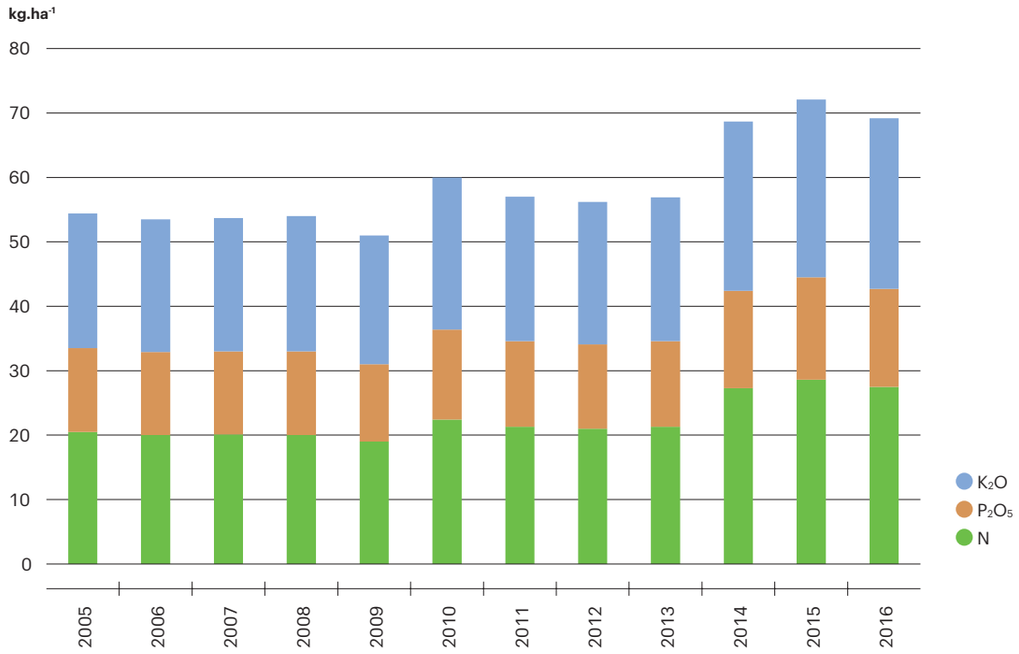
Development of the consumption of mineral fertilisers in the Czech Republic [kg of pure nutrients.ha^{-1}], 2000–2016



Source: Ministry of Agriculture

Chart 2

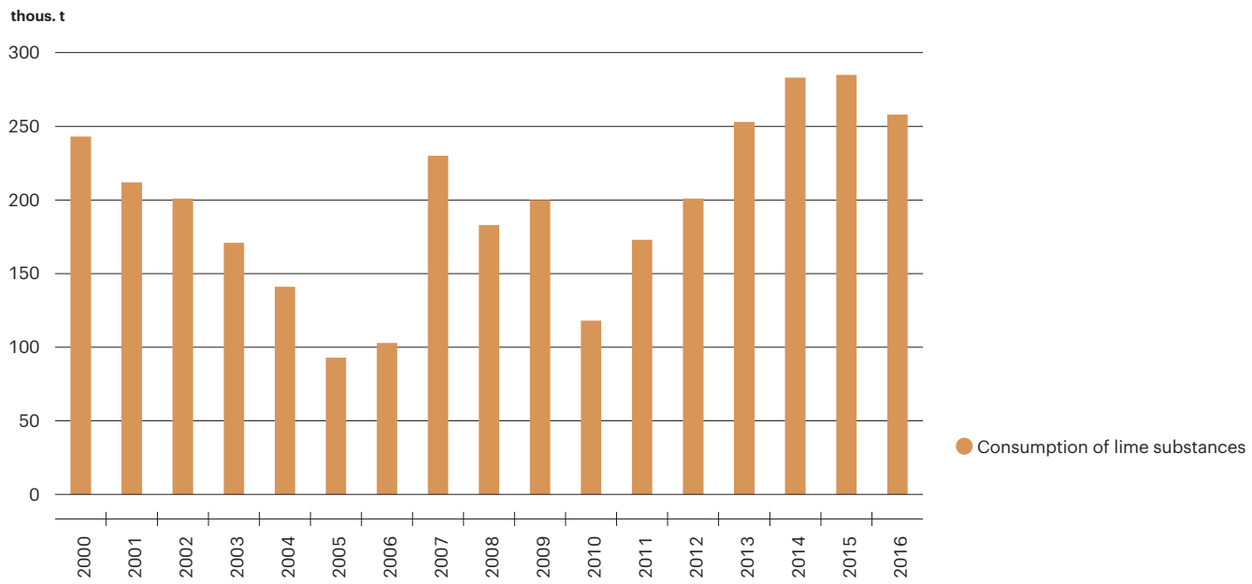
Development of the consumption of manure and organic fertilisers in the Czech Republic [kg of pure nutrients.ha^{-1}], 2005–2016



Source: Ministry of Agriculture

Chart 3

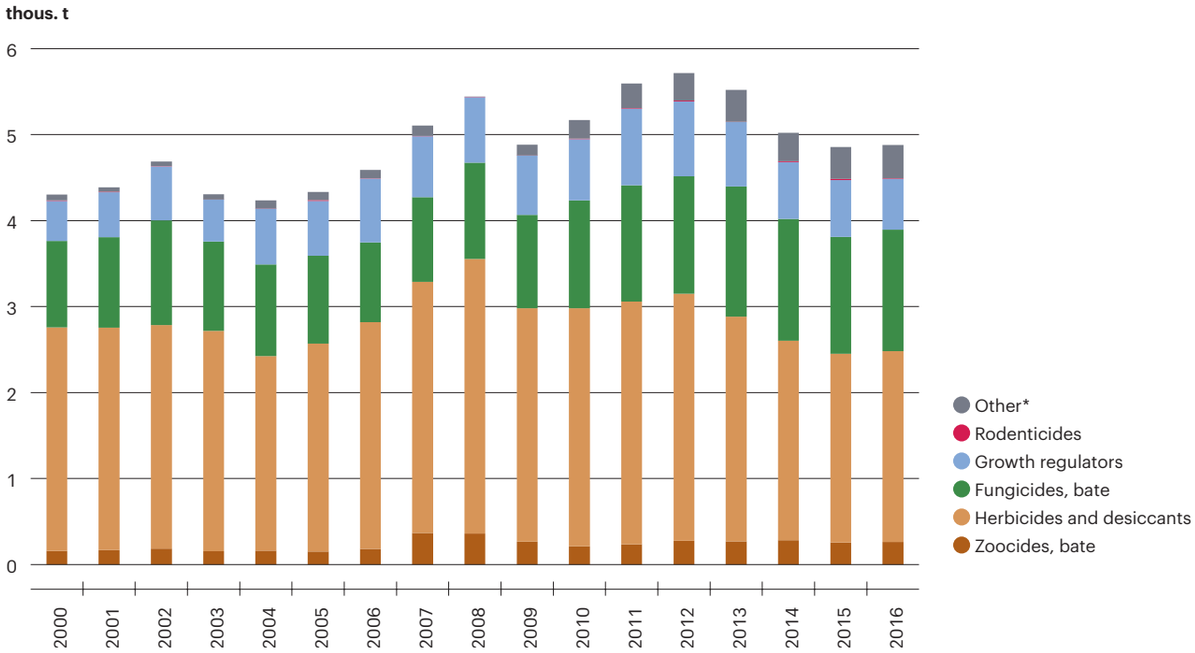
Development of the consumption of lime substances in the Czech Republic [thous. t], 2000–2016



Source: Ministry of Agriculture

Chart 4

Consumption of active substances contained in plant protection products and other resources according to the purpose of use in the Czech Republic [thous. t of the active substance], 2000–2016



**Other – auxiliary chemicals, repellents, mineral oils, etc.*

Source: Ministry of Agriculture

Since 2000, there has seen a gradually growing trend of **consumption of industrial mineral fertilisers**, with fluctuations in the individual years. In the period between the years 2011–2014 the development stagnated, but in 2015 there was a significant growth. A further overall slight increase occurred between the years 2015 and 2016, by 2.9% to 141.1 kg of pure nutrients.ha^{-1}. Mineral fertilizers application thus reached the highest values in the monitored period since 2000 (Chart 1). Compared to 2015, consumption grew the most for potassic fertilizers, by 13.7% to 10.8 kg.ha^{-1}. Nitrogenous fertilisers consumption increased by 2.7%, while consumption of phosphatic fertilisers decreased by 2.2%. Regarding the composition of mineral fertilisers, nitrogen fertilisers clearly dominate and represent more than 82.7% of total consumption. High consumption of fertilisers in the years 2015 and 2016 is associated with an effort to offset the negative effects of drought on crops. Atypical year in the entire period was 2009, with a marked decline, which was caused by high prices especially of phosphate and potassium fertilisers and low market prices of agricultural products.

The **consumption of organic fertilisers** after the previous decline caused by the decline of livestock production, stagnated in the period between 2004 to 2013. In 2014 it began to grow again (Chart 2) and since then it remains relatively balanced. In 2016, livestock manure (manure, slurry, etc.) and organic fertilizers (especially digestate from biogas plants) delivered 27.5 kg of N, 15.2 kg of P_2O_5 and 26.5 kg of K_2O per hectare of agricultural land (related to used land of 3,488,788 ha). Total intake of pure nutrients from manure and organic fertilisers was 69.2 kg.ha^{-1}. Input of nutrients in organic fertilizers, especially in the digestate, is included in this statistics from 2014. At the same time, a part of the livestock manure (slurry, but also manure), forming the input raw material for biogas plants, is deducted. Nutrients from the livestock manure make up an estimated half of the nutrients in the resulting digestate. The other half of the nutrients comes from biomass entering the biogas plants (mainly silage maize). That amount in fact increases the input of nutrients from organic fertilizing. Generally speaking, the consumption of fertilisers depends mainly on the temperature and precipitation conditions, the intensity of farming and cultivated crops. The limiting factor in fertiliser consumption is then the financial standing of farming entities.

Given the relatively large share of agricultural land with the unfavourable soil reaction (low pH), it is expedient to apply lime substances to these soils. **Adjustment of the soil reaction by applying lime substances** contributes to the improvement of the fertility of the soil and the production capacity while maintaining and improving their physical, chemical and biological properties. From 2010 to 2014, there was a growing trend of liming, between 2014 and 2015 it stagnated and in 2016, the consumption of lime substances declined year-on-year by 9.5% to 258.0 thous. t (Chart 3). The result is an increase in the share of agricultural land with increased acidity. In the Czech Republic, the average value of soil reaction of agricultural land over the period 2010–2016 was 6.10 pH (i.e. slightly acidic). A total of 29.7% of the acreage of agricultural land (i.e. 942.8 thous. ha of agricultural land) has an extremely acidic, strongly acidic and acidic soil reaction (i.e. pH up to 5.5). Given that the other 39.8% of agricultural land has a slightly acidic soil reaction, nearly 69.5% of agricultural land would require the application of lime substances. The proportion of alkaline soil (pH above 7.2) amounted to 13.4% of the agricultural land.

The **consumption of plant protection products**, as another anthropogenic input of substances into the soil, is influenced by the current occurrence of diseases and crop pests in a given year, which changes according to the weather during the year. The consumption of plant protection products declined since 2012, but in 2016 it increased slightly year-on-year by 0.5% to 4,878.8 kg of active substances (Chart 4). The largest proportion of the total consumption were herbicides and desiccants (45.5%), followed by fungicides and bate (29.0%) and growth regulators (12.1%).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

24 | Quality of agricultural land

Key question

What is the quality of soil having an effect on soil properties, water quality and the food chain?

Key messages

In monitoring the content of risk elements and substances in the soil (BSM), it was found in 2016 that the prevention values were exceeded for all persistent organic pollutants except for HCH. The highest share in the excess was recorded in PAH (20.0%).
According to the results of the determination of the content of the risk elements in the soil in the Registry of Contaminated Areas, the most problematic were in the period 1998–2016 the levels of cadmium (9.7% of samples in excess) and arsenic (9.0% of samples in excess).
PAH and cadmium are the most problematic also in reservoir and river sediments. In the samples for the period 1995–2016, the limit values were exceeded in 25.5% of the samples for PAH and in 16.8% of the samples for cadmium.

Overall assessment of the trend

Change since 1990

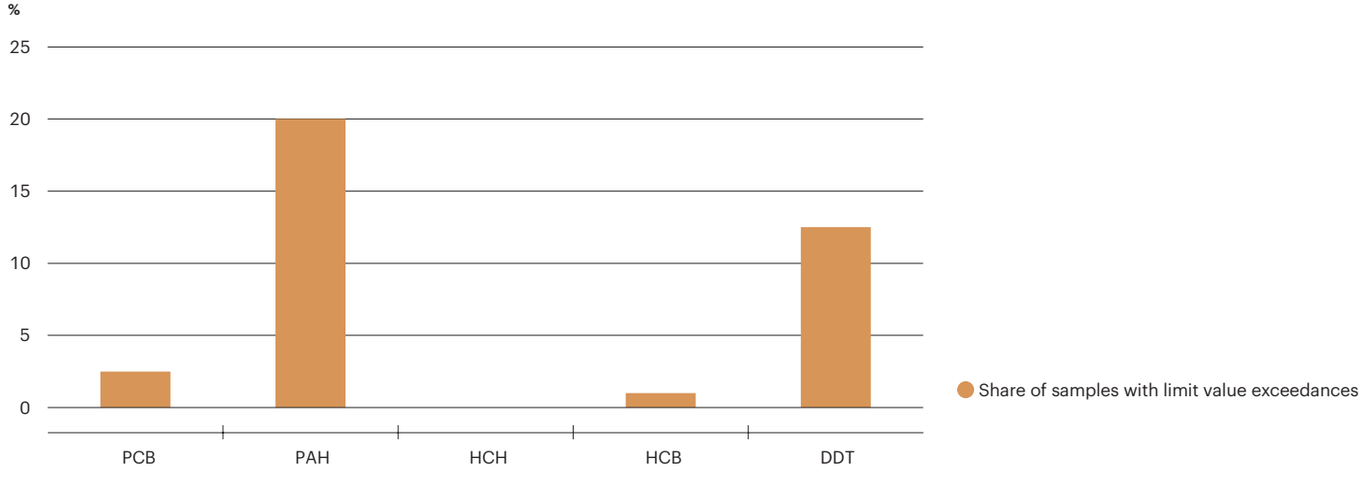
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

Proportion of samples exceeding limit values of risk substances in soil in the Czech Republic [%], 2016

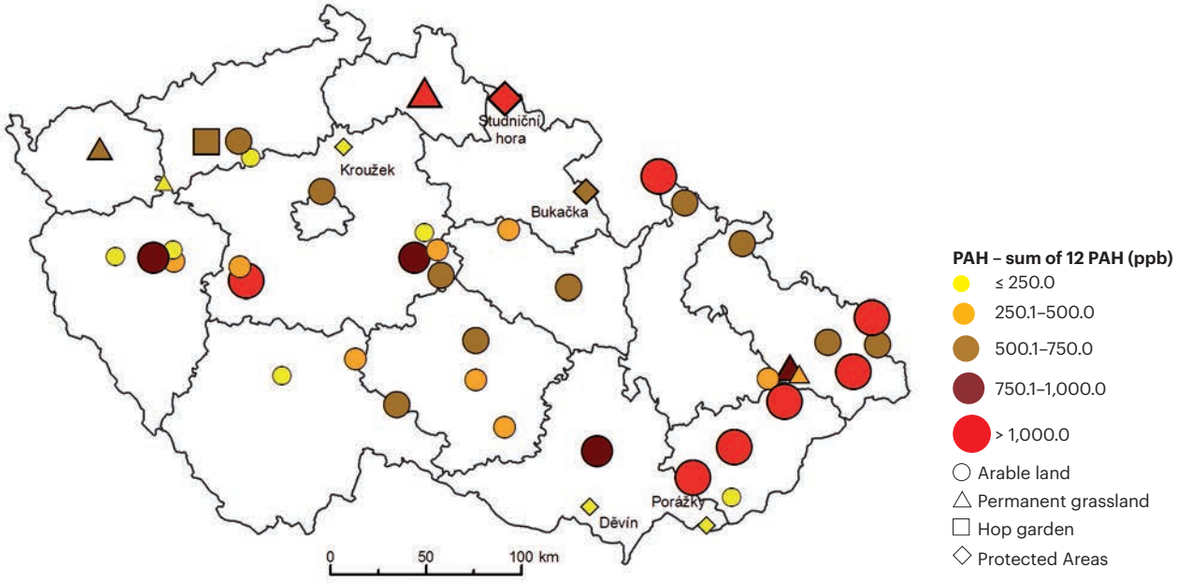


Results of Basal Soil Monitoring (BSM). Established on the basis of samples from 40 selected monitoring areas. The preventive values for the specified risk substances are established by Decree No. 153/2016 Coll.

Source: Central Institute for Supervising and Testing in Agriculture

Figure 1

Contents of the sum of 12 EPA PAH in the topsoil of agricultural land (under BSM) in the Czech Republic [μg.kg^{-1}], 2016

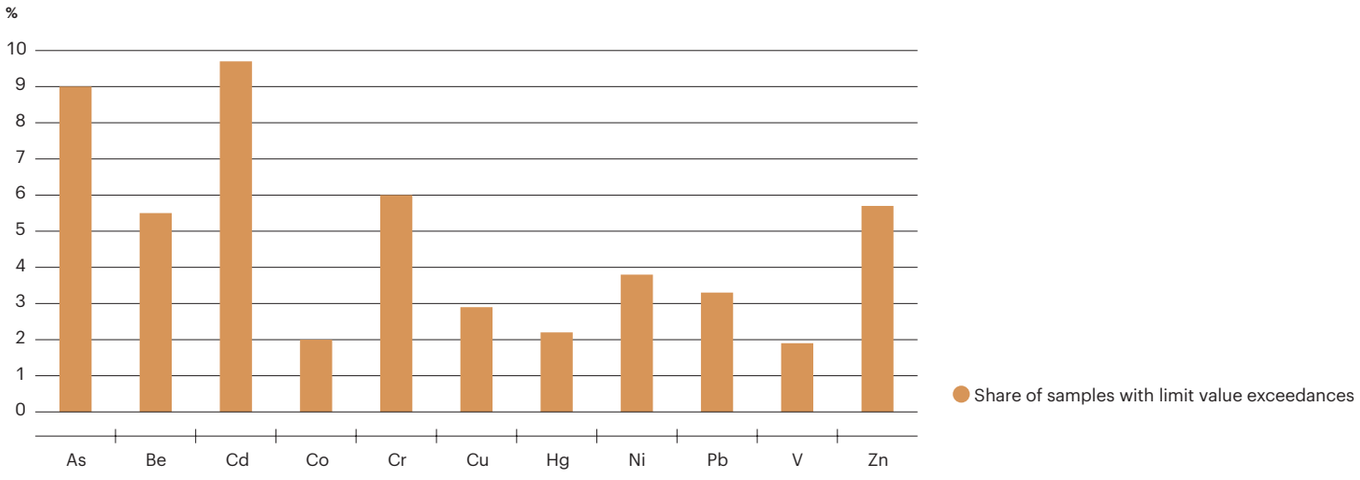


Established on the basis of samples from 40 selected monitoring areas and 5 localities in protected areas. Preventive value for the sum of 12 EPA PAH according to Decree No. 153/2016 Coll. amounts to 1,000 ppb (1.0 mg.kg^{-1} of dry matter).

Source: Central Institute for Supervising and Testing in Agriculture

Chart 2

Proportion of soil samples exceeding the preventive values for the content of elements in the extract of aqua regia in the Czech Republic [%], 1998–2016

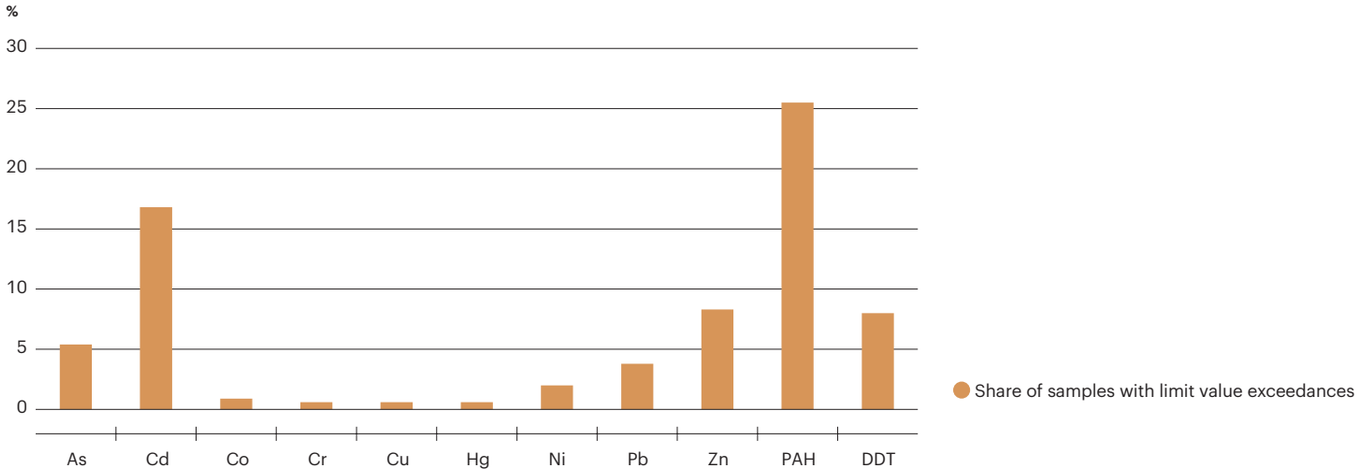


The results of the Registry of Contaminated Areas, 12,825 samples evaluated, in the case of mercury 51,004 samples evaluated. The preventive values for the specified risk substances are established by Decree No. 153/2016 Coll.

Source: Central Institute for Supervising and Testing in Agriculture

Chart 3

Proportion of reservoir and river sediment samples exceeding the limit values in the Czech Republic [%], 1995–2016



The results of the long-term monitoring of inputs into the soil (sediments). Risk elements 1995–2016, approximately 500 samples; PAH: polycyclic aromatic hydrocarbons (sum of 12 PAH), monitored 2009–2016, 47 samples; DDT: sum of DDT including metabolites, monitored 2007–2016, 50 samples.

Source: Central Institute for Supervising and Testing in Agriculture

The quality of agricultural land and subsequently the quality of agricultural production produced from it are adversely affected in the Czech Republic, in particular by the content of the risk elements, which get into soil and sediment by input from economic activity of humans. The **monitoring of the content of the risk elements and substances in the soil** covers both inorganic pollutants, or risk elements (e.g. As, Cd, Ni, Pb, Zn, etc.) and persistent organic pollutants. These include in particular the 16 polycyclic aromatic hydrocarbons (16 EPA PAHs), polychlorinated biphenyls (7 PCB congeners) and organochlorine pesticides (HCB, HCH, substances of the DDT group). The core network of BSM points was founded in 1992. The system currently includes 214 monitoring plots. Sampling of soil from all monitoring plots for the purpose of determining the content of risk elements takes place in six-year cycles. The first sampling was made in 1992, three years later, in 1995, the sampling was made according to an optimised sampling method and the subsequent sampling has been carried out on a regular six-year basis. The last cycle took place in 2013. The samples from the six-year cycles are used to determine, in addition to the risk elements, also the content of the accessible nutrients, of accessible microelements (B, Cu, Fe, Mn), exchangeable and active pH[12]. On selected plots, regular sampling of plants is made every year in order to determine the content of risk elements in agricultural crops and soil sampling focused e.g. on microbiological parameters, the content of mineral nitrogen, or on monitoring selected persistent organic pollutants (POPs). The presence of hazardous elements and substances in soil is not necessarily related to agricultural activity, and if so, it is mainly due to the application of plant protection products, sludge from WWTPs or sediments from water reservoirs and watercourses.

The contents of the risk elements and substances in the soil have been evaluated since 1 June 2016 according to a two-step system of preventive and indicative values, referred to in Decree No. 153/2016 Coll. Compared to the previously valid Decree No. 13/1994 Coll., several changes took place in the monitored POPs: polycyclic aromatic hydrocarbons (PAH) are evaluated as the sum of the 12 listed substances, the content of the individual hydrocarbons is no longer evaluated; the substances of the DDT group are evaluated as the sum of o,p'- and p,p'- isomers of DDT, DDE and DDD.

In 2016, the preventive value was exceeded in at least one sample for each of the above POPs. An exception is only HCH, whose content in the soil has been negligible in the long term and preventive value was not exceeded in 2016 (Chart 1). The highest proportion of samples exceeding the preventive values was measured in the sum of 12 PAHs. PAHs are formed also in natural processes, but currently their occurrence is higher in the environment, among other things as a result of human

[12] *A detailed evaluation of the contents and changes in monitored parameters can be found here: http://eagri.cz/public/web/ukzuz/portal/hnojiva-a-puda/publikace/bezpecnost-pudy-zpravy/monitoring-pud/bazalni-monitoring-zemedelskych-pud/*

activity, especially the inefficient burning of carbon fuels. They have a high bioaccumulation ability and depending on the structure, some of them have carcinogenic effects. The exceedance occurred on eight selected observation plots of BSM (it was, in particular, in Eastern Moravia) and on one of the sites of protected areas (Figure 1).

The monitoring of the content of the risk elements and substances in the soil can be used to monitor the development of the content of risk elements in agricultural soils in the Czech Republic. More detailed information about the contents of elements in soils can be obtained from so-called **Registry of Contaminated Areas**[13]. According to the results of the determination of the contents of the risk elements in the soil after extraction by aqua regia (Chart 2), the most problematic in the period 1998–2016 were the levels of cadmium with 9.7% of samples in excess for all soils (i.e., for light and other types of soils that include sandy-loamy, loamy, clayey-loamy and clayey soil), arsenic (9.0%), chromium (6.0%) and zinc (5.7%) and beryllium (5.5%).

In order to prevent undesirable increase of the contents of elements and substances in the soil, strict conditions have been laid down e.g. for the application of sediment, involving the monitoring of both the quality of the soil on which the sediment is to be applied, and the sediment itself. CISTA (Central Institute for Supervising and Testing in Agriculture) has performed **quality monitoring of reservoir and river sediments** since 1995 (Chart 3). In the period 1995–2016, the largest percentage of samples exceeding the limit values was recorded for PAH (25.5%), and cadmium (16.8% of the samples). For arsenic, zinc and DDT, 5 to 10% samples in excess were found.

Risk inputs of substances into soil include the **sludge from wastewater treatment plants**. Sludge can be applied to soil only if it is modified and must comply with the limits for the content of the risk elements and substances. The contents of each of the elements and organic pollutants have been evaluated since 2016 according to Decree No. 437/2016 Coll. In 2016, tests were made of 82 samples of sludge, one sample was taken from each of 80 selected WWTPs in the course of the year and two samples were taken directly from the field of sludge intended for direct application to agricultural land. Out of those samples, 18 were in excess (i.e. 22.0%) and 25 were found to exceed the limit contents of the risk elements. Same as in 2015, the most frequently exceeded limits were for copper (6 exceedances, the equivalent of 7.3% of the samples), followed by nickel (5 exceedances, 6.1%) and chrome (4 exceedances, 4.9%).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[13] *Registry of Contaminated Areas: the database of the Registry contains coordinates-determined areas of sampling and the relevant values of the contents of the risk elements in the soil (mg.kg^{-1}). A basic overview of the sites with detected excess levels of risk elements in the soil is provided by the maps of the Registry. The database has two parts: (1) results of determining the contents of the risk elements in the extract of 2M HNO_3 – this section is already closed; (2) results of determining the contents of risk elements after extraction by aqua regia – this part of the database is continuously replenished with the results of new investigations.*
For more detailed information see http://eagri.cz/public/web/ukzuz/portal/hnojiva-a-puda/bezpecnost-pudy/registr-kontaminovanych-ploch/.

25 | Organic farming

Key question

Is the proportion of agricultural land under organic farming increasing?

Key messages

The number of organic farms continues to grow. In 2016, the Czech Republic had already 4,243 organic farmers, which is by 147 more than in 2015 and 7.5 times more than in 2000.
The proportion of organically farmed land is slowly growing. In 2016, 506.106 ha, i.e. 12% of the total area of the agricultural land fund was farmed. Out of that area, 82.6% accounted for permanent grassland and 13.1% for arable land.

Although the organic food market is slowly developing, the average and total consumption per capita is still very low. The proportion of organic food in total food and drink consumption was only 0.8% in 2016 in the Czech Republic.

Even in 2016, the 15% share of organically farmed land in the agricultural land resources was not achieved, which was the objective set by the Action Plan for the Development of Organic Farming already for 2015.

Overall assessment of the trend

Change since 1990

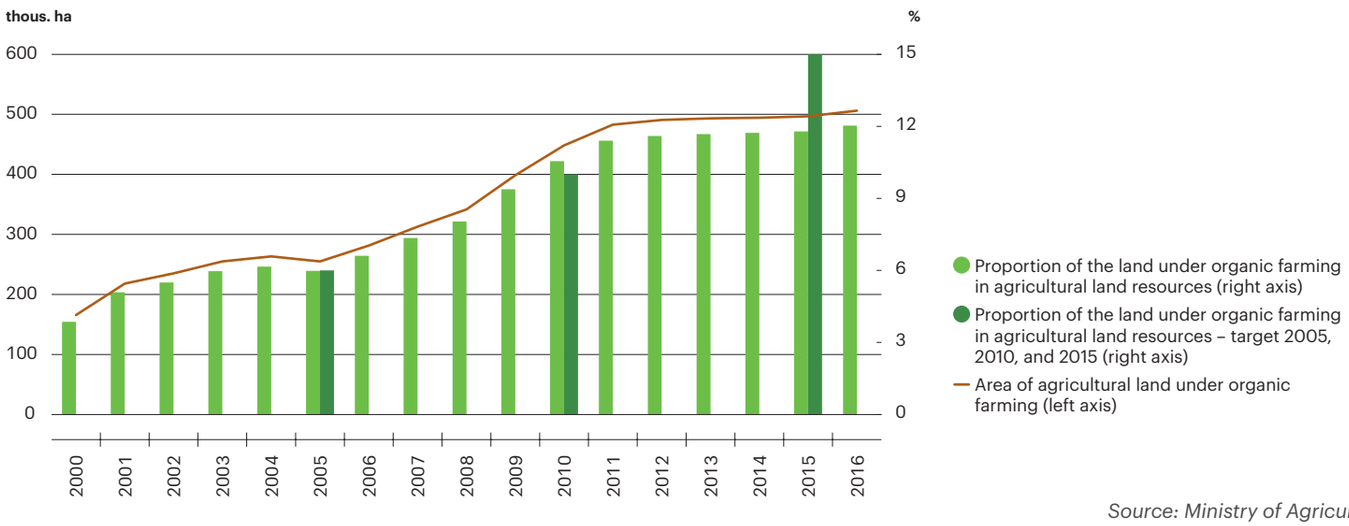
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

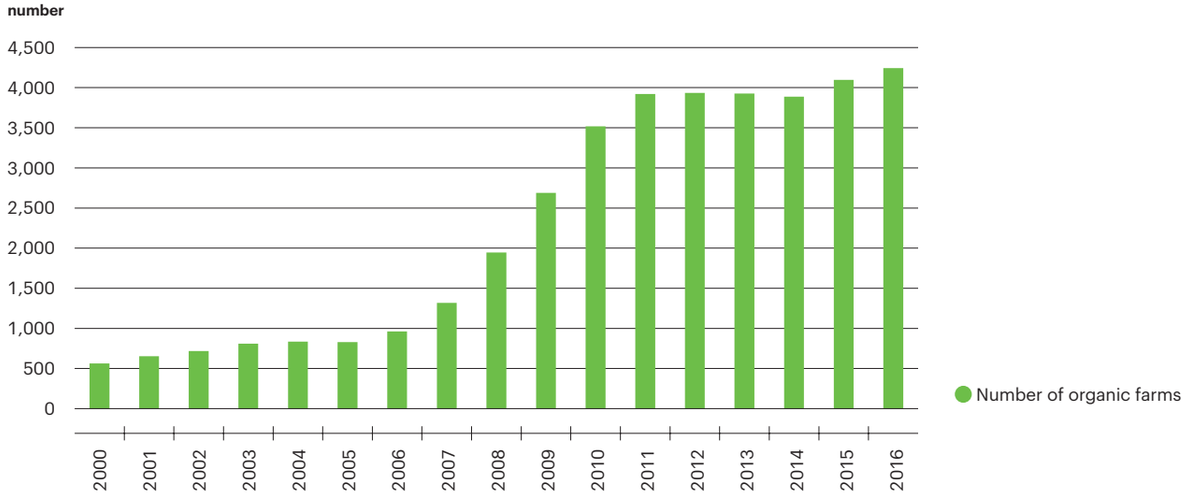
Area and proportion of the organically farmed land in agricultural land resources in the Czech Republic [thous. ha, %], 2000–2016



Source: Ministry of Agriculture

Chart 2

Organic farms in the Czech Republic [number], 2000–2016

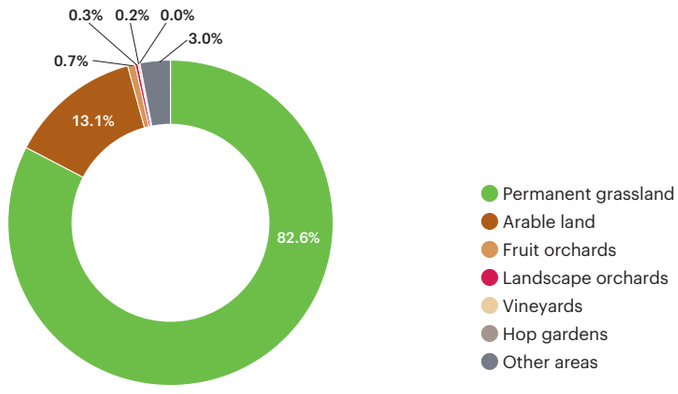


The number of organic farms does not include their branches.

Source: Ministry of Agriculture

Chart 3

Structure of land resources in organic farming in the Czech Republic [%], 2016

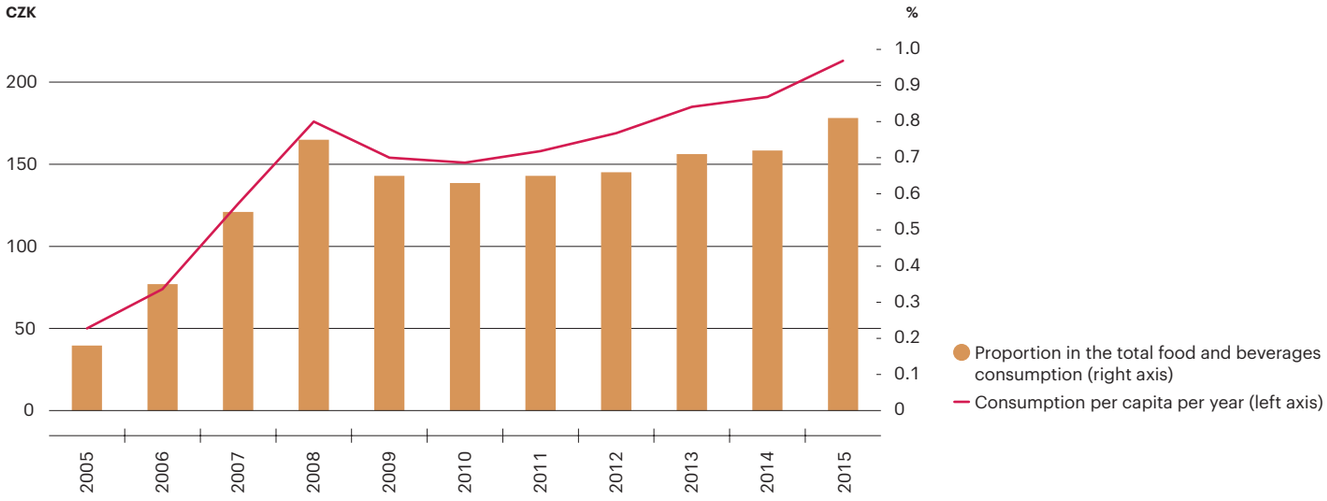


The category of Other areas includes the area of fast-growing tree species, nurseries, forested land and other culture.

Source: Ministry of Agriculture

Chart 4

Consumption of organic food in the Czech Republic [CZK, % of the total food and beverages consumption], 2005–2015

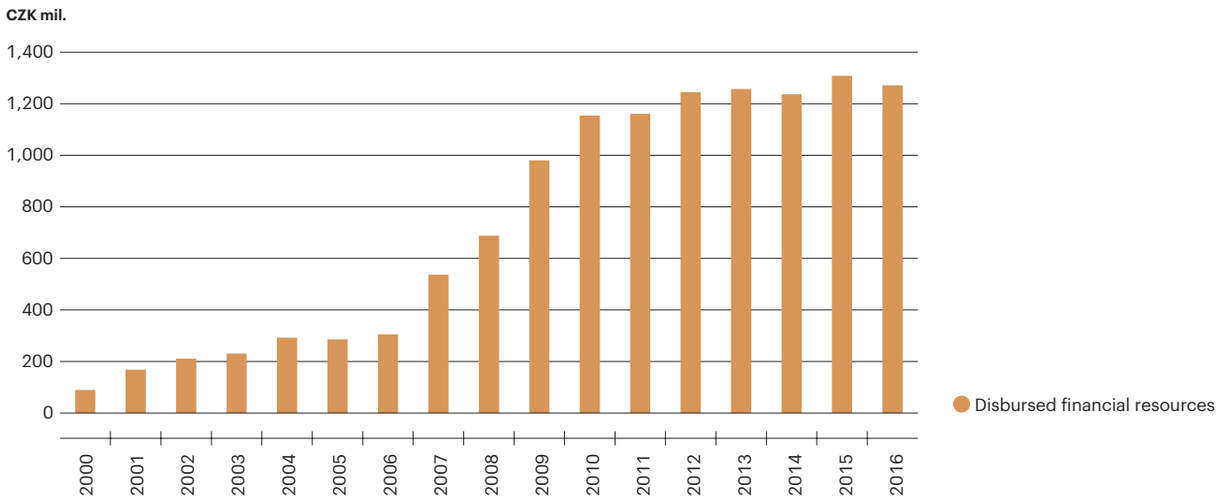


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Institute for Agricultural Economics and Information, Ministry of Agriculture

Chart 5

Financial resources disbursed within the „Organic Farming" agro-environmental measure in the Czech Republic [CZK mil.], 2000–2016



Source: Ministry of Agriculture

One of the important indicators of the development of organic farming is the **acreage of organically farmed land in the Czech Republic** (Chart 1). Since 2000, it has risen more than threefold – from 165.7 thous. ha to 506.1 thous. ha in 2016 and year-on-year by 11.5 thous. ha. In 2016, 12.0% of the total area of the agricultural land fund was organically farmed. While in the years 2005 and 2010 the targets of the relevant Action Plan for the Development of Organic Farming concerning the share of land under organic farming in the total agricultural land resources were achieved in the period 2011–2015, the targets for 2015[14] (15% share) were far from being achieved, as this share was only 11.8%. One of the main reasons for the failure to achieve the goal was the closure of entry for new applicants under the scheme Organic Farming as part of the Rural Development Programme (2007–2013) in the years 2012–2014. The reason was an effort to avoid overlapping of old and new commitments with different grant terms at the end of the programming period, and also the absence of the final text of the new legislation for the forthcoming programming period. The target of 15% of the agricultural land resources was therefore extended until 2020[15].

Since the year 2000, the **number of organic farms**, farming in accordance with the established principles of organic farming increased 7.5 times from 563 to 4,243 organic farms in 2016 (Chart 2). After a period when the number of organic farms stagnated with only small fluctuations in the period 2011 to 2014 due to the development of the Rural Development Programme, since 2015 it has grown again. In 2016, 147 more organic farms were registered than in 2015.

Regarding the **structure of the use of organically farmed land** (Chart 3), the largest proportion in the organically farmed land is permanent grassland, which accounted for 82.6% (418.3 thous. ha) in 2016. The second largest proportion of organically farmed land area is represented by arable land accounting for 13.1% (66.4 thous. ha). Although the size of both of these categories increased year-on-year, the proportion to the total area of organically farmed land remained almost the same. The rest of organically farmed land area, i.e. 4.2% then consists of permanent crops (vineyards, orchards, hop gardens) and other areas. Although permanent grassland play an irreplaceable role in the landscape and are used for organic livestock farming, it is desirable to increase the share of organically-farmed arable land, so that the availability and variety of Czech organic food and the number of job opportunities in the organic farming sector could grow.

The number of **producers of organic food** is increasing in the long term. While in the year 2001 organic food was made by 75 producers, in the year 2016 it was already 607 producers. Despite the growing trend (Chart 4), the Czech organic food market is still underdeveloped – the average annual consumption of organic food in 2015 reached CZK 213 per capita and the proportion of organic food in the total consumption of food and beverages was 0.81%. Apart from the still relatively high average cost of organic foods, the reason is in particular the low-performing sales of organic products (marketing, distribution networks) and underdeveloped processing industry for organic products. A large part of organic food comes from imports-import by distributors in 2016 was approximately 39% of the turnover, after including imports realised by the so-called "mix" entities (a combination of a manufacturer and a distributor), the share of imports grew to about 62%.

Significant development of organic farming is primarily due to European and State aid, which, however, also has its downsides (increasing the dependence of organic farmers on subsidies, reducing their engagement in the economic efficiency of farming, etc.). Traditional support for organic farmers is currently paid under the **Rural Development Programme 2014–2020**, measure M 11 Organic farming. The volume of funds paid out under the agro-environmental scheme "Organic farming" has been relatively stable in recent years and ranges around CZK 1.3 bil. (Chart 5). The Ministry of Agriculture also financially supports the training of organic farmers and organic food producers every year, the educational activities are implemented predominantly by non-governmental organisations.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[14] *Action Plan of the Czech Republic for the Development of Organic Farming in the years 2011–2015*

[15] *Action Plan of the Czech Republic for the Development of Organic Farming in the years 2016–2020*

Land and agriculture in the global context

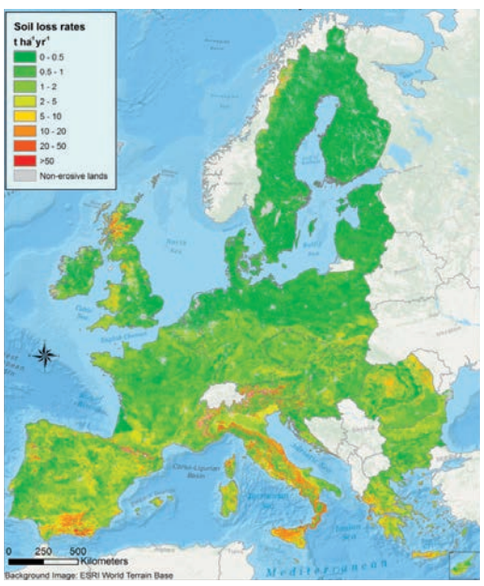
Key messages[16]

- Water erosion, according to the model data as of 2015, threatens 90.3% of the EU28 territory. The most vulnerable soils are exposed to the soil loss exceeding 10 $t.ha^{-1}.year^{-1}$. Wind erosion, which is estimated to threaten approximately 9.6% of EU28 territory, also represents a serious problem in many areas of Western Europe.[17]
- Contaminated sites represent a major problem for the quality of soils and water in many European countries. In 2011, 2.5 mil. of potentially contaminated sites were estimated to exist in selected European countries, of which 45% (around 1.1 mil. sites) have been identified to date. Of these identified sites, 30% (342.0 thous.) were found to need remediation and 15% of them (51.3 thous.) have already been remediated. In 2011, the average national expenditure of selected European countries on removal of old environmental burdens amounted to EUR 10.7 per capita.
- Consumption of mineral fertilisers in the Czech Republic is above the EU average, a higher consumption in $kg.ha^{-1}$ of cultivated agricultural land is only in Germany, the Netherlands, Poland and Ireland. The consumption or, more precisely, sales of plant protection products in the Czech Republic are average in the European context. Most products sold fall into the category of herbicides. The most sold products per hectare are reported by Malta and Cyprus, where the sold products are dominated by fungicides.
- Organic farming in the EU27 and the Czech Republic has been developing in the long term. In the year 2015, agricultural land under organic farming occupied a total of 11.2 mil. ha in EU27, which is 8.7% more than in 2014. The largest share of agricultural land cultivated organically was reached in Austria (20.3%), the share of the Czech Republic was 13.7%. The number of organic farming producers in the EU27 in 2015 was 269,453, the increase between the years 2014 and 2015 in the EU was 4.6%.

Indicator assessment

Figure 1

Water erosion of soil determined according to the RUSLE2015 model [$t.ha^{-1}.year^{-1}$], 2015



Soil erosion by water is determined by a calculation according to the RUSLE2015 model (Revised Universal Soil Loss Equation).
The current model includes the slope length (L) and steepness (S) factor, the cover-management factor (C), the support practices factor (P), the rainfall-runoff erosivity factor (R) and the soil erodibility factor (K), which reflects the average precipitation characteristics. On the contrary, it does not include the impact of local precipitation extremes. The presented map therefore provides only an approximate view of soil erosion by water in Europe and specific sites cannot be evaluated in detail on its basis. Currently, data are being validated based on national data and expert assessments.

- < 0,5
- 0,5–1
- 1–2
- 2–5
- 5–10
- 10–20
- 20–50
- > 50
- Non-erosive territory

Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

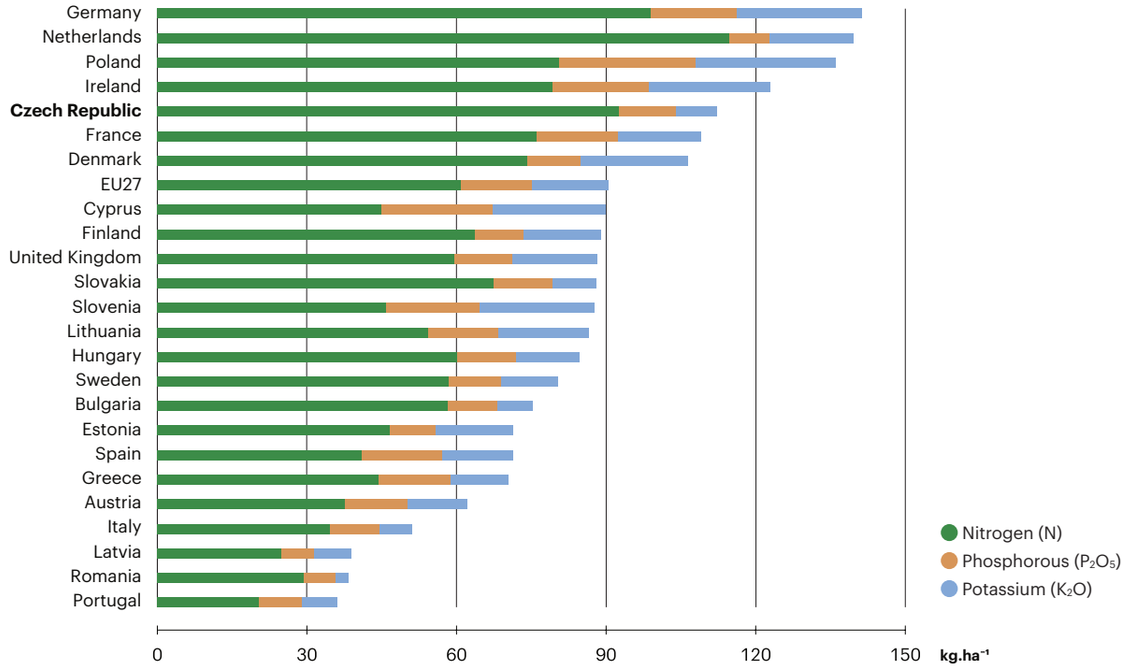
Source: JRC

[16] *Data for the years 2012–2016 are not, due to the methodology of their reporting, available at the time of publication.*

[17] *The defined area can be affected by both types of erosion at the same time (different types of erosion are not mutually exclusive).*

Chart 1

Consumption of mineral fertilisers (N, P_2O_5, K_2O) [kg.ha^{-1} of farmed agricultural land], 2014

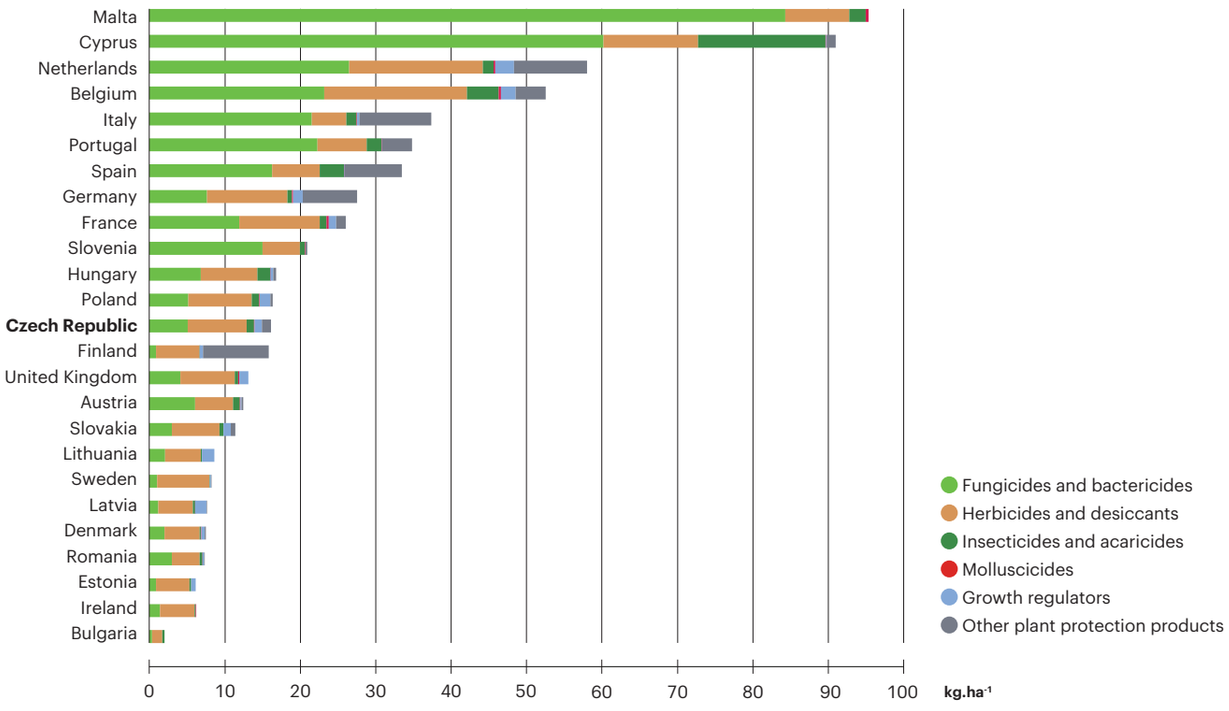


Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

Chart 2

Quantity of plant protection products sold [kg.ha^{-1} of farmed agricultural land], 2014

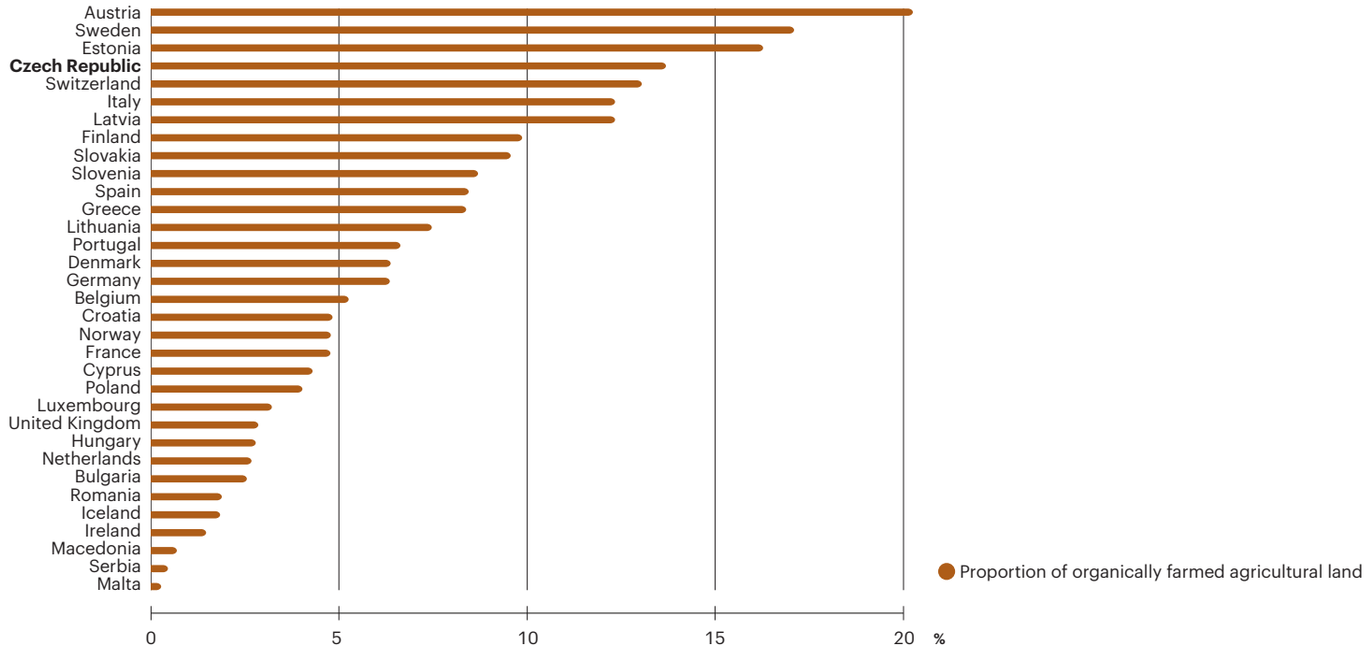


Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

Chart 3

Proportion of land under organic farming in the total area of farmed agricultural land [%], 2015

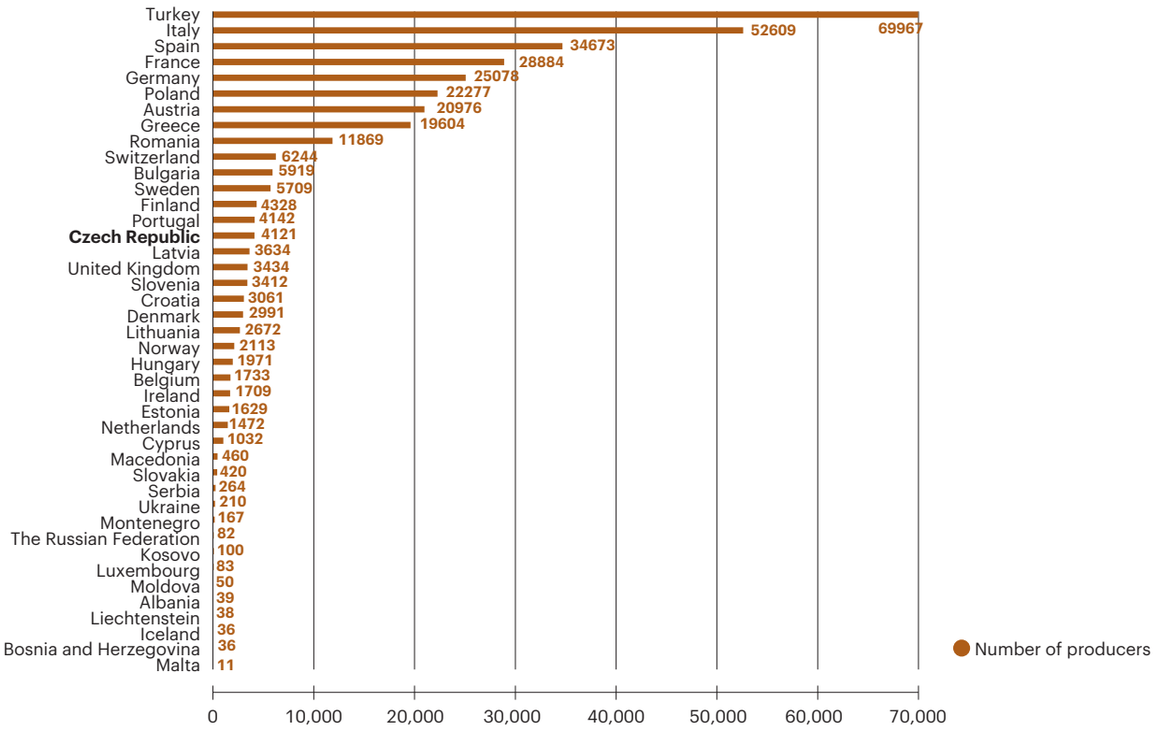


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

Chart 4

Organic producers in Europe [number], 2015



Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: OrganicDataNetwork – FiBL-AMI survey 2016

In the EU28, 90.3% of the area is threatened by **water erosion** according to the latest available model data (Figure 1) (about 394.1 mil. ha of the total area of 436.6 mil. ha). The most vulnerable soils are exposed to loss exceeding 10 $t.ha^{-1}.year^{-1}$ especially in the south of Europe. Losses in excess of 10 $t.ha^{-1}.year^{-1}$contribute to the overall erosion in 50%. Moreover, an increase in the exposure of soil to water erosion due to increased extremities of rainfall and due to changes in land use is expected in the future. **Wind erosion** (especially in many areas of Denmark, eastern England, north-west France, northern Germany and eastern Netherlands) also represents a serious problem which is estimated to threaten approximately 42 mil. ha of land (around 9.6% of land) of which 1 mil. ha of land is threatened seriously. In the case of wind erosion, an increase in erosion vulnerability due to more frequent occurrences of droughts are also expected. Although in the European context, the Czech Republic does not rank among the states most threatened by erosion, it has also areas that are heavily threatened by erosion. In the final assessment, it is necessary to take into account the uncertainties stemming from the inaccuracies in the input data of the model and the fact that there were no specific measurements of soil erosion, but erosion vulnerability given by the individual factors.

In 2011, 2.5 mil. of potentially **contaminated sites**[18] were estimated to exist in selected European countries. Inappropriate manipulation with hazardous substances occurred on those sites in the past, and therefore they pose a significant risk of soil contamination or groundwater or surface water contamination. From this the number of potentially contaminated sites, 45% (1.1 mil. sites) have been identified[19]. Of these identified sites, 30% (342.0 thous.) were found to need remediation and 15% of those (51.3 thous.) have already been remediated. The most common source of contamination in European countries is mining, metal-working industry and out of the service sector it is petrol stations, while the main contaminants include mineral oils and heavy metals. In 2011, the average national expenditure of selected European countries on removal of old environmental burdens amounted to EUR 10.7 per capita, which represents on average 0.04% of national GDP. Approximately 81% of the national expenditure was spent on remediation works and 15% on site investigations. The stated values, however, reflect the situation of only 27 of the total polled 39 member states of the EEA. Moreover, the source data are not complete for all states and in selected cases set definitions and interpretations for the identification of sites differ. Although most European countries have adopted national, or where appropriate, regional legislation governing the exploration and remediation activities in contaminated sites, no European framework strategy has been created so far.

The potential environmental burden caused by agriculture, especially in water pollution is above average in the Czech Republic, compared to other EU27 countries. The reason is the high proportion of arable land in the total land resources and **above average consumption of mineral fertilisers** compared to the EU27 countries (Chart 1). Regarding the development in recent years, it can be stated that the trend in fertiliser consumption in the Czech Republic is similar to the development of the EU27 average. In the composition of the consumed fertilisers prevail nitrogenous fertilisers. The potassium fertilisers, with the lowest application in the Czech Republic, in the EU27 average slightly prevail over the phosphate fertilisers. The consumption of fertilisers and plant protection products in each country depends mainly on the temperature and precipitation conditions, the intensity of farming, type of crops, and last but not least on the financial possibilities of the farming entities. The development of organic farming in each country also plays its role. Comprehensive international data on **plant protection products** are available for the quantity sold. In this respect, the Czech Republic in the European context achieves average values (Chart 2), the majority of the sold products are herbicides. States with a higher volume of products sold per agricultural land area have a higher proportion of fungicides. The most sold products per hectare are reported in Malta and Cyprus, therefore the States with a very small acreage of cultivated agricultural land. In the individual states, sales of plant protection products are mainly influenced by the actual incidence of diseases and pests in the given crop year, which varies according to the weather conditions during the year, and is especially driven by air temperature and precipitation.

Organic farming in the EU27 has been developing in the long term. In the year 2015, agricultural land under organic farming occupied a total of 11.2 mil. ha, which is 8.7% more than in 2014. With regard to the use, the permanent grassland prevails with an area of 5.1 mil. ha. Arable land covers 4.7 mil. ha and permanent crops 1.2 mil. ha. Land under organic farming occupied in 2015 in total 6.2% of the total farmed agricultural land in the EU27. In the case of the Czech Republic, the share is 13.7%, making it one of the leading countries in the EU27. The highest share is reached in Austria, 20.3% (Chart 3). The largest area of organically farmed land was in 2015 in Spain (2.0 mil. ha), in Italy (1.5 mil. ha) and in France (1.4 mil. ha). The number of organic farming producers in the EU27 in 2015 was 269,453, in all of Europe 349,261 (Chart 4). The increase between the years 2014 and 2015 in the EU27 amounted to 4.6%, 2.8% throughout Europe. Most of the producers are in Turkey (69,967), followed by Italy (52,609) and Spain (34,673).

[18] *The definition of the term in the individual countries is based on national regulations. In the Czech terminology it is referred to as old environmental burdens.*

[19] *The identification of the site was carried out, where appropriate, preliminary study has been carried out.*

7

Industry and energy

Industry and energy

Mining and the industrial and energy production bound to it has a considerable impact on the environment. The extraction of raw materials disrupts the landscape and affects the quality, quantity and level of groundwater in the mining areas. In the vicinity of the mined deposits, dust and noise emissions often increase, not only due to the mining itself, but also as an impact of transportation large quantities of material. These factors then affect the surrounding ecosystems and populations.

Industry sectors consume significant amounts of natural resources, which are used as raw materials for the production of materials and also as a source of energy. In industrial areas, an increased environmental pollution often occurs, especially regarding air pollution, both for commonly monitored substances and for specific substances associated with specific industrial production. The proven results of air quality deterioration are: increased morbidity, allergies, asthma, respiratory and heart problems, cancer, reduced immunity etc.

Energy production is of great importance for the quality of the environment due to the energy mix of the Czech Republic. Given the high proportion of fossil fuels, it is a source of emissions of pollutants and mainly greenhouse gases. Due to the production of greenhouse gases into the atmosphere, energy consumption contributes to climate change associated with more frequent occurrence of hydrometeorological extremes – heatwaves, flooding or extreme temperatures, and thus to the overall disruption of the landscape.

At present, a very hot issue is home heating using solid fuels. Local combustion heaters affect air quality in the immediate environment of people. Pollutants emitted by smokestacks of low buildings, mostly family houses, do not have sufficient time to dispel, and they reach the respiratory systems of the inhabitants. Due to choosing low quality fuel and the often incomplete combustion of solid fuels, polycyclic aromatic hydrocarbons are produced, which have carcinogenic effects and contribute also to a number of other health problems of the population: increase in morbidity especially in the form of higher incidence of cardiovascular disease, respiratory problems or respiratory diseases.

References to current conceptual, strategic and legislative documents

Decision 406/2009/EC on the effort of Member States to reduce their greenhouse gas emissions to meet the Community's greenhouse gas emission reduction commitments up to 2020
- reducing greenhouse gas emissions by at least 20% by 2020, compared to 1990

Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC
- increasing the share of renewables in final energy consumption, the Czech Republic aims at 13% share of RES in gross domestic final consumption in 2020

Regulation of the European Parliament and of the Council (EU) 2017/1369, laying down the framework for energy labelling and repealing Directive 2010/30/EU
- marking energy-related products with labels, and providing information on energy consumption and energy efficiency of such products so that end users had the option to choose products with higher efficiency

European Parliament and Council Directive 2010/31/EU on energy performance of buildings
- decreasing the energy demand of buildings

Directive 2012/27/EC of the European Parliament and of the Council on energy efficiency, amending Directives 2009/125/EC and 2010/30/EU and repealing Directives 2004/8/EC and 2006/32/EC
- fulfilling the main objective of 20% energy efficiency by the year 2020 and further energy efficiency improvements beyond this date
- fulfilling the national indicative target established for the Czech Republic at 47.84 PJ (13.29 TWh) of new savings in final energy consumption by the year 2020

Action Plan for Energy Efficiency: Realising the Potential COM/2006/545
- framework of policies and measures designed to strengthen the utilisation of possibilities related to the estimated savings potential of 20% of the EU's annual primary energy consumption by 2020

European Parliament and Council Regulation (EC) No. 1907/2006, on the registration, evaluation, authorisation and restriction of chemicals, establishing a European Chemicals Agency, amending Directive 1999/45/EC and repealing Council Regulation /EEC/No. 793/93, Commission Regulation /EC/No. 1488/94, Council Directive 76/769/EEC and Commission Directives 91/155/EEC, 93/67/EEC, 93/105/EC and 2000/21/EC
- exclusion of substances with the worst impact on human health and the environment from circulation and replacing them with less harmful substances

State Environmental Policy of the Czech Republic 2012–2020
- reducing the environmental impact of the industry, in particular emissions of pollutants and greenhouse gases, reducing energy and material intensity of industry
- removing and preventing the consequences of mining activities and minerals extraction
- securing 13% proportion of energy from renewable sources in gross final energy consumption by the year 2020
- securing a 10% share of renewable energy in transportation by the year 2020
- ensuring commitment to energy efficiency by 2020 (for the EU as a whole it is 20%)

Raw material policy in the area of minerals and mineral resources (2012)
- enhancing resource security of the state
- ensuring the protection of reserved mineral deposits
- using domestic sources of raw materials to the maximum extent possible
- supporting material saving technologies
- economical use of available reserves of brown coal and evaluation of the real potential of domestic resources of brown coal

State Energy Policy of the Czech Republic (2015)
- import dependence shall not exceed 65% by 2030 and 70% by 2040
- diversified mix of primary sources with the target structure in the corridors: nuclear fuel 25–33%, solid fuels 11–17%, gas fuels 18–25%, liquid fuels 14–17%, renewable and secondary sources 17–22%
- the target structure of electricity production by 2040 in the corridors: nuclear fuel 46–58%, solid fuel 11–17%, gaseous fuels 18–25%, liquid fuels 14–17%, renewable and secondary sources 17–22%
- net final energy consumption in 2020 will be 1,060 PJ (according to Eurostat methodology) or 1,020 PJ (according to International Energy Agency methodology)
- to ensure self-sufficiency in the production of electricity, with an increasing share of RES sources and secondary sources, the gradual replacement of nuclear energy production with coal-fired energy as a pillar of electricity production
- gradual decline of exports of electricity and maintaining the balance in the range of +/–10% of domestic consumption

National Action Plan of the Czech Republic for Energy from Renewable Sources (2015)
- achieve a 15.3% share of energy from renewable sources in gross final consumption of energy in the year 2020
- achieve a 10.0% share of energy from renewable sources in gross final consumption in transport in the year 2020

Action Plan for Biomass in the Czech Republic for the period 2012–2020
- determining of the potential of various types of biomass in the Czech Republic for efficient energy use while respecting food self-sufficiency of the Czech Republic

Secondary Raw Materials Policy of the Czech Republic (2014)
- increasing self-sufficiency in raw material resources of the Czech Republic by substituting primary sources by secondary raw materials
- promoting innovation securing the extraction of raw materials in a quality suitable for further use in industry
- promoting the use of secondary raw materials as an instrument to reduce energy and material demands of the industrial production while eliminating of negative impacts on the environment and human health

Fourth National Action Plan for Energy Efficiency for the Czech Republic (2016)
- achieving the national indicative target at 50.67 PJ (14.08 TWh) of new savings in final energy consumption in the period 2016–2020

Strategy on Adaptation to Climate Change in the Czech Republic 2015
- ensuring the functioning of critical infrastructure
- ensuring the safety of industrial installations

Act No. 44/1988 Coll., on the protection and utilisation of mineral resources (Mining Act)
- obligation of the reclamation of the territories affected by mining and the creation of financial reserves for this reclamation
- protecting the deposit area
- economical utilisation of deposits

Act No. 201/2012 Coll., on air protection
- minimum emission requirements for combustion sources using solid fuels with a rated thermal input up to and including 300 kW, serving as a heat source for hot water central heating systems

Act No. 114/1992 Coll., on nature and landscape protection
- the demarcation and limitation of mining in specially protected areas

Act No. 406/2000 Coll., on energy management
- improving energy performance of buildings, certificate on the energy performance of buildings
- the obligation to provide labels to buildings and energy-using products

Operational Programme Environment 2014–2020
- improving energy performance of public buildings and increasing the use of renewable energy sources
- reducing emissions from domestic heating contributing to the population's exposure to excessive concentrations of pollutants
- reducing emissions from stationary sources contributing to the population's exposure to excessive concentrations of pollutants

Operational programme Enterprise and Innovation for Competitiveness 2014–2020
- ensuring efficient energy management
- development of energy infrastructure and renewable energy sources
- support for the introduction of new technologies in the management of energy and secondary raw materials

26 | Extraction of raw materials

Key question

What is the development of the extraction of mineral resources and how does mining affect the state of the environment?

Key messages

The volume of the extraction of mineral resources in the Czech Republic has been declining since 2000. The area affected by mining in the Czech Republic is decreasing, and on the other hand, the amount of reclaimed areas is increasing.

Overall assessment of the trend

Change since 1990

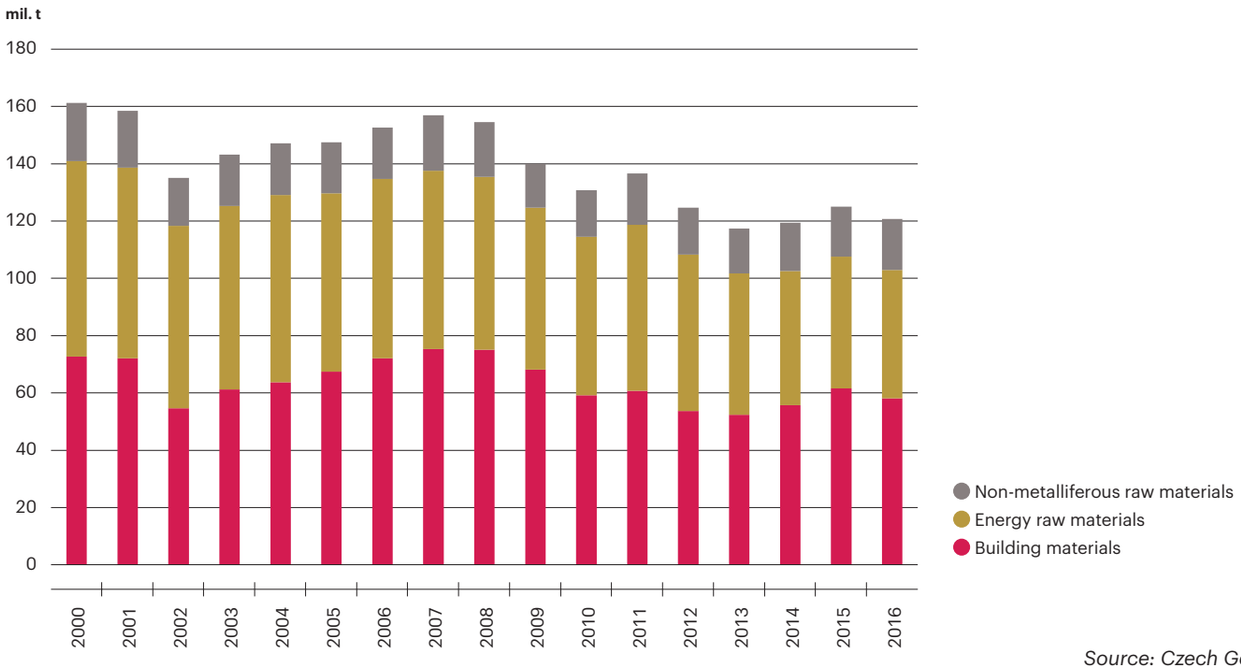
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

Overview of the extraction of mineral resources in the Czech Republic [mil. t], 2000–2016



Source: Czech Geological Survey

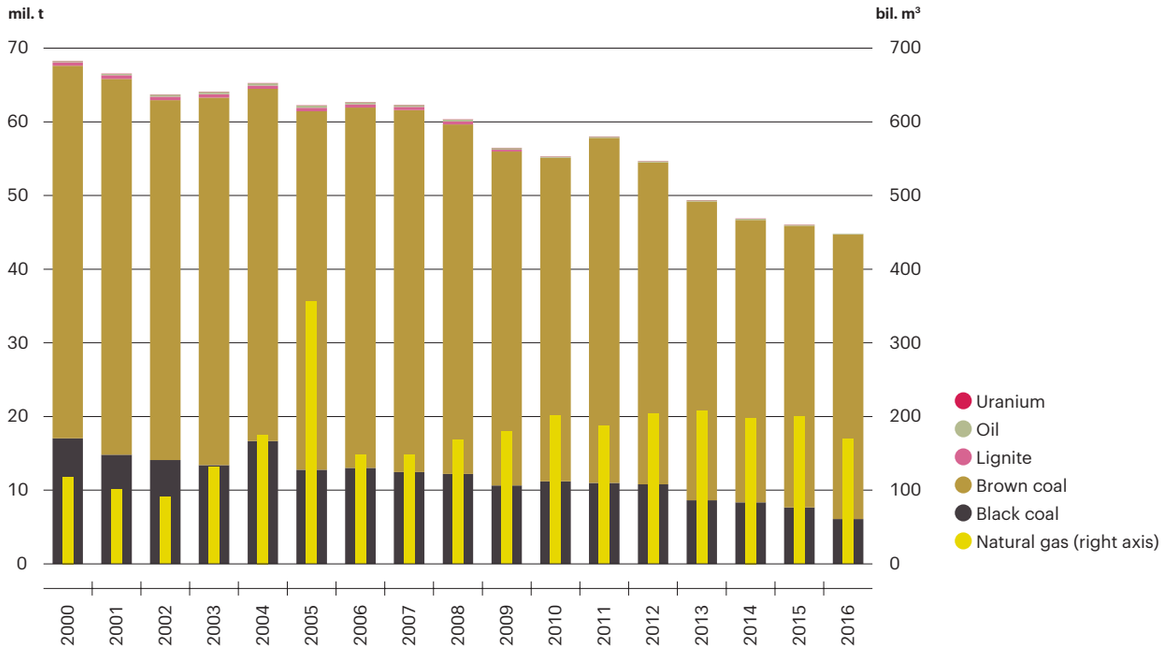
Chart 2

Mining of construction minerals [mil. t], 2000–2016

Source: Czech Geological Survey

Chart 3

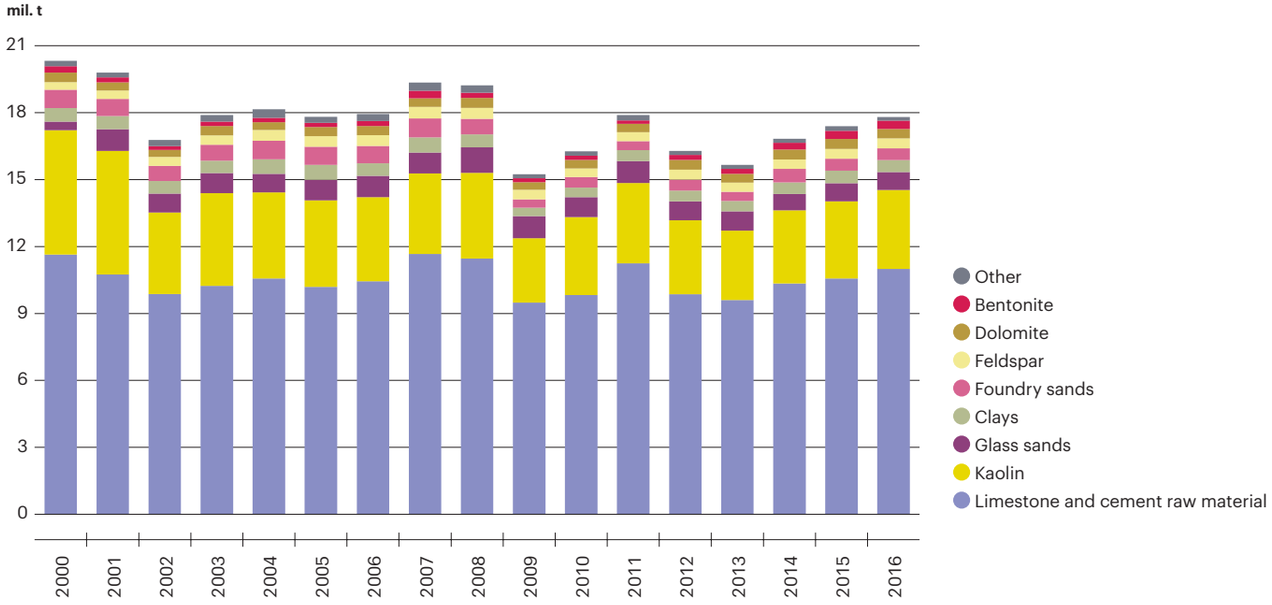
Extraction of energy raw materials in the Czech Republic [mil. t, bil. m^3 (natural gas)], 2000–2016



Source: Czech Geological Survey

Chart 4

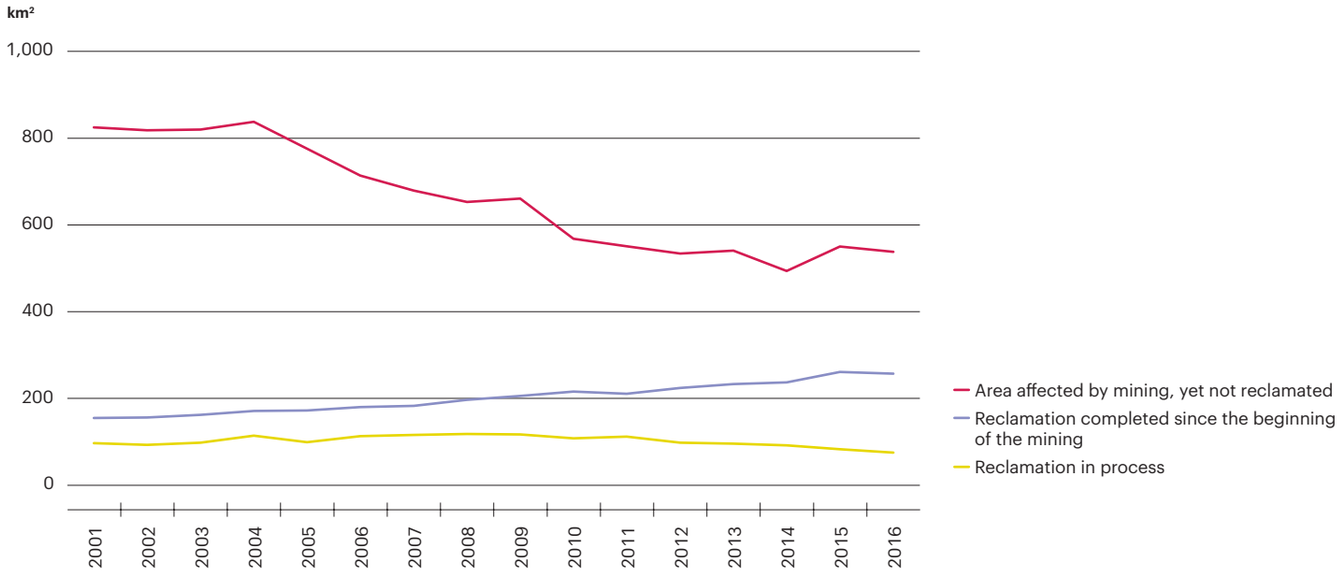
Mining of non-metallic minerals in the Czech Republic [mil. t], 2000–2016



Source: Czech Geological Survey

Chart 5

Advancement of reclamation after mineral extraction in the Czech Republic [km^2], 2001–2016



Source: Czech Geological Survey

Mineral extraction in the Czech Republic gradually decreases, this trend is influenced by the development of industry and energy. In 2000, total mineral extraction in the Czech Republic was 161.3 mil. t, in 2016 only 120.8 mil. t (Chart 1). All mining can be divided into four basic groups: energy raw materials, construction minerals, non-metallic minerals and metallic minerals.

Of these groups, the largest volumes are mined in the Czech Republic of **construction minerals** (58.1 mil. t in 2016). Their mining is closely linked to the construction industry and the mining rates therefore correspond to the intensity of building production. The decline in mining of construction minerals (Chart 2) reacts to the fall in construction output in 2009–2013 after the economic recession, since 2014 it has responded to subsequent economic recovery and development of the construction industry. In 2016, 20.0% less construction minerals were mined than in 2000.

From **energy raw materials** (Chart 3) in the Czech Republic there is mainly coal mining. Brown coal is extracted from the surface in the Czech Republic, in the North Bohemian and Sokolov basins. The relatively large reserves of brown coal were, based on the publication of the so-called territorial limits of mining in 1991, blocked in the ČSA and Bílina mines in North Bohemia because of the protection of the environment and landscape. In October 2015 the Government decided to abolish the limits in the Bílina mine. The reason for this were primarily the needs of the heating sector, and the associated energy security of the country and also maintaining of many jobs. As a result of breaking the limits it is possible to take advantage of up to 120 mil. t of coal. Mining limits in the CSA mine are maintained. Black coal is currently in the Czech Republic extracted in the Upper Silesian coal basin by excavation. Extraction of brown and black coal covers the consumption of the Czech Republic, black coal is also exported.

Extraction of all energy raw materials with the exception of natural gas gradually decreased in the reference period 2000–2016. The mining of brown coal decreased in that period by 23.6%, however, between 2015 and 2016 it increased by 1.0% to 38.6 mil. t. The mining of black coal decreased from 2000 by 64.3%, year-on-year by 20.5% to 6.1 mil. t. Mining of lignite in 2000 was 453 thous. t, however, its production declined gradually, and since 2010 this material is not extracted in the Czech Republic.

Uranium was mined in the Czech Republic in 2016 at a single site, Dolní Rožínka, in the Rožná uranium mine. In 2016, the Government approved its gradual closure. Additionally, as a by-product there is the cleaning of underground and mine waters in the context of the liquidation works and the reclamation after mining, in particular in the deposits in Příbram and Stráž pod Ralskem. Extracted uranium must be processed before it can be used as nuclear fuel, but the only uranium ore treatment plant in the Czech Republic was cancelled in 1991. Therefore, the Czech Republic is dependent on imports of nuclear fuel from Russia, despite its own uranium reserves. Mining of uranium between 2000 and 2016 decreased from 498 t to 128 t (decrease by 74.3%), the year-to-year decrease in 2016 amounted to 4.5%.

Natural gas is mined in the Czech Republic in south and north Moravia, its mining only covers approximately 3.4% of domestic consumption. In 2016, 169 mil. m^3 of natural gas were extracted in the Czech Republic, which is 43.2% more than in 2000 and 15.5% less than in 2015.

The **crude oil** is extracted in the Czech Republic in Southern Moravia in the Vienna basin, and on a smaller scale in the Moravian-Silesian region in the deposit area of the Carpathian Foredeep. Oil production in the Czech Republic makes 1,6% of domestic consumption. In the period 2000–2016, the oil production dropped by 31.0%, between 2015 and 2016 by 7.9% to 116 thous. t.

From **non-metallic minerals** (Chart 4), in the Czech Republic extracts in the largest volumes limestone and cement raw material, where belongs also high-percentage limestone, other limestone and cement and other corrective sialitic raw materials. Extraction of **limestone and cement raw materials** fluctuates, 11.0 mil. t were mined in 2016, which is 4.0% more than in 2015 and 5.6% less than in 2000. Another important raw material extracted in the Czech Republic is **kaolin**. In the global kaolin extraction, the Czech Republic holds the 5th rank, while its share of world production is approximately 9.7%. In 2016, the extraction of kaolin in the Czech Republic amounted to 3.5 mil. t.

The extraction of non-metallic minerals since 2000 was gradually declining, with fluctuations, in the period 2000–2016 it declined by 12.4% to 17.8 mil. to per year. The development reflected the gradual reduction of the material intensity of industrial production and the decline in industrial production since 2008. With the economic revival and development of industrial production, since 2014 there is a noticeable growth in extraction of these raw materials. The annual growth in the extraction of non-metallic minerals for 2015–2016 was 2.4%.

The extraction of **metallic minerals** (in the form of iron ore and ores of non-ferrous metals) has been suspended in connection with the restructuring of the economy in the first half of the 1990s. The reasons are purely economic. With the growth of prices at the global markets, however, it is not excluded that domestic extraction will begin to pay off and will be restored.

Impacts of extraction, adjustment, and consumption of mineral resources on the environment are minimised in the Czech Republic thanks to the validity of the strict environmental and mining legislation. The extraction in the conditions of the Czech Republic burdens the environment much less than extraction in countries where such legislation does not exist, or is not complied with. Act No. 44/1988 Coll., on the protection and utilisation of mineral wealth (the Mining Act) directs the mining companies to recultivate the territory affected by extraction and to create financial reserves for such reclamation. The area affected by mining has been gradually decreasing since 2001 and, on the contrary, the amount of reclaimed areas is increasing (Chart 5). In 2016, there were 538 km^2 of not yet reclaimed areas in the Czech Republic, in 2001 they occupied 825 km^2. In 2016, by contrast, there were 257 km^2 of reclaimed areas and in 2001 only 155 km^2.

Mining and quarrying changes the landscape character, affecting the natural environment and the conditions of existence of organisms. Extraction is carried out in one place often for decades, and a more permanent new arrangement of natural conditions and relationships in the area concerned is not immediately apparent. Where there has been a reclamation by way of natural succession, ecosystems are developed, which are subsequently often declared as specially protected areas of nature and also as Natura 2000 sites. A positive effect on the environment has also the hydric, reclamation of the mining territory that holds back water in the landscape, creating thus sources of drinking water or welcomed landscape forming elements to which wetland habitats are connected.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

27 | Industrial production

Key question

What is the environmental impact of industrial production development and of its structural changes?

Key messages

The industrial production in 2016 increased year-on-year by 3.5%.
The energy intensity of industry decreases.
Despite the growing industrial production, emissions of pollutants from industry are decreasing.

Overall assessment of the trend

Change since 1990

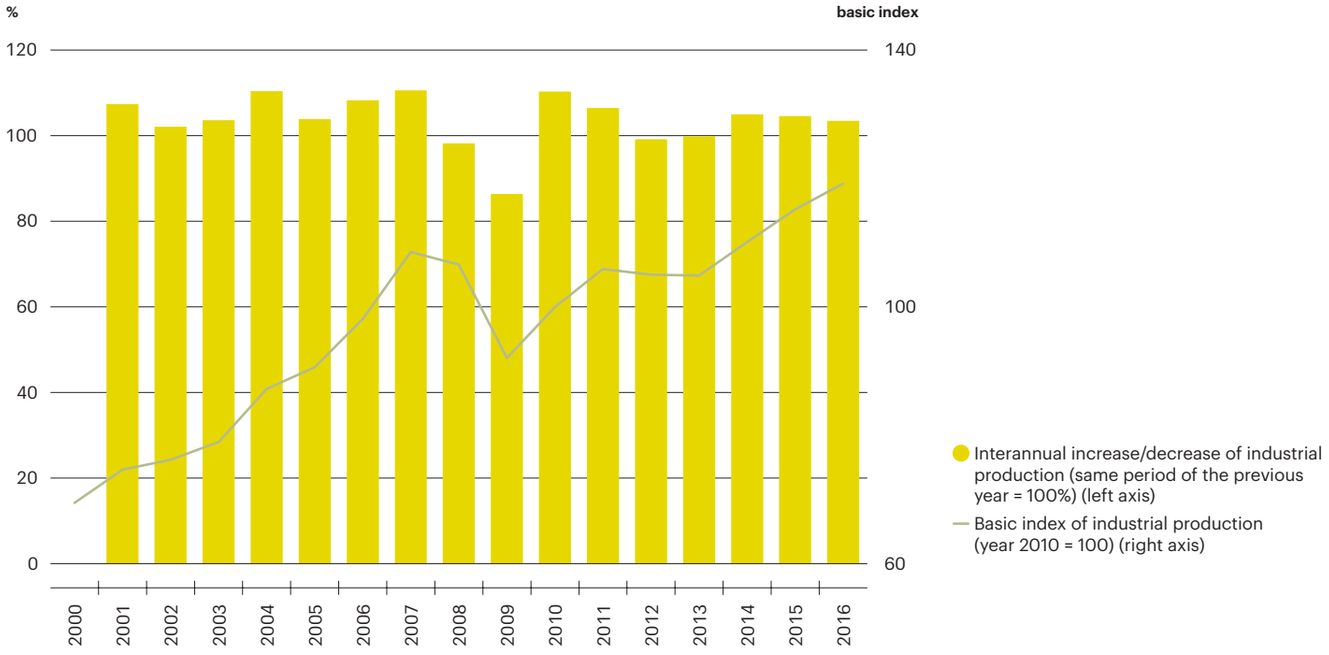
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

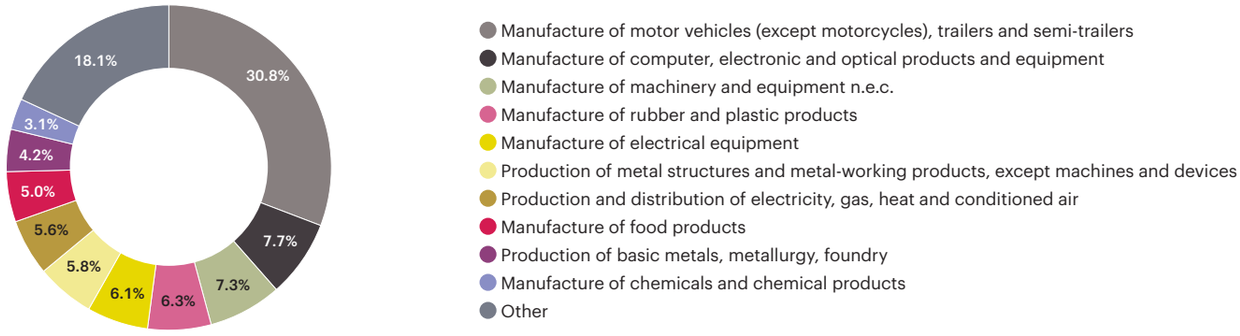
Year-on-year changes in industrial production, basic index of industrial production in the Czech Republic [%], 2000–2016



Source: Czech Statistical Office

Chart 2

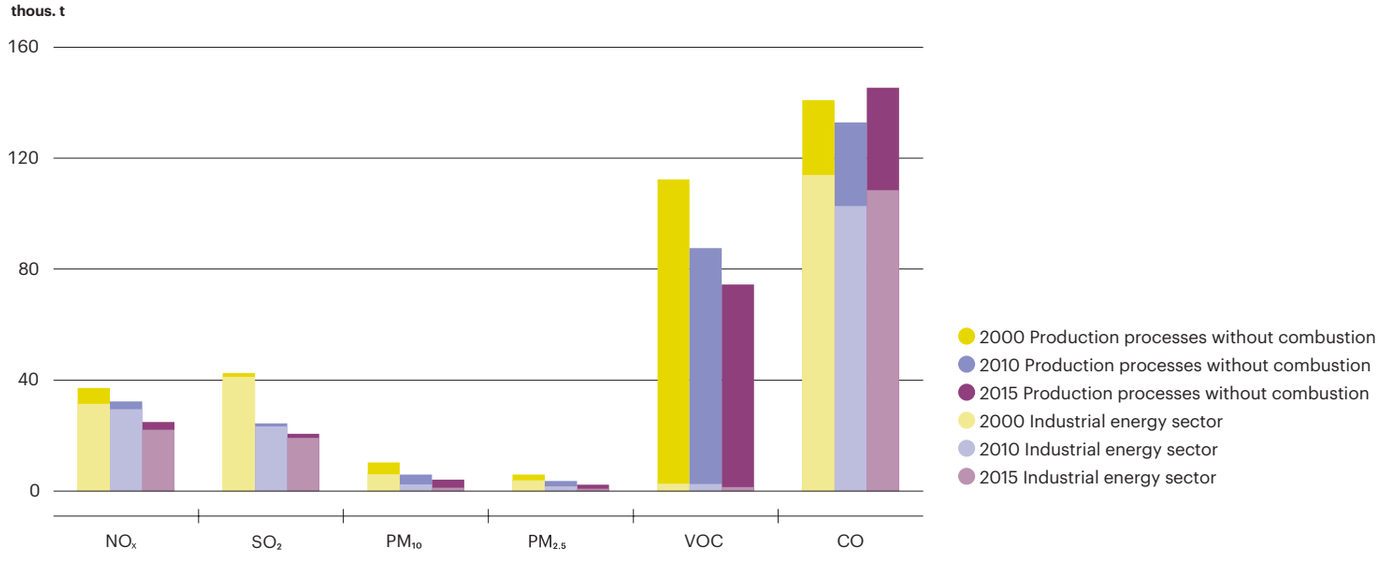
Structure of industrial production in the Czech Republic [%], 2016



Source: Czech Statistical Office

Chart 3

Pollutant emissions from industry in the Czech Republic [thous. t], 2000, 2010, 2015



Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

Industrial production has a considerable **influence on the environment** in the Czech Republic. It produces a wide range of **pollutant emissions and waste products** while consuming a significant amount of non-renewable natural resources and energy sources. On the other hand, it generates approximately 30% of the Czech Republic's GDP, and so represents one of the critical elements of the Czech economy. This sector has environmental impact especially in the localities where the large industrial enterprises are concentrated (Moravian-Silesian Region, Ústí nad Labem Region, Central Bohemian Region).

Industrial production continued to grow in 2016 for the third year in a row (Chart 1). Its annual index, however, fell to 103.5%, due to a slowdown in the growth of new contracts in industry, problems in the coal market, limited production in the chemical industry and downtime of reactors in both nuclear power plants.

In the crucial **manufacturing industry**, almost a third of total sales (30.8%) was produced by the manufacture of motor vehicles (Chart 2). Other important industrial sectors include the manufacture of computer, electronic and optical products and equipment (7.7%), manufacture of machinery and equipment (7.3%), manufacture of rubber and plastic products (6.3%) and manufacture of electrical equipment (6.1%). The industrial production grew between 2015 and 2016 mostly due to the motor vehicle sector, whose production grew by 11.8%. Out of the other sectors, production increased the most in the sectors of printing and reproduction of recorded media (by 13.9%), manufacture of furniture (by 6.3%), manufacture of metal structures and fabricated metal products (by 5.0%), manufacture of textiles (by 4.8%), manufacture of leather and related products (by 4.7%), and manufacture of computer, electronic and optical products (by 4.1%). By contrast, production fell year on year for example in the manufacture of chemicals and chemical products (by 7.1%), or in the manufacture of beverages (by 1.3%).

The **emissions from the industrial sector** (Chart 3) can be divided into two groups – emissions from industrial energy (production processes involving fuel combustion) and emissions from industrial processes (production processes without fuel combustion). Among the emissions from industrial energy are in particular the NO_x and SO_2 emissions from fuel combustion, including CO, emissions from iron and steel production. The second group, industrial production processes without combustion of fuel, it is highly specific regarding the type of production. These sources emit a wide range of emissions that affect the environment in different ways. That group includes the category of solvents, which are a significant source of VOC emissions.

In 2015[1] (Chart 3), the industrial energy category exhibited a year-to-year decrease in **emissions** of all monitored substances, the category of production processes without fuel combustion exhibited a decrease in emissions of SO_2, PM_{10} and $PM_{2.5}$ and, on the contrary, growing emissions of NO_x, VOC and CO. Overall, a decline was seen in emissions of CO (by 13.3%) $PM_{2.5}$ by 11.2%, PM_{10} by 8.8%, SO_2 by 4.2% and NO_x by 3.1%. Only VOC experienced a slight increase in emissions by 0.1%. The decline in most emissions from industry is positive, especially in the context of the year-on-year increase in industrial production in 2015 by 4.6%, which could be expected to produce higher amounts of discharged pollutants.

In the longer term of 2000–2015, there is a noticeable downward trend in emissions of all pollutants except for CO, both from the industrial energy and manufacturing processes without combustion (Chart 3). This trend was supported in part by a decline in industrial production in the context of the economic crisis, nevertheless after the economic recovery since 2010, emissions of almost all substances from the industry retained values with a decreasing trend. The exception is CO, the emissions of which are volatile. The vast majority of CO emissions from industrial sources comes from iron and steelworks in Ostrava and Třinec and the increase or decrease of emissions here corresponds with the volume of production.

The **energy intensity of the industry** in the period of 2010–2015[2] decreased, with slight fluctuations, which has led to a decline in specific environmental load per unit of industrial production. While in 2010 the energy intensity[3] of the industrial sector was 302.3 MJ.thous. CZK^{-1}, in the year 2015 it amounted to only 261.7 MJ.thous. CZK^{-1}, which means a decline by 13,4%. Year-on-year, the energy intensity of the industry in 2015 dropped by 3.6%. This trend was favourable for the environment, because lower energy consumption in production means a lower burden for the environment.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[1] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

[2] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

[3] *Energy intensity is calculated as the ratio of the final energy consumption in industry, according to Eurostat methodology, and GVA of this sector at constant prices of 2010.*

28 | Final energy consumption

Key question

Is the final energy consumption[4] in the Czech Republic dropping, and thus the burden on the environment from the production of energy?

Key messages[5]

Since 2010, final energy consumption in the Czech Republic has been gradually decreasing. The objective of the State Energy Policy for energy consumption is being achieved.
Most of the energy is consumed in industry, households and transportation.
Energy consumption is reduced by measures of savings and improvements in energy efficiency, on the other hand it increases due to the trend of higher use of information and communications technologies and the general seeking of greater comfort.

Overall assessment of the trend

Change since 1990

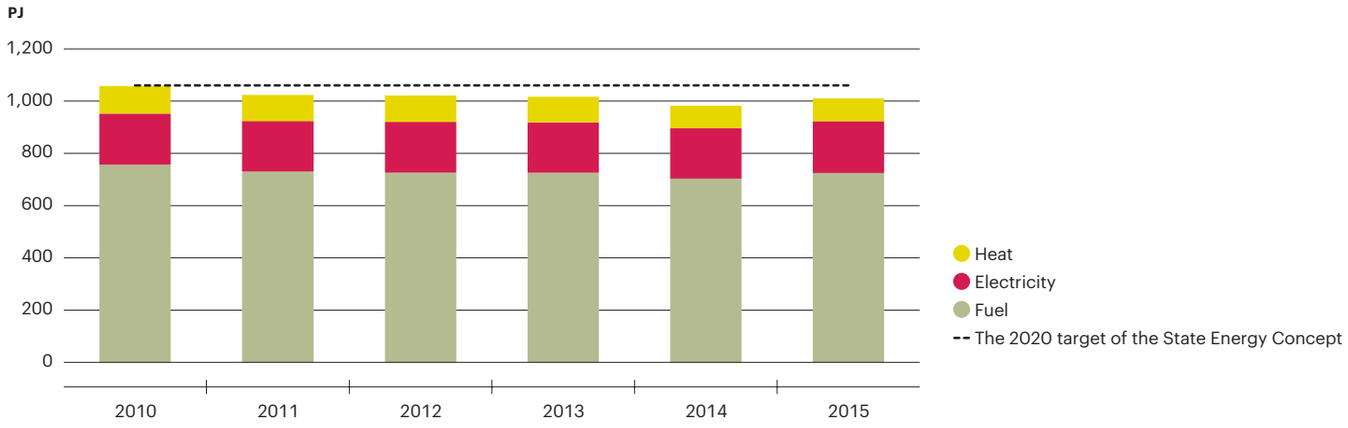
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

Development of the final energy consumption by sources in the Czech Republic [PJ] and its level against the target of the State Energy Policy of the Czech Republic up to 2020, 2010–2015



Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication. The reason for modifying the time series is a change in the reporting methodology for the energy balance, made by the Czech Statistical Office according to the methodology of Eurostat, and retrospective recalculating of data since 2010 only.

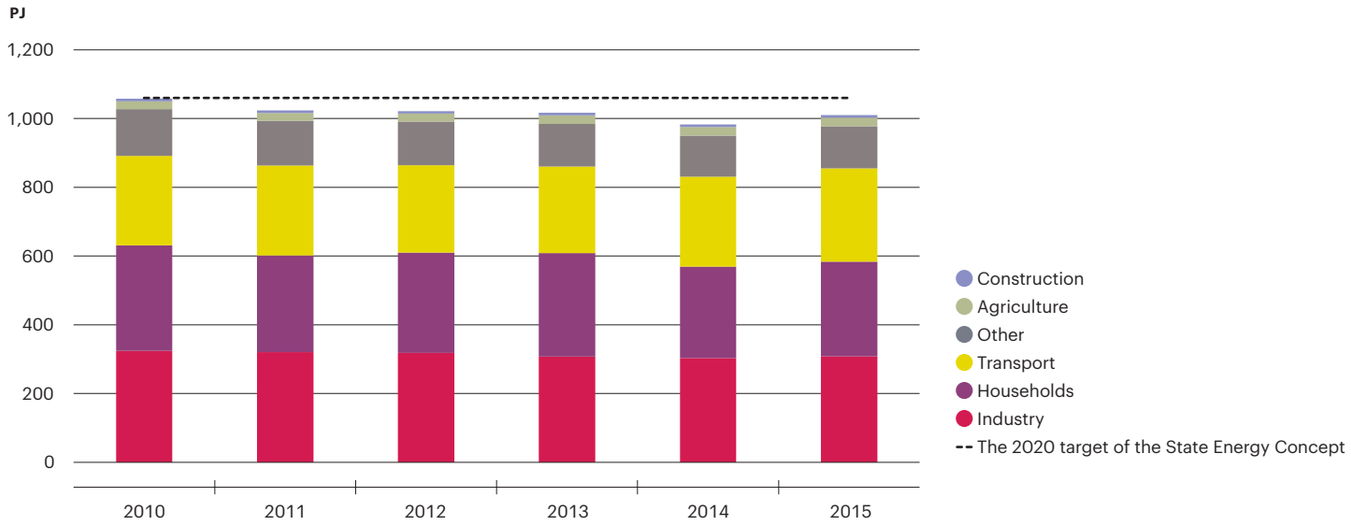
Source: Czech Statistical Office

[4] *The final energy consumption is consumption determined before entering the appliances in which it is used to produce the final useful effect, but not to produce another form of energy (with the exception of secondary energy sources).*

[5] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Chart 2

Development of the final energy consumption by sectors in the Czech Republic [PJ] and its level against the target of the State Energy Policy of the Czech Republic up to 2020, 2010–2015



Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication. The reason for modifying the time series is a change in the reporting methodology for the energy balance, made by the Czech Statistical Office according to the methodology of Eurostat, and retrospective recalculating of data since 2010 only.

Source: Czech Statistical Office

Final energy consumption has not changed since 2000. Due to the fact that energy consumption in the Czech Republic is driven the most by industry, it is clear that here, too, the economic crisis manifested itself in reduced consumption in 2008–2009, with subsequent transient increase in relation to the overall growth of industrial production and of the national economy. Since 2010, final energy consumption has been erratic, but there is an evident trend of slow decline in final consumption. In 2015, the value of final energy consumption in the Czech Republic amounted to 1,010.2 PJ, which means an increase of 2.8% year on year, however, in the longer term of 2010–2015, there was a decrease of 4.5%. The objective of the updated State energy concept is not to exceed the level of 1,060 PJ by 2020. This objective is being met, since 2010 the final energy consumption in the Czech Republic has been below that threshold (Chart 1).

The largest **share of energy consumption** in the Czech Republic is in fuels (71.8% in 2015). This section includes fuel for industrial production, fuel for transportation and home heating fuel. It also includes renewable sources and energy recovered from waste. Less electricity is consumed (19.6% in 2015) in heavy industry, services and households. The lowest energy consumption is in the form of heat (8.6%). Most of the heat is consumed for heating households as a system of thermal energy supply, but is also used in industry for heating in manufacturing and in services.

Energy consumption is influenced by many different factors in every field of human activity. In terms of sectors (Chart 2), the highest consumption is in industry (308.3 PJ in 2015). There, it is determined by the high share of industry in GDP generation and by the energy intensity of industrial production. The industrial sector accounts for approximately 30% of the country's GDP. The most energy-intensive industries within the manufacturing industry are: manufacturing of metals including metallurgic processing, manufacture of non-metallic mineral products, chemical and petrochemical industries.

Households consumed 275.2 PJ in 2015, and are the second most important sector in the total consumption. In this sector, energy consumption increases on the one hand because of the increasing living area, the striving for higher comfort or the growing number of electrical appliances, but on the other hand, the efficiency of appliances and of heating installations is improving, existing buildings are covered with thermal insulation and new buildings are already built in a low energy standard. Developments in household energy consumption are significantly affected by the character of the heating seasons,

because heating consumes the majority of the overall energy consumed in households. The curve of energy consumption in households copies the character of the heating season in that year.

Consumption of energy in transport in 2015 was 271.7 PJ, and is also affected by several conflicting factors. The proportion of individual automobile transportation in transportation energy consumption is consistently high, but energy consumption per unit of transport output declines. A similar situation is in road transportation where the transport performance increases.

In the **agricultural** sector the main driver of the decrease in energy consumption is the effort to gradually increase energy efficiency and to improve productivity. Energy consumption in this sector in 2015 was 25.3 PJ.

The category "Other" includes for the most part the service and other unspecified sectors. In the area of services, energy consumption is the result of the balancing of conflicting interests: on the one hand, it is the quest for efficient use of energy, but the increasing demands for comfort work against the reduction of consumption in the sector. Higher energy consumption then occurs especially in connection with the installation of air conditioning and the trend of increased use of information and communication technologies. The factors leading to reducing the energy intensity of service the sector may include building insulation and the installation of efficient equipment for heating, air conditioning and lighting.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

29 | Fuel consumption by households

Key question

What progress has been made in reducing the negative impacts of local heating units on air quality and public health?

Key messages[6]

Since 2001, the ways of heating homes in the Czech Republic have been changing very slowly. The heat energy supply systems (35.7%) and natural gas heating (34.8%) predominate. Solid fuel heating is not falling (15.0%).

Combustion heaters have a major impact on air emissions. In 2015, the total emissions of PM_{10} were generated by domestic heating in 36.4%, the total emissions of B(a)P even in 97.3%.

Overall assessment of the trend

Change since 1990

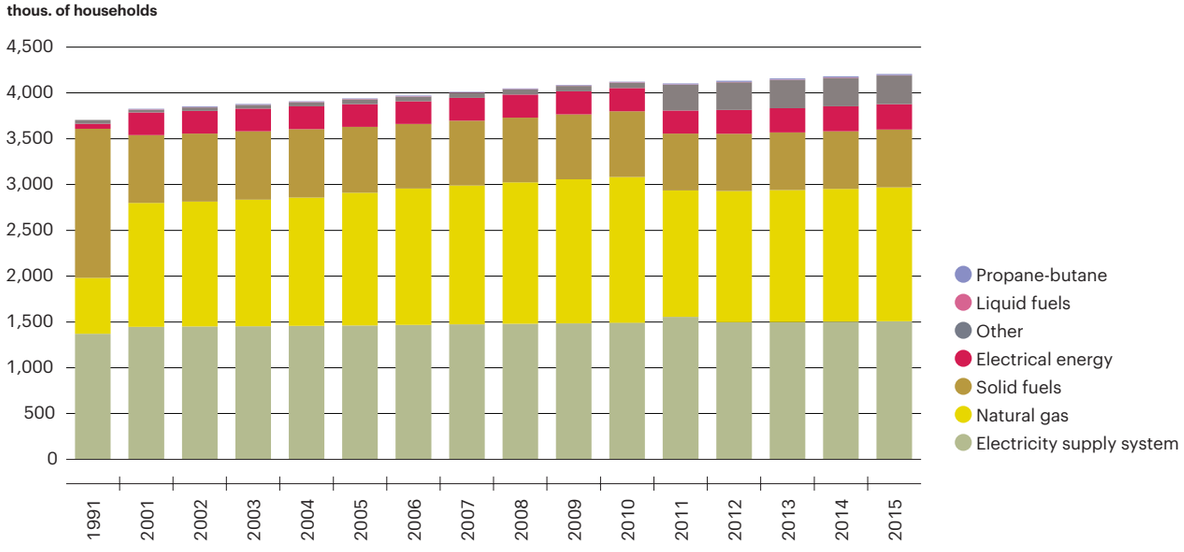
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

Prevailing heating methods used in permanently inhabited households in the Czech Republic [thous. of households], 1991, 2001–2015



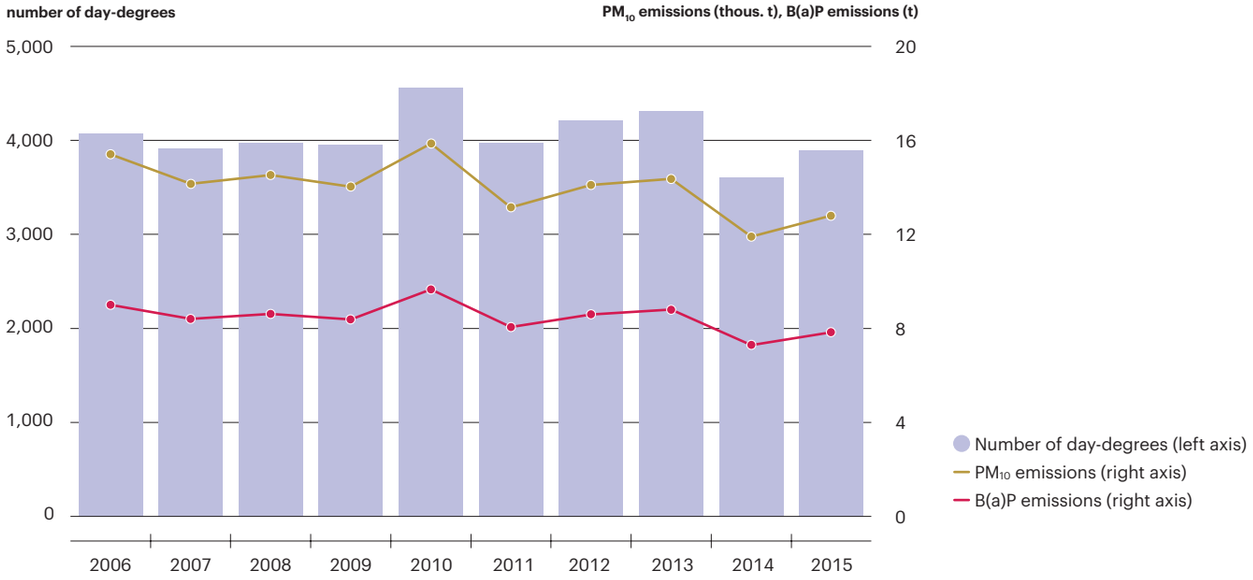
Data from the population and housing censuses in 1991, 2001 and 2011 have been included in the calculation. Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

[6] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Chart 2

Comparison of the characteristics of the heating season with the PM_{10} and B(a)P emissions from home heating in the Czech Republic [number of day-degrees, thous. t, t], 2006–2015

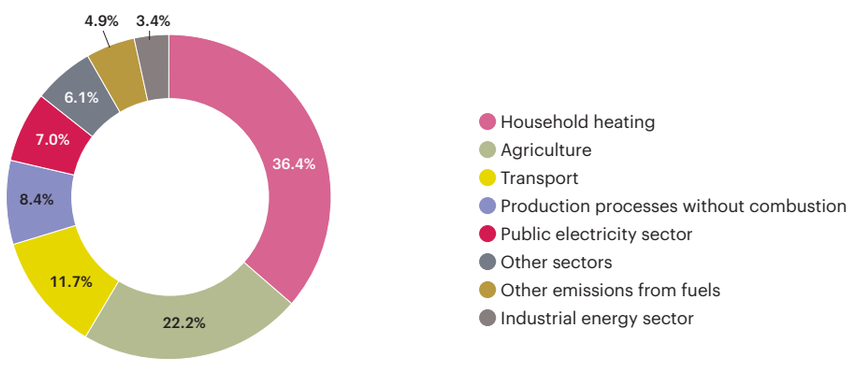


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

Chart 3

PM_{10} emissions from different economic sectors in the Czech Republic [%], 2015

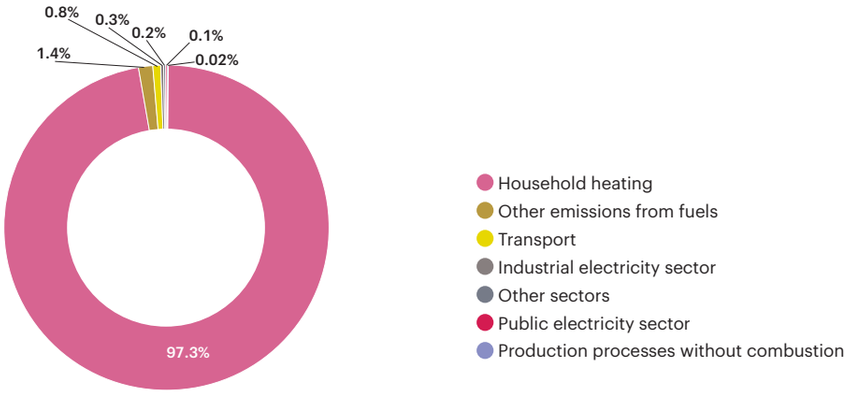


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

Chart 4

B(a)P emissions from different economic sectors in the Czech Republic [%], 2015



Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

Fuel consumption in households is affected by many factors. The intensity of heating in buildings is largely dependent on the outside temperature in a given location, a significant factor, however, are also the individual needs of the residents. The feeling of thermal comfort or the need for ventilation are quite subjective perceptions, but they significantly affect the consumption of heat. Due to the rising energy prices and the fact that the vast majority of energy in homes is consumed for heating and hot water, the households gradually replace their appliances with more economical ones with higher efficiency. In addition, the thermal insulation of houses and apartments continues. The method of heating also has a significant impact on the environment. The choice of fuel type, especially in home boilers, greatly influences the emissions and subsequently the state of the atmosphere. The type of fuel used for the heating of households is driven particularly by its availability, price, and convenience of use.

Since 2001, the household **heating methods**[7] have been changing very slowly in the Czech Republic and heating using solid fuels has not been declining (Chart 1). This category of solid fuels includes mainly coal and wood, however their exact proportion cannot be exactly specified, wood and coal are often burned together and their proportion depends upon their current availability and price. Households are often heated by multiple types of fuel, and the prevailing method cannot be accurately quantified. Usual are the combinations of gas/wood and coal/wood, in the rural areas for example gas or electricity/coal/wood. Since 2001, the sector of local home heating has shown an increase in the share of burning firewood, while the consumption of other fossil fuels is declining. However, this trend has resulted in an increase in emissions of PM_{10}, $PM_{2.5}$ and B(a)P.

In 2016, the most commonly used **type of home heating** was the system of heat supply (35.7% of households) and heating by natural gas (34.8% of households). Solid fuels heated 15.0% of households (Chart 1). In these households, combustion sources are installed, where according to expert estimates, approximately one third consists of old combustion installations with slow burn design with the worst parameters regarding formation of emissions.

The **emissions of pollutants from home heating** and concurrently the quantity of heat used in heating systems are fundamentally impacted, apart from the heating method, by the meteorological conditions. In 2015, the **heating season**[8] was

[7] *Data on the prevailing way of heating households are derived from the Population, houses and apartment census which is conducted once every 10 years. In the meantime, the data are estimated and supplemented by the number of newly completed apartments and from the documentation of distributors of fuels and energy.*

[8] *The heating season is characterized by the unit day-degree, which is the product of the number of heating days and the average difference between indoor and outdoor temperature. The day-degree thus illustrates how cold or warm it was for a certain period of time and the quantity of energy needed to heat the buildings.*

cooler, and therefore requires more heating than in the year 2014 (Chart 2). This development also affected the production of emissions from heating of households in 2015.

Local combustion heaters have a major impact on the amount of **emissions of PM_{10} and B(a)P**. In 2015 the local heating units generated 12.8 kt of PM_{10} emissions, representing 36.4% of the total emissions of these pollutants (Chart 3). Compared to 2014, the quantity of PM_{10} emissions from household heating increased by 7.5%. B(a)P emissions from home heating (Chart 4) in 2015 amounted to 7.8 t, which represents 97.3% of the total emissions of that pollutant. Year on year, in 2015 the amount of B(a)P emissions from home heating grew by 7.5%. These changes are associated in particular with the cooler heating season, when it was necessary to stoke more intensely than in the previous year.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

30 | Energy intensity of the economy

Key question

Are the efforts to reduce energy intensity of the Czech Republic economy successful?

Key messages[9]

Energy intensity of the Czech economy has a decreasing trend, since 2010 it has declined in total by 13.6%.

The structure of primary energy sources is dominated by the consumption of solid fuels.
The transportation, agriculture and industry sectors represent the most significant proportion in the economy energy intensity by sectors.

Overall assessment of the trend

Change since 1990

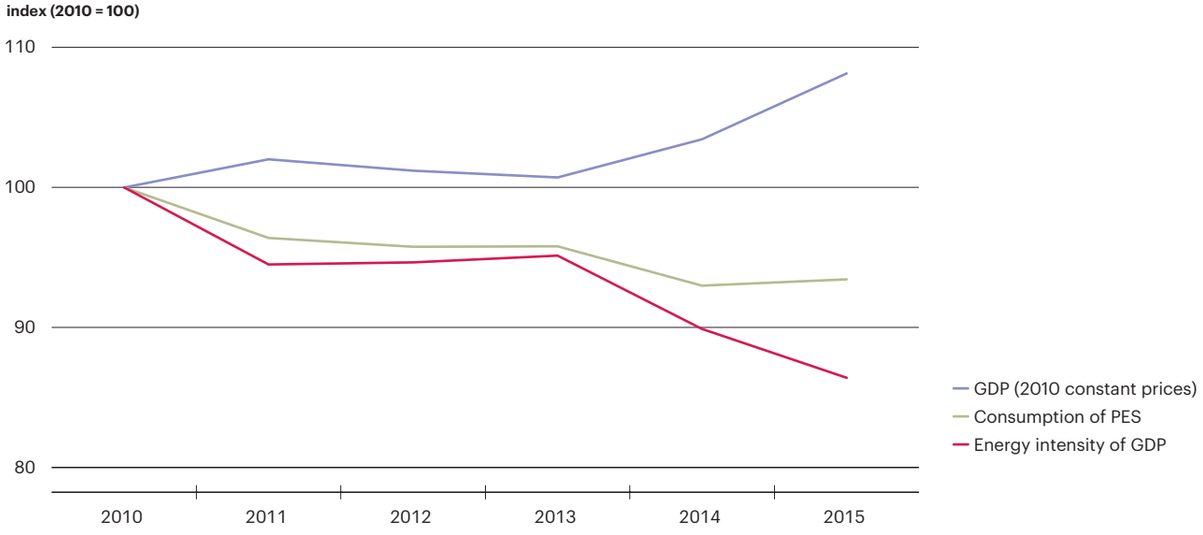
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

Energy intensity of GDP in the Czech Republic [index, 2010 = 100], 2010–2015



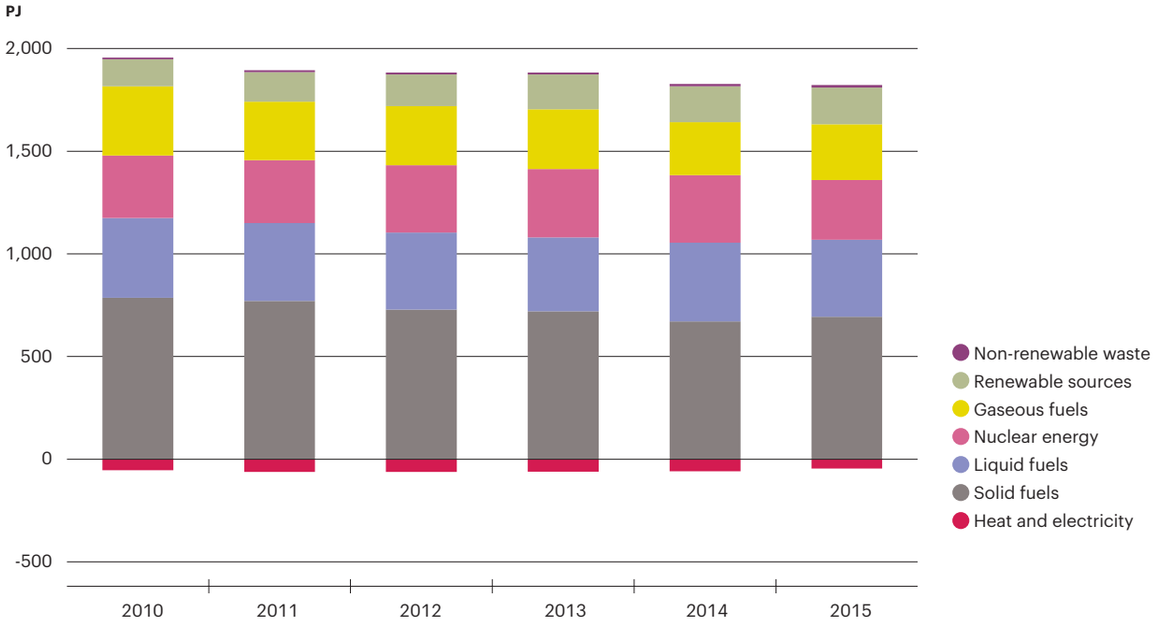
Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Statistical Office

[9] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Chart 2

Development of primary energy sources consumption in the Czech Republic [PJ], 2010–2015

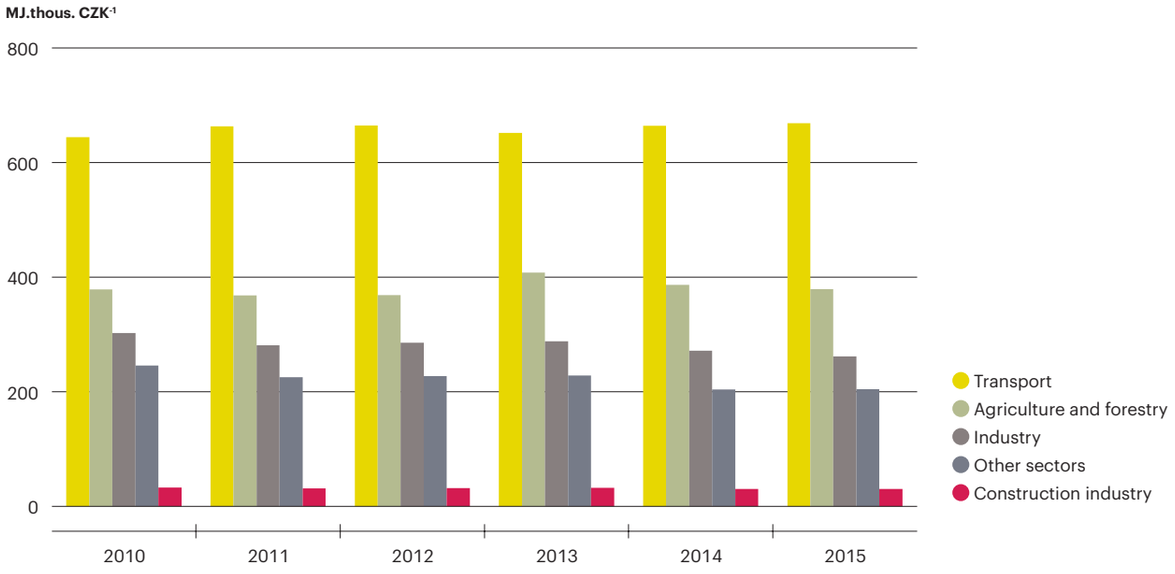


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Statistical Office

Chart 3

Energy intensity trends by sectors, expressed as the proportion of the final energy consumption in the sector and gross value added of the sector in the Czech Republic [MJ.thous. CZK^{-1}], 2010–2015



Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Statistical Office, Eurostat

Energy intensity of the economy measures the energy consumption of the economy. It represents the total amount of energy consumed per unit of domestic product. The aim of the European and national strategies is to reduce energy intensity in all areas where this is possible, which leads to increasing energy security, competitiveness and sustainability. The indicator of energy intensity of the economy is obtained as a ratio of energy consumption and the GDP value; therefore, it decreases if the change in energy consumption is lower than the GDP change in the reference period (ideally, if the GDP grows and energy consumption decreases, so-called absolute decoupling).

In the Czech Republic, energy intensity of the economy in the reference period has had a downward trend since 2010 (Chart 1). An exception were the years 2012–2013, when there was a slight decline in GDP and stagnation of the consumption of primary energy sources (PES), therefore energy intensity increased slightly. In 2014–2015, however, the energy intensity of the economy continues in its downturn. In 2015, the consumption of PES decreased year-on-year (by 0.5%), but at the same time there was an increase in gross domestic product (by 4.5%). The economy's energy intensity has reached 415.7 GJ.CZK.1,000^{-1} (at constant 2010 prices) and therefore it decreased by 3.9% year-to-year. In longer term, i.e. since 2010 (when this value was 481.1 GJ.CZK.1,000^{-1}), there was a total decline in energy intensity by 13.6%.

PES consumption in the Czech Republic (Chart 2) has been declining or stagnant since 2010. Between years 2014–2015, however, it slightly grew about 0.5%, in 2015 the PES consumption reached 1,777.0 PJ.

The PES structure (Chart 2) is dominated by the consumption of solid fuels, in 2015 it represented 39.1% of the total amount of PES. The share of liquid fuels was 21.1%, gas fuels 15.3%, nuclear power 16.4% and renewable sources 10.1%. The category heat and electricity is moving in the negative numbers, because electricity is exported, and heat has a zero value in the PES balance (in the Czech Republic, there is no primary source of heat, potentially it could be e.g. geothermal energy).

The aim of the State Energy Policy of the Czech Republic 2015 for 2040 is a diversified mix of primary sources with the target structure in the corridors: nuclear fuel 25–33%, solid fuels 11–17%, gas fuels 18–25%, liquid fuels 14–17%, renewable and secondary sources 17–22%. Currently, PES are not within these values, solid and liquid fuels have a higher proportion and other sources a lower one.

The transportation, agriculture and industry sectors represent the most significant proportion in the **economy energy intensity by sectors** (Chart 3). The energy intensity of transport, compared to other sectors, is high because it includes also private automobile transportation. That transportation accounted for 56.7% of the total fuel consumption in transport in 2015 and is still growing, but does not contribute to the economic performance of the Czech Republic. The energy intensity of transport has a growing trend, since 2010 it has increased by 3.8%. Other sectors reported slight fluctuations in energy intensity over the reference period 2010–2015, without a clear trend.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

31 | Electricity and heat generation

Key question

What is the structure and quantity of generated energy and what impacts does the electricity and heat generation have on the environment in the Czech Republic?

Key messages

Electricity production in 2016 decreased for the fourth year in a row, the year-on-year decrease was 0.7%.

Half of the electricity is produced in the Czech Republic from coal (50.4%), another important source is the nuclear fuel (28.9%).
Foreign trade with electricity in 2016 had an export character. The balance of exports and imports for the whole year amounted to 11.0 TWh, which corresponds to 12.3% of the overall amount of electrical energy produced in the Czech Republic. This value is the lowest in the last ten years.

Overall assessment of the trend

Change since 1990

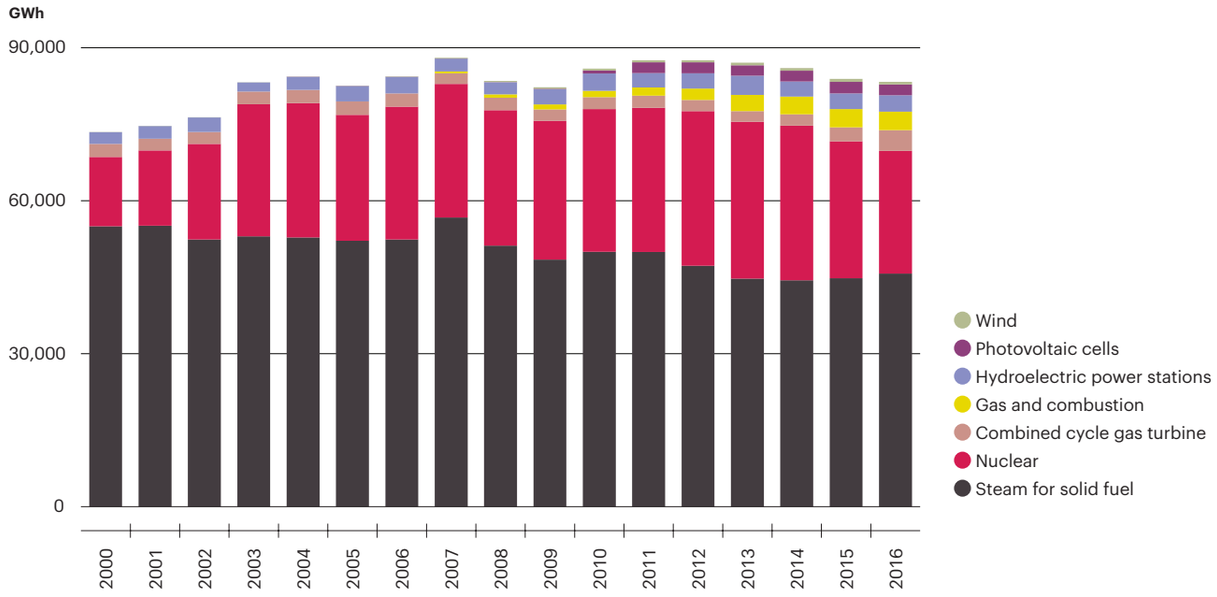
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

Electricity generation by the type of power stations in the Czech Republic [GWh], 2000–2016

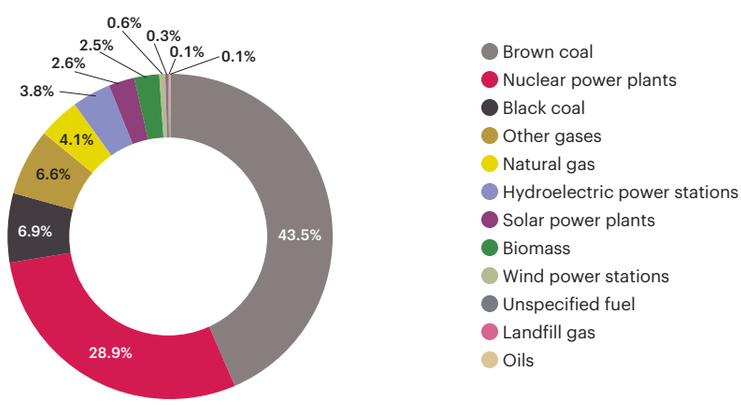


Wind power stations: The wind drives the propeller through an electric generator that produces electricity.
Photovoltaic power plants: Gaining energy from the solar radiation transformation on the principle of the photoelectric effect.
Hydroelectric power stations: The electric energy is produced by converting the potential energy of water so that the water turns a water turbine that drives an electric generator.
Gas and combustion power plants: Energy is produced by the gas combustion in a gas turbine. Combustion gases directly drive a gas turbine.
Combined cycle gas turbine power plant: The gas is first burned in a gas combustion turbine, where the first part of the energy is produced. The formed hot flue gas produces steam in the boiler, and it is led into a steam turbine that produces the second part of electricity This double production greatly increases the energy efficiency of the equipment.
Nuclear power plants: This is in principle of a steam power plant, which has a nuclear reactor in place of a steam boiler and the energy is gained by conversion of binding energy from the nuclei of heavy elements (uranium 235 or plutonium 239).
Steam power plant for solid fuel: Energy is obtained by the combustion of fossil fuels (coal) or biomass. The resulting heat is heated by steam, which powers a steam turbine generator.

Source: Energy Regulatory Office

Chart 2

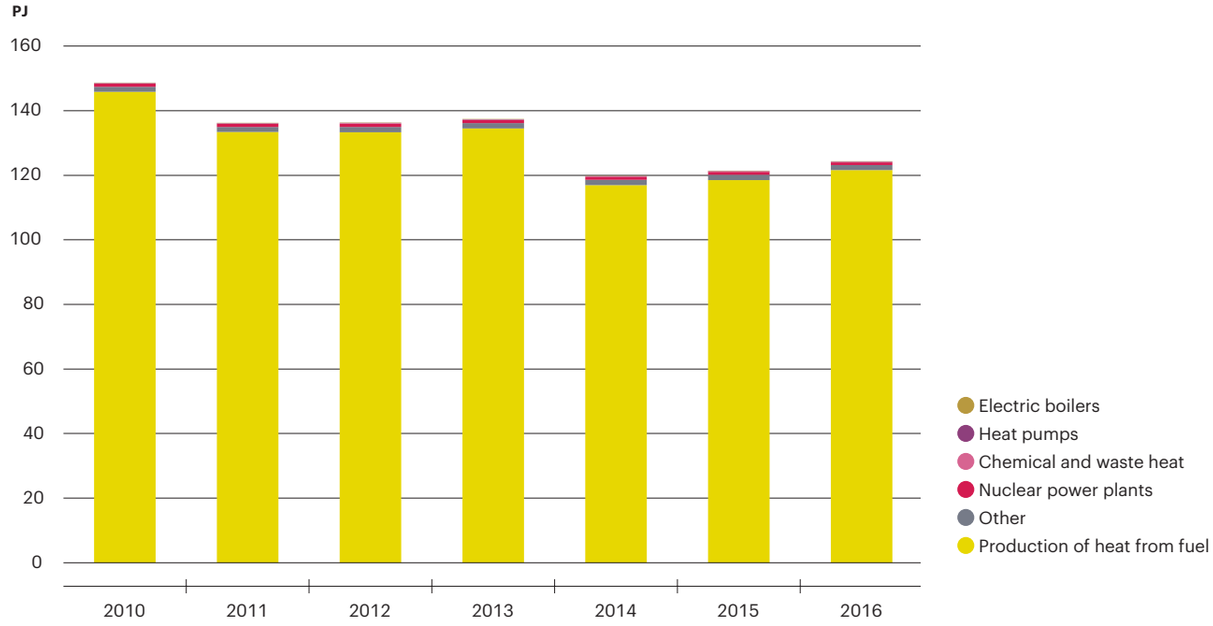
Electricity generation by fuel type in the Czech Republic [%], 2016



Source: Energy Regulatory Office

Chart 3

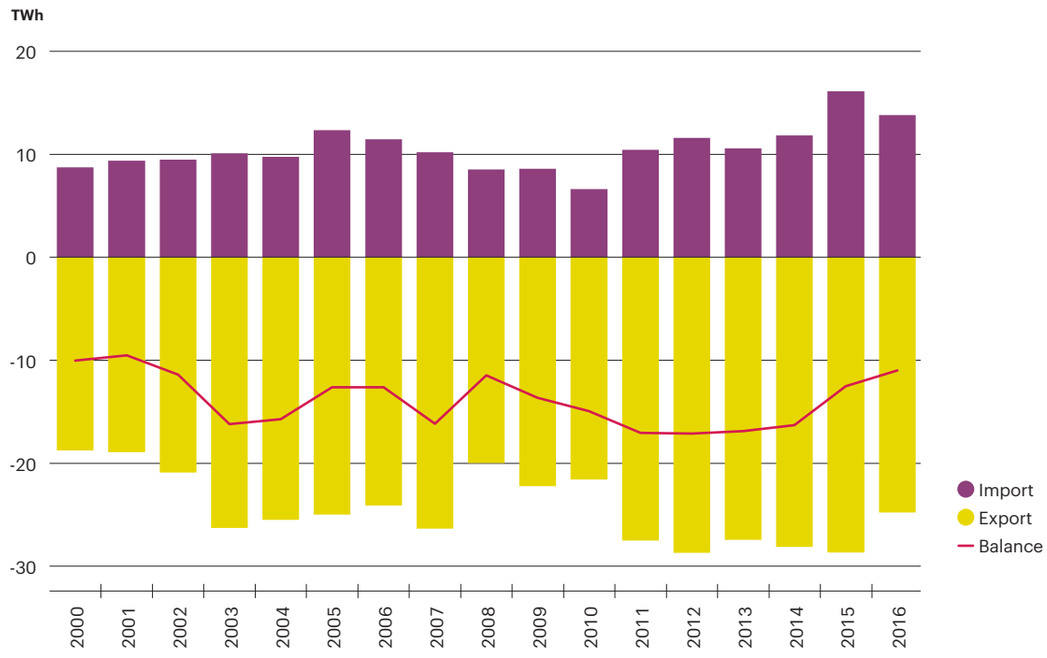
Net heat production by sources in the Czech Republic [PJ], 2010–2016



Source: Czech Statistical Office

Chart 4

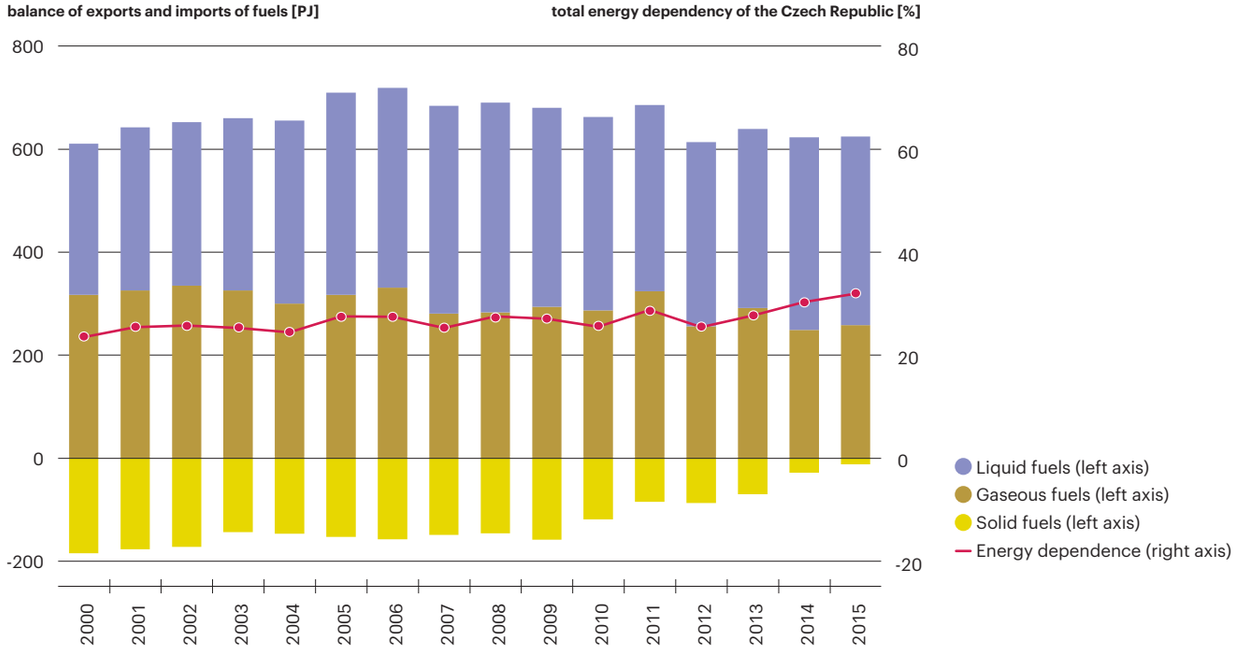
Electricity imports and exports in/from the Czech Republic [TWh], 2000–2016



Source: Energy Regulatory Office

Chart 5

Export/import balance by fuels, overall energy dependence of the Czech Republic [PJ, %], 2000–2015



Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Statistical Office

Production of electricity and heat is determined by the demand, therefore, closely related to power consumption. Foreign trade enters the demand as well, apart from the domestic market, because a part of electricity produced in the Czech Republic is exported. Sources from which electricity and heat are produced and the extent of their use (energy mix), however, are influenced by many factors. Among the most important ones are the availability of energy raw materials; the energy policy is also an important factor, as it sets the conditions for their use.

The total gross **production of electricity** in 2016 decreased for the fourth year in a row and reached 83,301.7 GWh (Chart 1), which represents a decrease of 0.7% year on year. Compared to 2000, 13.4% more electricity was produced in 2016. Steam power plants burning solid fuel generated 45,704.3 GWh of electricity in 2016, which represents 54.9% of the total production. Their production grew year-on-year by 2.0%. The largest year-on-year change in electricity production was recorded at the steam-gas power plants, where it increased by 47.3% under an unchanged installed capacity. On the contrary, the year-on-year fall continued in electricity production from nuclear power plants by 10.2%. The reason there were longer stoppages in both nuclear power plants (Dukovany and Temelin) for maintenance and equipment upgrades. The production of electricity from hydroelectric power plants increased year-on-year by 4.3%. Wind power plants produced 13.2% less electricity year-on-year. The production of electricity from solar sources fell by 5.8% year-on-year, their installed capacity has been growing slightly since 2011.

The **energy mix of the Czech Republic** (Chart 2) is gradually evolving and changing. Historically, the production of electricity in the Czech Republic was based especially on the combustion of brown and black coal, whose reserves were always sufficient. In 1985 the Dukovany nuclear power plant was put into operation, in the year 2002 the nuclear power plant Temelín. Steam powers plant for solid fuel[10] combusting particularly brown coal were partially shut down, partially reconstructed. In 2005, that situation started to be influenced by support and development of renewable energy sources, which took up a growing share

[10] *Steam power stations are generally those that use steam to drive the generator of electricity, whereas water vapour is extracted by heating the water that occurs by burning fuels or nuclear reactions. In this document, however, the category of steam power plants is taken from the statistics of the Energy Regulation Office and includes thermal power plants that burn, in the conditions of the CR, particularly brown coal. Nuclear power plants are listed in a separate category.*

in the total energy mix until 2013. In 2015, the territorial limits of the extraction of brown coal in the mine Bílina were broken, which allows for using another up to 120 mil. t of coal. In 2016, combustion of brown coal produced 43.5% of electricity, another 6.9% were produced by the combustion of black coal. Coal therefore fuels a whole half of the electricity production in the Czech Republic. Another key source is the nuclear fuel which produced 28.9% of electricity. Other resources include natural gas, landfill gas, or renewable energy sources.

The vast majority of **heat production** (97.9%) in the Czech Republic is ensured mainly by the combustion of fuels (Chart 3). Heat is produced either in independent heat production installations, or as the combined production of electricity and heat, where residual heat is used in the production of electrical energy. Other sources producing heat make up only a small share. The produced heat is used for industrial purposes or as a system of thermal energy supply to households. The total amount of produced heat has been decreasing since 2010, which is a consequence of the economical use of thermal energy and of the efforts to reduce heat consumption in the industrial and public sectors. In 2016, however, there was a slight year-on-year increase of 2.4% to the value of 124.2 PJ, due to the colder winter than in the previous year, causing a higher heat consumption for heating.

The public and industrial energy sector is a major producer of **emissions** of pollutants and greenhouse gases into the atmosphere. In 2015[11], SO_2 contributed to total emissions by 79.8% (98.3 thous. t), NO_x emissions by 46.7% (76.8 thous. t), CO_2 emissions by 68.6% (63,175.0 thous. t) and PM_{10} emissions by 10.4% (3.7 thous. t). Compared to previous year 2014, this sector saw a decrease of all the main monitored emissions except CO_2: NO_x by 6.3%, SO_2 by 6.5% and PM_{10} by 13.5%, emissions decreased from public energy as well as from industrial energy. CO_2 emissions rose in public energy by 0.9%, in industrial energy they decreased by 2.3%. Overall, however, the emissions of that substance grew by 0.5% year-on-year.

Foreign trade with electricity in 2016 had an export character, same as in the previous years (Chart 4). 24.8 TWh of electricity was exported, but imports amounted to 13.8 TWh. The balance of exports and imports for the whole year thus amounted to 11.0 TWh, which corresponds to 13.2% of the overall amount of electrical energy produced in the Czech Republic (83,301.7 GWh). The value of the balance is lower than in 2015 by 12.3%, this is the lowest value in the last ten years. The decline in the export of electricity is positive with regard to the environment, since it reduces the emissions and other environmental impacts from the production of electricity that is consumed abroad but produced in the Czech Republic.

The **energy dependence** indicator indicates the extent to which an economy relies on imports of energy or its sources to meet its energy needs. The target is to keep this value at the lowest possible level, which ensures high energy security of the country. The Czech Republic is currently almost self-sufficient only in electricity production from coal, because that raw materials are mined on its territory. Electricity and coal are also exported (Chart 4 and Chart 5). Regarding coal, this concerns in particular black coal, which is, due to its quality, used in metallurgy. Concurrently the Czech Republic imports black coal. The Czech Republic is dependent on supplies of oil and natural gas. The Czech Republic also imports nuclear fuel for nuclear power plants. More than two-thirds of oil and gas and all nuclear fuel are purchased by the Czech Republic from Russia. The total energy dependence of the Czech Republic in 2015[12] amounted to 31.9%, the highest value in the period from the year 2000 (Chart 5).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[11] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

[12] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

32 | Renewable energy sources

Key question

What is the structure and the share of renewable energy in the total energy sources?

Key messages

The production of electricity from renewable energy sources has stagnated since 2014.
Heat production from renewable sources is mostly influenced by the use of wood for heating households.

Overall assessment of the trend

Change since 1990

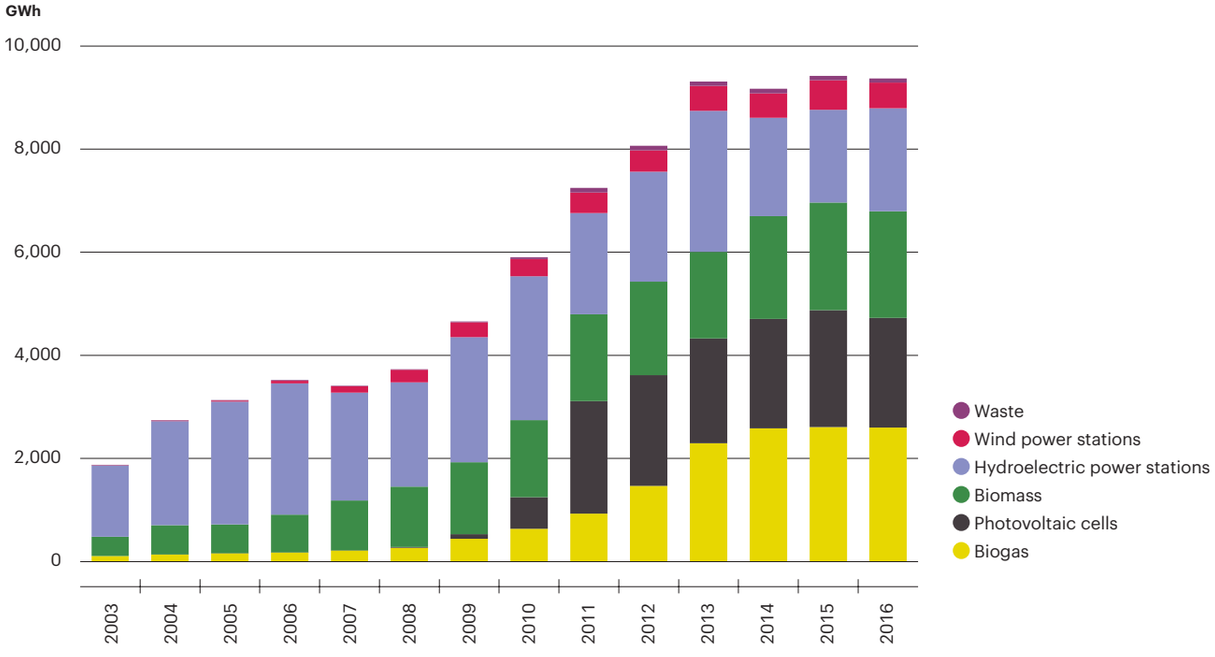
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

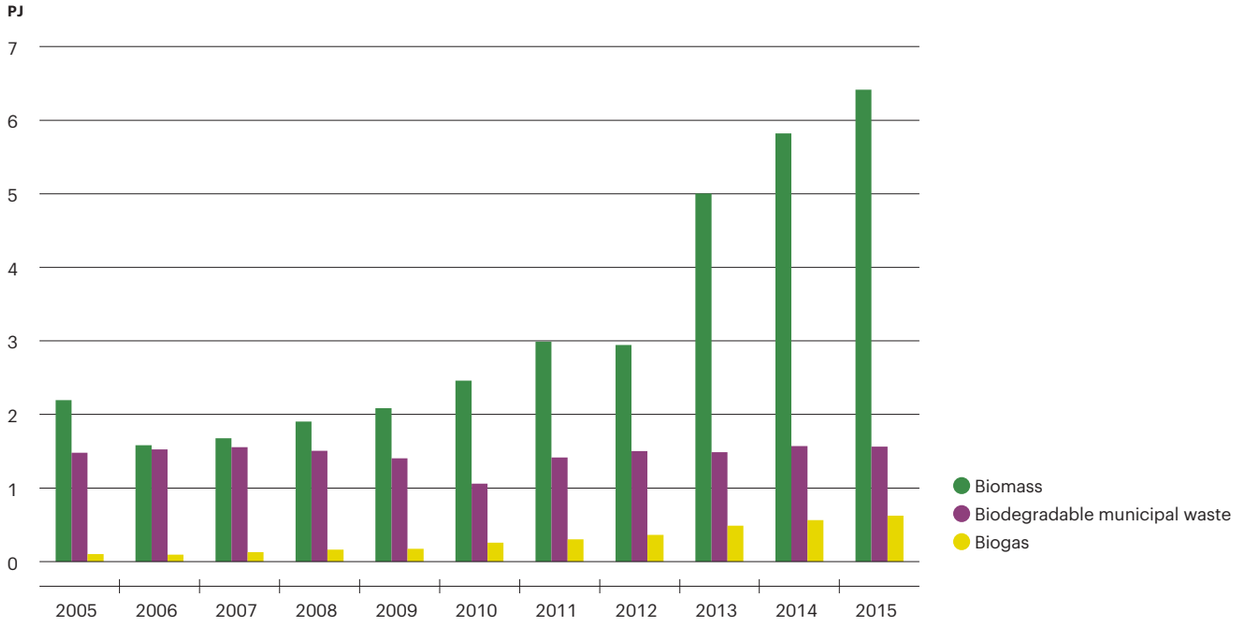
Electricity generation from RES in the Czech Republic [GWh], 2003–2016



Source: Ministry of Industry and Trade

Chart 2

Heat from RES to be sold in the Czech Republic [PJ], 2005–2015

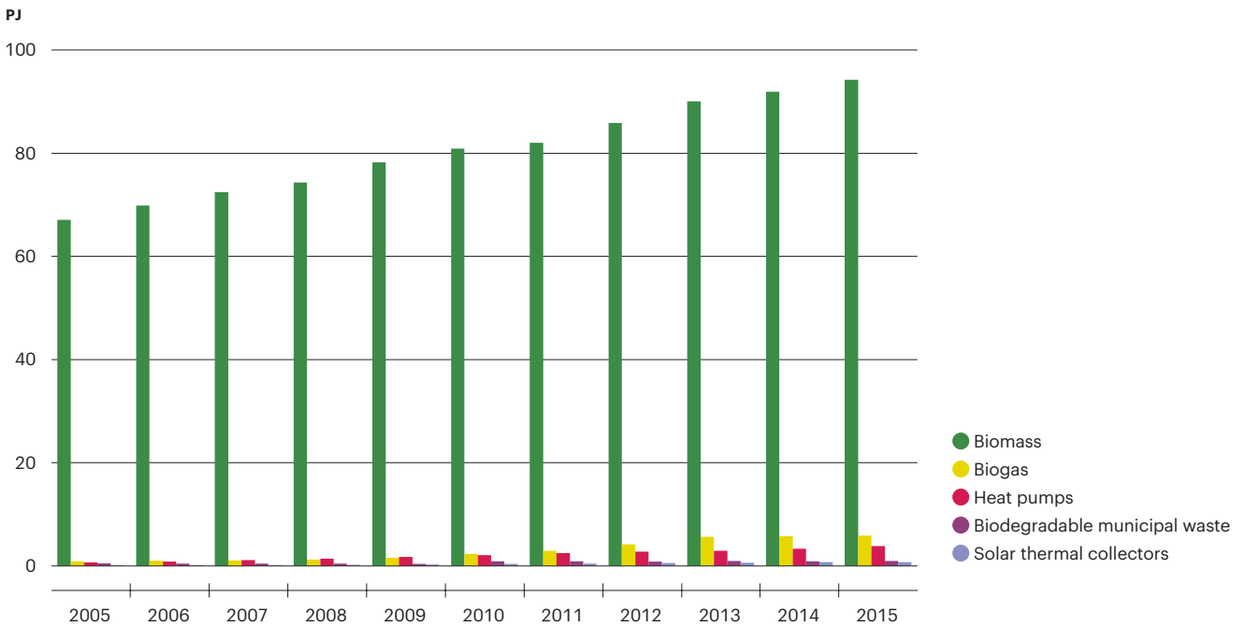


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Ministry of Industry and Trade

Chart 3

Final consumption of heat from RES in the Czech Republic [PJ], 2005–2015

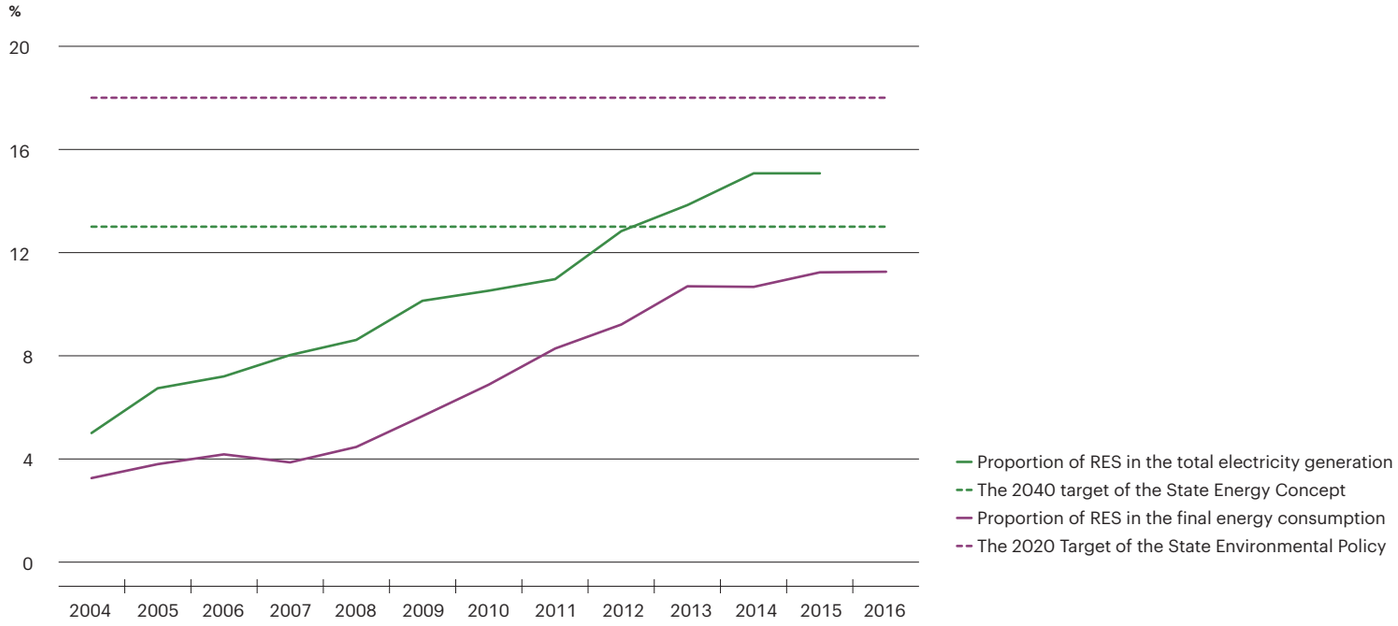


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication

Source: Ministry of Industry and Trade

Chart 4

Targets for RES and the status of their implementation in the Czech Republic [%], 2004–2016



The aim of the State Energy Policy of the Czech Republic is to ensure by 2040 the share of annual electricity generation from renewable sources and secondary sources in the range of 18–25%, in the Chart only the lower limit is marked: 18%.
Data for the RES share in the final energy consumption in 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Statistical Office, Energy Regulatory Office, Ministry of Industry and Trade

The **renewable energy sources** (RES) are an important part of the energy mix because they contribute to the reduction of pollutant emissions and of greenhouse gases. Furthermore, given that the energy produced from them comes from own territory, they increase the country's energy security and independence on the international trade in energy commodities. Their disadvantage is, however, considerable dependence on climatic, meteorological and geographical conditions. Production of electricity and heat from these sources is limited by those factors, and at the same time it is difficult to adjust according to the current demand.

The **production of electricity** from renewable sources developed dynamically in the Czech Republic since 2003 (Chart 1). The reason is the establishment of international and national strategies and goals that led to the promotion of RES in the Czech Republic, especially thanks to Act No. 180/2005 Coll., on aid for the production of electricity from renewable energy sources. While wind power or the production of electricity from biomass grew at a soft pace, the development of photovoltaic power plants was very steep due to favourable feed-in tariffs, especially in the years 2009 and 2010. After that, due to the amended legislation, the new photovoltaic plants stopped being built, but biogas plants started to develop. In 2013, the sharp rise in the production of electricity from RES stopped and it stagnated in 2014–2016.

In 2016, 9,373 GWh of electricity was produced from renewable sources, which is five times more than in 2003, but is 0.5% less than in 2015. The largest year on year change was seen in the production of electricity from hydroelectric plants, when after two dry years with low production now the production increased by 11.4%. All other renewable sources decreased their production year-on-year: wind by 13.3%, photovoltaic by 6.0%, waste by 5.7%, biomass by 1.1%, and biogas by 0.5%.

The **structure of electricity production from RES in the Czech Republic** is relatively diverse and the proportion of the different energy sources is balanced. That situation started in the Czech Republic only in 2011 when RES started to develop thanks to their considerable support. In the previous period, the only major renewable source of energy were the hydropower stations, while other sources had a minimum share. In 2016, the largest proportion of RES electricity was produced from biogas (27.7%), followed by photovoltaics (22.7%), and biomass (22.1%). The following important source are the hydroelectric power

plants (21.3%). On a much smaller scale electricity is produced by wind power (5.3%), its potential in the Czech Republic is strongly limited by natural conditions. The smallest share is taken up by the biodegradable fraction of municipal solid waste (Waste category) at 0.9%.

Heat production from renewable sources has grown in the long term. Heat for sale (Chart 2), i.e. heat which is used for district heating, grew year on year by 8.1% in 2015[13], the largest energy source for its production was biomass (74.6%).

The **final consumption of heat** from renewable sources (Chart 3) is the energy that is intended for the heating of own enterprises, but also households. It is the energy in the fuel, and it is statistically monitored according to the sales of fuels for heating. Also this category is clearly dominated by biomass, which made up 89.2% in 2015[14]. The largest share here is local heating of households with the combustion of wood. Other sources of heat are biogas, heat pumps, biodegradable municipal waste and solar thermal collectors. Final consumption of heat from RES grew in 2015[15] year-on-year by 2.9%, since 2005 the increase has been 52.7%.

In the **objectives for renewable resources**, after updating the State Energy Policy and the State Environmental Policy of the Czech Republic, the Czech Republic currently works towards two indicative targets relating to the production of electricity from RES (Chart 4). The State Environmental Policy of the Czech Republic implemented the target from the European Directive, i.e. the share of RES in gross final energy consumption of 13% by the year 2020. In 2015[16], the value for the Czech Republic amounted to 15.1%, the indicative target was met already in 2013. The second target, resulting from the updated State Energy Policy, is to achieve the proportion of RES in electricity production in the range of 18–25% to 2040. In 2016, this share amounted to 11.3%.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[13] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*
[14] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*
[15] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*
[16] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Industry and energy in the global context

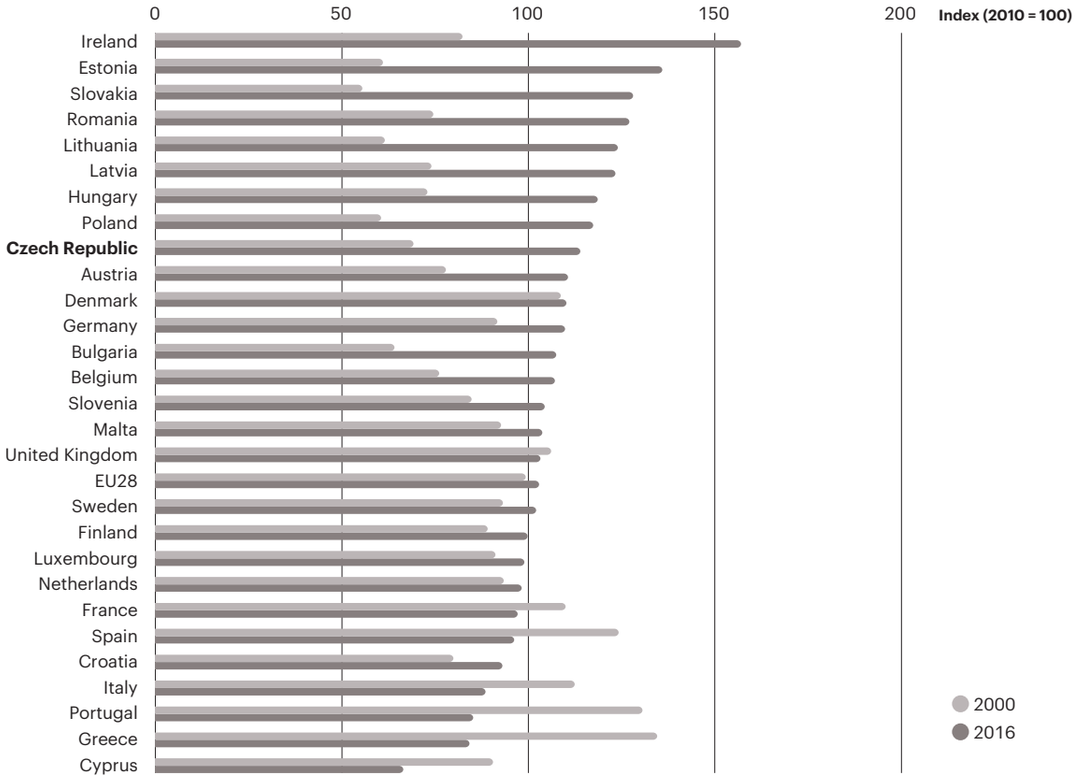
Key messages[17]

- In the individual countries of the EU28, industrial production has a different development. It is influenced by historic conditionality, the sources of raw materials, policy and international trade.
- The average annual energy consumption per capita in the EU28 decreases.
- The energy intensity of the economy is decreasing in all EU28 countries, which is caused by increasing the energy efficiency and structural changes in the economies of each state.
- Dependence on energy imports rages in the European countries from 7.4% to 97.7% and gradually increases. In 2015, energy dependency of the EU28 reached 54.0%.
- The share of renewable energy sources in final consumption in the EU28 countries is growing, in 2015 the share was 16.7%, while the target for the EU28 as a whole by the year 2020 is 20%. Their national objectives were already achieved by 10 countries of EU28, including the Czech Republic.

Indicator assessment

Chart 1

Index of industrial production [index, 2010 = 100], 2000, 2016

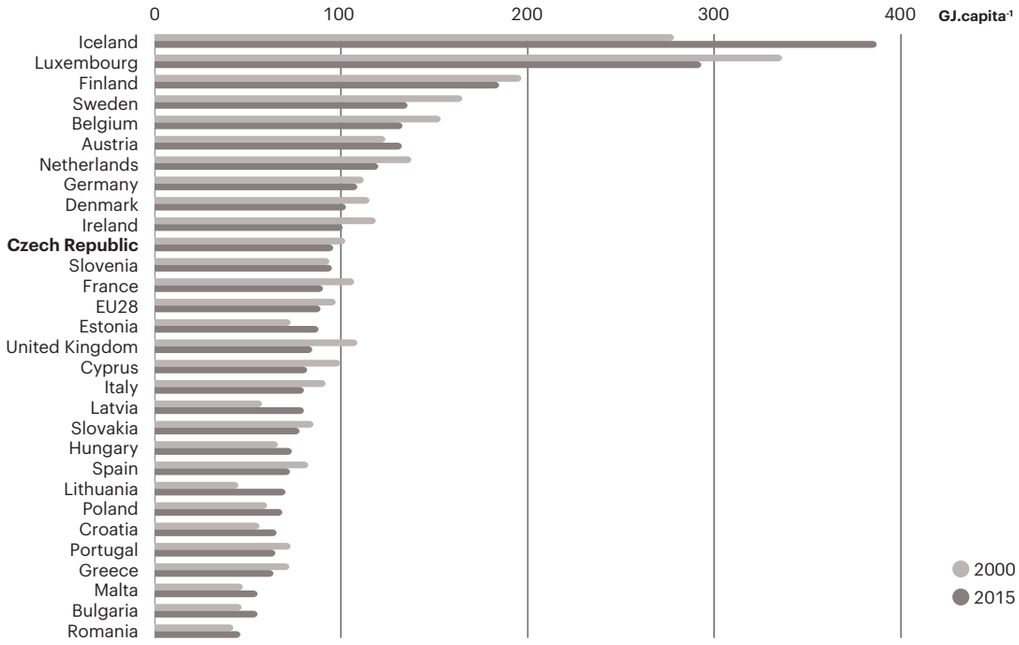


Source: Eurostat

[17] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Chart 2

Final energy consumption per capita [GJ.capita^{-1}], 2000, 2015

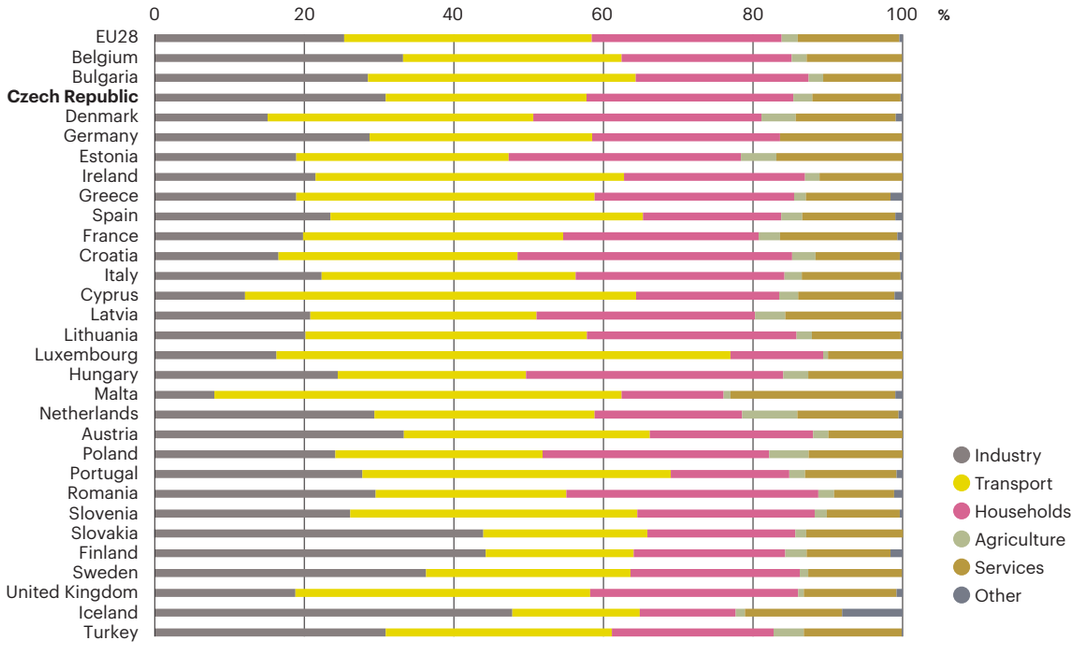


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

Chart 3

Final energy consumption by sectors [%], 2015

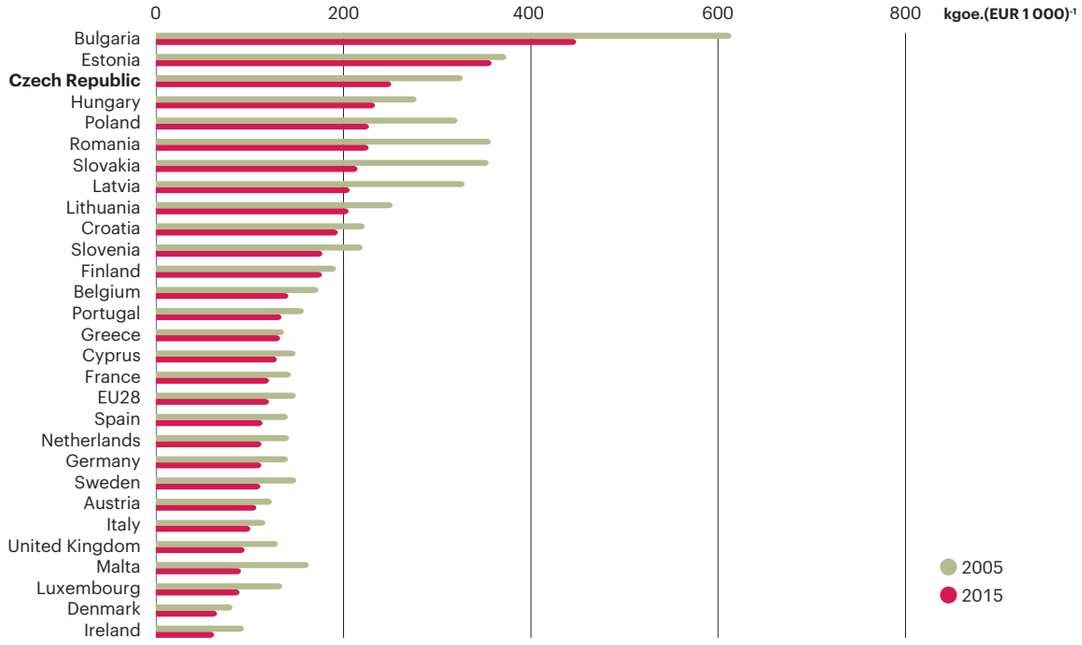


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

Chart 4

Energy intensity of the economy [kgoe.(EUR 1,000)$^{-1}$], 2005, 2015

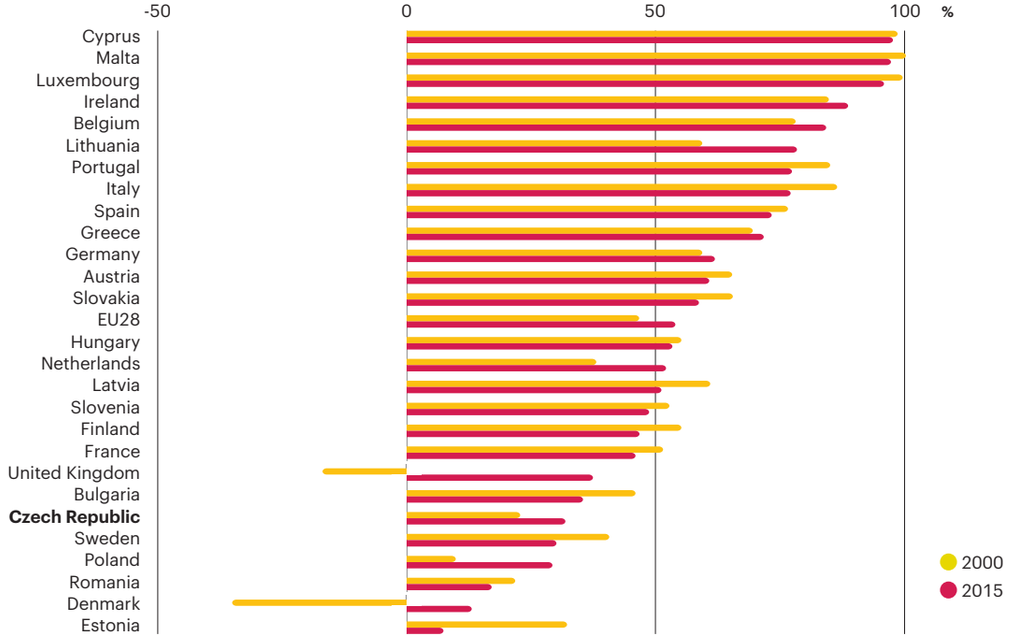


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

Chart 5

Energy dependence [%], 2000, 2015

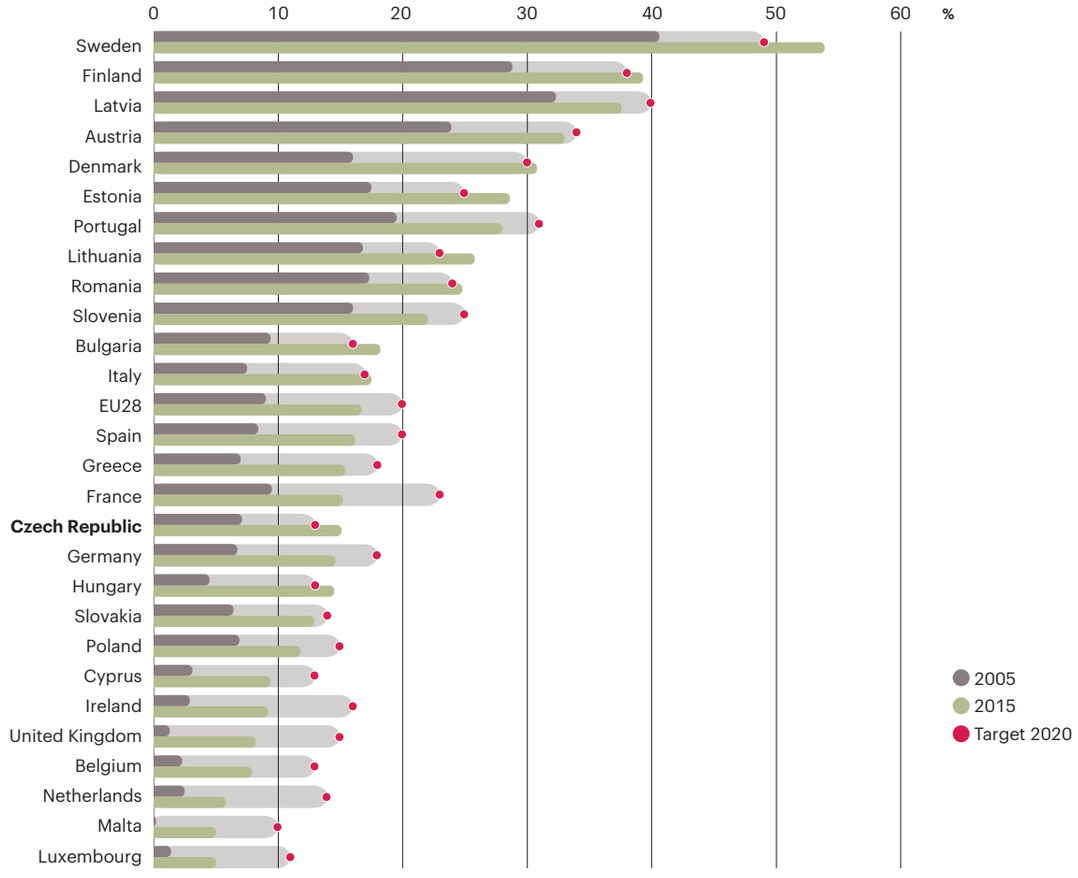


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

Chart 6

Proportion of renewable energy sources in final energy consumption [%], 2005, 2015



Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

Industrial production in European countries is developing variably (Chart 1). Some states are increasing their production at a significant rate (e.g. Estonia, Ireland, Slovakia), others, on the contrary, face a significant drop (e.g. Greece, Portugal, Spain). These changes are influenced by the orientation of the individual national economies, the stability of the national economy, inter-connectivity of the national economies with other countries, openness to foreign trade, domestic markets and other economic, political and demographic factors.

The value of the **index of industrial production** grew collectively in the EU28 countries in the period 2005–2015 from 102.7 to 103.9 (2010 = 100, adjusted for calendar effects). For comparison, in the Czech Republic this change was much more pronounced, the index of industrial production in the same period increased from 90.4 to 115.2.

The greater or smaller **orientation** of the individual states **on industrial production** is significantly determined by the natural conditions, or the presence of mineral and energy resources. During the second half of the 20th century, the European countries have pursued two different directions. While the West European countries applied market economy based on the principle of balance between supply and demand, the Eastern European countries were subordinated to central planning, where the emphasis was on industrial production and industrialisation. The Czech Republic is historically focused on industrial production, in particular thanks to its deposits of precious metals and coal, and this heritage, despite a gradual slow-down of extracting in recent years, it still continues.

Final energy consumption per capita in European countries varies greatly (Chart 2). The lowest values were reached in Romania, where its value in 2015 was 46.3 GJ.capita^{-1}, by contrast, the highest consumption was reported by Iceland, where the annual per capita consumption reached 387.0 GJ.capita^{-1}. The average consumption for the entire EU28 in 2015 was 89.1 GJ.capita^{-1}, which is 8.4% less than in the year 2000. That decline is in line with the general efforts to reduce energy intensity of the economy. It reflects the structural changes in the economy and higher energy efficiency. The per capita final energy consumption is related also to the country location and climatic conditions, because a significant portion of the energy is consumed for heating homes. Therefore, the higher per capita consumption is in the Nordic countries, and on the contrary lower in the countries in southern Europe with warmer climates. In the Czech Republic, energy consumption per capita in 2015 was 96.0 GJ.capita^{-1}, which is 7.8% more than the average of the EU28 countries.

Final energy consumption in the EU28 countries reached in 2015 the value of 45,383.1 PJ. Of this total consumption the largest share is held by transportation (33.1%), households (25.4%) and industry (25.3%). That is followed by the service sector (13.6%) and agriculture (2.2%). The share of energy consumption in each sector within EU28 countries varies (Chart 3), since it is affected by a number of factors. Those are, for instance, the type of economy, the level of living standards, climatic conditions, etc. Within the EU28, however, these shares are relatively stable in the long term.

The **energy intensity of the economies** in EU28 countries (Chart 4) is decreasing. Between the years 2005–2015 its value[18] dropped from 149.2 to 120.4 kgoe.(EUR 1,000)$^{-1}$. This trend is influenced by the improving energy efficiency both in energy production and at end users. In the national economies of the individual states, the changes are ongoing, including, for example, shift from energy-intensive industries towards less demanding industries, or increasing the share of services at GDP. The decline in the energy intensity of the economy in the period 2005–2015 is reported in all EU28 countries without exception. The energy intensity of the economy in the Czech Republic dropped during that period from 327.6 to 251.0 kgoe.(EUR 1,000)$^{-1}$, that is by 20.5%, however it is still high compared to the average of the EU28, approximately twice as high. The reason for that is the significant role of industry in the Czech Republic on the creation of GDP.

Energy dependence of EU28 countries increases. In the 1980s, its value amounted to less than 40%, in 2000 it went up to 46.7% and in 2015 it reached 54.0%. This is because of the higher consumption of energy raw materials that must be imported from outside the EU, in particular oil and natural gas. The energy dependency varies significantly among the Member States of the EU28 (Chart 5), it ranges from 7.4% (Estonia) to 97.7% (Cyprus). These differences are caused by the different availability of domestic fossil resources and the differences in the potential of renewable energy sources in each country. In the Czech Republic in 2015, the total energy dependency was 31.9%, which is the fifth least dependent position among the EU28 countries. This position is determined by its own resources of solid fuels (brown and black coal), which are also exported abroad, both in the form of extracted materials as well as products – most of them in the form of coke or electrical energy. Gaseous and liquid fuels and fuel for nuclear power stations, however, have to be imported to the Czech Republic. In EU28 at present none of the countries is energy independent (i.e. with higher exports than imports), in 2000 it was still two countries: the United Kingdom and Denmark (Chart 5).

The **share of renewable energy sources (RES)** in the EU28 final consumption grew year-to-year from 16.1% to 16.7% in 2015, while in 2005 this value amounted to only 9.0% (Chart 6). EU Member States have set a target by 2020, that the share of electricity production from renewable sources in final energy consumption will reach 20%. However, due to the varying potential of renewable energy sources the individual countries set their national targets, for which national action plans were drawn up, stating measures to achieve these objectives. For example, Denmark, Finland and Estonia extensively use wind turbines to produce electricity, installed at sea and on land, Germany develops photovoltaics and intends to supplement its energy mix by the installation of wind turbines at sea. Austria bets on water energy and by using pump and storage plants it can well regulate renewable energy production with greater fluctuations (photovoltaic and wind). This capacity will be used by the surrounding states, as is currently done already by Germany. Slovakia plans a uniform development of electricity production from solar radiation, wind and biomass. In 2015, the national target for renewable sources had been already reached by 10 of the EU28 countries including the Czech Republic (Chart 6). The value of the share of renewable sources in final consumption in the compared year of 2015 in the Czech Republic reached 15.1%, while the target for 2020 is 13%.

[18] *Unit kgoe – Kilogram of Oil Equivalent. Corresponds to the energy obtained from one kilogram of oil: 41.868 MJ.*

8 Transportation

Transportation

Transport is an economic sector with a significant impact on the environment. Production of greenhouse gases from burning fossil fuels influences the climate system, it is a source of pollutant emissions that worsen air quality and last but not least is the main source of noise exposure of the population in the urban environment. Transport infrastructure is causing land take and fragmentation of the landscape. The greatest negative impacts on human health and ecosystems are caused by road transportation.

The effect of transport on air quality is most pronounced in settlements and other densely populated areas, which increases the potential impacts of air pollution on the health of the population, which include reduced immunity, deteriorated condition of asthmatics and people with allergies and more frequent occurrence of diseases of the respiratory and cardiovascular system. The air pollution caused by transport also burdens ecosystems, namely through secondary pollutants, mainly ground-level ozone which is produced from precursors emitted by transport and damages the green parts of plants.

The negative effects of transport on the environment can be reduced by changing the composition of the transport performance of both passenger and freight transport towards environmentally more friendly types (e.g. rail transport), in passenger transport by a higher use of public transport instead of passenger car transport. Other measures focus on reducing energy and emission intensity of vehicles and developing the use of alternative fuels and drives, including RES, in order to achieve a gradual reduction of the dependence of transport on oil products.

References to current conceptual, strategic and legislative documents

White Paper – Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system
- reducing (and gradually eliminating) dependence of the EU transport system on oil
- shifting 50% of medium- and long-distance freight transport from road to railway and water transport, completing the European high-speed railway network by 2050
- reducing greenhouse gas emissions from transport by 60% compared to 1990 levels by 2050
- reducing the use of "conventionally powered" cars in urban transport by the year 2030 in half, and gradually wind up their operation in cities by 2050

Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources
- achieve a 10% share of energy from renewable sources in gross final energy consumption by the year 2020

Directive 2002/49/EC of the European Parliament and of the Council relating to the assessment and management of environmental noise
- determining exposure to environmental noise, through noise mapping and by using assessment methods common to the Member States
- adopting action plans by the Member States, based upon noise-mapping results, with a view to preventing and reducing environmental noise
- drawing up strategic noise maps by 30.06.2012 and then every five years

State Environmental Policy of the Czech Republic 2012–2020
- reduction of emissions of NO_x, VOC and $PM_{2.5}$ from transportation, implementation of measures to protect air quality and compliance with limit values, for example construction of bypasses and the establishment of low emission zones
- ensuring a 10% share of energy from renewable sources in transport by 2020, increasing the proportion of vehicles with alternative propulsion in the sector of public and passenger car transport

National Emission Reduction Programme of the Czech Republic
- reduction of emissions from transport, implementation of measures to reduce the impact of transport on air quality in settlements

- moving the freight transport from roads to railways
- speeding up the renewal of the fleet of passenger vehicles, increasing the use of alternative drives in transport
- defining key construction projects of transport infrastructure at the national level

Air Quality Improvement Programmes
- improving the quality of the public transport system, supporting integrated transport systems and ensuring the preference of public transport in the organization of transport in cities
- construction and reconstruction of transport infrastructure for road and rail transport, construction of commuter parking lots
- improving air quality in the settlements by setting emission ceilings for road transport for municipalities with a population of over 5,000 inhabitants
- defining key construction projects of transport infrastructure at the regional level

Transport Policy of the Czech Republic for the Period 2014–2020, with prospects till 2050
- promotion of energy-efficient public transport and non-motorised transport in the transport system
- reducing NO_x, VOC and $PM_{2.5}$ emissions from the road transport sector by renewing the car fleet in the Czech Republic and increasing the share of alternative fuels
- increasing the proportion of renewable sources in total energy consumption in transport to 10% by 2020

National Action Plan for Energy from Renewable Sources
- achieve a 10% share of energy from RES in the final consumption of energy in transport by the year 2020

National Action Plan for Clean Mobility
- creating favourable conditions for a wider application of alternative fuels and drives in the transport sector in the Czech Republic

Act No. 267/2015 Coll., amending Act No. 258/2000 Coll., on the protection of public health and amending some related laws, as amended, and other related laws
- drawing up, and update every 5 years at the latest, strategic noise maps under the responsibility of the Ministry of Health, making strategic noise maps accessible to the public
- procuring action plans for reducing noise pollution in areas specified by noise mapping, establishing limit values for noise indicators and requirements on the content of the strategic noise maps and action plans through an implementing regulation

33 | Transport performance and infrastructure

Key question

What is the development of transport and the related environmental burden?

Key messages

Public passenger transport in the Czech Republic accounted for 33.6% of the total performance of passenger transport by land (without air transport) and this share is stable in the time development. The performance of public passenger transport grows faster than the passenger car transport performance, in the case of urban public transport, the year-on-year increase in 2016 was 8.0%. The performance of railway in passenger and freight transport grows steadily.

The total transport performance of passenger transport is increasing, which increases the burden on the environment from transport. The performance of passenger car transport increased year-on-year by 3.7%. Between the years 2010 and 2016, the traffic intensity on the road network of the Czech Republic significantly rose.

Overall assessment of the trend

Change since 1990

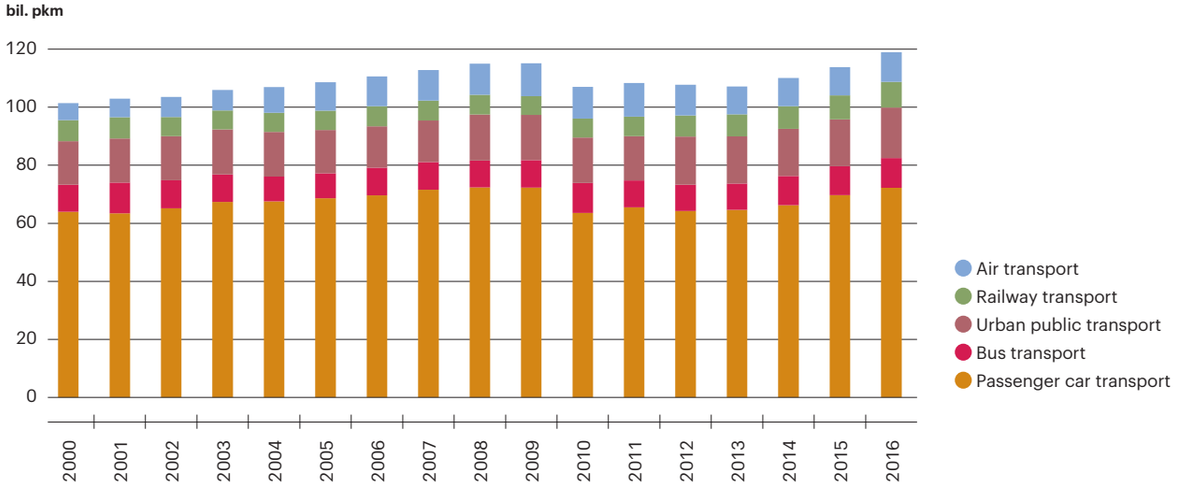
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

Development of the passenger transport performance in the Czech Republic by mode of transport [bil. pkm], 2000–2016

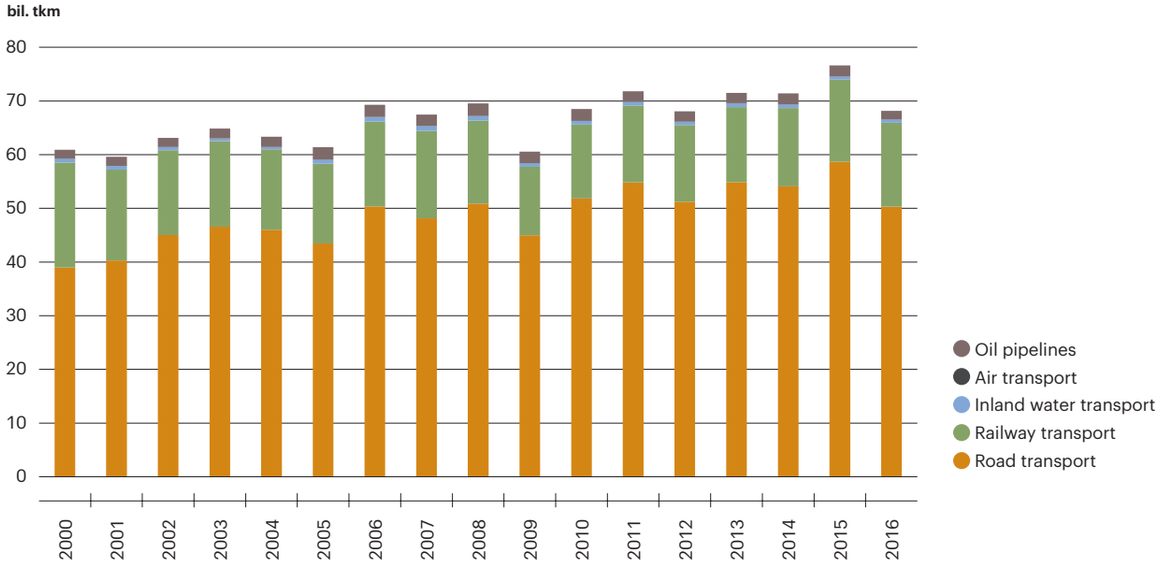


The decline in the performance of passenger car transport in the years 2009 and 2010 was influenced by a change in the methodology of road traffic census. It is therefore impossible to interpret the variation as a drop in passenger car transport or in passenger transport as a whole.

Source: Ministry of Transport

Chart 2

Development of the freight transport performance in the Czech Republic by mode of transport [bil. tkm], 2000–2016

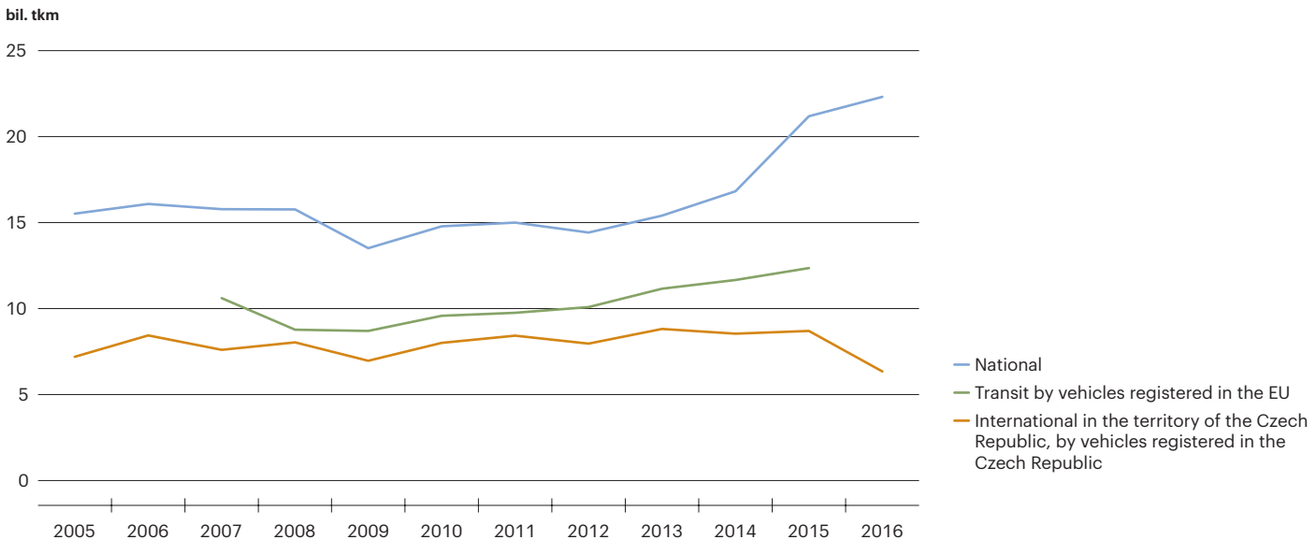


The data on the road freight transport include only the volumes of carriers registered in the Czech Republic, including the volumes carried out abroad as part of international transport.

Source: Ministry of Transport

Chart 3

Performance of road freight transport in the territory of the Czech Republic [bil. tkm], 2005–2016



Data on the transit of vehicles registered in the EU from the source Eurostat for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Ministry of Transport, Eurostat

In 2016, the **total transport performance in passenger transport** in the Czech Republic in the year-on-year comparison grew by 4.5% to 119.0 bil. pkm, which means an increase of 17.3% in comparison with the year 2000 (Chart 1). The growing transport performance increases the burden on the environment from the consumption of energy and fuels and from the development of transport infrastructure.

The growth of performance of **passenger car transport** was restored after a temporary stagnation in the period of 2010–2013, and it accelerated in 2015 and 2016. It was influenced by the growth of the economy of the Czech Republic with an impact on rising sales of new private vehicles, and even a relatively lower price of fuel. In 2016, the performance of the passenger car transport in year-on-year comparison grew by 3.7%, and during the period of 2000–2016 increased by 13.0%.

Performance of **public passenger transport** in 2016 grew year-on-year by 5.9% to 46.7 bil. pkm, representing 39.3% of total passenger transport performance. Excluding air transport, the share of public transport in land modes of passenger transport was 33.6%, this proportion only slightly fluctuated without a clear trend over the period 2000–2016.

Transport performance of **railway passenger transport** has grown continuously since 2009, in 2016, the year-on-year increase was 6.6% to 8.8 bil. pkm, in the period 2000–2016, the performance of the railway increased by 13.7%. In 2016, railways transported 179.2 mil. people, which is 2.6 mil. people (1.5%) more than in 2015. The growth of rail passenger transport is fostered by the growing speed of transport on corridor lines and the competitive environment leading to the improvement of the quality of the services provided. Rail transport also grows within integrated transport systems in cities, in 2016 its share in the overall performance of rail transport accounted for 12.4% and in the total number of passengers transported by rail it had even 35.1%.

Transport performance of the **bus transport** outside the urban public transport, i.e. regular and irregular lines, fluctuated in the period 2000–2016, in 2016 it slightly increased year-on-year by 2.6% to 10.3 bil. pkm, which is 9.7% more than in 2000. The number of passengers travelling by bus decreased year-on-year by 18.8 mil. (5.4%) to 332.1 mil. people. The decline in the number of transported persons concerned the irregular transportation and regular national connections, in contrast, the number of passengers on international regular lines grew year-on-year by approximately 450 thous. persons. The performance of the **urban public transport i**n 2016 rose by 8.0% to 17.4 bil. pkm and was 16.2% higher than in 2000.

The **air transport performance** in the Czech Republic grew dynamically by 86.4% in the period of 2000–2010. In the subsequent years it fell slightly, but in 2016 it rose again by 5.2% year-on-year. The number of checked-in passengers at airports in the Czech Republic in 2016 rose year-on-year by about 1 mil. people (7.3%) to 13.8 mil. people, which is the most checked-in passengers since 2000.

Freight transport in the Czech Republic, after several years of growth, in 2016 recorded a year-on-year decline in transport performance by 11.0% to 68.1 bil. tkm (Chart 2). The increasing trend of total freight transport performance was reversed by the development of the performance of road freight transport, which fell in 2016 year-on-year by 14.3% to 50.3 bil. tkm. A significant decline by 25.4% (including performance carried out abroad) was recorded, in accordance with Europe-wide trends, in international road transport, which is affected by the poor economic situation of carriers, increasing restrictions in freight road transport and the lack of drivers. National road freight transport, however, continued to grow also in 2016, expressed in year-on-year comparison the performance rose by 5.3% (Chart 3). Performance of rail freight transport in 2016 increased year-on-year by 2.3%, but it was 19.9% lower than in 2000.

The results of the **national transport census** for the year 2016[1] transport show that in comparison with the year 2010 the traffic intensities grew on almost all of the monitored profiles of motorways and class I roads. The largest increases in traffic intensity occurred in the vicinity of Prague on the southern section of the Prague ring road and on D10 motorway towards Mladá Boleslav, in percentage terms, the highest increases were recorded on the D1 motorway between Olomouc and Ostrava, traffic tripled in the section Vrbice–Bohumín.

The **motorway network** in 2016 was extended with a new section of the D8 motorway Lovosice–Řehlovice with 16.4 km in length to a total of 1,223 km. A change was made in the register of road infrastructure as of 01.01.2016 whereby most of the expressways that were part of class I roads were transferred under motorways. The total length of class I roads therefore decreased by about 440 km to 5,807 km, the total length of roads and motorways in the Czech Republic as of 31.12.2016 was 55,757 km.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[1] *Detailed results of the census are available on http://scitani2016.rsd.cz.*

34 | Energy and fuel consumption in transport

Key question

Is energy consumption in the transport sector decreasing and are the objectives of the share of renewable energy sources in overall energy consumption in the transport sector being met?

Key messages

The CNG consumption increases significantly, in 2016 it increased by 36.1%.

Energy consumption in the transport sector is growing, in 2016 it increased in the year-on-year comparison by 4.2%. The consumption of fuels of oil origin is growing, diesel consumption in transportation more than doubled in 2016 compared to 2000, in 2016 the consumption of petrol rose too. In contrast, the consumption of biofuels has been decreasing since 2014. The share of renewable sources in overall energy consumption in transport in 2015[2] reached 6.5%. The objective of the National Action Plan for energy from renewable sources that 10% of energy in transport will be from renewable sources by 2020 is not yet fulfilled.

Overall assessment of the trend

Change since 1990

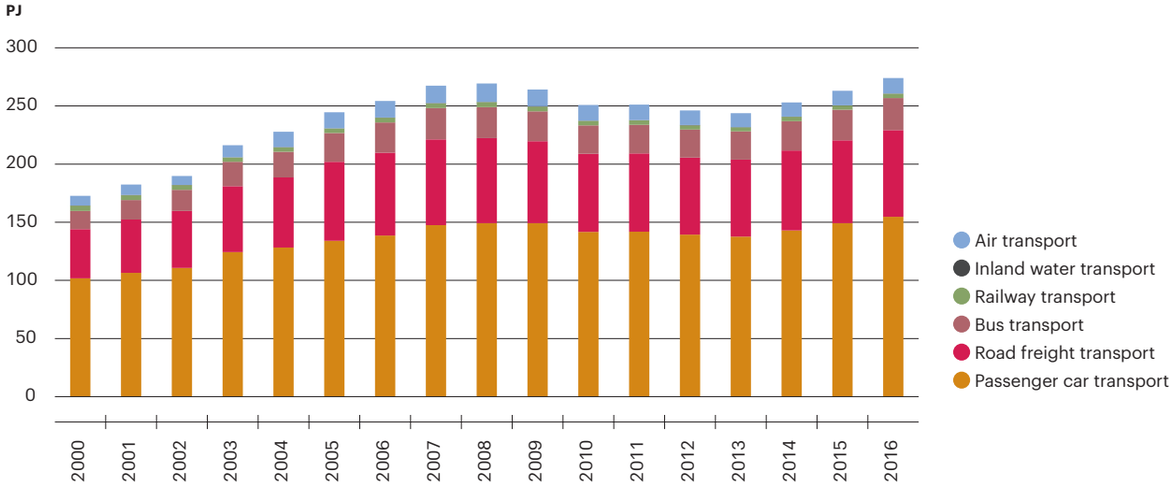
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

Energy consumption in transport by mode of transport in the Czech Republic [PJ], 2000–2016



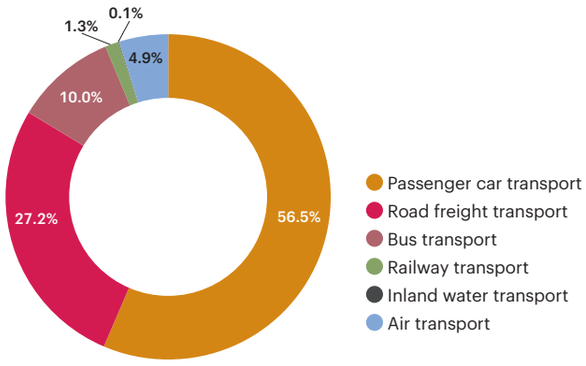
Source: Transport Research Centre

[2] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

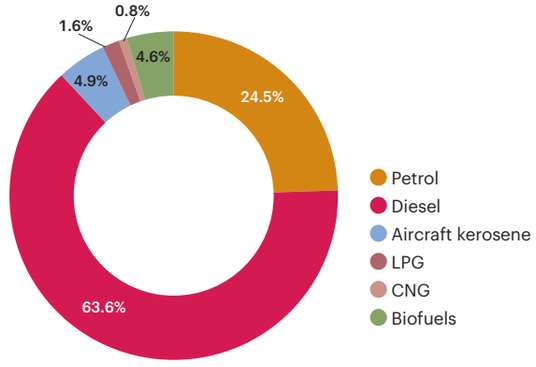
Chart 2

Structure of energy consumption in the transport sector by mode of transport and by fuel in the Czech Republic [%], 2016

Energy consumption by mode of transport



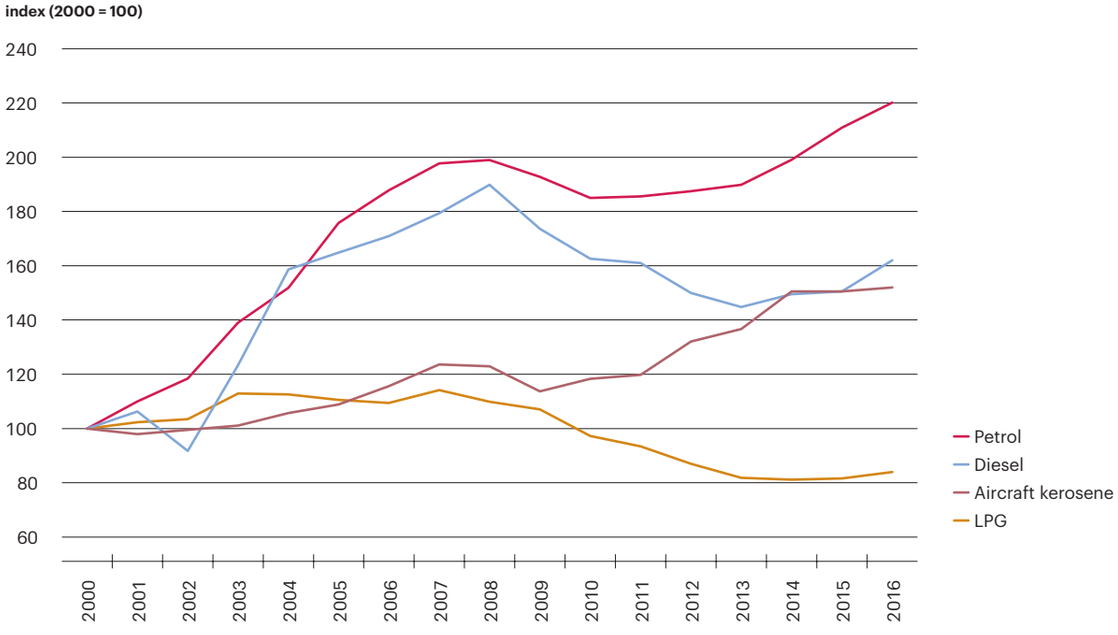
Energy consumption by fuel



Source: Transport Research Centre, Czech Statistical Office, Czech Gas Association

Chart 3

Development of consumption of oil-based fuels in transport in the Czech Republic [index, 2000 = 100], 2000–2016



Source: Czech Statistical Office

Chart 4

Consumption of biofuels in transport in the Czech Republic [PJ], 2006–2016

Source: Ministry of Industry and Trade

The total **consumption of energy from combustion processes in transport** grew in 2016 in the year-on-year comparison by 4.2% (11.0 PJ) to 274.0 PJ[3] (Chart 1), it was the third significant year-on-year growth in a row. With the exception of a temporary decrease in the period 2008–2013, affected by the development of the Czech economy, the consumption of energy in transport has grown in the long term, in the period 2000–2016 it increased by 59.5%.

The most energy in the transport sector is consumed by the **passenger car transport** with a share in the overall energy consumption at 56.5% in 2016 (Chart 2). Together with other categories of road transport, i.e. road freight and bus transport, this share amounted even to 93.7%. Passenger car transport also contributes the most to the growth of energy consumption in transport, in 2016 the increase in energy consumption by passenger cars was 5.5 PJ (3.7%).

In the **structure of energy consumption by fuel**, the highest share in 2016 was held by diesel fuel (63.6%), which is also used in passenger cars in addition to the road freight and bus transport.

The **development of fuel consumption** is in the period of 2000–2016 (Chart 3) characterized by a growth of diesel consumption, which copied the development of passenger and freight road transport performance and was influenced by the growing number of passenger cars with diesel engines. In the period 2000–2016, diesel consumption in the transport sector more than doubled, between 2015 and 2016 it increased by 4.6% to 4.3 mil. t (including biofuel). The development of the fleet of passenger cars affects also the consumption of petrol, which has fallen below the level of the year 2000, at the end of the reference period, however, it rose slightly, and in 2016 it increased year-on-year by 1.8% to 1.6 mil. t (including biofuel).

Consumption of **liquefied petroleum gas** (LPG) is stagnating after a slight growth at the end of the reference period. Consumption of **compressed natural gas** (CNG) with the increasing use in public passenger transport has grown significantly, in the year-on-year comparison in 2016 by 36.1% to 59.3 mil. m^3. Since 2014, the consumption of CNG has doubled and every year the number of newly opened public CNG filling stations is growing. Compared to the year 2014, their number also

[3] *Without the energy consumption of electrical modes of transport, which amounted to 1,760.5 GWh (corresponding to 6.3 PJ) according to the Energy Regulatory Office data in 2016.*

doubled to 143 at the end of 2016. The CNG consumption growth also reflects the expansion of CNG vehicles in the Czech Republic. The average year-on-year growth of the number of CNG vehicles (since 2004) is more than 40%, in the Czech Republic in 2016 there were 15.5 thous. CNG vehicles, of which more than 1,000 buses. Compressed natural gas is currently the most common choice in the renewal of fleets, in particular in urban transport companies. Air quality will also be improved by greater use of liquefied natural gas (LNG) in road freight transport, or in rail transport, as a replacement for diesel fuel. The use of other alternative fuels and drives (hydrogen, electric vehicles, hybrids) is, however, only marginal and according to the registrations of new vehicles it does not rise significantly.

Renewable energy sources (RES) in the transport sector in the Czech Republic almost exclusively include **biofuels** (Chart 4). These are the compulsory part of petrol (bioethanol, bio-ETBE) and diesel (FAME)[4], and are also sold separately as high-percentage biofuels. After a steep growth in the period 2006–2011, and reaching highs in the year 2014, the consumption of biofuels fell in 2015–2016, despite the growth in consumption of petroleum fuels in that period. In 2016, the total consumption of biofuels decreased year-on-year by 1.6 PJ (11.9%) to 11.9 PJ, which represents 4.6% of the total consumption of energy in transport in the Czech Republic (in 2015 it was 5.4%, in 2014 it was 6.0%).

This negative trend can be explained by a clear decline in the consumption of high-percentage biofuels beyond the blending obligation, as a result of lower prices of petroleum products, and thus small competitiveness of biofuels. **FAME** consumption in 2016 decreased by 6.6% to 258.9 thous. t, of this amount, only 15.9 thous. t (6.1%) did not constitute the blending obligation, in the previous year, it was 44.1 thous. t, i.e. 15.9% of the total consumption. Despite the decrease in the consumption of FAME, the Czech Republic is not self-sufficient in this commodity, domestic production (148.8 thous. t in 2016) has been significantly lower since 2011 than the actual consumption. The consumption of **bioethanol**, the biofuel in gasoline, significantly decreased in 2016 year-on-year by 29.3% (33.6 thous. t) to 81.0 thous. t due to the decrease in sales of high-percentage bioethanol (for example E85). The consumption of bio-ETBE, added to the high-octane petrol to meet the statutory share of biofuel, decreased in 2016 by 12.2% to 4.8 thous. t.

The **share of renewable energy sources** according to the internationally used methodology SHARES[5] reached 6.5% in 2015. The objective of the National Action Plan for energy from renewable sources that 10% of energy in transport will be from RES by 2020 is not currently being met.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[4] *According to the applicable legislation, the minimum shares of biofuel is 4.1% for petrol and 6.0% for diesel.*

[5] *The Eurostat methodology (http://ec.europa.eu/eurostat/web/energy/data/shares) used for the calculation of the RES share in final energy consumption. Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

35 | Emissions from transport

Key question

Is the emission intensity of transport, together with its impact on the environment and public health, declining?

Key messages

The emissions of NO_x, VOCs, CO and suspended particulates from transport fell in the period 2000–2016. The production of specific emissions of those substances per unit of transport performance are declining in road transport.
In the traffic on the roads, there is an increasing representation of vehicles which satisfy the higher emission EURO standards.
The average production of CO_2 per km for new passenger cars fell in the period 2010–2016.

The emissions of pollutants from transport no longer decrease, in 2016 they stagnated year-on-year. Greenhouse gas emissions from transport are growing, same as PAH emissions.

Overall assessment of the trend

Change since 1990

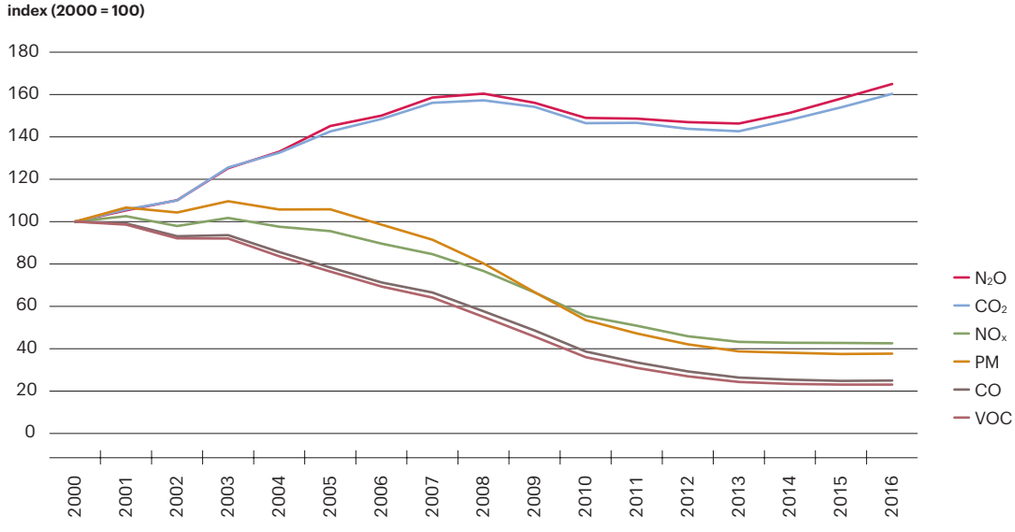
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

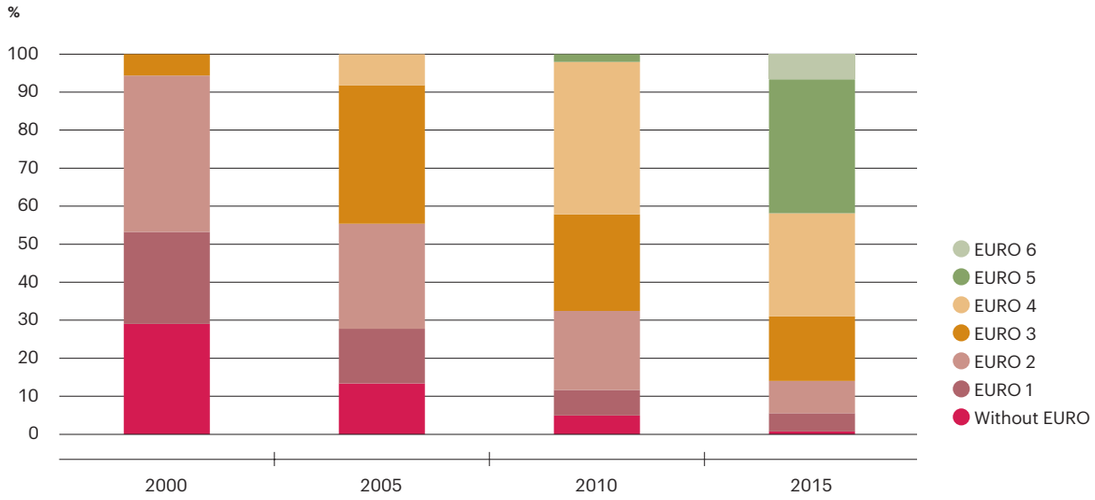
Development of emissions of air pollutants and greenhouse gases from transport in the Czech Republic [index, 2000 = 100], 2000–2016



Source: Transport Research Centre

Chart 2

Structure of the fleet of passenger cars in the traffic on the roads in the Czech Republic by EURO emission standards [%], 2000, 2005, 2010, 2015

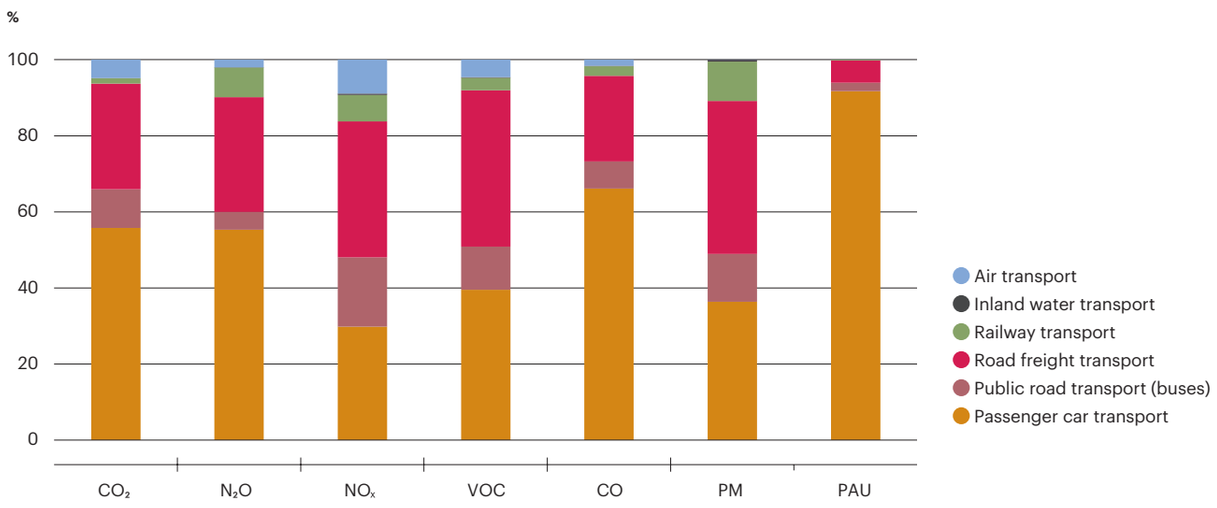


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Road and Motorway Directorate of the Czech Republic

Chart 3

Emissions of air pollutants and greenhouse gases from transport in the Czech Republic [%], 2016



Source: Transport Research Centre

The **emissions of NO_x, VOCs, CO and suspended particulates from transport** fell in the period 2000–2016 (Chart 1) and the emission burden on the environment with a negative impact on the public health and ecosystems was thus reduced. The emissions of NO_x decreased in that period by 57.4%, VOC by 76.9%, CO by 75.0% and suspended particles by 62.4%. A stronger decreasing emission trend was recorded within that period only in the years 2005–2010, which was influenced by a combination of renewing the vehicle fleet with lower emission vehicles and the economic recession in 2009. In the further development the slowdown trend occurs towards a gradual transition to the stagnation of emissions, such as stagnation can be described as well as the annual development of emissions in the year 2016 compared to the year 2015. The development of emissions at the end of the reference period begins to reflect more significantly the increasing dynamics of growth in energy and fuel consumption in the transport sector, which accounts for the significant growth of PAH emissions throughout the period, in the period 2000–2016 they grew by 175.1%, i.e. almost three times, in 2016 by 4.3% year-on-year.

The **decline in emissions** from road transport during the period 2000–2016 ensured that the specific emissions of NO_x, VOCs, CO and suspended particles decreased per unit of transport performance. In passenger car transport, specific NO_x emissions decreased between 2000 and 2016 by 68.2% to 173.3 t.bil. pkm^{-1}, i.e. to less than a third, the decline in emission intensity of road freight transport was even more pronounced, by 74.4%.

The emission intensity of transport decreased thanks to the **renewal of the vehicle fleet**. While in 2000, passenger cars without the emission EURO standard made up 28.3% of the vehicles on the roads and EURO 4 and higher standards were not yet introduced, in 2015, the EURO 4–6 standards were met in total by 67.4% of the passenger cars on the roads (Chart 2), the most substantial renewal of the fleet occurred on motorways and expressways. The modernisation of the fleet at the end of the reference period was supported by the growing sales of new vehicles, where passenger cars in 2016 reached a record number of 259.7 thous. vehicles (year-on-year increase by 12.5%), representing approximately 4.9% of the total fleet size. The fleet of registered vehicles, however, still remains very old, 60.6% of registered passenger cars (3.2 mil.) were older than 10 years in 2016. Even if the use, and hence the mileage, of those vehicles is lower than of newer vehicles, the decommissioning of such vehicles represents potential of further decrease in the emission intensity of the vehicle fleet.

Greenhouse gas emissions from transport go up in connection with the growing consumption of fuel and energy, the development of emissions also reflects the small (and not rising) representation of alternative fuels and drives in the vehicle fleet, whereby the most of the energy in the transport sector comes from fossil fuels. This increases the pressures on the climate system from transport and the overall proportion of transport in total emissions of greenhouse gases. A temporary decrease in greenhouse gas emissions from transport occurred only in the period 2009–2013 due to the decline in the transport performance, which was associated with the development of the Czech economy. In the period 2000–2016, CO_2 emissions from transport increased by 60.4%, N_2O emissions by 65.0%, in the year-on-year comparison, these emissions increased in 2016 by 4.1% and 4.4% respectively. The greenhouse gas emissions grow despite the improving emission performance of vehicles. Average production of CO_2 emissions for new passenger cars with petrol drive dropped in the period 2010–2016 by 15.1% to 125.9 $g.km^{-1}$, for diesel engines, it was a decrease of 18.8% to 122.6 $g.km^{-1}$. The target of 130 $g.km^{-1}$ by 2015 arising from European legislation was met and the target of 95 $g.km^{-1}$ in 2021 could be achieved.

The **structure of the emissions of monitored pollutants** and greenhouse gases from transport was completely dominated in 2016 by road transport (Chart 3). The largest source of emissions of CO_2, N_2O, CO_2, and PAH is passenger car transport, in the case of N_2O and PM emissions it is the road freight transport. Of the non-road modes of transport, air transport had the highest share (8.9%) in NO_x emissions, the motor traction of rail transport produced 10.3% of the total PM emissions from transport in 2016.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

36 | Noise pollution burden of the population

Key question

What is the state and development of the noise pollution in the Czech Republic?

Key messages

Investment in the implementation of noise-reduction measures on motorways and class I roads increased year-on-year in 2016 significantly by 40.9% to CZK 257.2 mil.

According to the results of the 2nd round of the Strategic Noise Mapping, roughly a third of the Czech Republic population was exposed to all-day noise from road traffic and more than 80% of the population of urban agglomerations. The all-day noise pollution above the limit value burdened 2.5% of the population of the Czech Republic and 6.2% of the population of Czech agglomerations. Noise pollution in the affected areas is significant even at night.

Overall assessment of the trend

The data currently available from Strategic Noise Mapping do not allow assessment of the noise pollution trends, as they were not collected over a longer period of time and according to the same methodology over multiple periods.

Indicator assessment

Table 1

Limit values for noise indicators in the Czech Republic [dB]

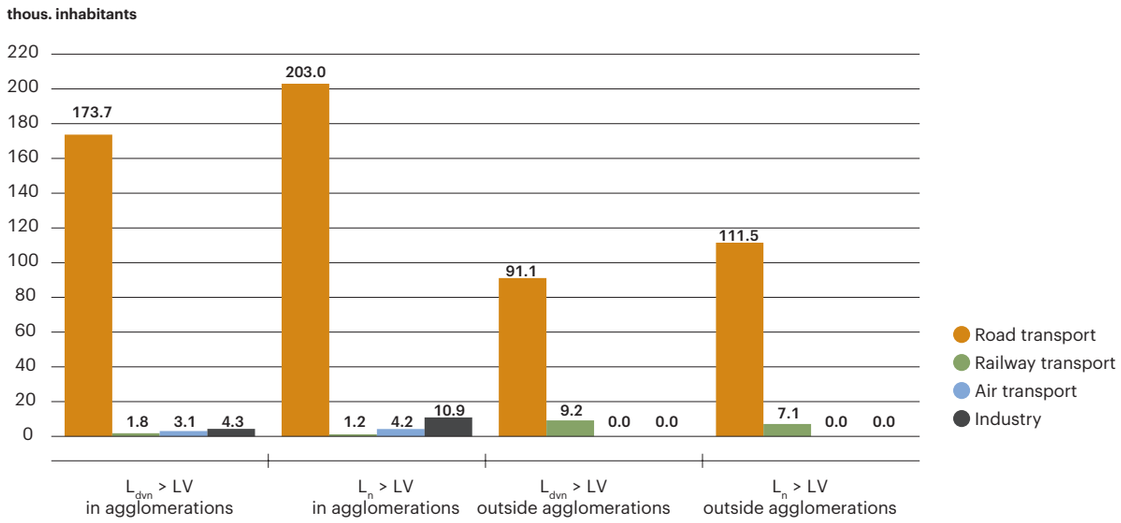
Source of the noise	L_{dvn} [dB]	L_n [dB]
Road transport	70	60
Railway transport	70	65
Air transport	60	50
Integrated devices	50	40

L_{dvn} – the noise indicator for day, evening, and night to characterise the all-day noise disturbance
L_n – the noise indicator for night hours (11 pm–7 am) characterising the sleep disturbance

Source: Decree No. 523/2006 Coll., on noise mapping

Chart 1

Total number of population exposed to noise exceeding the limit values laid down for each category of sources of noise burden in agglomerations and outside agglomerations, indicators L_{dvn} and L_n [thous. inhabitants], 2012

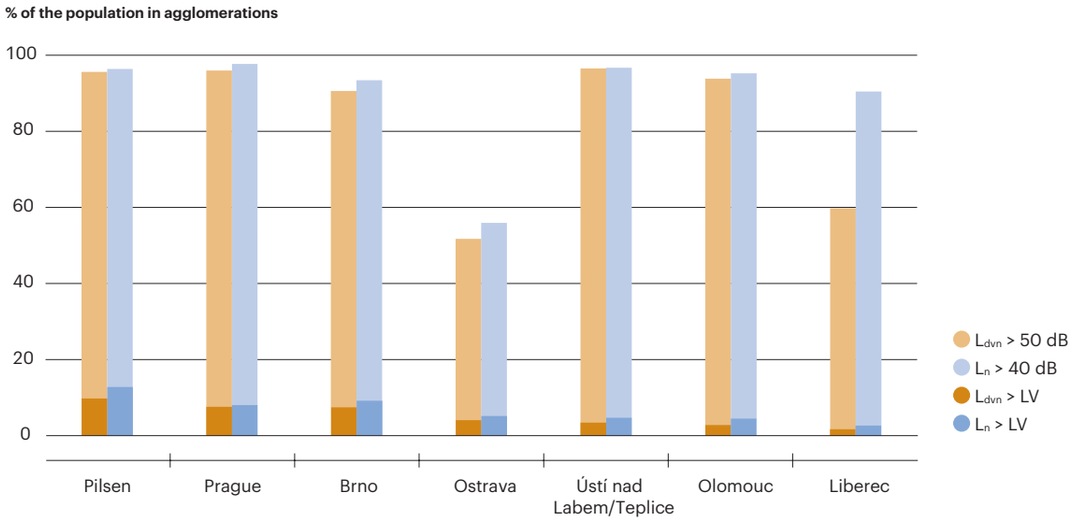


Noise pollution from industry is not, according to Directive 2002/49/EC, evaluated outside agglomerations. The criteria of the Directive for reviews of noise from air transport cover the Prague and Brno Airports only.
Data for the years 2013–2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: National Reference Laboratory for Environmental Noise

Chart 2

Proportion of the population of the Czech Republic´s city agglomerations exposed to noise pollution from road transport, of that exposed the noise pollution above the limit value for the noise indicators L_{dvn} and L_n [%], 2012

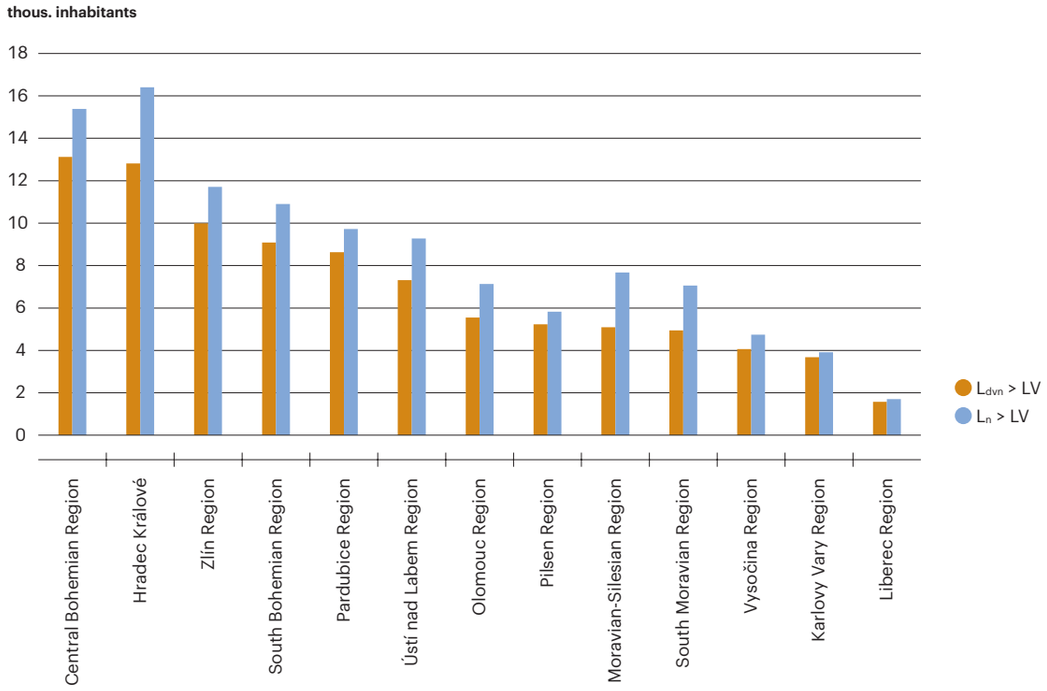


Data for the years 2013–2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: National Reference Laboratory for Environmental Noise

Chart 3

Number of inhabitants in the Czech Republic's regions exposed to transport-related noise pollution from main roads* exceeding the limit values of noise indicators L_{dvn} and L_n [thous. inhabitants], 2012



**Roads with traffic intensity exceeding 3 mil. vehicles per year.*
Data for the years 2013–2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: National Reference Laboratory for Environmental Noise

The most important source of **noise pollution** burden of the population in the Czech Republic is **road traffic**. All-day noise pollution from road traffic over 50 dB in the Czech Republic, according to the results of the 2nd round of the Strategic Noise Mapping[6] ended in 2012, affected 34.5% of the population of the Czech Republic (3.7 mil. people), at night the noise level above 40 dB affected 32.4% of the population. The highest exposure to noise pollution from road traffic affects urban agglomerations[7] with a population over 100 thous. where 84.9% of the population was exposed to all day noise pollution over 50 dB. High noise pollution from road transport above defined **threshold limit values**, the exceedance of which launches the mechanism for the creation of action plans, affected in the Czech Republic all day 264.8 thous. inhabitants (2.5% of the population of the Czech Republic) and 314.5 thous. inhabitants at night[8] (3.0% of the population, Chart 1). Even in the case of high noise exposure, the majority of the affected people live in urban agglomerations, where the all-day noise from road traffic over the limit values burdened 6.2% of the population, at night, because of the lower limit value, it was 7.3% of the population of those agglomerations.

Proportions of the population exposed to noise pollution from road transport in the different agglomerations do not differ significantly (Chart 2), with the exception of the **agglomeration** of Ostrava, which is according to the requirements of Directive 2002/49/EC delimitated also outside the city. More significant differences were reported for noise pollution in excess of the limit value, such pollution is the highest in the agglomeration of Plzeň (9.8% of the population all day and 12.8% at night), by

[6] *The objective of Strategic Noise Mapping is to obtain a general overview of the noise impact on the population in EU Member States and determining critical locations where the limit values of noise indicators are exceeded. Currently, the results of the 3rd round of the Strategic Noise Mapping are being processed.*

[7] *561/2006 Agglomerations will be defined by Decree No. 561/2006 Coll., stipulating a list of agglomerations for the purpose of assessing and reducing noise.*

[8] *The above values refer to the indicators L_{dvn} and L_n. The indicator L_{dvn} describes all-day noise disturbance (0–24 hrs); the indicator L_n is the noise indicator of sleep disturbance (23–7 hrs). The limit values of these noise indicators under Decree No. 523/2006 Coll. are set out in Table 1.*

contrast, a relatively favourable situation is in the Liberec agglomeration, where the shares of the exposed population (1.7% all day and 2.7% at night) range below national averages that include territory outside the agglomerations.

In the Czech Republic's agglomerations, there were a total of 16 **medical facilities** exposed to all-day road traffic noise pollution above the limit value in 2012, at night it was 23 facilities. Most medical facilities exposed to noise from road transport exceeding the limit value are in Pilsen (6) and in Ostrava (5). **School establishments** all day exposed to noise above the limit value from road transport totalled 149, the most (60) in Prague and in Pilsen (31).

Outside the agglomerations, noise pollution from traffic on the **main roads** with the intensity of traffic over 3 mil. vehicles per year affected in total (for indicator L_{dvn} > 50 dB) 1.4 mil. people, of which over limit value 91.1 thous. people, at night it was 958.6 thous. people, and 111.5 thous. people over the limit value. A comparison of the situation in the Czech Republic's regions[9] shows that the highest population exposed to levels of noise from main roads in excess of specified limit values has been found in the regions of Central Bohemia and Hradec Králové (Chart 3), the lowest noise burden is in the Karlovy Vary and Liberec regions. Significantly higher proportions of the population affected by noise from road traffic over the limit values in comparison with the regions have been identified in the municipalities where transit transport on major road routes passes through built-up areas.

Railway transport causes noise pollution, unlike road transport, especially outside urban agglomerations. Out of a total of 424.8 thous. people exposed to all-day noise from rail transport over 50 dB, 27.9% lived in agglomerations, exposure above the limit value (overall 11.0 thous. people) burdened in agglomerations only 16.4% of the total number of inhabitants exposed. The biggest noise pollution from the railways is in the regions of Central Bohemia, Ústí nad Labem and Pardubice, which have the corridor railway lines in their territories. Noise from **air traffic** affected a total of 13.1 thous. residents all day (3.1 thous. above the limit value) and 19.2 thous. at night (1.2 thous. over the limit value), especially in the Prague and Brno agglomerations. Noise pollution from **industry**, monitored only in agglomerations, burdened 4.3 thous. inhabitants for the whole day and 10.9 thous. inhabitants at night. These values are at the same time a burden exceeding the limit values. The greatest noise pollution from industry affected the Plzeň agglomeration.

In 2016, proposals were presented and public hearings were conducted of **action plans** to reduce noise exposure according to the results of the 2nd round of the Strategic Noise Mapping that are the legal responsibility of the Ministry of Transport. At the end of 2016, action plans for road transport were processed and discussed in 7 regions, as well as action plans for the main railways in the agglomerations, and an action plan for the Vaclav Havel Airport in Prague. Proposals of road transport action plans in the remaining 7 regions (including the City of Prague) were submitted at the end of 2016.

The investment from the State Fund for Transport Infrastructure and the state budget in the implementation of **noise abatement measures** on the roads and motorways in 2016 amounted to a total of CZK 257.2 mil., which indicates a significant year-on-year increase by 40.9%. The length of roads equipped with noise abatement measures increased by 32.3 km and the total length of noise barriers on the network of motorways and class I roads reached 375.0 km.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[9] *Apart from the Region of the Capital City of Prague, which is assessed as an agglomeration.*

Transport in the global context

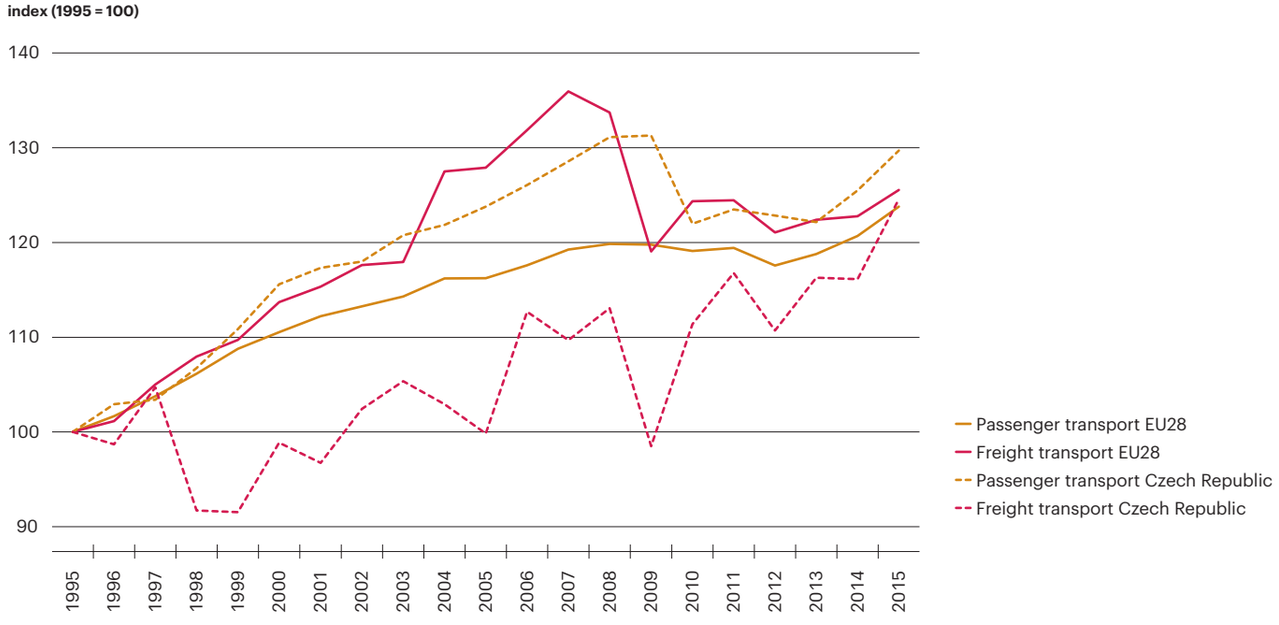
Key messages[10]

- The performance of both passenger and freight transport in the EU28 are growing. The use of public passenger transport in the Czech Republic belongs to the highest within the EU28.
- In the structure of the transport performance of inland freight transport in the EU28, the environmentally least friendly road transport prevails, with the share of 72.2% in 2015.
- In the EU28, there is one passenger car roughly per 2 inhabitants.
- Transport in the EU28 contributed to the total emissions of greenhouse gases with 21.0% in 2015, in the Czech Republic it was 14.0%.
- Noise pollution from road transport in urban agglomerations with over 100 thous. people is above average in the Czech Republic compared with the EU28.

Indicator assessment

Chart 1

Development of total transport performance of passenger and freight transport (excluding maritime transport) in the Czech Republic and EU28 [index, 1995 = 100], 1995–2015



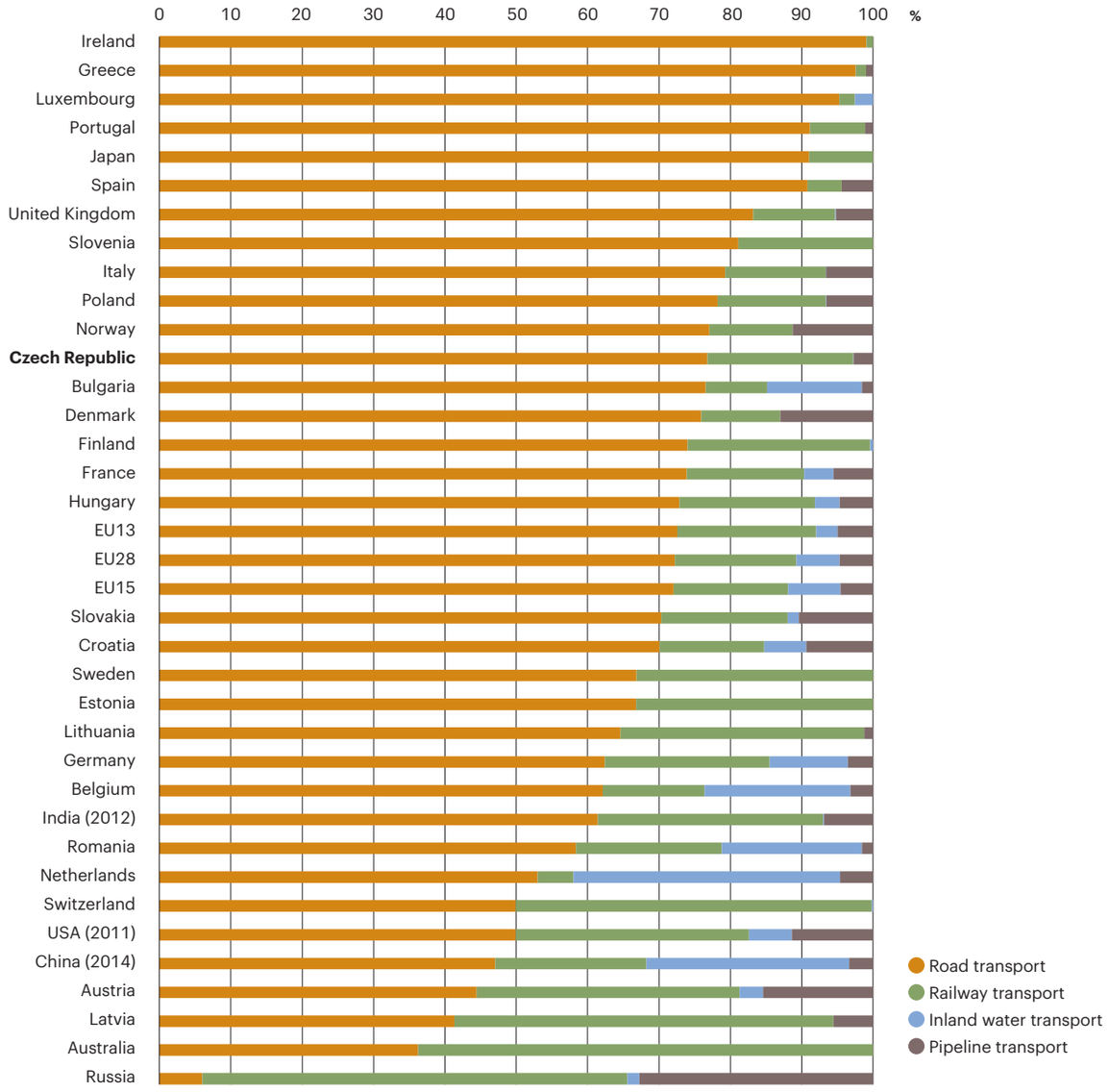
Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Commission, Ministry of Transport

[10] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Chart 2

Structure of freight transport performance (excluding maritime transport) [%], 2015

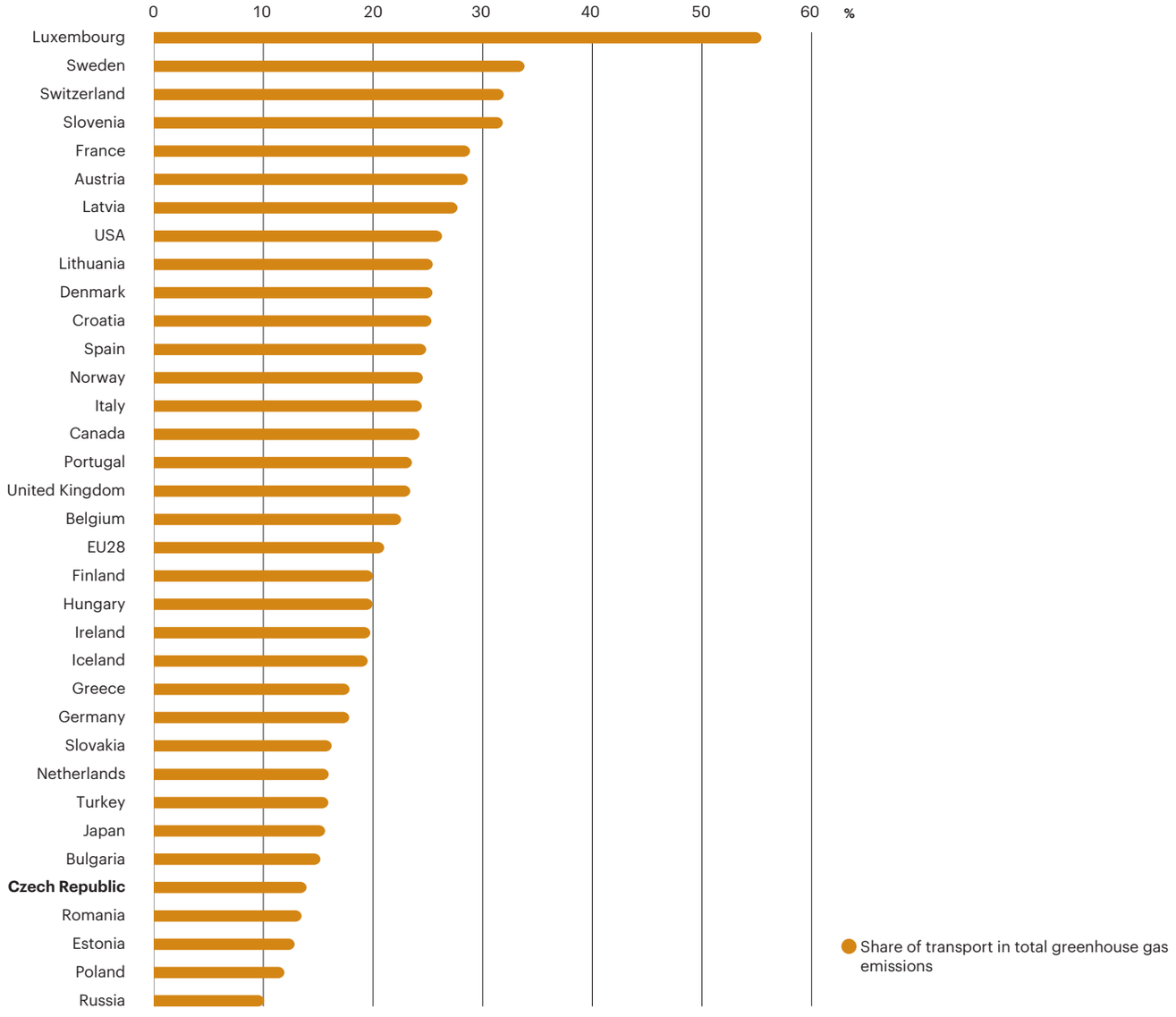


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Commission, OECD

Chart 3

Proportion of transport-related greenhouse gas emissions in total aggregated greenhouse gas emissions, excluding LULUCF [%], 2015

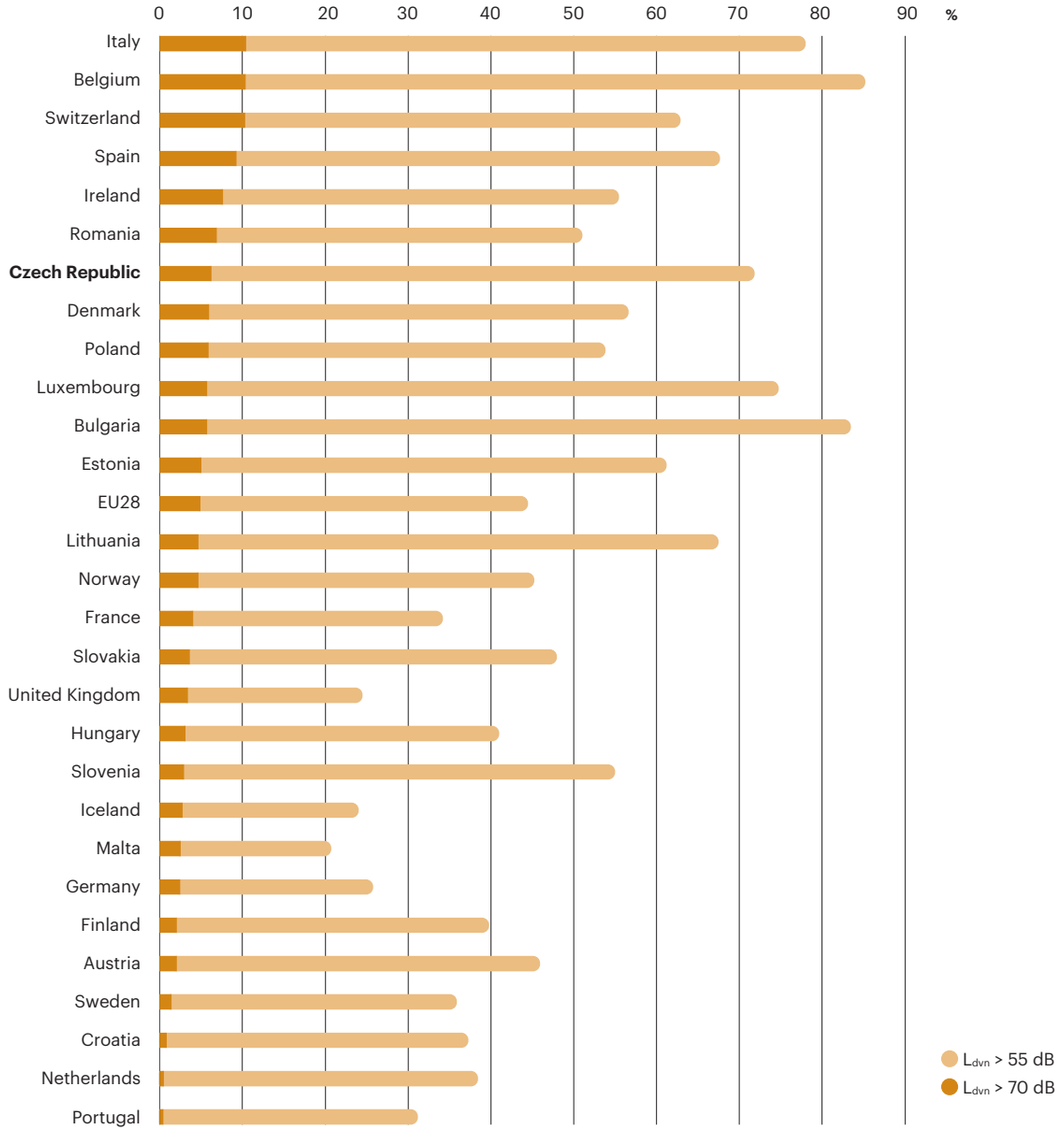


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: UNFCCC

Chart 4

Noise pollution from road transport in agglomerations with over 100 thous. inhabitants [% of exposed population of agglomerations], 2012



The calculation used only agglomerations with the available data. Countries not listed in the chart did not provide data, or the number of agglomerations with the available data is too low.
Data for the years 2013–2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Environment Agency

The **performance of both passenger and freight transport** in the EU28 including the Czech Republic is growing, the development of transport is largely dependent on the development of the performance of the economy with a clear influence of the economic recession in the period of global economic and financial crisis in 2009 (Chart 1). **Passenger transport** in the EU28 is greatly individualized, most of the volume of land modes of passenger transport is delivered by passenger cars (81.3% in 2015). The share of public transport in total passenger transport performance (without air transport) was in 2015 in the Czech Republic significantly higher (33.0%) than the EU28 average (18.7%), which is thanks to the above-average use (in the European context) of rail urban public transport (tram, underground) and bus transport. The proportion of railways in total passenger transport performance on land in the Czech Republic (7.8%) is around the European average, it is higher e.g. in Austria, Germany and France.

The intensity of the use of passenger car transport can be measured according to the so-called **motorisation rate**, which indicates the number of registered passenger cars per 1,000 inhabitants. Throughout the EU28, this indicator reached in 2015 the value of 498 vehicles (i.e. about 1 vehicle per 2 inhabitants), the Czech Republic with the motorisation rate at 485 vehicles was 2.7% below the EU average. The highest motorisation rates are in economically strong countries of West Europe, by contrast, it is lower in most new EU13 Member States, in particular on the Balkan peninsula.

The structure of the transport performance of inland **freight transport** (i.e. without maritime and air freight transport) is dominated in the EU28 by road transport with 72.2% in 2015 (Chart 2), in the Czech Republic it was 76.8%. Apart from the small island countries, road transport is entirely dominant mode of freight transport also for example in Greece, Ireland and Luxembourg. In contrast, a relatively lower proportion of road transport in the total performance of freight transport is in countries with developed railway freight transportation (Baltic countries, Austria) and inland waterway transport (the Netherlands, Romania). From a global point of view, the whole EU28 is among regions with above-average use of road transport for transporting freight, in non-European countries such as the USA, Australia, China and Russia, railway transport plays a more important role in freight transport in comparison with the EU28.

Transport in the EU28 is a **significant source of greenhouse gas emissions**, the share of transport in total aggregate greenhouse gas emissions (without LULUCF) in 2015 throughout the EU28 reached 21.0% (Chart 3), in the Czech Republic it was 14.0%. The lower proportion of transport in the total greenhouse gas emissions in the Czech Republic is determined by the structure of the GDP generation with a higher proportion of industry and by the energy mix based on fossil fuels, which increases emissions from large stationary sources. Transport has the highest share in total greenhouse gas emissions in countries with a high intensity of road transport, and with the energy sector and industry producing less emissions, such as Luxembourg, Sweden and France.

Urban agglomerations in the EU28 with a population of over 100 thous. inhabitants have, based on the results of the 2nd round of the Strategic Noise Mapping, a high **noise pollution from road transport.** The proportion of the population in agglomerations, exposed to all-day noise pollution from road transport above 55 dB, exceeds 50% in many countries (Chart 4), this indicator varies widely between countries and within regions, depending on the transit routes of road transport. In the Czech Republic, in the European comparison, the proportion of the exposed population is above average (65.6%), while it is below the European average even in countries with dense road traffic, such as Germany and France. The proportion of the population of agglomerations affected by high levels of all-day noise above 70 dB is the highest in Italy and Belgium, where it exceeds 10%, the Czech Republic with the value of 6.3% of the affected population is slightly above the EU28 average (4.9%).

9 Material flows

Material flows

Evaluation of material flows allows us to comprehensively assess the demands of the economy on natural resources and the degree of environmental burden associated with consumption and processing of raw materials and materials. With regard to the structure of GDP generation with a high proportion of industry and energy based on fossil sources, the Czech Republic is characterized by higher values of specific indicators of material consumption and therefore higher environmental burdens, which are related to the extraction and consumption of materials.

These pressures to the landscape and ecosystems are associated with the extraction of minerals and the cultivation of biomass, which may cause a decrease in biodiversity. Processing and consumption of materials is also associated with a direct environmental burden, in particular in the form of air emissions, water pollution and waste generation. Emissions to air and water have a negative effect on human health and ecosystems, combustion of fossil fuels is a significant source of anthropogenic greenhouse gas emissions and therefore of a burden on the climate system.

References to current conceptual, strategic and legislative documents

Europe 2020 – strategy for smart, sustainable and inclusive growth
- resource efficiency, creating a knowledge base and analytical apparatus for monitoring the efficiency of resource use
- creation of a circulatory economy based on the use of secondary raw materials as resources
- reduction of material intensity of economy

Renewed EU Sustainable Development Strategy
- improving the effectiveness of resources in order to reduce the overall use of non-renewable natural resources and reducing the impact of the use of raw materials on the environment
- transition to low-carbon economy and economy with low material inputs based on resource-efficient technologies effectively using resources, and sustainable consumer behaviour

7th Environmental Action Programme until 2020
- protection and development of natural capital of the EU
- creating a sustainable, low-carbon, competitive and resource-efficient economy

EU Action Plan for a Circular Economy
- the transition to a circular economy in which the value of products, materials, and resources is maintained as long as possible, and in which the waste is minimized

Strategic Framework for Sustainable Development of the Czech Republic
- support of sustainable material economy of the Czech Republic
- achievement of a sustainable state between economic effectiveness of material consumption and impact of material flows on the environment
- increase of energy and raw material efficiency of economy

Secondary Raw Materials Policy
- increase of the self-sufficiency of the Czech Republic on raw material resources by resorting to the use of secondary resources
- inclusion of secondary raw materials in the statistical surveys in the area of material flow accounts
- promoting the use of secondary raw materials as an instrument to reduce energy and material intensity of the industrial production while eliminating of negative impacts on the environment and human health

National Reform Programme
- streamlining of the life cycle of natural resources and reduction of material and energy intensity of the Czech economy

37 | Domestic material consumption

Key question

Is the environmental burden associated with the extraction and consumption of materials decreasing in the Czech Republic?

Key messages[1]

Consumption of fossil fuels in the Czech Republic decreased in the period 2000–2015 by 18.1%. The consumption of solid fossil fuels is decreasing and solid fuels are being substituted with liquid and gaseous fuels, which cause less burden on the environment and the climate system.

Domestic material consumption in 2015 in the Czech Republic increased by 4.2%, mainly due to growth in consumption of non-metallic minerals and metallic ores as a result of the growing industrial and construction production. The consumption of biomass decreased by 3.7% year-on-year because of the drop in domestic production affected by drought, and the share of renewable sources in the total domestic material consumption was reduced to 13.4%. In the material groups of metal ores and liquid and gaseous fossil fuels, the Czech Republic is almost completely dependent on foreign countries.

Overall assessment of the trend

Change since 1990

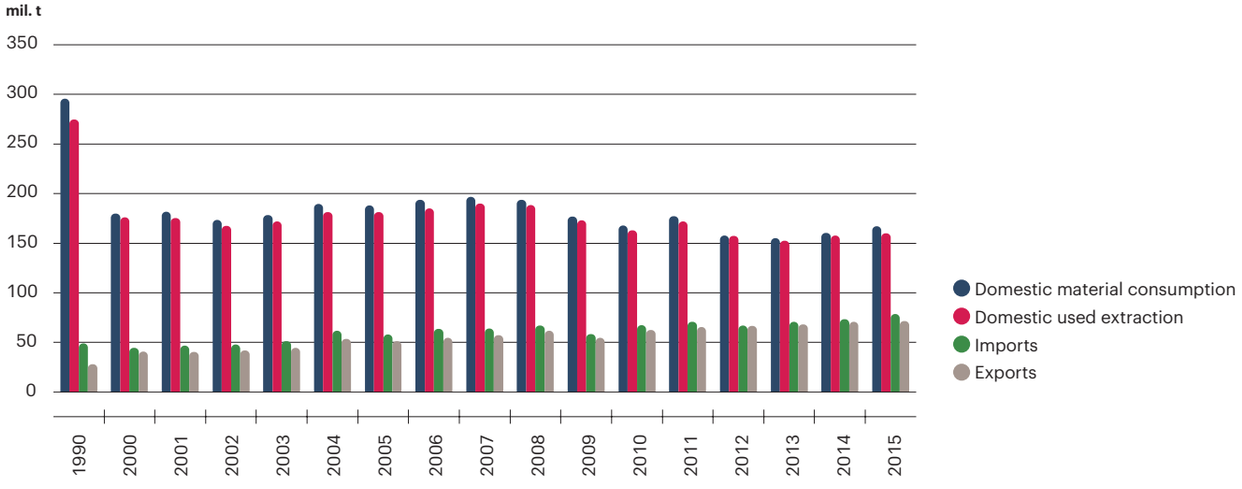
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

Development of domestic material consumption and its components in the Czech Republic [mil. t], 1990, 2000–2015



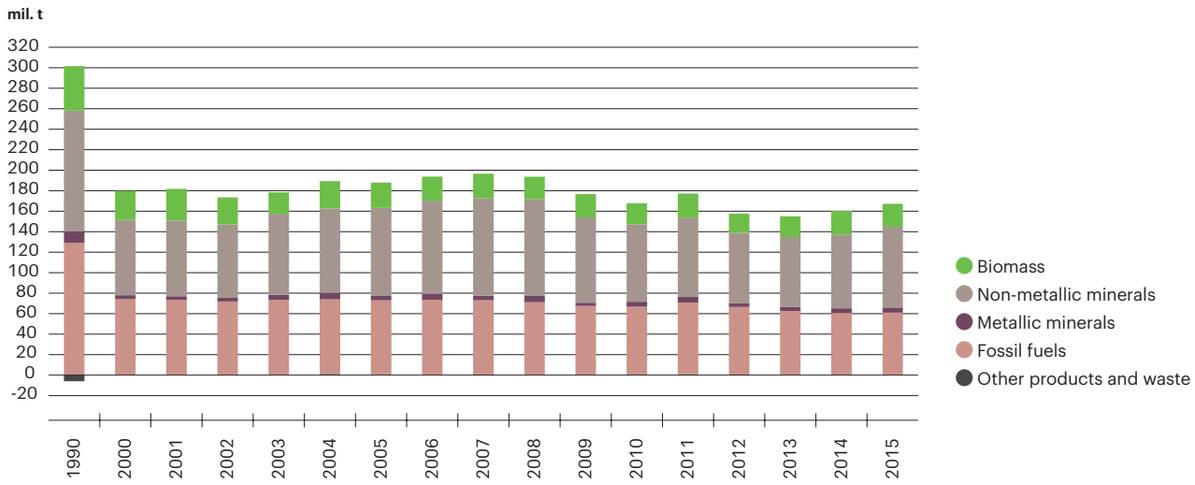
Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Statistical Office

[1]*Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Chart 2

Development of the structure of domestic material consumption in the Czech Republic by material group [mil. t], 1990, 2000–2015

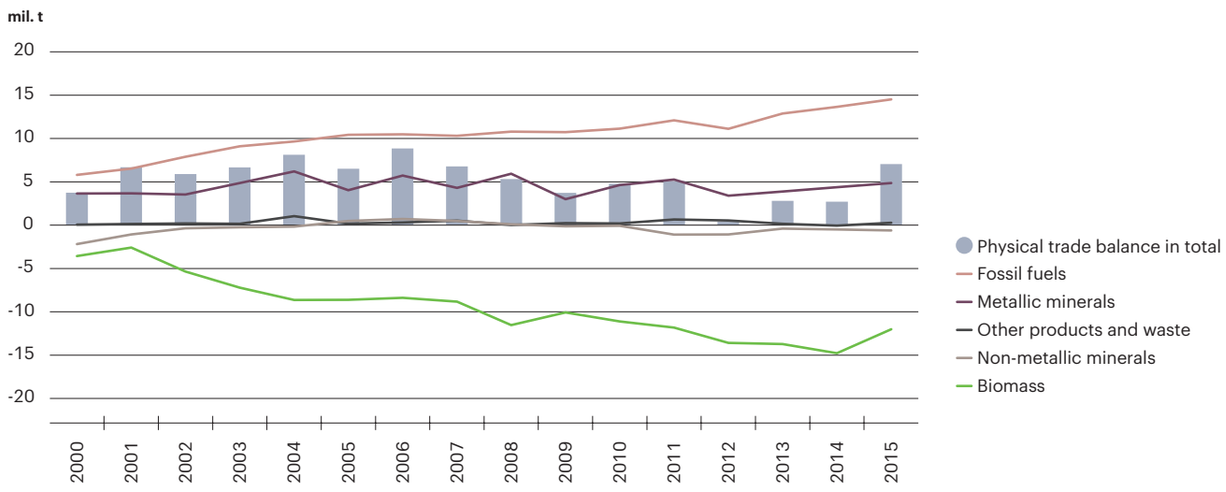


Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Statistical Office

Chart 3

Physical trade balance in the Czech Republic by material group [mil. t], 2000–2015



Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Statistical Office

Domestic material consumption (DMC[2]) in the Czech Republic in 2015 grew year-on-year by 4.2% (6.8 mil. t) to 167.2 mil. t (Chart 1), i.e. roughly to the level of the year 2010, the development of the DMC was influenced by the growth of the economy of the Czech Republic. From the long-term perspective, the DMC declined substantially at the beginning of the 1990s in connection with the restructuring of the economy, after the year 2000 the DMC varies in relation to the development of the economy, for the entire period 2000–2015 it slightly decreased by 7.1%. Environmental burden associated with the exploitation of natural resources and the use of materials is now clearly lower level than at the beginning of the 1990s, however, further systematic decrease in material consumption after the year 2000 has not occurred.

[2] *DMC is calculated as domestic used extraction minus exports plus imports. It measures the amount of materials (raw materials, semi-finished products and products) consumed by the economy for production and consumption.*

The **development of the DMC** copies in the Czech Republic the development of domestic used extraction (DE), which rose in 2015 to 1.6% (2.5 mil. t) to 160.1 mil. t. **Foreign trade of the Czech Republic** in physical units increases, the physical imports increased in 2015 year-on-year by 7.3%, since the year 2000 by 76.6%, physical exports rose by 1.4% and 75.6% respectively.

In the **structure of DMC** in 2015, the highest proportion was taken up by the material groups of non-metallic minerals (47.2%) and fossil fuels (36.3%), on the contrary, the share of biomass or renewable sources in the DMC has been lower in the long term, in 2015 it reached 13.4%, indicating a year-on-year decrease by 0.9 percentage points (Chart 2).

The consumption of **non-metallic minerals** in the year-on-year comparison increased in 2015 by 9.5% (6.9 mil. t) and was decisively involved in the growth of the overall DMC in that year. In the period 2000–2015, the DMC of non-metallic minerals grew by 7.3%, during that period, it was the highest in 2007 (94.8 mil. t). The development of the DMC in this material category was influenced in 2015 by the growth of construction, construction index increased year-on-year by 7.1%, mainly due to the growth of civil engineering construction by 17.1%, which includes, inter alia, the construction of transport infrastructure.

In the category of **fossil fuels**, the DMC stagnated in 2015, compared with the previous year, however, the long-term trend of the consumption of fossil fuels is declining, in the period 2000–2015, the decline was 18.1%, since 1990 their consumption has decreased by 53.0%. The factors influencing this positive development include the decline in the energy intensity of the economy, reducing the share of solid fuels in the consumption of primary energy sources, as well as the growing use of RES and other non-fossil sources of energy. Solid fossil fuel consumption is declining, consumption of black coal decreased in the period 2000–2015 by 42.7%, in 2015 by 2.7%, in the case of brown coal, the DMC fell during that period by 19.6% (9.3 mil. t), or 1.3% in 2015. Oil consumption is stagnating, the growth of the transport performance in road transport is counterbalanced by increasing energy efficiency of transport. In the case of natural gas, consumption fluctuates, fluctuations are largely affected by temperatures in the heating season of the given year. The proportion of liquid and gaseous fuels in total DMC of fossil fuels increased from 19.2% in the year 2000 to 23.4% in 2015.

The consumption of **metal ores** increased in 2015 year-on-year by 9.6% (0.5 mil. t), since 2000 by 32.4%. The growth in consumption of metal minerals at the end of the reference period was mainly due to the growth of industrial production, in 2015, the industrial production index increased year-on-year by 4.6%, the industrial sectors processing metals were doing very well, especially the automotive industry, which rose by 12.1%.

Consumption of **renewable sources** decreased in 2015 by 3.7% (0.9 mil. t), the consumption of biomass reflected the decline in domestic used extraction of biomass by 9.6%, which was largely influenced by the lower yields of agricultural crops as a result of drought. Biomass production from agriculture in 2015 decreased year-on-year by 13.9%, while the production of biomass from forestry rose by 3.8%. In the long term, consumption of biomass decreases slowly (by 21.3% since 2000 and by 48.5% since 1990), in the last 5 evaluated years (2010–2015), however, it slightly increased by 7.7%.

The proportion of DE in DMC, expressing the **degree of national self-sufficiency** in the given material group, was the lowest in 2015 for metallic minerals (1.8%) and for liquid and gaseous fossil fuels (2.0%), while the Czech Republic has a surplus in domestic extraction beyond the consumption in biomass (153.6%) and non-metallic minerals (100.8%).

Physical trade balance (PTB) in the Czech Republic was overall positive in 2015 (import exceeds export) and year-on-year it significantly rose to 7.1 mil. t (Chart 3). A positive PTB is in the material groups of fossil fuels and metallic minerals, in those groups the Czech Republic mostly imports raw materials and semi-finished products and exports products, which weigh less compared to primary raw materials, the growth in positive PTB for fossil fuels is affected by the decline in domestic coal extraction. The opposite situation and negative PTB is in biomass where the Czech Republic exports the surplus of domestic production. The foreign trade of the Czech Republic is significantly oriented on export in the case of biomass from agriculture (with the exception of fruit and vegetables) and biomass from forestry (wood), however, the negative PTB means an additional burden on the environment from the biomass production in excess of domestic consumption.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

38 | Material intensity of GDP

Key question

Is the material intensity of GDP generation decreasing in the Czech Republic?

Key messages[3]

The material intensity of the Czech economy is decreasing in the long term, in the period 2000–2015 it decreased by 37.1%. The decline in material intensity results in reduced environmental burden per unit of GDP generated. The most notable decrease is in the material intensity of fossil fuels, due to the reducing energy intensity of the economy and the development of the energy mix.

Because of the nature of the national economy and its development, there was not a prolonged situation in the period 2000–2015 where the economy is growing and the environmental burden represented by the consumption of materials is declining, so called absolute decoupling. Material intensity in the groups of non-metallic minerals and metal ores increased in 2015, compared with the previous year.

Overall assessment of the trend

Change since 1990

Change since 2000

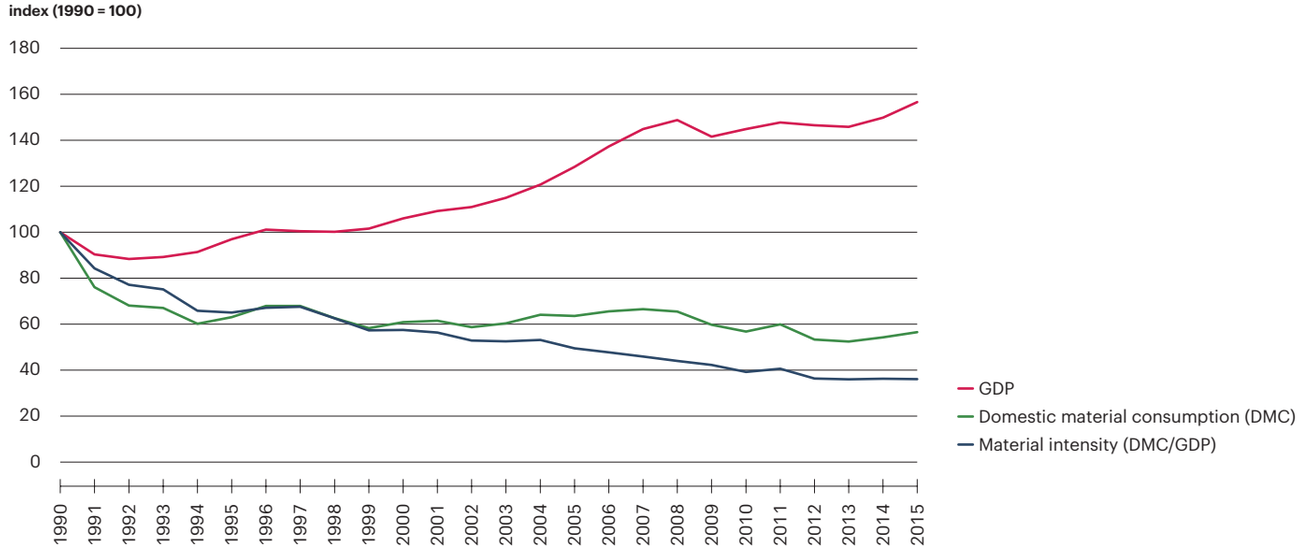
Last year-on-year change

[3] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Indicator assessment

Chart 1

Material intensity, domestic material consumption and GDP in the Czech Republic [index, 1990 = 100], 1990–2015

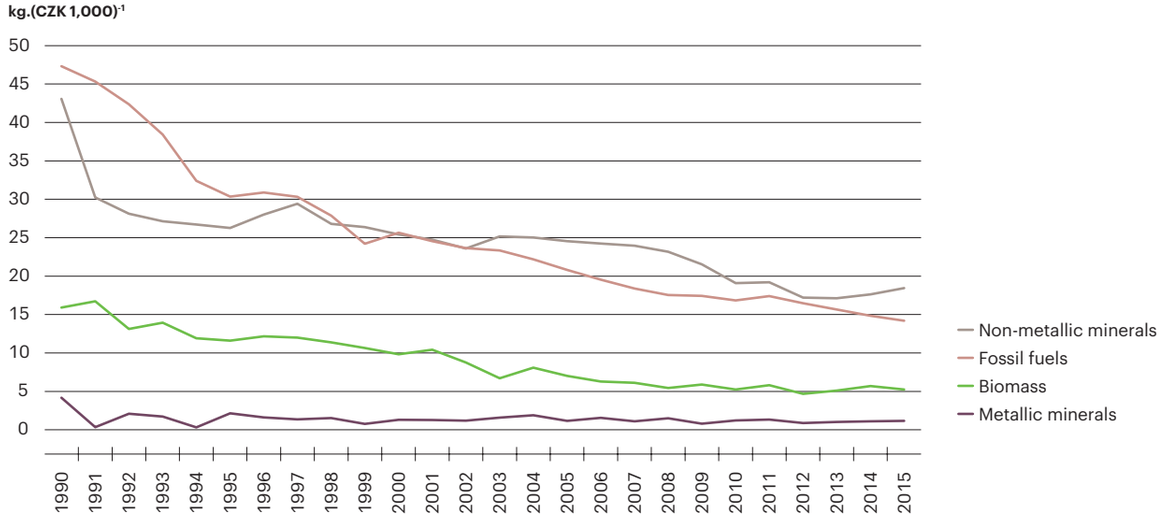


GDP figures in constant prices in 2010.
Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Statistical Office

Chart 2

Development of the material intensity of selected material groups in the Czech Republic [kg.(CZK 1,000)$^{-1}$], 1990–2015



GDP figures in constant prices in 2010.
Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Statistical Office

The **material intensity of the economy of the Czech Republic** in 2015 slightly decreased by 0.3% year-on-year to 39.1 kg.(CZK 1,000 of GDP)$^{-1}$ (Chart 1), the economic growth rate of 4.5% was accompanied by the growth of domestic material consumption of 4.2%. The situation in 2015 can be characterized as a **relative decoupling**, in which economic performance and material consumption have the same direction of the trend, the efficiency of conversion of material inputs to economic performance increases and the environmental burden per unit of GDP decreases.

The **long-term trend** of the material intensity of the Czech economy is declining, in 2015 it was less than half in comparison with the early 1990s, in the period 2000–2015 it fell by 37.1%, in the last 5 evaluated years (2010–2015) by 7.9%. The factors underlying the decline in material intensity after the year 2000 may include reducing the share of solid fuels in the energy mix of the Czech Republic, the growing use of renewable energy sources and other non-fossil energy sources and reducing the energy and material intensity of the industry.

During the period 1990–2015, in the Czech Republic, the development of the environmental burden caused by material consumption was separated from the economic performance, so-called **decoupling**, however, in most years of that period, it was a relative decoupling. It is a consequence of the structure of the GDP generation in the Czech Republic with a high proportion of industry, and of the fact that the economic growth at the start of the 21st century, and in the last two evaluated years 2014 and 2015, was significantly driven by the processing industry and its materially more intensive sectors (manufacture of motor vehicles, manufacture of metal structures and fabricated metal products). An absolute reduction of the environmental burden represented by the material consumption while the economy is growing, so-called absolute decoupling, which is ideal from an environmental point of view, was registered after the year 2000 only in the years 2002, 2005, 2008, and for the last time in 2010.

The decline in material intensity in the period 1990–2015 was most notably driven by the category of **fossil fuels**, in which the material intensity has decreased since 1990 by 70.0%, in the period 2000–2015 by 44.6%, i.e. almost to a half, and in the year-on-year comparison by 4.2% (Chart 2). In the case of **non-metallic minerals**, the drop in material intensity was less pronounced (by 27.4% in the period 2000–2015), year-on-year it even grew by 4.8%. By analogy, due to the development of the industry, the material intensity increased year-on-year even in the category of **metallic minerals** (by 4.9%), in which the material intensity decreased especially in the early 1990s, in the period 2000–2015, there were fluctuations, the overall decrease was 10.5%. On the contrary, the material intensity decreased dramatically after the year 2000 in the **biomass** consumption (by 46.8% in the period 2000–2015), year-on-year in 2015 by 7.9%, however, due to the small proportion of biomass in the total domestic material consumption, the impact of the development in this material group on the overall trend of the material intensity is less significant.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

Material flows in the global context

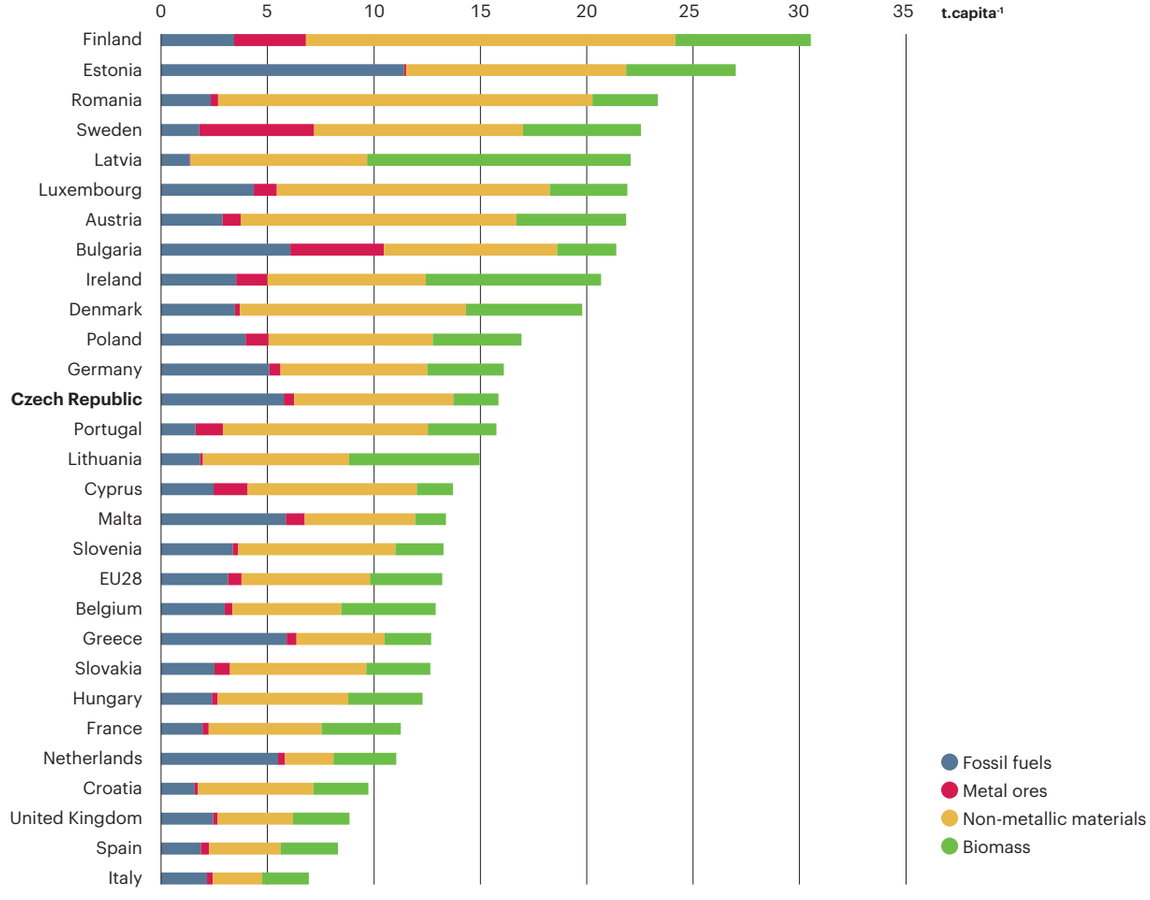
Key messages[4]

- Both the domestic material consumption (DMC) per capita and the material intensity of Czech economy were above the average of EU28 countries in 2015. That is related to higher environmental burden per capita and unit of GDP, associated with the consumption of materials.
- In the DMC structure, the Czech Republic has a high proportion of fossil fuels. On the other hand, the share of renewable sources on the DMC, whose consumption is causing lower environmental burden than the consumption of non-renewable resources, are among the lowest in the EU28.

Indicator assessment

Chart 1

Domestic material consumption per capita, by material group [t.capita^{-1}], 2015



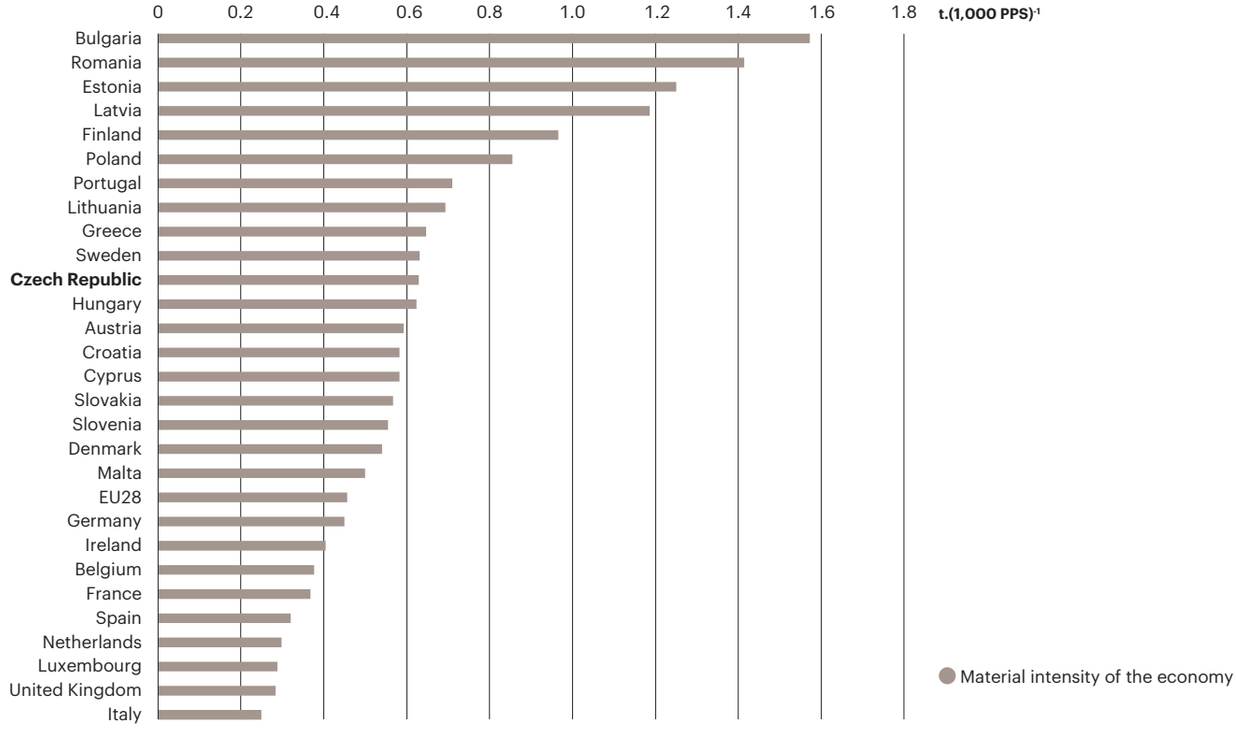
Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

[4] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Chart 2

Material intensity of the economy [t.(1,000 PPS)$^{-1}$], 2015



Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

The values of **intensity indicators of material flows**, and thus the specific environmental burden per capita and unit of GDP associated with extraction and consumption of materials, are above average in the Czech Republic compared with the other countries of the EU28, which is related, in particular, to a higher proportion of industry in the GDP generation and to the fossil fuel-based energy sector.

Domestic material consumption per capita in the Czech Republic in 2015 reached 15.9 t.capita^{-1} (year-on-year growth by 4.3%) which is 20.1% above the average for the EU28 countries (Chart 1). The highest per capita material consumption in the EU28 is in the Scandinavian countries with a small population density (Finland, Sweden), countries with high extraction and consumption of non-metallic minerals (Romania) and countries where the energy sector is based on fossil fuels (Estonia). Domestic material consumption per capita in the Czech Republic and in the EU28 is below the average of the OECD countries, but above the global average, which is around 12 t per capita. Worldwide, the countries with the highest material consumption per capita include Australia with rich mineral reserves and mining of fossil fuels and metallic and non-metallic minerals.

In **the structure of DMC** by material groups, the Czech Republic has an above EU28 average proportion of fossil fuels (36.4%, the EU28 average is 23.8%), and on the contrary, in the European and global comparison, it has one of the lowest shares of biomass (13.4%) in the total DMC, its consumption is related to lower environmental burden compared to non-renewable sources.

The **material intensity of the Czech economy** in 2015 was 0.63 t.(1,000 PPS)$^{-1}$, and was therefore 37.7% higher than the average material intensity of the whole EU28 (Chart 2). The Western European countries with high GDP per capita have the lowest material intensity, while higher material intensity is typical for countries with high DMC per capita in combination with lower economic performance, such as Romania, Estonia and Bulgaria. Globally, the highest material intensity, and therefore the low effectiveness of transforming materials to economic performance, is in the rapidly emerging economies of BRIICS countries, especially Brazil and China[5], that have a material intensity more than four times higher in comparison with the EU28 and the average of the OECD countries.

[5] *Data for the year 2011 (source: OECD).*

Waste

10

Waste

The consumer society generates large quantities of waste and packaging, which may present a risk factor both for human health and ecosystems. Alien substances leak into the environment, and therefore subsequently pollute its individual components, both during the generation of waste and during the subsequent treatment of waste. In addition, generation and treatment of waste, in particular landfilling, causes the land take. That may affect the landscape character and functions of the landscape and influence the development of biotopes and the various species of plants and animals. The odour and noise produced by waste treatment facilities pose a problem as well. The substances contained in waste (mainly in the waste from selected products) and in packaging can get into the human body through the food chain and negatively affect human health.

Special attention is paid to municipal waste, the generation of which is closely related to the place of residence and lifestyle of each individual, and so it also immediately affects the individual's surroundings. The mixed municipal waste, where sorting is absent, can also contain hazardous components such as batteries and accumulators, paints, solvents, medicaments, etc.

To limit the negative impact of all types of waste on the environment and human health, it is important to treat of the waste and packaging correctly, and, ideally, prevent their generation.

References to current conceptual, strategic and legislative documents

Directive 2008/98/EC of the European Parliament and of the Council on waste and repealing certain directives
- minimising the adverse effects of waste and its treatment on the environment and human health
- supporting implementation of the hierarchy of waste treatment

Council Directive 1999/31/EC on the landfill of waste
- preventing and minimising adverse environmental impacts of municipal waste landfilling
- reducing the proportion of landfilled biodegradable municipal waste to 35% (of weight) of the total amount of biodegradable municipal waste (produced in 1995) by 2020

European Parliament and Council Directive 94/62/EC on packaging and packaging waste
- minimising environmental effects of packagings and packaging waste
- preventing the generation of packaging waste through a reduction of the total volume of packagings
- supporting repeated use of packagings
- developing innovative, environment-friendly and sustainable recycling processes
- reducing the toxicity of packaging waste through preventing the use of heavy metals in packagings

Directive 2012/19/EU of the European Parliament and of the Council on waste electrical and electronic equipment (WEEE)
- preventing adverse effects of generation and treatment of WEEE on the environment and human health
- minimising the disposal of WEEE as unsorted municipal waste
- the achievement of the levels of collection of more than 40% for the year 2016, and 65% in the year 2021

Directive 2006/66/EC of the European Parliament and of the Council on batteries and accumulators and waste batteries and accumulators and repealing Directive 91/157/EEC
- achieving the following minimum levels of collection of batteries and accumulators: 25% up to 26 September 2012; 45% to 26 September 2016
- supporting recycling of waste batteries and accumulators
- minimising the disposal of waste batteries and accumulators as mixed municipal waste
- prohibition of the placing of certain batteries and accumulators containing mercury and cadmium on the market
- achieving the recycling efficiency of recycling processes: lead-acid batteries and accumulators 65%, nickel-cadmium batteries and accumulators 75%, other waste batteries and accumulators 50%

Directive 2000/53/EC of the European Parliament and of the Council on end-of-life vehicles
- preventing generation of waste from vehicles
- increasing rates of reuse and recycling of waste from vehicles and reducing their quantity that is disposed of

Directive 2009/125/EC of the European Parliament and of the Council establishing a framework for the setting of ecodesign requirements for energy-related products
- improving the environmental impact of a product throughout its whole life cycle
- reducing the impact of energy-related products on the environment and achieving energy savings
- ensuring the functioning of the internal market by establishing appropriate environmental requirements for products

The European Commission's package on the circular economy
- changing the current linear model to a circular model, i.e. returning the potential waste back into the economic process and closing the loop in a ring
- reducing dependence on primary raw materials
- emphasizing waste prevention and reducing food waste
- increasing the targets for recycling municipal waste and packaging, and setting a target for reducing landfilling
- restricting illegal transportation of waste

State Environmental Policy of the Czech Republic 2012–2020
- supporting the development and generation of easily repairable, recyclable and materially usable products
- adhering to and complying with the hierarchy of waste treatment: prevention of the generation of waste, preparations for reuse, waste recycling, other waste recovery (e.g. energy) and disposal methods
- reducing the share of landfilling in the total waste disposal and increasing the material and energy recovery of waste
- minimising risks of transport of waste and its environmental impacts
- increasing the level of material recovery to 70% and the level of overall recovery of packaging waste to 80% by 2020

Government Regulation No. 352/2014 Coll., on the Waste Management Plan of the Czech Republic for the period 2015–2024
- waste prevention and reduction of the specific waste generation, including hazardous waste
- maximising the recovery of waste as a substitute of primary resources and transition to the circular economy
- sustainable development of society and the approach to the European "recycling society"
- creating and maintaining a comprehensive, appropriate and effective network of waste treatment facilities in the territory of the Czech Republic

Czech Republic's Waste Prevention Programme
- reducing the quantity and dangerous properties of generated waste
- prevention in the form of reuse of products and improved efficiency of manufacturing

Secondary Raw Materials Policy of the Czech Republic
- supporting innovations allowing secondary raw materials to be obtained from waste in a quality suitable for further industrial use
- supporting innovations in and transfers of science and research into the industry of processing and use of secondary raw materials obtained from waste, in the framework of programmes of the Ministry of Industry and Trade (Operational Programme Enterprise and Innovation for Competitiveness)

- inclusion of technologies of processing and use of secondary raw materials obtained from waste among industries supported by investment incentives
- removing barriers to the increased use of secondary raw materials
- supporting the introduction of voluntary agreements between state authorities and the business community for the purpose of voluntarily establishing product take-back systems, and thus eliminating the generation of waste

Act No. 477/2001 Coll., on packaging and amending certain acts (the Packaging Act)
- preventing the generation of packaging waste through reducing the weight, volume and harmful effects of and contents of chemical substances contained in packagings
- producing packagings that are reusable, recyclable or organically recyclable, or can be used for energy recovery
- increasing the level of material recovery to 70% and the level of overall recovery of packaging waste to 75% by 1 January 2020 (the objectives are set for every year)

Act No. 185/2001 Coll., on waste and amending some other acts
- ensuring a minimum take-back level of used tyres in the amount of 35% for each calendar year

Operational Programme Environment 2014–2020
- waste prevention
- increasing the share of material and energy recovery of waste
- reclamation of old landfills

39 | Total waste generation

Key question

Is total waste generation declining?

Key messages

Total waste generation in the period between the years 2015–2016 fell by 8.3% year-on-year. Since 2009, however, it has increased by 6.1%.

Overall assessment of the trend

Change since 1990 N/A

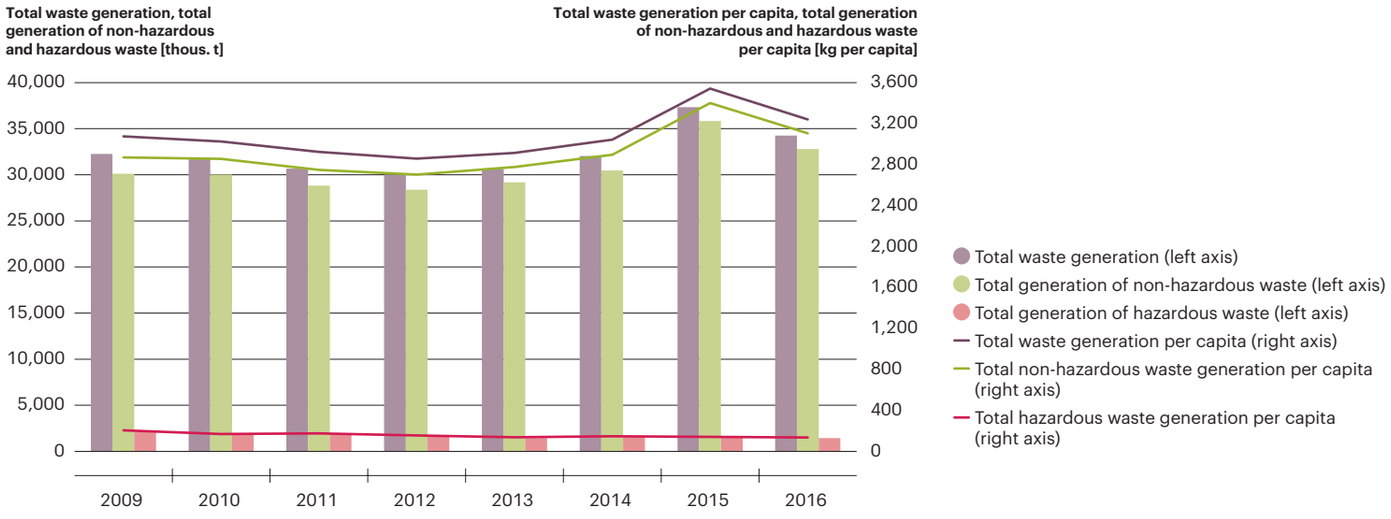
Change since 2009[1]

Last year-on-year change

Indicator assessment

Chart 1

Total waste generation, total generation of non-hazardous and hazardous waste in the Czech Republic [thous. t], total waste generation per capita, total generation of non-hazardous and hazardous waste per capita in the Czech Republic [kg per capita], 2009–2016



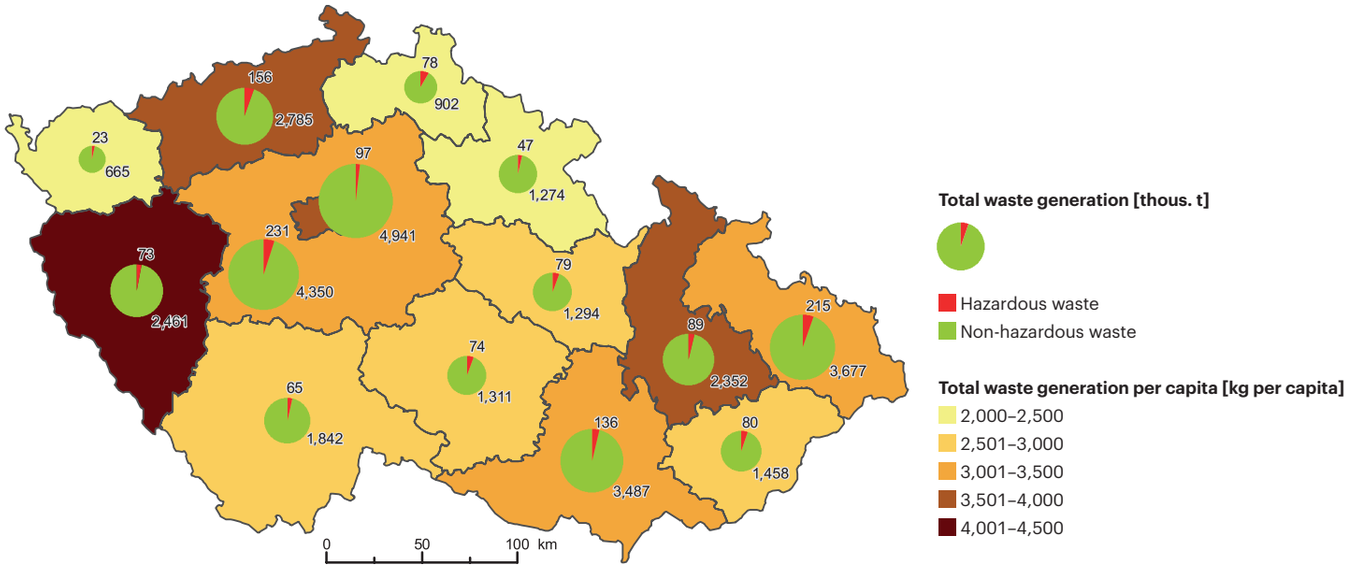
The data was determined according to the methodology Mathematical Expression of Calculating the "Waste Management Indicator Set" applicable for a given year.
Czech Statistical Office is the source of data on the population of the Czech Republic (mid-year population).

Source: CENIA, Czech Statistical Office

[1] *Overall assessment of the trend postponed because of changes of the calculation methodology.*

Figure 1

Total waste generation, total generation of non-hazardous and hazardous waste in regions of the Czech Republic [thous. t], total waste generation per capita in regions of the Czech Republic [kg per capita], 2016

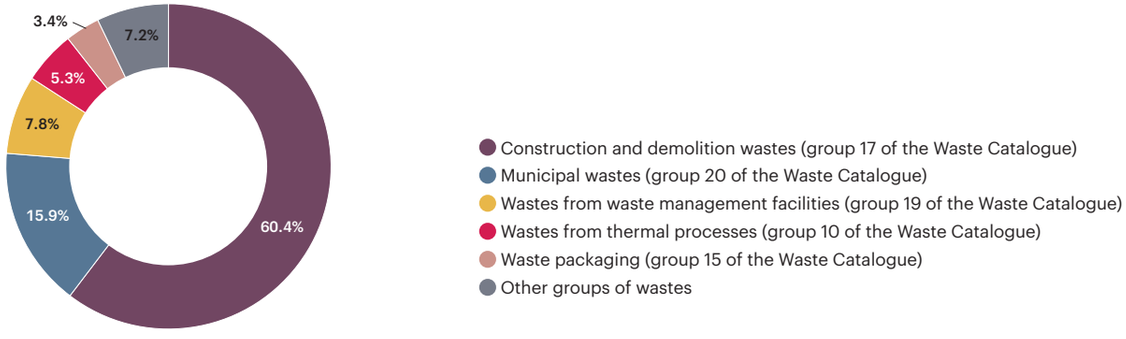


The data was determined according to the methodology Mathematical Expression of Calculating the "Waste Management Indicator Set" applicable for a given year.
Czech Statistical Office is the source of data on the population of the Czech Republic (mid-year population).

Source: CENIA, Czech Statistical Office

Chart 2

Structure of total waste generation in the Czech Republic [%], 2016



The data was determined according to the methodology Mathematical Expression of Calculating the "Waste Management Indicator Set" applicable for a given year.

Source: CENIA

Total waste generation (the sum of the total generation of the other and of hazardous wastes) in 2015–2016, after an increase between the years 2014–2015, decreased by 8.3% to the value of 34,242.1 thous. t. Since 2009, it increased by 6.1%.

Another important indicator is the **total waste generation per capita**, which was 3,241.0 kg per capita in 2016. In the period 2009–2016, the value of this indicator rose by 165.4 kg per capita, between the years 2015 and 2016, after a marked increase between the years 2014 and 2015, it fell by 300.5 kg per capita (Chart 1).

Several factors influence the indicator's value. However, construction activities resulting from government contracts (Chart 2) are reflected most in this indicator because 60.4% of the generated waste come from construction (group 17 of the Waste Catalogue). This waste group generation in 2016, after a dramatic increase in 2015, especially in connection with investments in modernisation and construction of transport infrastructure (road and rail) dropped by 3,622.7 thous. t to a total of 20,669.2 thous. t. For the reduction of waste generation, it is crucial to prevent waste, to use it as a substitute for the primary sources, and so gradually shift to the circular economy.

The total waste generation is significantly influenced by the **total generation of non-hazardous waste**, which is mainly driven by the generation of construction and demolition waste. Since 2009, the total generation of non-hazardous waste grew by 8.9% to 32,798.3 thous. t, despite the 2015–2016 reduction by 8.5%, which followed the stronger increase between the years 2014 and 2015 (Chart 1). **Total generation of non-hazardous waste per capita** grew from 2009 by 234.3 kg per capita to 3,104.3 kg per capita in 2016. Between 2015 and 2016, on the contrary, after its previous increase between 2014 and 2015, it was reduced to 294.5 kg per capita.

Hazardous waste represents only 4.2% of the total waste generation. However, because of the danger it poses, the percentage of hazardous waste in the total waste generation is an essential indicator in the monitoring of the development of waste management in the Czech Republic. The value of this share fell since 2009 from 6.7% to 4.2% in 2016, despite the mild 2015–2016 increase from 4.0% to 4.2% due to a decrease in the total generation of waste. A positive trend can also be observed in an absolute reduction of the total generation of hazardous waste. Between 2009 and 2016, the total generation of hazardous waste dropped by 33.2% to the total of 1,443.8 thous. t and from 2015 it dropped by 4.0%. **Total generation of hazardous waste per capita** in 2016 amounted to 136.7 kg per capita, between the 2009 and 2016 it declined by 69.4 kg per capita and in last year-on-year comparison of 2015–2016 by 6.0 kg per capita (Chart 1). There are no clearly defined development trends in the generation of hazardous waste. This depends mainly on the condition of economy and industry. The increased amount of hazardous waste generated was attributable to projects of remediation of contaminated sites which were going on during the monitored period. The generation of hazardous waste can be prevented by reducing the content of hazardous substances in products.

In individual **regions of the Czech Republic** the total generation of waste and the proportion between generation of non-hazardous and hazardous waste and also the total waste generation per capita varies with regard to different economic focus of individual regions. The highest total generation of non-hazardous waste, and thus the total waste generation is in the region of the Capital City of Prague, Central Bohemian and Moravian-Silesian regions, the highest total waste generation per capita is in the Pilsen region, Capital City of Prague and Olomouc regions (Figure 1).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

40 | Municipal waste generation and treatment

Key question

Is the municipal waste generation decreasing and the structure of the treatment of municipal waste changing?

Key messages

Total generation of municipal waste between 2015 and 2016, after prolonged stagnation, increased by 6.4%.

Although landfilling continues to prevail as the principal method of municipal waste treatment, its use has been declining since 2009 in favour of material and also energy recovery of municipal waste.

Overall assessment of the trend

Change since 1990 N/A

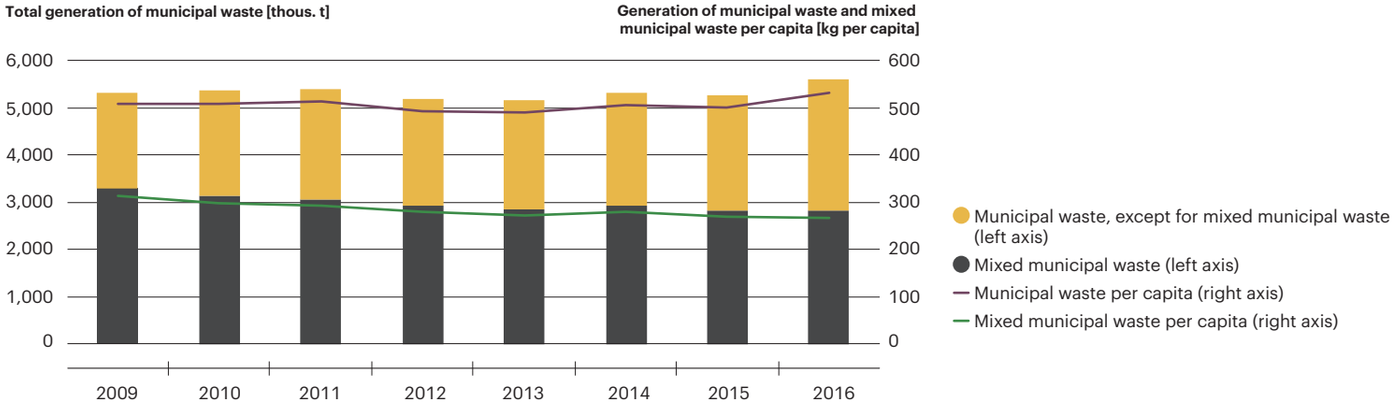
Change since 2009[2]

Last year-on-year change

Indicator assessment

Chart 1

Total generation of municipal waste in the Czech Republic [thous. t], generation of municipal and mixed municipal waste per capita in the Czech Republic [kg per capita], 2009–2016



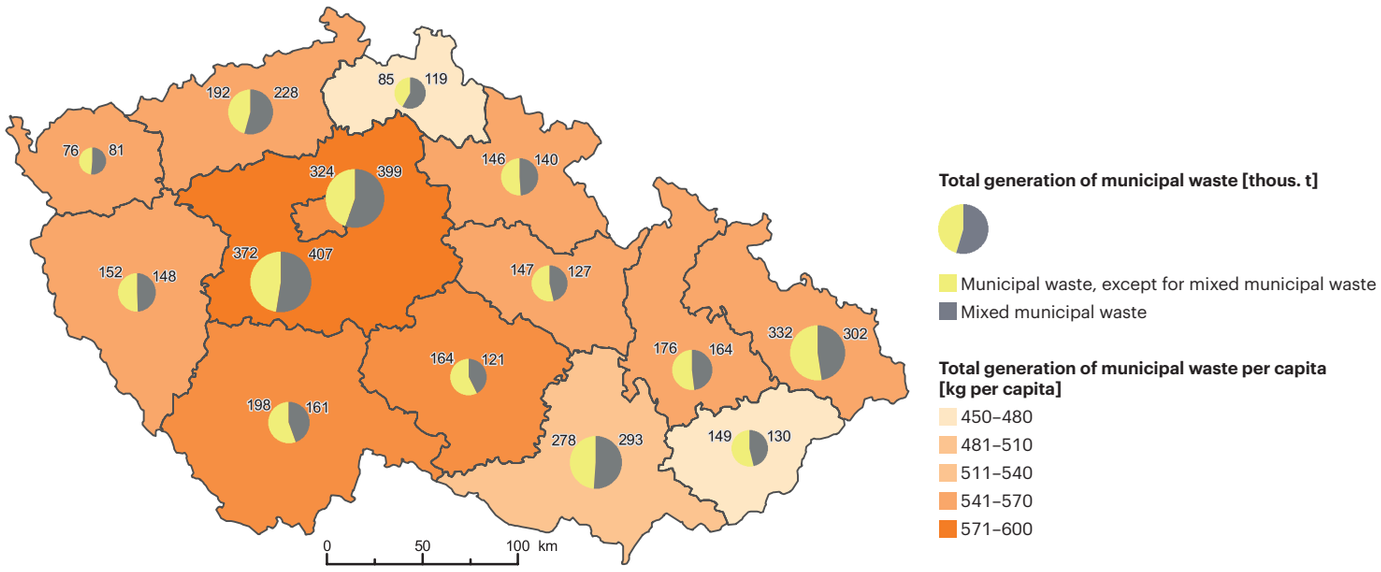
The data was determined according to the methodology Mathematical Expression of Calculating the "Waste Management Indicator Set" applicable for a given year.
Czech Statistical Office is the source of data on the population of the Czech Republic (mid-year population).

Source: CENIA, Czech Statistical Office

[2] *Overall assessment of the trend postponed because of changes of the calculation methodology.*

Figure 1

Total municipal waste generation, total generation of mixed municipal waste in regions of the Czech Republic [thous. t], total municipal waste generation per capita in regions of the Czech Republic [kg per capita], 2016



The data was determined according to the methodology Mathematical Expression of Calculating the "Waste Management Indicator Set" applicable for a given year.
Czech Statistical Office is the source of data on the population of the Czech Republic (mid-year population).

Source: CENIA, Czech Statistical Office

Table 1

Selected municipal waste treatment methods as percentages of the total generation of municipal waste in the Czech Republic [%], 2009–2016

Treatment method [%]	2009	2010	2011	2012	2013	2014	2015	2016
Proportion of municipal waste used for energy recovery	6.0	8.9	10.8	11.8	11.9	11.8	11.8	12.1
Proportion of municipal waste used for material recovery	22.7	24.3	30.8	30.4	30.2	34.7	35.6	38.1
Proportion of municipal waste disposed of by landfilling	64.0	59.5	55.4	53.6	52.2	48.3	47.4	45.0
Proportion of municipal waste disposed of by incineration	0.04	0.04	0.04	0.04	0.05	0.07	0.07	0.06

The data was determined according to the methodology Mathematical Expression of Calculating the "Waste Management Indicator Set" applicable for a given year.

Source: CENIA

The **municipal waste** includes, for example, mixed municipal waste, its separated components (paper, plastic, glass, metal), large-volume waste, but also hazardous waste.

The **total generation of municipal waste** stagnated in the period 2009–2015, between the years 2015 and 2016, however, it increased by 6.4% to 5,612.4 thous. t (Chart 1). Since 2009, it increased by 5.4%.

As municipal waste is closely related to the place of residence of every individual, the development of its **per capita generation** represents an important indicator. Between 2009 and 2016, the average generation of municipal waste per capita was equal to 506.7 kg per capita. The indicator in 2016 reached the value of 531.2 kg per capita. In the period 2009–2016, the value increased by 23.7 kg per capita, which was mainly due to the significant increase of 31.0 kg per capita between the years 2015 and 2016 (Chart 1).

The category of **mixed municipal waste** includes waste falling under catalogue number 20 03 01. It is the residual (unseparated) waste produced by households, but also by non-manufacturing activities of businesses. The fact that the generation of mixed municipal waste has been declining since 2009 can be regarded as positive. Between 2009 and 2016, the mixed municipal waste generation decreased by 14.1% and in 2016 it decreased slightly year-on-year by 0.6% to a total of 2,820.9 thous. t. The proportion of mixed municipal waste in the total municipal waste generation amounted to 50.3% in 2016. Just like in the case of the total generation of municipal waste, the **per capita generation** of mixed municipal waste is an important indicator for comparisons. Between 2009 and 2016, the total generation of mixed municipal waste per capita dropped by 46.0 kg per capita; the generation decreased between 2015 and 2016 by 2.1 kg per capita to 267.0 kg per capita (Chart 1).

Due to the significant concentration of the population and services is the total municipal waste generation and the total municipal waste generation per capita is higher over the long term in the region of the Capital City of Prague and the Central-Bohemian region (Figure 1). In these **regions** there is also high generation of mixed municipal waste.

The different **waste treatment methods** are identified using codes that are defined by the Act No. 185/2001 Coll., on waste, and Decree No. 383/2001 Coll., on waste treatment details, as amended. According to the methodology Mathematical Expression of Calculating the "Waste Management Indicator Set", the waste treatment methods can be divided as follows:

- use of municipal waste for material (recovery, recycling and others),
- use of municipal waste for energy (using waste in a manner similar to fuels and in other ways to generate energy),
- disposal of municipal waste in landfills (by landfilling),
- disposal of municipal waste in incinerators (incineration on land).

Municipal waste is a specific group of waste, which fact is also reflected in its **treatment methods**. Unlike in other groups of waste, the prevailing method of disposal in this case is **landfilling**. Since 2009, however, there was a slight decline in the share of landfilled municipal waste every year (Table 1). Comparing 2015 and 2016, the proportion of municipal waste disposed of by landfilling in the total generation of municipal waste decreased from 47.4% to 45.0% and between 2009 and 2016 it fell from 64.0% to 45.0%. In 2016, the amount of landfilled municipal waste was 2,522.8 thous. t. The current situation in the landfilling of municipal waste in the Czech Republic is not satisfactory. The aim is to reduce more decisively the share of the landfilling in the total generation of municipal waste, and by contrast, improving the material and energy recovery of waste, in accordance with the principles of the circular economy.

The gradual shift away from landfilling of municipal waste makes way for the development of its **material recovery**, which is another significantly represented method of treatment of municipal waste. Its share in the total generation of municipal waste increased since 2009 from 22.7% to 38.1% in 2016. Between 2015 and 2016, the quantity of municipal waste used for material recovery rose by 258.8 thous. t to 2,136.2 thous. t.

At the same time, the **energy recovery** of municipal waste is also becoming more important. Since 2009, the percentage of municipal waste used for this purpose grew from 6.0% to 12.1%. Between 2015 and 2016, the quantity of municipal waste used for energy recovery rose by 60.2 thous. t to the total of 680.5 thous. t.

As to **incineration**, the situation is dramatically different; the method is used to treat of an almost negligible amount of municipal waste (its percentage is almost zero).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

41 | Waste treatment structure

Key question

How is the structure of the waste treatment changing?

Key messages

Between 2009 and 2016, the proportion of waste used for material recovery rose from 72.5% to 81.6%. In line with that, the proportion of landfilled waste in the total waste generation declined in the same period.

In the long run, the use of waste for energy recovery has been more or less stagnating.

Overall assessment of the trend

Change since 1990 N/A

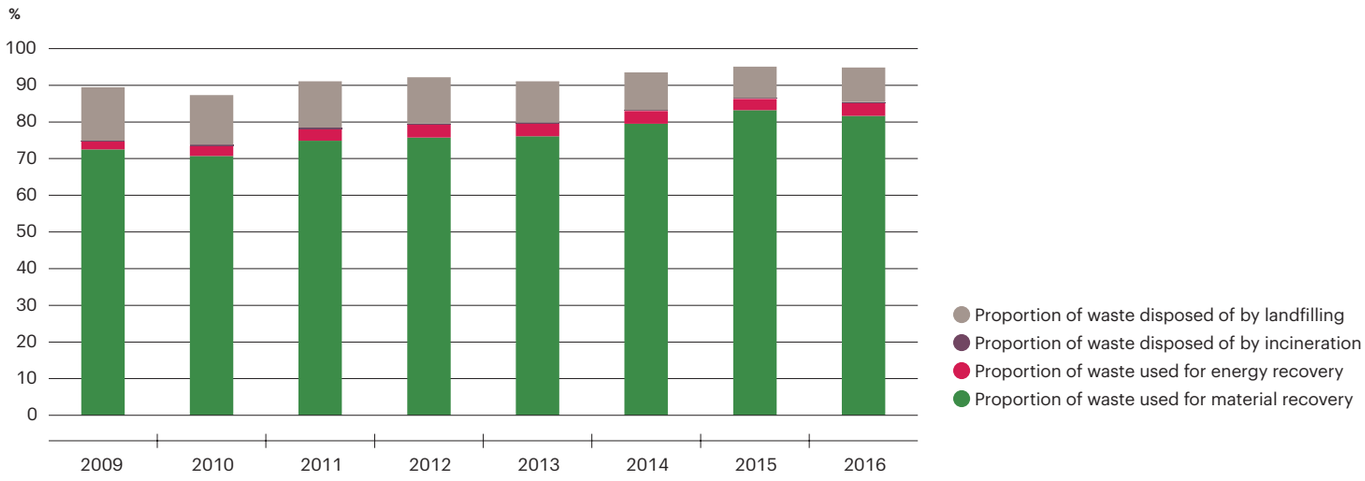
Change since 2009[3]

Last year-on-year change

Indicator assessment

Chart 1

Proportions of selected waste treatment methods in the total waste generation in the Czech Republic [%], 2009–2016



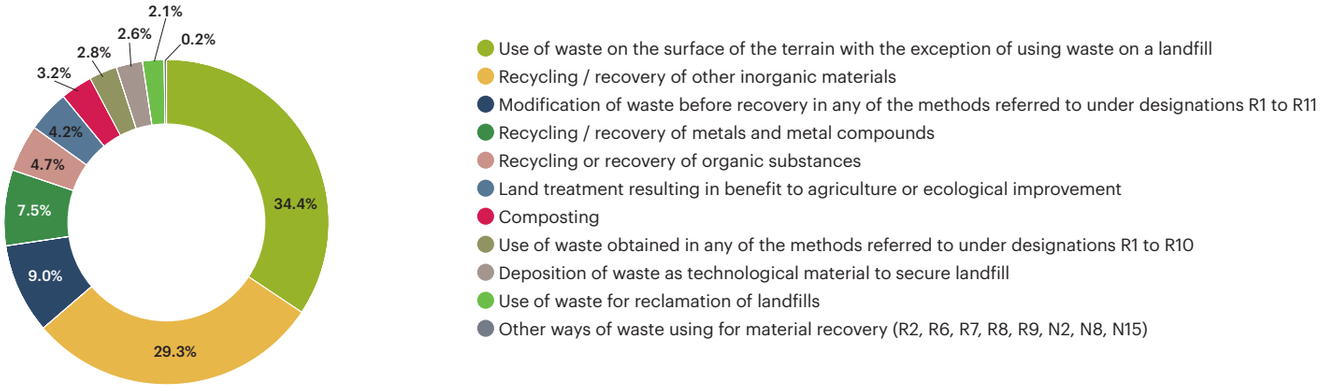
The data was determined according to the methodology Mathematical Expression of Calculating the "Waste Management Indicator Set" applicable for a given year.

Source: CENIA

[3] *Overall assessment of the trend postponed because of changes of the calculation methodology.*

Chart 2

Structure of waste used for material recovery in the Czech Republic [%], 2016



The data was determined according to the methodology Mathematical Expression of Calculating the "Waste Management Indicator Set" applicable for a given year.

Source: CENIA

In a broader sense, the term **waste treatment** includes, according to the Waste Act, gathering, collection, purchase, handling, transport, storage, treatment, recovery and disposal of waste.

The different **waste treatment methods** are identified using codes that are defined by the Act No. 185/2001 Coll., on waste, and Decree No. 383/2001 Coll., on waste treatment details, as amended. According to the methodology Mathematical Expression of Calculating the "Waste Management Indicator Set", the waste treatment methods can be divided into uses of waste for material recovery (regeneration, recycling and others), uses of waste for energy recovery (use of waste similarly as fuel or in another way to generate energy), disposal of waste by landfilling (deposition on landfills and others), and waste incineration (incineration on land).

Since 2009, a positive trend of a step-by-step increase of the proportion of **recovered wastes** at the expense of that of disposed wastes can be observed. The reasons include, in particular, changes of waste treatment technologies, the need to substitute primary materials (which waste can be a good source of), and financial support of waste use facilities provided under the Operational Programme Environment. Due to the waste treatment hierarchy, laid down in legislation, increasing the share of recovered waste is a necessity and must be emphasized.

Similarly, there has also been a positive trend in the **use of waste for material recovery**; between 2009 and 2016, the proportion of waste used for this purpose rose from 72.5% to 81.6%. Between 2015 and 2016, however, the quantity of waste used for material recovery decreased by 3,112.1 thous. t to a total of 27,958.1 thous. t (Chart 1). Insofar as the structure of the use of waste for material recovery is concerned, no significant changes have been observed. The most frequent methods of material recovery of waste still include the use of waste on the surface of the terrain with the exception of using waste on a landfill (particularly construction and demolition wastes are used this way) and recycling of other inorganic materials and metals (Chart 2).

Only a small proportion of the total waste generation is used for energy recovery. In the long run, the use of waste for **energy recovery** has been more or less stagnating. Between 2009 and 2016, the share of the energy recovery of waste in total waste generation increased from 2.2% to 3.5% and between 2015 and 2016 the amount of energy recovered waste slightly increased by 55.2 thous. t to a total of 1,208.9 thous. t in 2016 (Chart 1).

The **proportion of waste that is disposed of** in the total generation of waste has been steadily declining. The reasons include a higher level of recycling, uses of waste instead of primary materials, and, last but not least, also the introduction and implementation of modern waste treatment technologies.

The most frequent method of waste disposal is depositing waste onto or into land, i.e. **landfilling**. This fact represents a persistent major problem for the Czech Republic. However, the situation changed for the better since 2009, with the proportion of landfilled waste in the total generation of waste dropped from 14.6% to 9.5% in 2016. The 2015–2016 year-on-year comparison indicates a slight increase in the amount of landfilled waste by 29.6 thous. t to 3,236.9 thous. t (Chart 1). The long-term aim is a further reduction of the share of landfilling in the total waste generation in favour of the material as well as energy recovery of waste. It is important to use the proper tools for this gradual change that can significantly help the transition to the circular economy.

Another method of waste disposal is **incineration**. In the long run, it has been stagnating. Only some 0.2% of the total waste generated is incinerated every year, which is a negligible proportion compared to landfilling (Chart 1).

Proper waste treatment and compliance with rules of operation applying to waste treatment facilities are regularly **checked** by the Czech Environmental Inspectorate. In 2016, inspectors of waste management department in the field of waste management, packages and chemical substances carried out 3,261 inspections, of which 1,245 were planned and 2,016 unplanned, of which 631 inspections were based on an obtained proposal or submission delivered. The amount of the fines imposed on the basis of these checks in 2016 was CZK 59,364 thous., i.e. CZK 410 thous. less compared to the previous year.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

42 | Packaging waste generation and recycling

Key question

Is the amount of generated packaging waste decreasing and is the proportion of packaging waste recovery increasing?

Key messages

In the period 2009–2016, the generation of packaging waste rose by 28.6%. At the same time, however, the rate of recycled waste from packaging is growing. The most frequent uses of packaging waste include recycling and energy recovery. Annual legislative objectives of recycling and overall recovery of packaging waste were fulfilled.

Overall assessment of the trend

Change since 1990 N/A

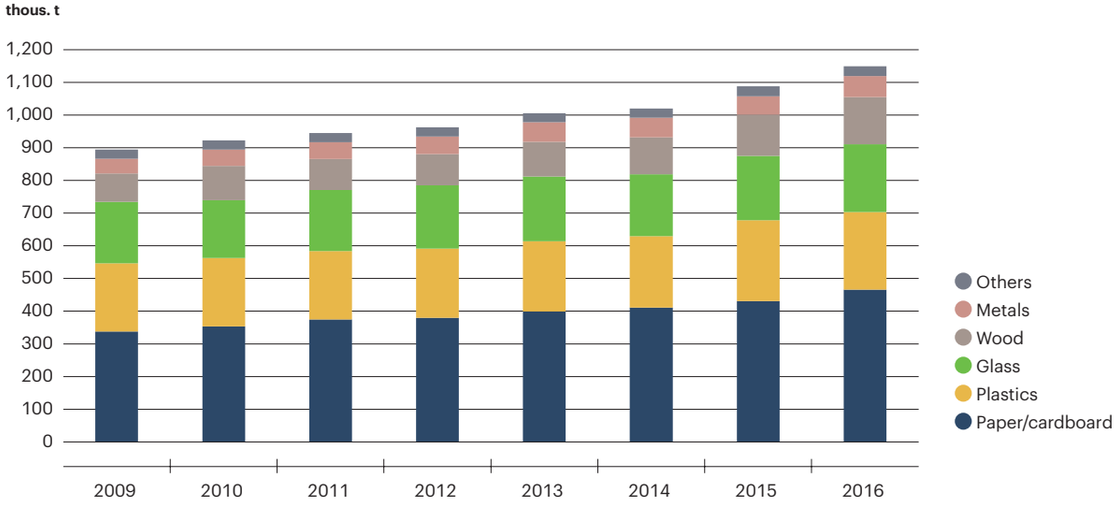
Change since 2009[4]

Last year-on-year change

Indicator assessment

Chart 1

Generated packaging waste and material structure of packaging waste in the Czech Republic [thous. t], 2009–2016

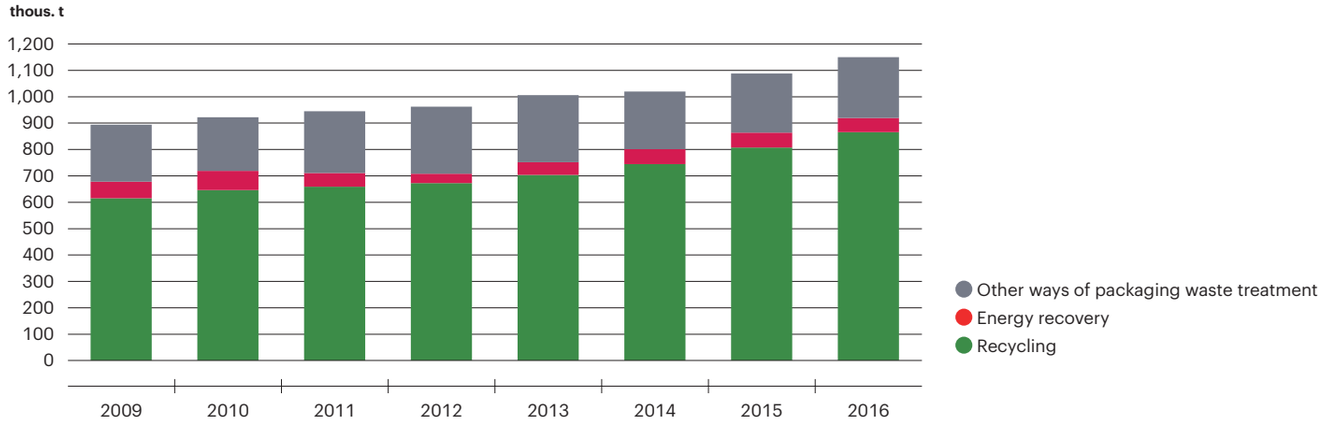


Source: Ministry of the Environment

[4] *Overall assessment of the trend postponed because of changes of the calculation methodology.*

Chart 2

Recovery of packaging waste in the Czech Republic [thous. t], 2009–2016



Source: Ministry of the Environment

Table 1

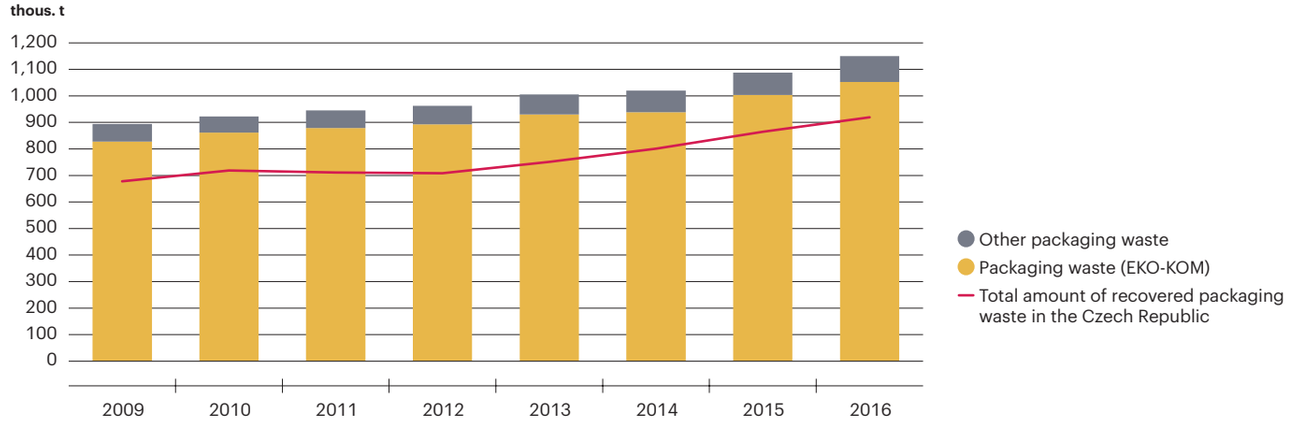
Number of entities that are obligated to utilise packaging waste or to provide take-back and that participate in the EKO-KOM system, and the number of municipalities that participate in the EKO-KOM system, 2009–2016

Year	Number of clients participating in the EKO-KOM system	Number of municipalities participating in the EKO-KOM system
2009	20,573	5,861
2010	20,591	5,904
2011	20,482	5,993
2012	20,241	6,025
2013	20,233	6,057
2014	20,277	6,073
2015	20,382	6,085
2016	20,586	6,114

Source: EKO-KOM, a.s.

Chart 3

Generated packaging waste (within the EKO-KOM system and other) and its recovery in the Czech Republic [thous. t], 2009–2016



Source: Ministry of the Environment

A growing **generation of packaging waste** is one of the most characteristic phenomena of the consumer society. This phenomenon has been present in the Czech Republic for quite some time. Between 2009 and 2016, the generation of packaging waste rose by 28.6%. In 2016, the generation of packaging waste in the Czech Republic amounted to 1,149.8 thous. t, a 5.7% increase compared to 2015. The year-on-year growth rate of the generation of packaging waste has been increasing since 2009 (Chart 1).

As to the **material structure of packaging waste**, the most frequently occurring component are paper or cardboard packagings (40.5% in 2016), a long way ahead of plastics (20.6%) and glass (18.0%). That structure is relatively stable in the course of years. The year-on-year fluctuations of percentages of the different types of packaging waste not exceeding 4% (Chart 1).

The **total amount of recovered packaging waste** in the Czech Republic in 2016 was 919.1 thous. t, i.e. 79.9% of the total generation of packaging waste. The legislative objective (65%) for 2014 was thus met. Since 2009, the amount increased by 240.9 thous. t, i.e. 35.5%, and the year-on-year increase between 2015 and 2016 was 54.7 thous. t, i.e. 6.3% (Chart 3).

In the light of the steadily growing generation of packaging waste, the increasing **proportion of recycled packaging waste** can be viewed as a very positive phenomenon (Chart 2). Recycling is the most frequent use of packaging waste. Since 2009 there has been an increase in the amount of recycled waste from packaging by 250.4 thous. t and in the year-on-year comparison of 2015–2016 by 58.2 thous. t to the total 866.0 thous. t. The proportion of recycled packaging waste in the total generation of packaging showed an increase between 2009 and 2016 as well as year-on-year (by 75.3%), and so it significantly exceeds the legislative target for the year (60%). Raising the targets for the recycling of packaging waste is one of the principles of the circular economy.

The second most frequent category is **energy recovery**; however, the proportion of packaging waste used for this purpose dropped from 7.0% in 2009 to 4.6% in 2016 of the total generation of packaging waste. The last year-on-year comparison between 2015 and 2016 showed a decrease of 3.6 thous. t to 53.1 thous. t.

Issues related to packaging waste are dealt with in Act No. 477/2001 Coll., on packaging, according to which all entities introducing packagings or packaged products in the market are obliged to take back and use packaging waste. The relevant entities can meet the above obligation either on their own, or collectively, through EKO-KOM, a.s., the authorised packaging company. There were no significant changes in the number of clients meeting their obligation through the **authorised packaging company** between 2009 and 2016 (Table 1); nevertheless, when looking at each year, it is possible to see some dynamism in the number of clients joining or leaving the collective system. The EKO-KOM system had the highest number of clients in 2010; since then, the number was gradually dropping until 2014, when the trend was reversed. The fluctuations of the number of client are caused by winding up or mergers of companies. In 2016, the number of clients involved in the system of the authorised packaging company EKO-KOM therefore reached 20,586. The number of municipalities making use of the system was gradually growing; by 2016, their number was 6,114 (out of the total number of 6,258 municipalities in the Czech Republic), with 10.515 mil. inhabitants (i.e. roughly 99% of the Czech population). The number of new entrants in 2016 was 29. In 2016, the proportion of packaging waste registered in the EKO-KOM system accounted 91.5% of the total generation of packaging waste (Chart 3).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

43 | Generation and recycling of waste from selected products

Key question

Is the amount of generated waste from selected products decreasing and is the proportion of its recovery increasing?

Key messages

Although the generation of waste from selected products increased since 2009 and the generation also increased year-on-year (2015 and 2016), the take-back of selected products also increased since 2009 in most cases, even in the last year-on-year comparison (2015–2016). During the monitored period, it was the take-back of portable batteries and accumulators that showed the greatest progress. The most frequent uses of waste from selected products include material and energy recovery. The percentage of waste from selected products used for material recovery is increasing.

Overall assessment of the trend

Change since 1990 N/A

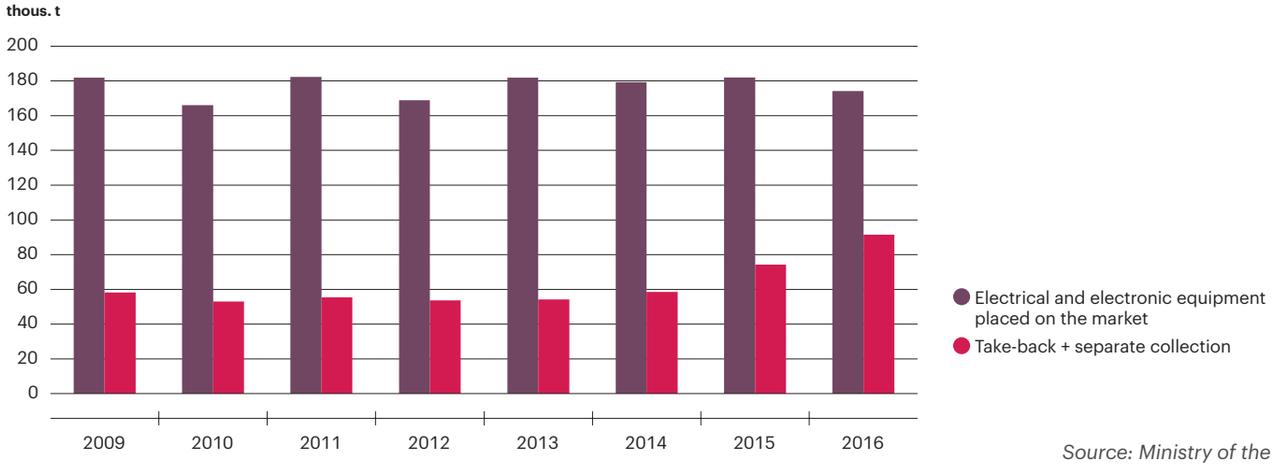
Change since 2009[5]

Last year-on-year change

Indicator assessment

Chart 1

Quantity of electrical and electronic equipment placed on the market and the take-back rate of electrical and electronic equipment and separate collection of waste electrical and electronic equipment achieved in the Czech Republic [thous. t], 2009–2016

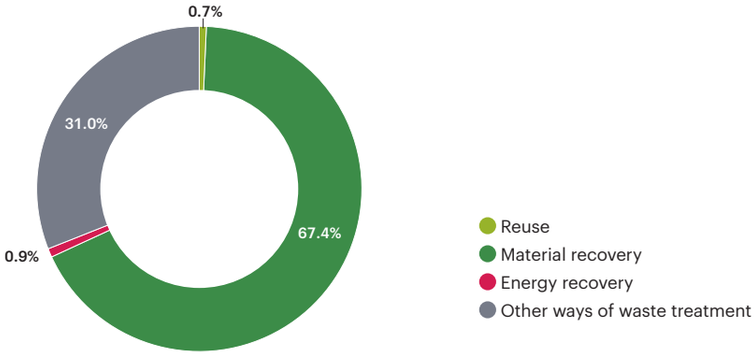


Source: Ministry of the Environment

[5] *Overall assessment of the trend postponed because of changes of the calculation methodology.*

Chart 2

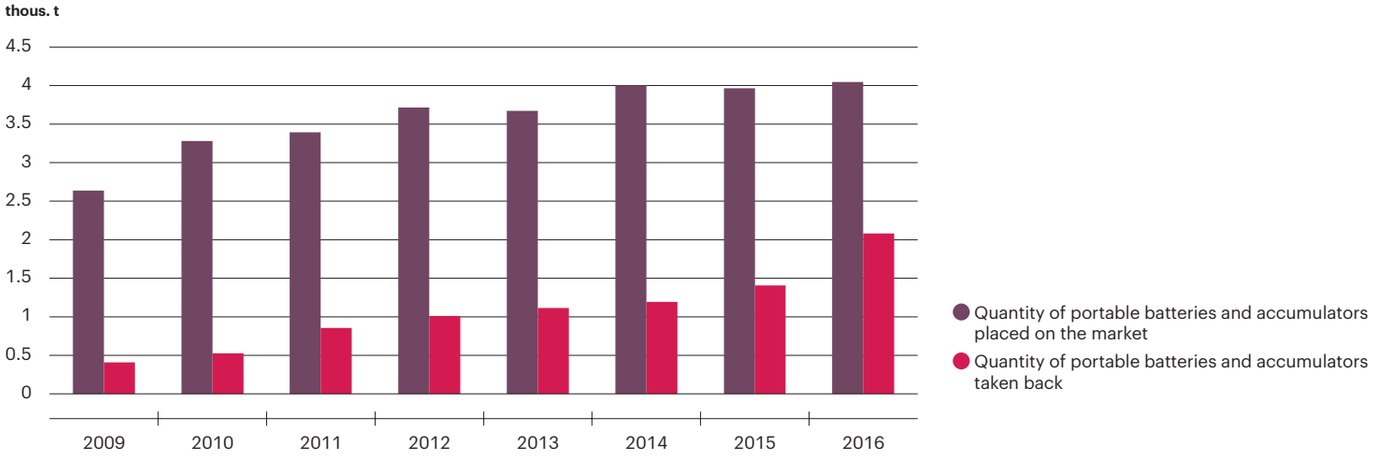
Treatment of electrical and electronic equipment and of waste electrical and electronic equipment in the Czech Republic [%], 2016



Source: Ministry of the Environment

Chart 3

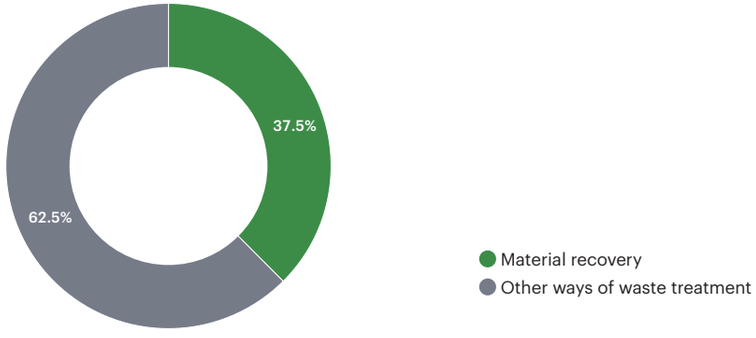
Quantity of portable batteries and accumulators placed on the market and quantity of portable batteries and accumulators taken back in the Czech Republic [thous. t], 2009–2016



Source: Ministry of the Environment

Chart 4

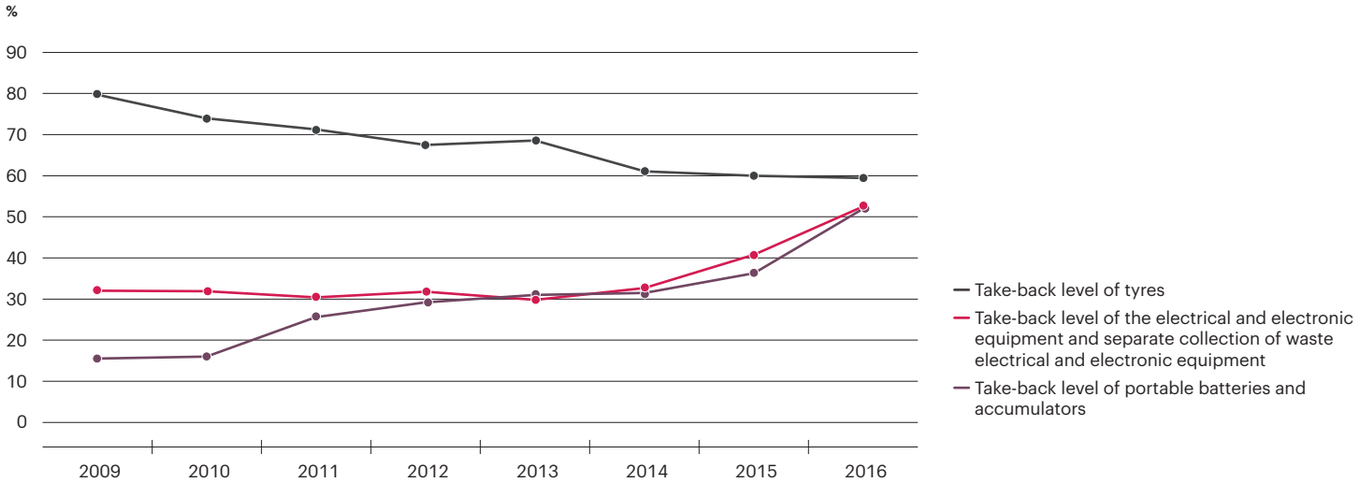
Treatment of portable batteries and accumulators taken back in the Czech Republic [%], 2016



Source: Ministry of the Environment

Chart 5

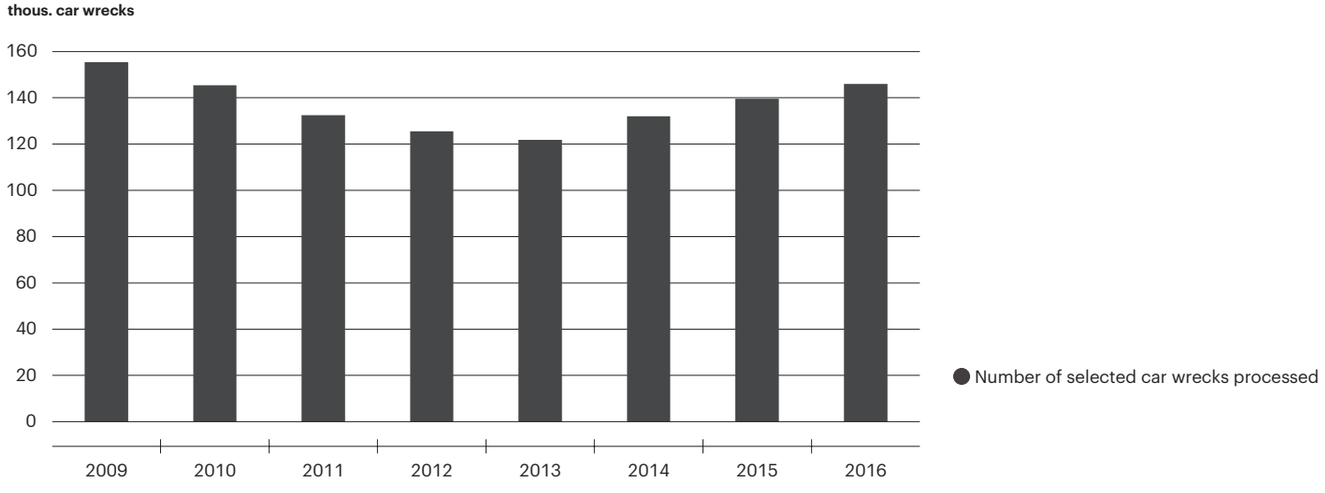
Development of the take-back level of selected products in the Czech Republic [%], 2009–2016



Source: Ministry of the Environment

Chart 6

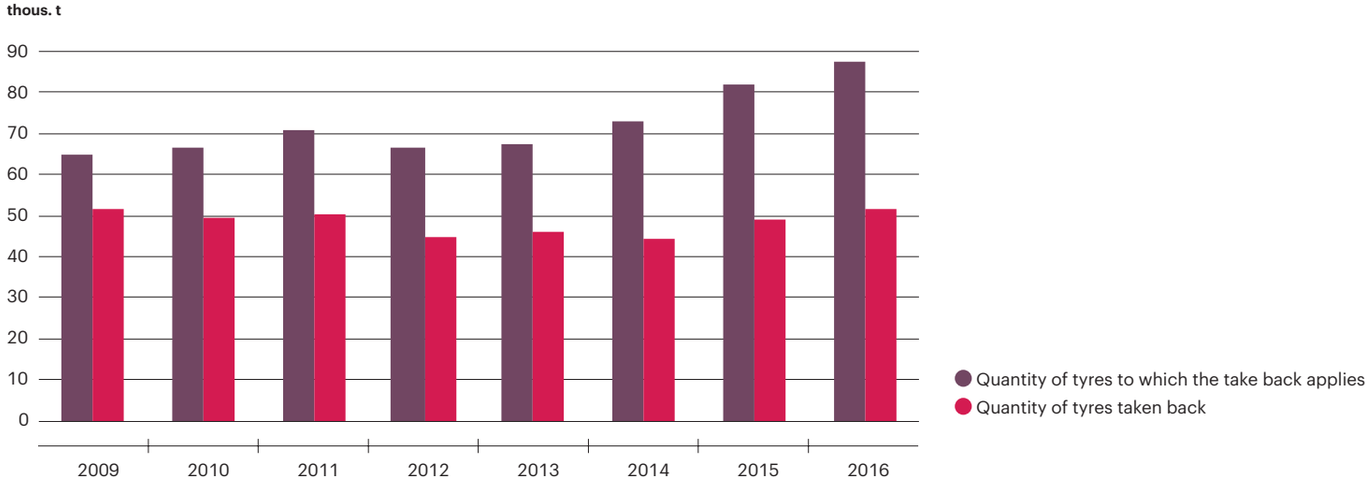
Number of selected car wrecks processed in the Czech Republic according to the MA ISOH system [thous. car wrecks], 2009–2016



Source: Ministry of the Environment

Chart 7

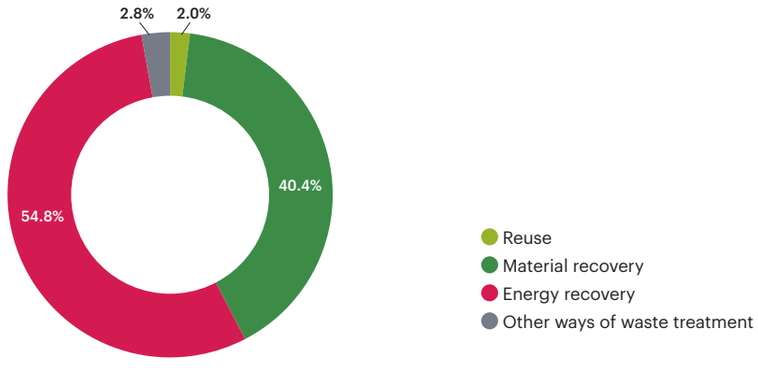
Quantity of tyres placed on the market and quantity of tyres taken back in the Czech Republic [thous. t], 2009–2016



Source: Ministry of the Environment

Chart 8

Treatment of tyres in the Czech Republic [%], 2016



Source: Ministry of the Environment

Between 2009 and 2016, the **quantity of electrical and electronic equipment**[6] **placed on the market** decreased by 4.2%, and a similar decrease, i.e. 4.3%, was also registered between 2015 and 2016, bringing the total to 174.1 thous. t (Chart 1).

The take-back applies to selected used household electrical and electronic equipment and appliances, which are handed back at take-back points, to firms processing electrical and electronic waste, or at end sellers of such equipment and appliances. As to non-household electrical waste but coming from electrical and electronic equipment intended exclusively for professional applications, its separate collection is arranged by the manufacturer. Since 2009, the take-back and separate collection has a rather stagnating trend until 2015, when there was a more distinct increase against 2014 and the rise continued in 2016 by 23.2% to the value of 91.5 thous. t (Chart 1). Between 2009 and 2016, the total increase was 57.2%. In most cases, manufacturers fulfil these obligations through collective systems.

The take-back level of electrical and electronic equipment and a separate collection of waste electrical and electronic equipment since 2009 grew from 32.0% to 52.5% and in the year-on-year comparison of 2015–2016 increased from 40.8% to

[6] *http://www.mzp.cz/cz/odpadni_elektronicka_zarizeni_nakladani_cr*

52.5% (Chart 5). The target according to Directive 2012/19/EU for the year 2016 was met and exceeded. The current rate of growth of the collection should be quite sufficient for achieving the target for 2021.

In 2016, the most frequent **utilisation of electrical and electronic equipment and waste electrical and electronic equipment** was material recovery, which accounted for a 67.4% of all methods of treatment. The use of the waste for energy recovery was 0.9% and reuse accounted for 0.7% (Chart 2). Between the years 2015–2016, the proportion of material recovery declined slightly from 69.6% to 67.4%, however, the amount of materially recovered electrical and electronic equipment and waste electrical and electronic equipment grew by 13.7 thous. t to a total of 64.5 thous. t. Energy recovery decreased between 2015 and 2016 from 1.3% to 0.9% and the share of reuse fell from 1.1% to 0.7%.

When assessing data on **batteries and accumulators**[7], it is necessary to distinguish between their different groups, which include automotive, industrial and portable batteries and accumulators. The greatest attention is paid to portable batteries and accumulators, as they pose the highest risk that they would be, due to their small dimensions, disposed of as a component of mixed municipal waste.

Between 2009 and 2016, the generation of portable batteries and accumulators was found to grow by 53.4%. Between 2015 and 2016, the generation of portable batteries and accumulators slightly increased by 2.1% to a total amount of 4.0 thous. t (Chart 3).

The growing generation was also reflected in an increased volume of portable batteries and accumulators taken back; between 2009 and 2014, there was a significant increase of 408.4% to 2.1 thous. t. The increase between 2015 and 2016 was 48.0% (Chart 3).

Between 2009 and 2016, the **take-back level** of portable batteries and accumulators increased from 15.5% to 52.0%. Year-on-year 2015–2016, it increased from 36.3% to 52.0%. The reasons why the take-back level was growing included better awareness of take-back obligations and an expanded network of collection points. The number of manufacturers which properly meet their obligations, in particular through collective systems, is also increasing. One of the essential requirements applying to portable batteries and accumulators is achieving a minimum take-back level. The target for the year 2012 (25%) was met with the value of 29.2% and the 45% collection rate required in 2016 was also easily achieved with the value of 52.0% (Chart 5).

As to **methods employed to treat of** portable batteries and accumulators taken back in 2016, the dominant position belonged to material recovery, with a 37.5% share, as they are not used for energy recovery (Chart 4). Between the years 2010–2016, the proportion of material recovery dropped from 46.7% to 37.5%. In the year-on-year comparison of 2015–2016, the quantity of portable batteries and accumulators used for material recovery (0.9 thous. t) almost did not change.

According to the directive, recycling processes must achieve a prescribed recycling efficiency. In 2016, the recycling efficiencies of lead-acid batteries, nickel-cadmium batteries and accumulators and other waste batteries and accumulators were 80.4%, 94.6% and 58.5%, respectively. The target figures were thus achieved in all the groups.

The assessment of data on car wrecks is based on the **Car Wrecks**[8] Module of the Waste Management Information System (in Czech acronymized as MA ISOH) into which car wrecks processing entities and companies enter data directly. Based on the data of MA ISOH it can be stated that in the year 2016, compared to 2009, 6.1% less car wrecks were processed, by contrast, between the years 2015 and 2016 there was a 4.6% increase for a total of 146.0 thous. processed car wrecks (Chart 6). In the area of implementation of the objectives of recycling, reuse and recovery in the long term the Czech Republic fulfils objectives of reuse and recovery at 95.7% and reuse and material recovery at 90.2%.

The quantities of **tyres**[9] placed on the market and taken back were, to some extent, underrated in the reporting system. For this reason, there were considerable differences between the generation of waste tyres and the quantity of tyres taken back. In 2014, the number of entities subject to the reporting duty, and hence the amount of collected data, increased as a result of a legal obligation of entry into the register of entities subject to the reporting duty.

[7] *http://www.mzp.cz/cz/ukazatele_odpadoveho_hospodarstvi_baterie_akumulatory*

[8] *http://www.mzp.cz/cz/modul_vraky_isoh*

[9] *http://www.mzp.cz/cz/vybrane_ukazatele_odpadoveho_hospodarstvi*

Since 2009, the quantity of tyres which the take-back applies rose by 34.3%. As to the 2015–2016 period, the quantity increased by 6.3% to 87.4 thous. t (Chart 7).

As to the quantity of tyres taken back, a slight increase of 0.1% was registered between 2009 and 2016; 2016 saw a year-on-year increase by 5.4% to 51.9 thous. t (Chart 7).

The take-back level of tyres since 2009 decreased from 79.7% to 59.4% and in the year-on-year comparison of 2015–2016 there was a slight decline from 60.0% to 59.4%. The legislative objective (35%) for 2016 was thus met (Chart 5).

For tyres, unlike for the other mentioned product groups, the predominant way of treatment is their energy recovery (54.8%). For material recovery are used 40.4% of tyres (Chart 8). The reuse is minimal (1.0 thous. t), which indicates that retreading of tyres takes place outside the waste treatment system. Between 2009 and 2016, the share of waste tyres used for energy recovery dropped from 71.8% to 54.8%. In the year-on-year comparison, in 2016, the amount of tyres used for energy recovery grew by 3.5 thous. t to a total of 28.8 thous. t. The material recovery of tyres in the years 2009–2016 increased from 14.5% to 40.4% and in 2016 the amount of tyres used for material recovery increased by 5.0 thous. t to a total of 21.2 thous. t. There was a gradual shift away from energy recovery toward the material recovery, which can be seen, with regard to the hierarchy of waste treatment, as a positive trend. The reuse of tyres between 2009 and 2016 was reduced from 3.4% to 2.0% and in the year-on-year comparison of 2016 a decrease was recorded in the quantity of reused tyres by 0.2 thous. t.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

11 Financing

Financing

Financing of the environment is an essential prerequisite for the improvement of the status of the individual components of the environment, and is also an expression of the public need of environmental protection at both central and regional level. This need is not only possible to quantify by the volume of financing spent from own resources of economic entities, but also by the amount of public funding from local, central and international sources.

Without a reasonable amount of expenditure dedicated to the protection of the environment, it is not possible to achieve the objectives laid down in the environmental protection policy or the sustainable development objectives. Their absolute amount and share in the GDP demonstrates the difficulty of maintaining and achieving the desired environmental state levels, but also the social consensual understanding of the need of a quality environment.

The theme of financing is divided into two chapters, the first of which focuses on investment activity of both corporate and the government sector, i.e. on investment and the related current (non-capital) costs of environmental protection. Their aim is, in particular, the reduction or elimination of environmental pollution produced by the company or a public body. An essential precondition of the success of investment activities and projects is ensuring adequate financial resources. Those may be in the form of own resources or in the form of public resources which are the subject of the second section of this theme. The public sources of expenditure on environmental protection include in particular grants and subsidies granted from the national and international public sources, i.e. in particular, from the state budget, state funds, local budgets and the related funding from European or international sources.

References to current conceptual, strategic and legislative documents

Europe 2020: Strategy for smart, sustainable and inclusive growth
- supporting research, development and innovations in combination with more effective use of resources; investment into clean low-carbon technologies to secure competitiveness and job creation (green jobs)

Strategic Framework for Sustainable Development of the Czech Republic
- supporting an increase in the proportion of environmentally friendly technologies (e.g., low-waste and BAT technologies)
- supporting research, development and innovations in the area of environmentally friendly and knowledge-based technologies with a high added value and lower demands on material consumption
- ensuring investment in the priority areas of risk prevention and protection of health, lives, environment and property
- rationalising subsidy systems for providing EU and state budget resources to cover the needs of regions and municipalities, especially as regards the financing of investments in environmental protection, ensuring long-term sustainability of public finance

State Environmental Policy of the Czech Republic 2012–2020
- increasing investments in the use of clean technologies, renewable energy sources and in more economical management of non-renewable resources, in the protection and conservation of ecosystem services and biodiversity protection
- strengthening promotion of science, research and innovation from foreign sources for the effective implementation of environmentally friendly technologies and eco-innovation in industry
- including negative externalities into the polluters' costs, such as application of the "polluter pays" principle
- reinforcing financing support for monitoring and mitigating natural hazards and increasing funding for ensuring permeability of migration barriers, especially transport structures
- ensuring maximum use of financial resources, especially from EU funds

National Research, Development and Innovation Policy of the Czech Republic in 2009–2015 and the National Priorities of Oriented Research, Experimental Development and Innovations
- increasing the share of investment in support for science, research and innovation in the protection of the environment as one of the conditions for ensuring sustainable development of the Czech Republic and its competitiveness

National Reform Programme of the Czech Republic, 2015

- support for the realisation of the near-nature and technical measures and flood control measures to mitigate the risk of drought in the context of climate change impacts

Operational Programme Environment 2014–2020

- allocating financial assistance of EUR 2.7 bil. to the Operational Programme Environment 2014–2020 (contribution from the Cohesion Fund and European Regional Development Fund) into the following priority axes (PA):
  PA 1 – Improvement of Water Quality and Reduction of Flood Risks: 29.2% of the total programme allocation
  PA 2 – Improvement of air quality in human settlements: 17.2% of the total programme allocation
  PA 3 – Waste and material flows, environmental burdens and risks: 17.4% of the total programme allocation
  PA 4 – Conservation and care of nature and landscape: 13.3% of the total programme allocation
  PA 5 – Energy savings: 20.1% of the total programme allocation
  PA 6 – Technical assistance: 2.8% of the total programme allocation

44 | Investments and non-investment costs of environmental protection

Key question

What amount of funding in the form of investment expenditure and non-investment costs is spent on maintaining and improving the environment?

Key messages

The amount of non-investment costs of environmental protection has long-term rising trend, which was confirmed in 2016, when those costs increased by CZK 1.1 bil. year-on-year (i.e. by 1.9%) to CZK 57.2 bil. and continued to form a substantial part of the total expenditure on environmental protection (almost 70% in 2016).
In terms of the programming focus, as in previous years, the most of the resources was spent in the area of waste management (CZK 39.9 bil. in total), followed by the area of the waste water treatment with the total amount CZK 19.9 bil. and the protection of air quality and climate change with the amount of CZK 12.8 bil.

In 2016, the total expenditure i.e. investments and non-investment costs of environmental protection reached a total of CZK 82.6 bil. and compared with 2015 they decreased by CZK 13.6 bil., i.e. by 14.1%. The reason for the year-on-year decline was primarily a significant reduction in the volume of investments by CZK 14.6 bil. to the total of CZK 25.5 bil., in connection with the decline of resources in the form of grants and subsidies provided mainly from public budgets and from abroad. That led to an interruption of the long-term upward trend in the volume of investment funds spent on environmental protection, which reflected in a reduced proportion of total expenditure on environmental protection in the GDP by 0.4 percentage points to 1.7% of GDP.

Overall assessment of the trend – investment expenditure

Change since 1990

Change since 2000

Last year-on-year change

Overall assessment of the trend – non-investment costs

Change since 1990 N/A

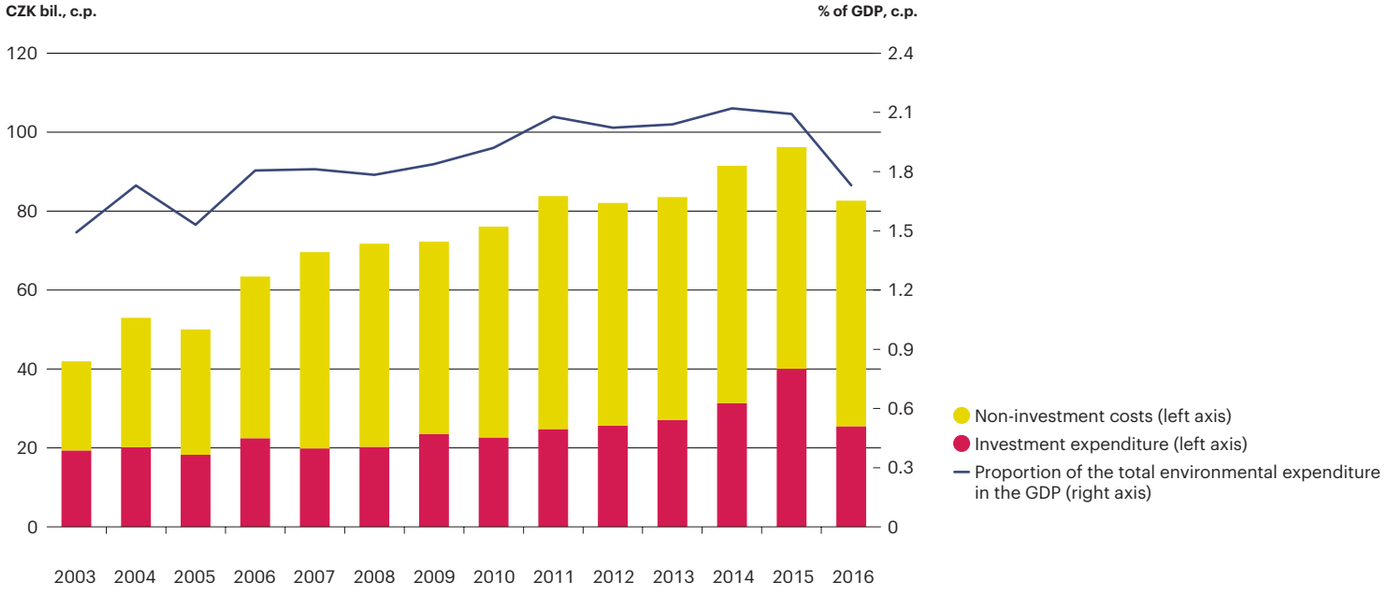
Change since 2003

Last year-on-year change

Indicator assessment

Chart 1

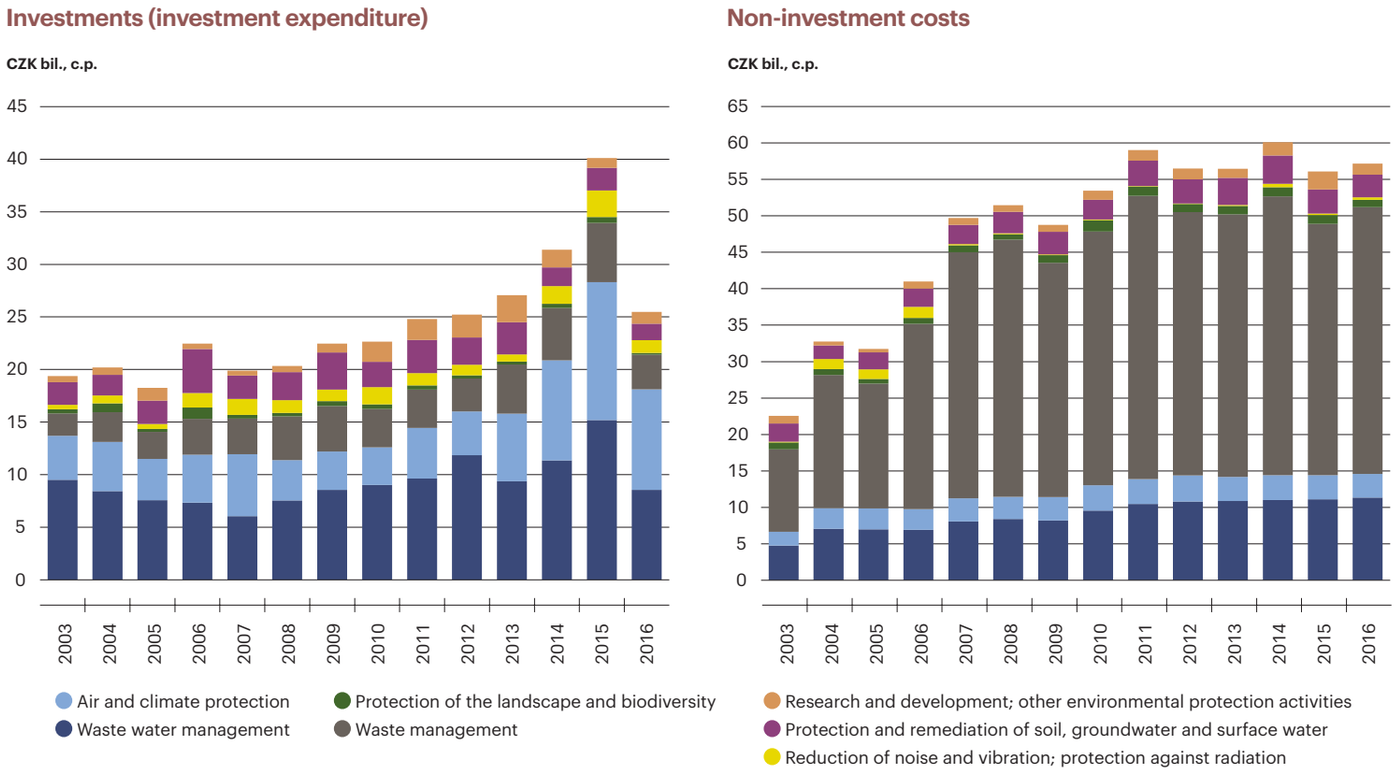
Total environmental protection expenditure in the Czech Republic [CZK bil., % of GDP, current prices], 2003–2016



Source: Czech Statistical Office

Chart 2

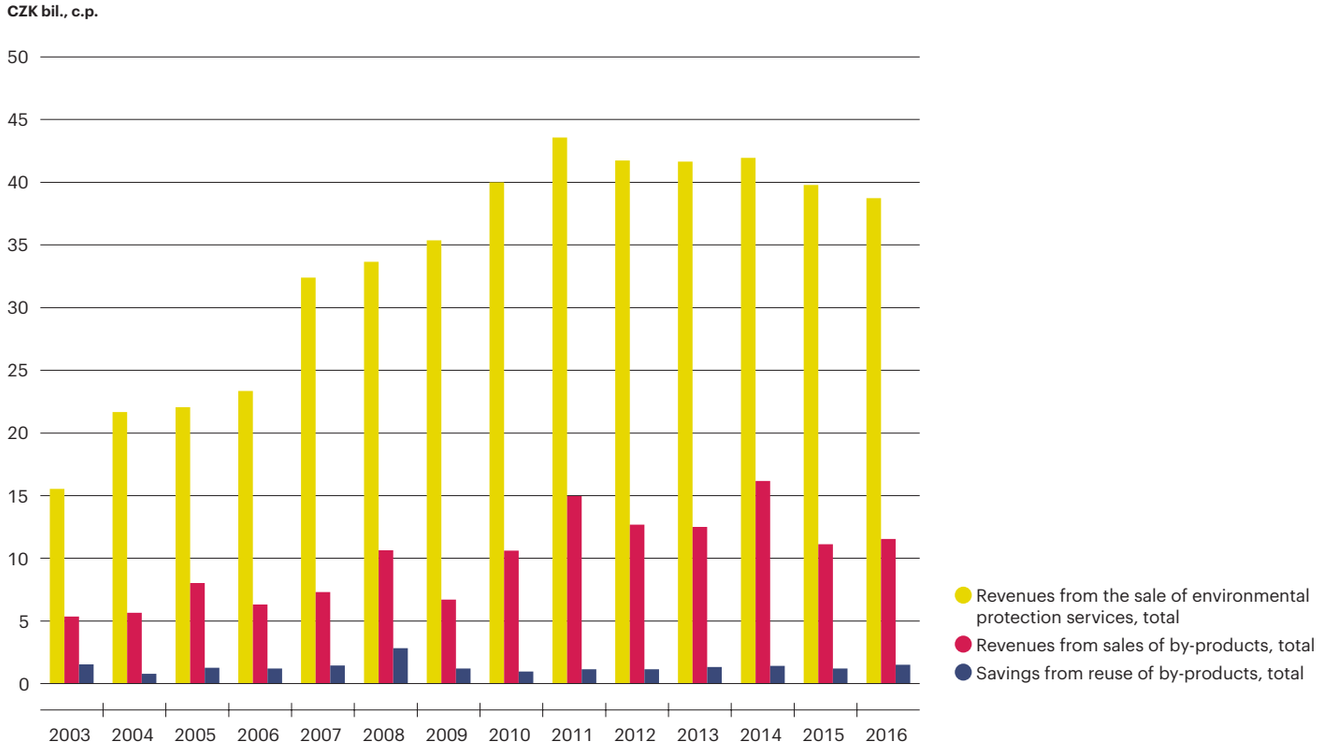
Investments and non-investment costs on environmental protection according to the programme focus in the Czech Republic [CZK bil., current prices], 2003–2016



Source: Czech Statistical Office

Chart 3

Economic benefit of environmental protection activities in the Czech Republic [CZK bil., current prices], 2003–2016



Source: Czech Statistical Office

Total environmental protection expenditure

The total statistically monitored expenditure on environmental protection represents the sum of investments in environmental protection and non-investment costs of environmental protection that are expended by the monitored entities of the Czech economy (i.e. both private companies and the public sector). Investment expenditure includes all expenditure for tangible fixed assets, i.e. expenditure that relates to environmental protection activities, the main objective of which is to reduce the negative effects resulting from the business activity. Non-investment costs are current expenditure, especially payroll costs, payments for material consumption, energy, repairs, maintenance, etc. The statistical survey of source data is carried out by the Czech Statistical Office, since 1986 in the case of investment expenditure on environmental protection, and since 2003 in the case of non-investment costs.

In 2016, the **investments and non-investment costs of environmental protection** reached a total of CZK 82.6 bil. and compared with 2015 they decreased by CZK 13.6 bil., i.e. by 14.1%. The reason for the year-on-year decline was primarily the significant cut in the volume of investments by CZK 14.6 bil. to the total of CZK 25.5 bil. That led to an interruption of the long-term upward trend in the volume of investment funds spent on environmental protection, which reflected in a reduced total proportion of investments and non-investment costs in the GDP by 0.4 percentage points to 1.7% of GDP (Chart 1).

Investments in environmental protection

In the context of **investments**, expenditure on integrated equipment (i.e. to prevent pollution) prevailed with more than 60% share over expenditure on terminal equipment (i.e. to remove pollution). Therefore, it is possible to conclude that there was a high level of investments in the long-term, where an integrated approach to environmental protection is applied based on

the principle of introducing and using BATs and other innovations. The aim of this approach is the gradual modernisation of production and operating facilities of environmental polluters, which will lead particularly to a removal of the negative impacts caused by their operations.

In 2016, after 10 years of sustained growth, the investment spending **dropped significantly year-on-year** by CZK 14.6 bil. (i.e. by 36.5%) to the total CZK 25.5 bil., which was CZK 4.1 bil. (i.e. by 19.2%) more than the volume of investment in 2000. The reason for that development is to be found especially in the structure of the funding sources of the investments for environmental protection. While the volume of funds from own resources of the monitored entities decreased by only about CZK 1.3 bil., the sum of funds in the form of grants and subsidies provided mainly from public budgets and from abroad decreased by CZK 12.8 bil. That development can be put into the context of the final closure of the programming period of the Operational Programme Environment 2007–2013, which represented the most important source of subsidies and grants for the implementation of projects and investment activities in environmental protection. In 2016, the implementation of the follow-up Operational Programme Environment 2014–2020 was launched, but it meant in particular the gradual publication of calls, projects processing and administration of project applications, while more significant drawing of grants will be felt from 2017 on. The volume of funds provided under the Operational Programme Environment 2014–2020 is also approximately half compared to the previous programming period, therefore, many projects had or will have the aid significantly reduced so that the highest possible number of projects could be supported.

In terms of the **programming focus**, in 2016, despite a significant decrease, the most investment expenditure was spent traditionally on the protection of air and climate (CZK 9.5 bil., i.e. year-on-year decrease by 27.2%), on waste water management (CZK 8.6 bil., i.e. year-on-year decrease by 43.6%) and waste management (CZK 3.3 bil., i.e. year-on-year decrease by 41.7%, Chart 2). In the protection of air and climate, funding was invested in 2016 in particular in further emission reductions, for example in connection with Directive of the European Parliament and of the Council 2010/75/EU on the industrial emissions (IED) and with the emission standards in transport, in the field of waste water management, sewerage systems and waste water treatment plants continued to be reconstructed and new ones were built. In the area of waste management, in 2016 the most investments went to the collection and gathering, and the use and disposal of municipal waste.

In terms of the **economic activities sectors of the investing entity (CZ-NACE)** it is the energy, i.e. the production and the distribution of electricity, gas, heat and conditioned air (33.8% of total investments), and public administration and defence, compulsory social security (30.4% of total investments in 2016) that contribute the most to total investments in the long term. A significant share of the total investments is reached also by the water supply, including activities related to waste water management, waste management and remediation (16.7% of total investments) and the manufacturing industry (12.1% of total investments).

Concerning the division into **corporate and government sectors**, in 2016 the private and public non-financial enterprises invested CZK 17.3 bil. (i.e. CZK 5.6 bil. less than in 2015) and the government sector (central and regional) CZK 8.2 bil. (i.e. CZK 9.0 bil. less than in 2015). As in previous years it was the corporate sector which contributed more on the investments in environmental protection, while the “polluter pays” principle applies: the main responsibility for protecting the environment has to be transferred onto private entities.

Economic benefits from environmental protection activities, which consist in revenue from the sale of environmental protection services, revenue from the sale of by-products and savings related to the re-use of by-products are closely related to environmental protection investments (Chart 3). Despite the slight year-on-year decline in total sales or savings by 2.6% to CZK 38.7 bil. in 2016, all three groups of benefits continued to be clearly dominated by the area of waste management. While this area contributed 71.7% to revenues from the sale of services and 81.6% to savings on the use of by-products, its proportion in the sale of by-products was as high as 93.5%.

Non-investment costs of environmental protection

The **amount of non-investment costs** has a long-term rising trend, which was confirmed in 2016, when those costs increased by CZK 1.1 bil. year-on-year (i.e. by 1.9%) to CZK 57.2 bil. and continued to form a substantial part of the total expenditure on environmental protection (almost 70% in 2016). Compared with 2003, when they began to be tracked, the non-investment costs have increased by CZK 34.6 bil., i.e. more than 2.5 times. The largest volume of non-investment costs was spent on consumption of materials and energy, and on wages.

Financing in terms of **programme focus**, in 2016, same as in previous years, most of the current expenditure was spent on waste management (CZK 36.6 bil., which, together with investment expenditure in that area, comprises the biggest part of total environmental protection expenditure) and on waste water treatment (CZK 11.3 bil.), Chart 2. Other priority areas include long-term protection and remediation of soil, protection of ground water and surface water and air and climate protection (in both cases more than CZK 3 bil. in 2016). As regards the year-on-year changes in the volume of non-investment costs within the main areas of environmental protection, in 2016 the greatest absolute increase was recorded in waste management (by CZK 2.1 bil.), and a decline in the other activities of environmental protection (by CZK 0.8 bil.). Relatively compared to 2015, the highest increase was in spending on the protection against radiation (by 108%) and reduction of noise and vibration (by 65.0%), while the biggest cut was in research and development in environmental protection (by 61.0%).

In terms of **economic activities sectors of the investing entity (CZ-NACE)**, in 2016, same as in the previous year, the biggest proportion in total non-investment costs on environmental protection was spent in the water supply sector and in activities related to waste water, waste and remediation (50.2% of total non-investment costs), in the manufacturing industry (21.9% of total non-investment costs) and in the sector of public administration and defence, and compulsory social security (17.4%).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

45 | Public expenditure on environmental protection

Key question

What is the structure and the volume of funding from national and international public resources to protect the environment?

Key messages

The biggest financial support was directed in 2016 to water protection, specifically, the collection and treatment of waste water. Other priority areas of public expenditure included protection of biodiversity and landscape, waste management, and air protection wherein programmes continued to be implemented in 2016 to support thermal insulation, energy savings and heating technology changes (e.g. New Green Savings Programme or boiler subsidies). Under the Operational Programme Environment for the programming period 2014–2020 with a total allocation of EUR 3.2 bil. (i.e. CZK 86.2 bil.) of total eligible expenditure, a total of 22 new calls were published in 2016 with the allocation of nearly EUR 821 mil. (i.e. CZK 22.2 bil. of total eligible expenditure). From the beginning of the programming period, 140 Decisions to Provide a Subsidy were issued at a total of EUR 177.3 mil. (i.e. CZK 4.8 bil. of total eligible expenditure), of which the grant beneficiaries have spent approximately EUR 35.9 mil. (i.e. CZK 1.0 bil. total eligible expenditure).

The volume of expenditure from central resources (i.e. particularly from the state budget and state funds), as well as from local budgets significantly decreased in 2016 year-on-year. Expenditure on environmental protection from central resources decreased by 66.7% to CZK 15.4 bil. (i.e. to 0.32% of GDP) and from the local budgets by 31.1% to the total CZK 30.9 bil. (i.e. to 0.65% of GDP). The reason for this decline is, in particular, the closure of the previous Operational Programme Environment 2007–2013 and the gradual launch of Operational Programme Environment 2014–2020, which has a smaller financial allocation and at the same time different requirements for co-financing from national sources.

Overall assessment of the trend

Change since 1990

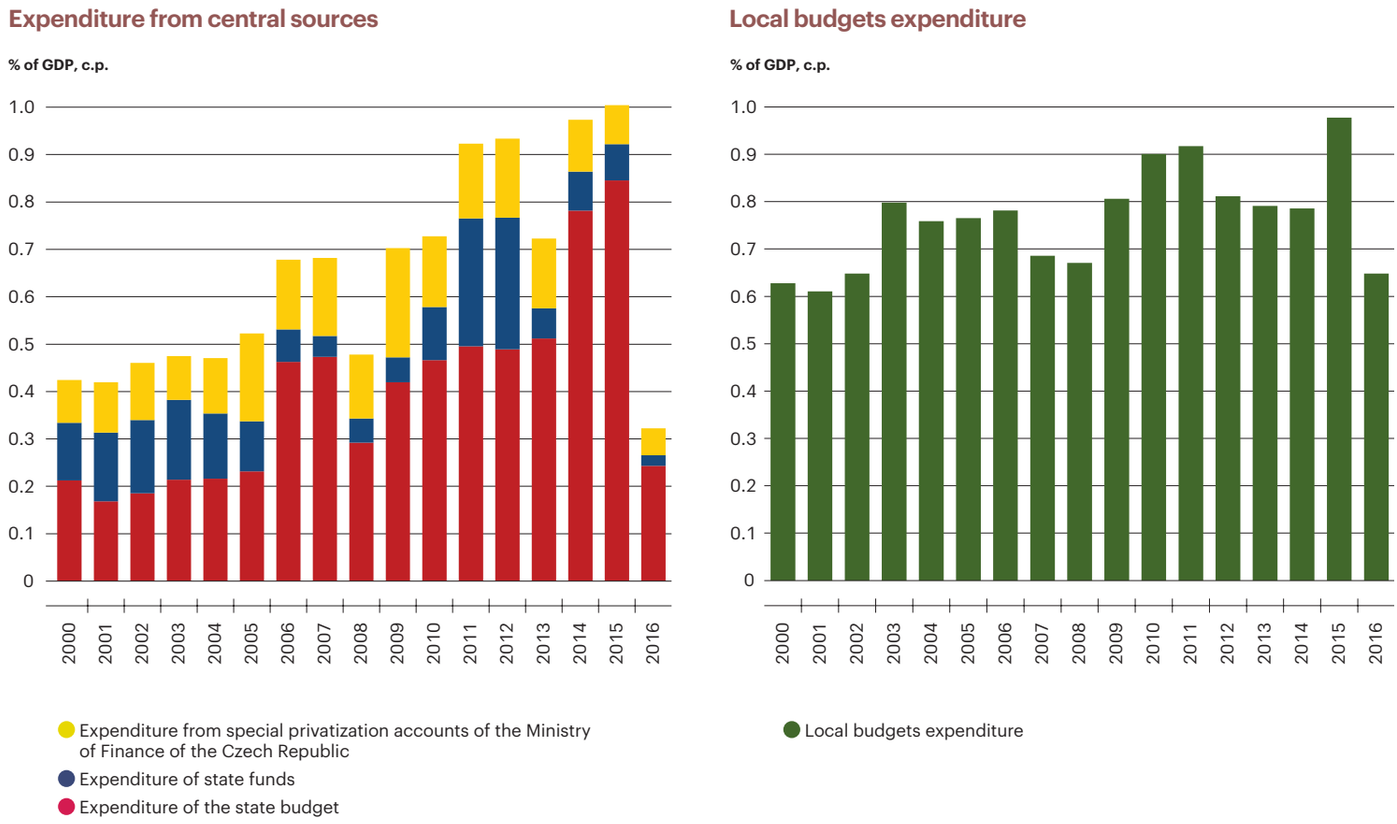
Change since 2000

Last year-on-year change

Indicator assessment

Chart 1

Share of public expenditure on the environment protection from central and local budgets in GDP in the Czech Republic [% of GDP, current prices], 2000–2016

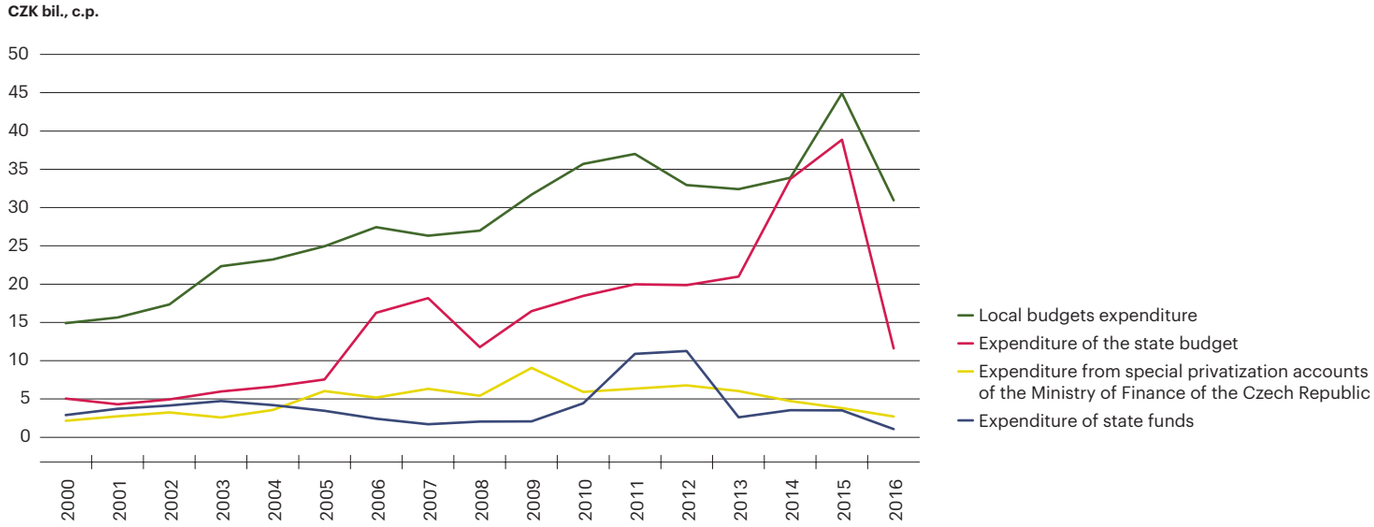


Expenditure from the special accounts of privatization of the Ministry of Finance of the Czech Republic (up to 2005 the expenditure of the National Property Fund) include resources of the former National Property Fund abolished on 1 January 2006. These expenses cover the removal of old environmental damage caused before privatization and caused by the previous activities of enterprises, or the remedying of environmental damage caused by the extraction of minerals, and the revitalization of the affected territory.
A part of public environmental expenditure of local budgets may be a duplication of expenditure from central sources.

Source: Ministry of Finance of the Czech Republic, Czech Statistical Office

Chart 2

Public environmental protection expenditure in the Czech Republic by source type [CZK bil., current prices], 2000–2016

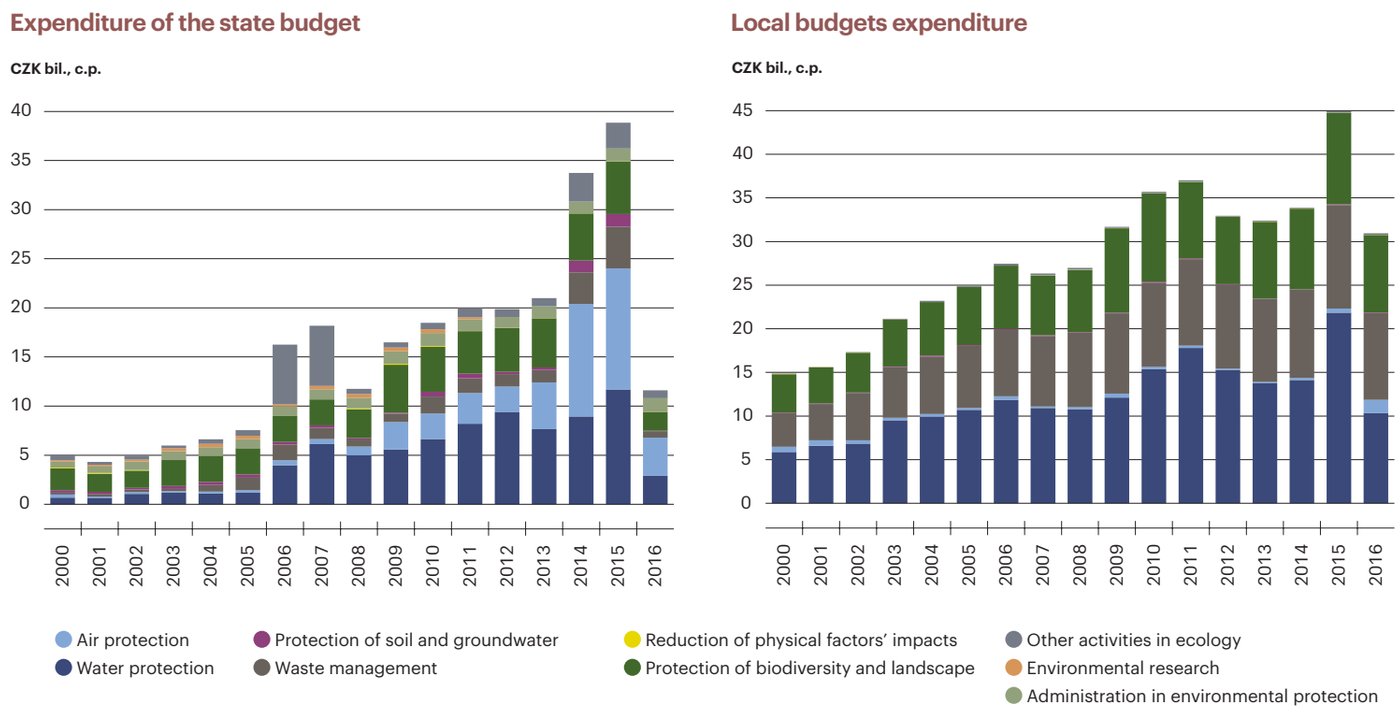


Expenditure from the special accounts of privatization of the Ministry of Finance of the Czech Republic (up to 2005 the expenditure of the National Property Fund) include resources of the former National Property Fund abolished on 1 January 2006. These expenses cover the removal of old environmental damage caused before privatization and caused by the previous activities of enterprises, or the remedying of environmental damage caused by the extraction of minerals, and the revitalization of the affected territory. A part of public environmental expenditure of local budgets may be a duplication of expenditure from central sources.

Source: Ministry of Finance of the Czech Republic

Chart 3

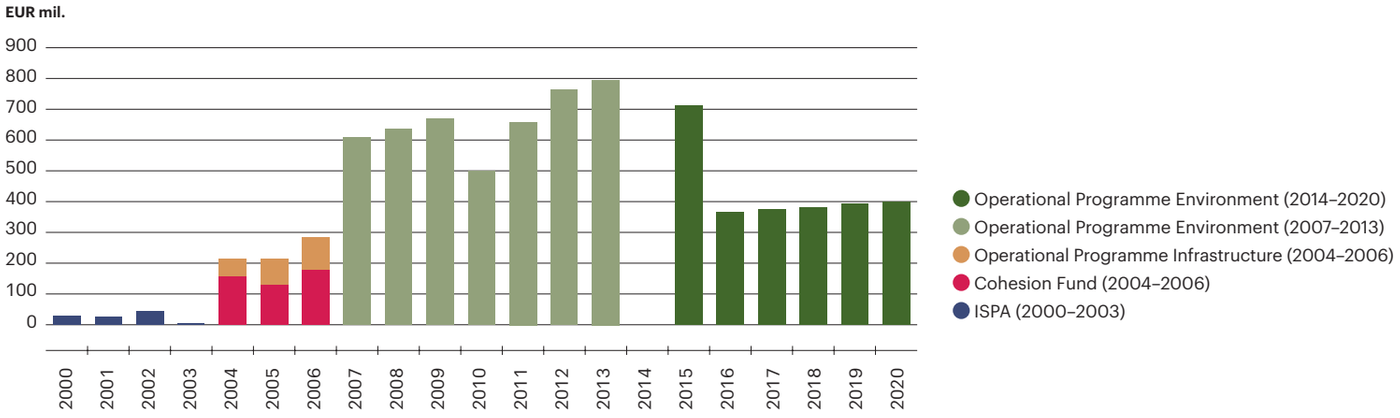
Public environmental protection expenditure from the state budget and local budgets in the Czech Republic by programme orientation [CZK bil., current prices], 2000–2016



Source: Ministry of Finance of the Czech Republic

Chart 4

Allocation of financial resources from the EU funds for projects in the field of the environment in the Czech Republic [EUR mil.], 2000–2020



The year 2014 is not indicated in the chart because in the Operational Programme Environment no allocation was determined in the 2007–2013 programming period for 2014 and for the 2014–2020 programming period the allocation 2014 was moved to 2015.

Source: Ministry of Finance of the Czech Republic

Public environmental protection expenditure comprises environmental protection expenditure both from national sources, i.e. **from central sources and local budgets, and from international sources**. Same as in other areas, also in the field of environmental protection it is monitored whether the expenditure incurred is adequate to the economic possibilities and performance of the Czech Republic, or the gross domestic product. In 2016, in comparison with the previous years, there was a sharp decrease in the volume of expenditure from central sources and local budgets, which was projected into the substantially reduced share of such expenditure in GDP (Chart 1). This development was caused, in particular, by the final closure of the programming period of the original Operational Programme Environment 2007–2013, which was successfully financially completed in 2016, and also by the gradual launch of the follow-up Operational Programme Environment 2014–2020. Resources from the operational programmes financed by the EU funds are in fact intertwined with resources from national public sources in the form of co-financing or pre-financing of the supported projects and actions to protect the environment. This consistency was a major influence on the total volume of expenditure, including their share in the GDP, which in the case of expenditure from central sources amounted to 0.32% of GDP (year-on-year decrease by 0.68 percentage points), and in the case of the expenditure of local budgets 0.65% of GDP (year-on-year decrease by 0.33 percentage points).

Public expenditure from central sources

The state budget is the most significant central source of public funding for environmental protection, especially subsidies or repayable financial aid. Other central sources of funding are the State Environmental Fund of the Czech Republic and the dissolved National Property Fund, whose remaining competencies and resources are now in the remit of the Ministry of Finance of the Czech Republic on special privatization accounts. Despite the high year-on-year slump in 2016 (by 66.7%), when evaluating the long-term development of public expenditure from central sources, it is possible to observe a growth of the volume of spent funds by 52.8% of the total amount of CZK 10.1 bil. in the year 2000 to CZK 15.4 bil. in 2016.

Expenditure from the **state budget** in 2016 fell year-on-year by 70.1% to CZK 11.6 bil. (Chart 2), primarily because of the above-mentioned closure of the original Operational Programme Environment 2007–2013 and the associated reduced co-financing by the state budget and the gradual start of the new Operational Programme Environment 2014–2020. The most supported area within the state budget, was the area of the air protection (CZK 3.9 bil.), and particularly in relation to support insulation and energy savings programmes or programmes to eliminate emissions of solid pollutants (Chart 3). This was followed by the water protection area with CZK 2.9 bil., represented primarily by expenditure on collection and treatment of waste water and on solutions for sludge, and the protection of biodiversity and landscape with CZK 1.9 bil. Within this area, in particular, the most resources were spent to support protected parts of nature (e.g. through Programme of Landscape Management or Landscape Natural Function Restoration Programme) and on erosion control and fire protection.

The largest central sources of financing for environmental protection outside the budget are state funds, for example the State Agricultural Intervention Fund of Ministry of Agriculture or State Transport Infrastructure Fund of Ministry of Transport and of course the **State Environmental Fund of the Czech Republic**. In 2016, the expenditure on environmental protection from the state funds amounted to CZK 1.1 bil. and compared to 2015 they dropped year-on-year by 69.4%. The role of the State Environmental Fund of the Czech Republic is important in the area of financing environmental protection, the importance of this Fund is currently connected with, inter alia, with the provision or administration of grants under national programmes, the Operational Programme Environment (for more on this programme see the paragraph Financing from the EU and foreign sources) or the **New Green Savings Programme**[1]. This programme, which started in 2014, falls within the area of programmes on thermal insulation and energy savings, changes of heating technologies, and measures to reduce the production of greenhouse gases. In 2016, under the calls of this programme, measures in family and apartment houses were reimbursed with about CZK 1 bil. The main source of financing of the programme is the set share of the revenues from the auctions of emission allowances EUA and EUAA under the EU ETS and the total allocation for the programme will be mainly dependent on the amount of that revenue; according to the updated estimates, the total revenues of the programme could reach CZK 19.4 bil., of which CZK 18.1 bil. should be covered by income from the proceeds of the auctions of emission allowances. The programme runs continuously, it is possible to apply for a grant at any time until the year 2021 or until the full absorption of the programme.

The State Environmental Fund of the Czech Republic also administers the collection of **fees** related to environmental protection. The purpose of the collection of fees is direct return of the fees back to environmental protection, as opposed to environmental taxes for which such return is not a necessary precondition. The fees therefore represent a source for providing support within the Fund's competence; the support is used mainly in a form of loans, subsidies and payment for a part of interests from loans and it goes primarily to the priority areas of environmental protection in the Czech Republic (i.e. air protection, water protection, biodiversity and landscape protection and waste management). The main source of State Environmental Fund of the Czech Republic income from the collection of fees or dues were in 2016 in particular the abstraction of groundwater (in total CZK 379.3 mil.), air pollution (CZK 268.3 mil.), the take of agricultural and forest land (CZK 258.6 mil.) or support for the collection, processing, recovery and disposal of selected car wrecks (CZK 230.5 mil.).

From the resources of the defunct National Property Fund, which are managed by the **Ministry of Finance of the Czech Republic on special privatisation accounts**, CZK 2.7 bil. was spent in 2016 (Chart 2). These expenses are directed towards the removal of old environmental damage caused before privatization and caused by the previous activities of enterprises, or the remedying of environmental damage caused by the extraction of minerals, and the revitalization of the affected territory.

Public expenditure from local budgets

The second main pillar of public expenditure on environmental protection is funding from **local budgets of municipalities and regions**, which are intended to finance actions that are implemented on an ongoing basis based on the competencies of the municipalities or regions. As in the case of central resources, here too in 2016, in connection with the transition to the new programming period of the Operational Programme Environment, the expenditure on environmental protection decreased, though not as dramatically. In 2016, the year-on-year decline was 31.1% to a total of CZK 30.9 bil. (Chart 2). Despite that drop, however, in comparison with the year 2000 when the spending of local budgets amounted to CZK 14.9 bil., its volume more than doubled (up by 107%).

The main priorities of the **protection of environmental components** at the level of municipalities and regions in the long term include the protection of water, namely the collection and treatment of waste water. In 2016, CZK 10.4 bil. were spent on that area (Chart 3). The second largest item of funding from local budgets was the area of waste management, in particular collection and gathering of municipal waste, including its use and disposal (a total of CZK 9.9 bil.). The third most supported areas was in 2016 protection of biodiversity and landscape, focusing in particular on the care for the appearance of municipalities and public greenery and the protection of species and habitats (a total of CZK 8.9 bil.). In 2016, the growth of expenditure in the field of air protection continued, especially in supporting changes of heating technologies, i.e. supporting measures to reduce air pollution from local incinerators using solid fuel. In 2016 the amount of CZK 1.5 bil. was spent in this area. A fundamental initiative in this area was the implementation of the Joint Programme to Promote Replacement of Boilers (the so-called boiler subsidy).

[1] *The New Green Savings Programme is administered by the State Environmental Fund of the Czech Republic, however, the financial resources come from the state budget.*

Financing from the EU and foreign sources

In addition to national funding programmes in environmental protection, managed primarily by the State Environmental Fund of the Czech Republic, public expenditure on environmental protection is strengthened since 2004 thanks to the direct support from the EU and a possibility to co-finance projects from other foreign sources as well. At present it is especially the Norwegian and the EEA Financial Mechanisms, the LIFE Program, the Swiss-Czech Cooperation Programme and the Operational Programme Environment, which is the largest source in terms of subsidies and the main source of funding for environmental protection from EU sources. The intermediate body of the **Operational Programme Environment** is State Environmental Fund of the Czech Republic which, as a specialised state financial institution, arranges, based on delegation of agreements with the Ministry of the Environment, administration and financing of projects from EU sources. Within the programming period 2014–2020, the administration of requests for support in the area of the nature protection (Priority axis 4) is performed also by the second intermediate body – Nature Conservation Agency of the Czech Republic, also based on the delegation agreement with the Ministry of the Environment.

Under the original Operational Programme Environment 2007–2013 the allocation for the financing of environmental protection for the programming period 2007–2013 accounted for a total of EUR 4.6 bil. (CZK 122.9 bil.) of EU funding (Chart 4). Throughout the programme period, the Operational Programme Environment received 29,708 project applications requesting support from EU funds in the amount of EUR 10.3 bil. (CZK 278.9 bil.), of which 67% were implemented and completed. Most of the projects were implemented in the field of energy savings and utilization of waste heat (28% of all implemented projects). From the financial point of view, the largest implemented projects focused on Area of Intervention 1.1 "Improving the status of surface water and groundwater, improving the quality of the supply of quality drinking water for the population and reducing the risk of flooding". The implemented projects have contributed to the improvement of the environment for example by reducing CO_2 emissions by 732,267 t.year^{-1}, or by reducing emissions of primary particles and secondary particulate precursors by 32,953 t.year^{-1}. Energy consumption in relation with the implementation of projects decreased by 4,623,839 GJ.year^{-1}, the production of heat from RES, by contrast, increased by 355,146 GJ.year^{-1}. More than 4.7 thous. km of sewer mains were built and reconstructed, 354 waste water treatment plants were newly built, 156 waste water treatment plants were reconstructed or intensified.

In the course of the programming period 2007–2013, about 6% of the population of the Czech Republic were newly connected to a sewer system, and about 4% of the population to a water supply system. Furthermore, waste management was improved, for example by the construction of civic amenity sites with a total area of 1,058,505 m^2, reclamation of old landfills with 1,087,215 m^2 in total area, the acquisition of a waste treatment facilities, or by removal of 9 unauthorised dumps in specially protected areas. The total capacity of the waste management facilities has risen to nearly 10.5 mil. t.year^{-1} and the capacity of the waste separation and collection has increased thanks to the support of the Operational Programme Environment to more than 1.6 mil. t.year^{-1}. Specific impacts on the individual components of the environment are set out in the Operational Programme Environment annual reports, or in the Operational Programme Environment final report, available at www.opzp2007-2013.cz, or in the State Environmental Fund of the Czech Republic annual reports on www.sfzp.cz.

On 30. 04. 2015, the European Commission approved the follow-up Operational Programme Environment for the programming period 2014–2020. At the end of 2016, after reallocation of funds from the Operational Programme Transport, the total programme allocation amounted to EUR 2.7 bil. (CZK 73.2 bil.) of EU funds, or EUR 3.2 bil. (CZK 86.2 bil.) of total eligible expenditure. In 2016, 22 new calls were published with the allocation of nearly EUR 821 mil. (CZK 22.2 bil.) of total eligible expenditure, of which 20 calls were time-limited and 2 continuous. From the start of the programming period, the applicants were thus enabled to submit grant applications for more than 60% of the programme allocation. In the calls already closed, 4,482 project applications were registered by the end of 2016 at about EUR 1.6 bil. of total eligible expenditure (CZK 44.1 bil.), the allocation of the calls was exceeded by the demand. As of 31. 12. 2016, the selection committee recommended 1,555 applications for financing at the total financial volume of EUR 0.9 bil. of total eligible expenditure (CZK 24.3 bil.) and 73 applications amounting to EUR 145.6 mil. (CZK 3.9 bil.) of total eligible expenditure were included in the reserve of projects among the so-called substitute projects. From the beginning of the programming period, 140 Decisions to Provide a Subsidy were issued, including 14 projects on boiler subsidies with grant decisions from the year 2015, at a total of EUR 177.3 mil. (CZK 4.8 bil.) of total eligible expenditure. The beneficiaries reported to the Managing Authority (Ministry of the Environment) spending of funds at about EUR 35.9 mil. (CZK 1.0 bil.) of total eligible expenditure.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

Investments in environmental protection and revenues from the environmental taxes and charges in the global context

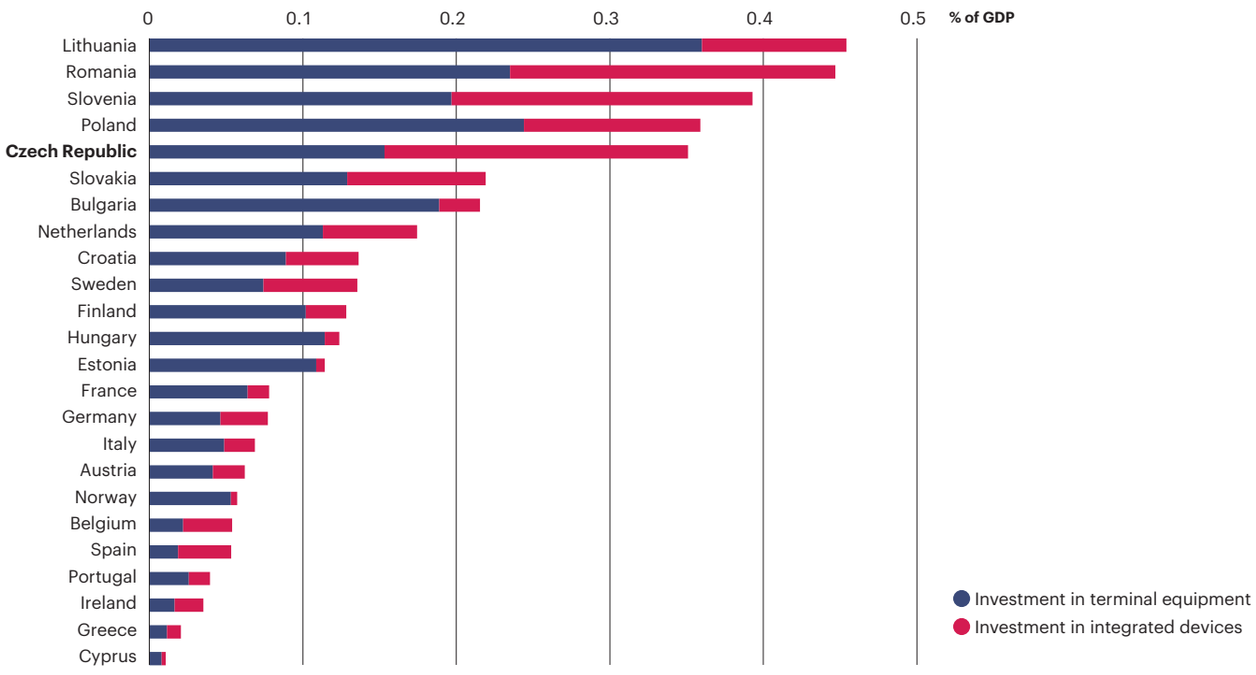
Key messages[2]

- Investments in environmental protection in the Czech Republic are, compared to the EU28 average, above-average over the long-term. This applies to both the public and industrial sectors. The reason for increased investments in the Czech Republic is first the need to fulfil the conditions and requirements of the respective European legal regulations and the need to resolve the high environmental burden related to intensive industrial production and mining in the last century.
- Total revenue from environmental taxes in 2015 in the EU28 amounted to EUR 359.3 bil., i.e. 2.4% of GDP of the EU28. From the perspective of the subject of taxation, energy products tax clearly prevailed, which were particularly significant in the Czech Republic, Lithuania, Luxembourg and Romania, where it accounted for more than 90% of total revenue from environmental taxes.

Indicator assessment

Chart 1

Investments in environmental protection in the industrial sector [% of GDP, current prices], 2014



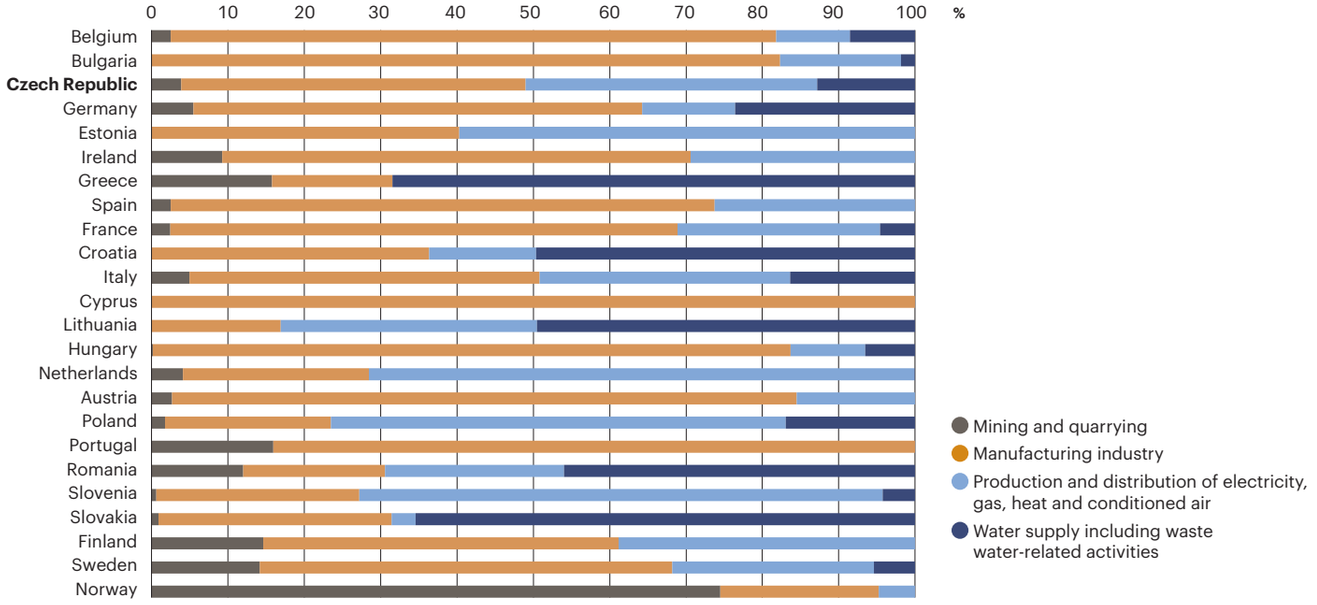
Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

[2] *Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.*

Chart 2

Industrial sector investments in environmental protection by the main industrial sectors [%], 2014

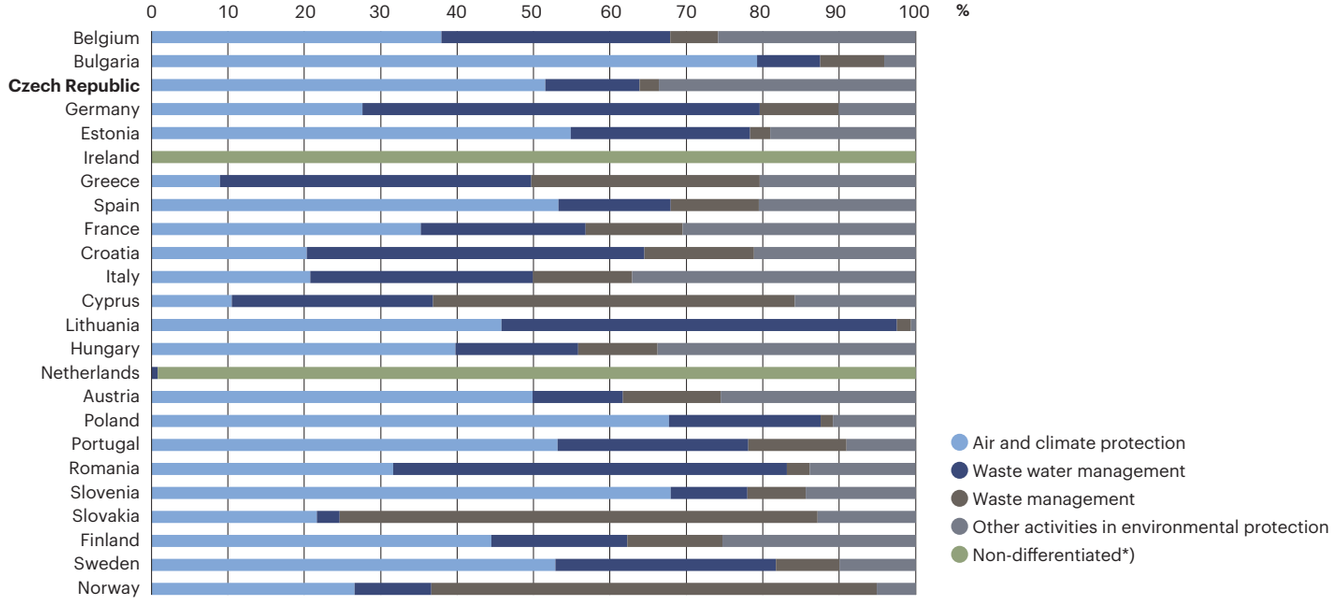


Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

Chart 3

Investments in environmental protection in the industrial sector, by the programme focus [%], 2014

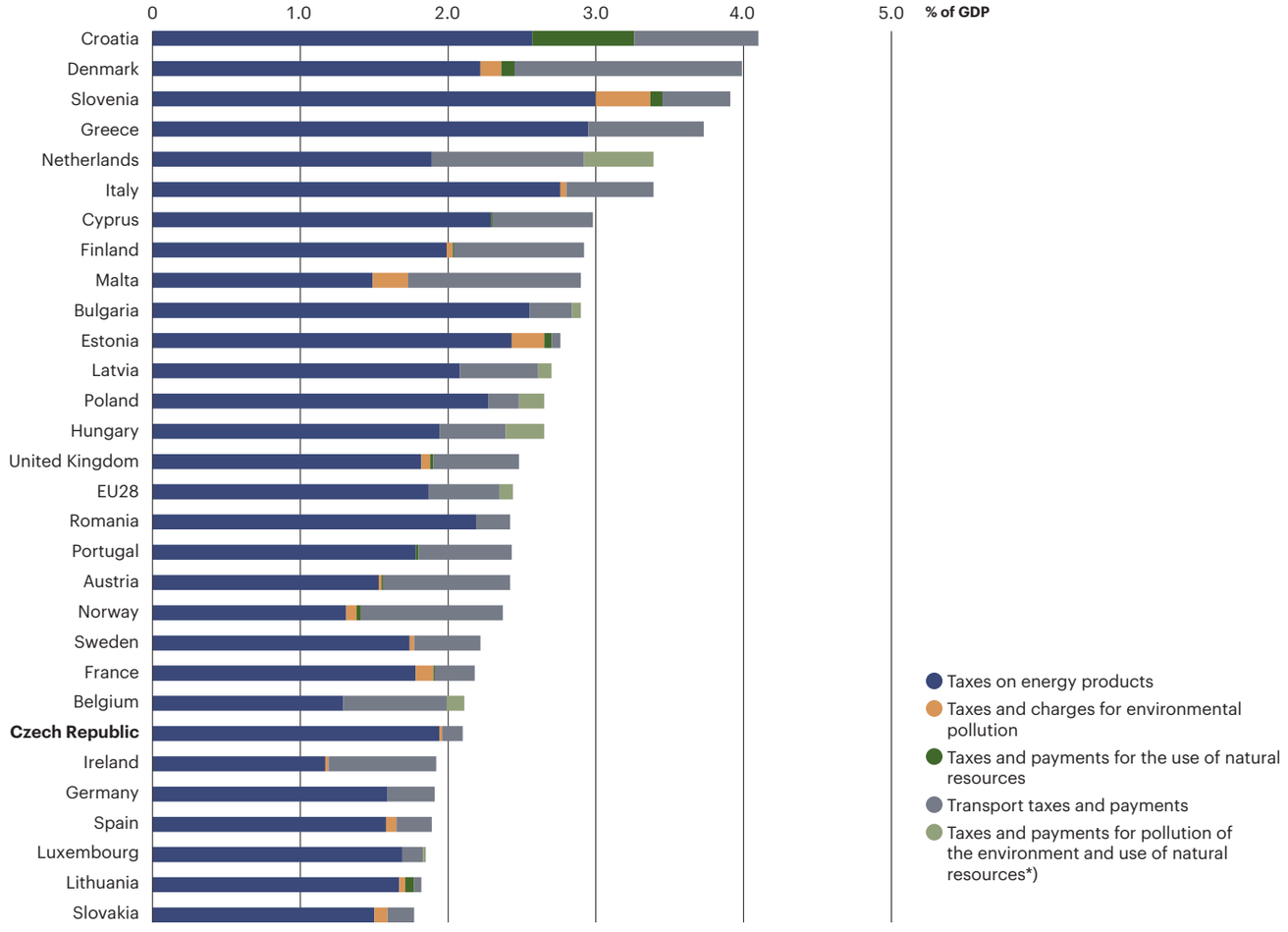


**) Stated for those countries that did not provide data separately by the programme focus.*
Data for the years 2015 and 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

Chart 4

Environmental taxes by the main groups [% of GDP, current prices], 2015



**) Stated for those countries that did not provide data separately for taxes and fees for environmental pollution and for taxes and fees for the exploitation of natural resources.*
Data for the year 2016 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

Same as in the Czech Republic, in Eurostat the total environmental protection expenditure is divided into two main groups: **investment expenditure** and **non-investment costs** (current expenses) related to the activities which are directly aimed at prevention, reduction and elimination of pollution or any other damage to the environment. From the perspective of investments that play a crucial role in the total expenditure on environmental protection, it can be concluded that the investments of the Czech Republic are strongly above average compared with the EU28, within both the public and industry sectors (Chart 1).

This is based on the fact that the Czech Republic, as well as other newly acceding member states, invests more intensively in environmental protection in order to comply with stricter requirements of the relevant EU legislation. The increased investments are related to the need for a solution to the high environmental burden caused by intensive industrial production and mining in the last century. The possible use of the EU funds or other foreign subsidy programs also enhances the investment level particularly in recent years (see the indicator "Public expenditure on environmental protection").

While **investments in the industrial sector** in some of the new Member States in 2014 exceed 0.4% of GDP in current prices (e.g. Lithuania or Romania), many of the old Member States did not reach even the level of 0.1% of GDP in current prices (Cyprus, Austria, Germany, France, etc.). Unlike the Czech Republic, where in 2014 the industrial sector mostly invested in **integrated equipment**, i.e. to prevent pollution (Chart 1), in the international comparison, the investments, on average, were more focused on the **terminal equipment**, i.e. to remove pollution.

In terms of the share of the main branches of the industrial sector in the total investments in environmental protection, in most EU28 countries including the Czech Republic, it was the biggest in the **manufacturing industry**, followed by production and distribution of electricity, gas, heat and conditioned air, i.e. the public energy (Chart 2). In terms of the programme focus, in 2014 in most EU28 countries including the Czech Republic, the largest investments were made in the **protection of air and climate**, or in the area of waste water management (Chart 3).

Total revenue from **environmental taxes** in 2015 in the EU28 amounted to EUR 359.3 bil., i.e. 2.4% of GDP of the EU28. Between 2002–2015, total revenue from environmental taxes in the EU28 increased by an average of 2.4% per year (in current prices), while the GDP in current prices increased on average by 2.7%. In 2015, the amount of revenue from environmental taxes was EUR 95.0 bil. higher than in 2002.

In the international EU28 comparison, the Czech Republic ranks rather among states with lower revenue from environmental taxes (2.1% of GDP, Chart 4). When comparing the levels of environmental taxation in European countries, it is necessary to analyse the differences in the context of the settings of the tax systems. For example, low revenue from environmental taxes may signal either relatively low rates of the environmental tax and the resulting lower revenue (as is the case for example in the Czech Republic), or on the contrary may result from high tax rates, which have an impact on behaviour change in the consumption of the related products or activities. On the other hand, a higher level of revenue from environmental taxes may be caused by a low tax rate, which encourages non-residents to purchase heavily taxed products outside the national borders (as e.g. in the case of petrol or diesel).

From the perspective of the subject of taxation, the **energy products taxes** clearly prevailed, which in addition to the tax on electricity, gas, or solid fuels include fuel tax. Those accounted for 76.7% in total revenue from environmental taxes in the EU28 in 2015. Environmental taxes were particularly significant in the Czech Republic, Lithuania, Luxembourg and Romania, where it accounted for more than 90% of total revenue from environmental taxes. **Transport taxes** (e.g. vehicle registration, toll, etc.) represented in 2015 the second most important contribution to the total income from environmental taxes (19.8% in the EU28). **Taxes on environmental pollution and use of natural resources** accounted for a relatively small proportion (3.5%) of total revenue from environmental taxes in the EU28 in 2015. This category of environmental taxes puts together various taxes or fees levied for example for pollution and extraction of water or for the landfill of waste. In many European countries, such taxes were introduced after 2010, which is reflected in the low revenue from them to date.

Strategies and policies in the environmental sector

The **Report on the Environment of the Czech Republic** assesses the condition and development of the individual components of the environment in the Czech Republic and presents thus a significant source of information identifying the current problems in environment. Results of the Report subsequently serve as the basis for the determination of the individual objectives, their prioritisation in the appropriate strategic and conceptional materials in the environmental field and for the evaluation of their fulfilment.

Figure 1

Map of the strategic documents of the Ministry of the Environment

<table>
<tr><th>Air and Climate Protection</th><th>Nature and Landscape Protection</th><th>Protection of Accumulated Water, Water Resources and Water Quality</th><th>Environmental Risks</th><th>Waste Management</th><th>Environmental Information System, Environmental Monitoring, Environmentally Friendly Products and Services, EMAS</th></tr>
<tr><td colspan="6">State Environmental Policy of the Czech Republic 2012–2020</td></tr>
<tr><td colspan="4">Strategy on Adaptation to Climate Change in the Czech Republic</td><td rowspan="2">Czech Republic's Waste Prevention Programme</td><td rowspan="2">The State Programme of Environmental Education, Awareness and Environmental Consultancy of the Czech Republic for the period 2016–2025</td></tr>
<tr><td>National Emission Reduction Programme of the Czech Republic</td><td>National Biodiversity Strategy of the Czech Republic for the period 2016–2025</td><td>National River Basis Management Plans of the Elbe, the Oder and the Danube River</td><td rowspan="2">Updated National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants 2012–2017</td></tr>
<tr><td>The National Programme to Abate Climate Change Impacts in the Czech Republic</td><td>State Nature Conservation and Landscape Protection Programme of the Czech Republic</td><td>Flood Risk Management Plans of the Elbe, the Oder, the Danube River Basin Districts</td><td>Waste Management Plan of the Czech Republic for the period 2015–2024</td><td>Updated EMAS Programme</td></tr>
<tr><td>Air Quality Improvement Programmes</td><td>Concept of the Preservation Programmes and Care Programmes</td><td>The Concept of Making the Czech River Network Passable, 2014 update</td><td>Strategy of Environmental Security 2016–2020, with an outlook to 2030</td><td></td><td>National Programme of Environmental Labelling</td></tr>
<tr><td>Medium-term Strategy (by 2020) to Improve Air Quality in the Czech Republic</td><td></td><td rowspan="2">The Concept of the Solution of the Problems of Flood Protection in the Czech Republic, using Technical and Nearnatural Measures</td><td></td><td></td><td>Concept of local Agenda 21</td></tr>
<tr><td>Climate Protection Policy of the Czech Republic</td><td></td><td></td><td></td><td>Action plans for the period 2016–2018 for the Concept of local Agenda 21</td></tr>
<tr><td colspan="6">R&D&I Concept</td></tr>
<tr><td colspan="6">National Cleaner Production Programme</td></tr>
</table>

Source: CENIA, adjusted according to the output of the project Streamlining the activities of the Technology Agency of the Czech Republic in the area of R&D&I support and support of the strengthening of the expertise of public administration organizations in the area of R&D&I; key activity 1: output of the Strategic Maps of Ministries, the Strategic Map – Ministry of the Environment

State Environmental Policy of the Czech Republic 2012–2020

State Environmental Policy of the Czech Republic 2012–2020 is the main covering document that sets out a plan for the implementation of effective protection of the environment of the Czech Republic. Its objective is to ensure a healthy and good environment for the citizens of the Czech Republic, to significantly contribute to the efficient use of all resources and to minimise the negative effects of human activities on the environment, including transboundary impacts of the state borders and thus contribute to improving the quality of life in Europe and worldwide. Despite the significant integration of individual objectives and priorities into other sectoral policies it is necessary to create consistency and link the objectives set in the other strategic materials (Figure 1) that contain additional concrete measures for achieving the objectives of the State Environmental Policy of the Czech Republic 2012–2020.

Medium-term evaluation of the State Environmental Policy of the Czech Republic 2012–2020 took place in 2015. Based on the findings from the individual thematic areas it can be stated that in order to achieve the objectives set out in the State Environmental Policy of the Czech Republic 2012–2020 it will be necessary to take great efforts in the following years. On the other hand, it is necessary to emphasise that the improvement in many supported areas in the State Environmental Policy of the Czech Republic 2012–2020 will take effect in the following years of reviews (2016), since during the medium-term the evaluation data was not available for the projects then executed. According to the evaluation of the individual thematic areas it can be summarised:

Thematic area 1: Conservation and sustainable use of resources

- The status of bodies of surface water and groundwater are improving very slowly and so far have not met the requirements of Council Directive 91/271/EEC on Urban waste water treatment.
- Waste generation in the Czech Republic has a long-term stagnant trend.
- The area taken as agricultural land has a growing trend, threats of soil erosion has not been decreased.
- Old environmental burdens and additional contaminated sites are continuously remediated, but in the long-term the funding for these activities is decreasing.

Thematic area 2: Climate protection and air quality improvements

- Mitigation and adaptation measures are implemented, and greenhouse gas emissions in the Czech Republic continue to fall. According to the existing development and forecasts, the Czech Republic will fulfil its climate commitments by 2020. The Czech Republic continues to reduce greenhouse gas emissions and other pollutants into the air.
- The fundamental problem of the environment of the Czech Republic remains to be the worsened air quality. The emission of pollutants into the air have declined overall, but even despite the long-term decline in emissions, air quality in the territory of the Czech Republic is not improving significantly. This problem is particularly true in areas with exceeded air pollution limits, especially in the Moravian-Silesian and Ústí nad Labem Regions.
- The share of renewable energy sources in final energy consumption increases and the energy demands of the economy are decreasing in the long term.

Thematic area 3: Nature and landscape protection

- The continued problem of nature and the landscape in the Czech Republic is transportation, intensive agriculture and energy, as they contribute to the fragmentation of the landscape, and reduce the ability of the landscape to balance changes caused by external factors and maintain its natural features and functions.
- It can be said that status of the species of European interest has improved, but in the case of the original endangered species there is a rather negative trend in the long term. A favourable conservation status has been reached yet in a few European major natural habitats.

Thematic area 4: Safe environment

- Long term monitoring and implementation of measures takes place to prevent the risk of anthropogenic and natural origin and to minimise the impacts of the emergency and crisis situations. The system access is ensured, inter alia, by the implementation of measures of the Strategy of Environmental Security 2016–2020, with a view to 2030, the Flood Risk Management Plans and since 2015 also through a Strategy on Adaptation to Climate Change in the Czech Republic.
- A detailed overview of the performance of the individual objectives, measures and instruments, and also the overall medium-term evaluation of the State Environmental Policy of the Czech Republic 2012–2020 is available at the website of the Ministry of the Environment.

Evaluation of the priority measures arising from the National Emission Reduction Programme of the Czech Republic

The main umbrella document that sets out a plan for the implementation of the improvement of air quality in the Czech Republic for the period up to 2020 with a view to the year 2030, is the **National Emission Reduction Programme of the Czech Republic** (NERP). Its main objective is to ensure, on the basis of an analysis of the current development of indicators of air quality and emissions, that the strategic objective together with the specific objectives and priorities are achieved. The achievement of the strategic objective should be fostered by priority, additional measures at the national level, resulting from the scenario NERP-WAM (with additional measures). In total, this means the implementation of 12 economic measures and 11 technical and organizational measures. The implementation of the priority measures is to help reduce emissions of each of the pollutants for which limit values or national emission ceilings and the national exposure reduction target are laid down. Each priority measure and its implementation within the set deadline is the responsibility of a specific coordinator.

Economic priority measures

- **AA3 – Supporting a faster renewal of the fleet of passenger vehicles**

  In 2009, Act No. 383/2008 Coll. amending the Waste Act, introduced a fee for registering a vehicle with the categories EURO 0 to EURO 2. The extension of the fee to the EURO 3 category was included the proposal of a new law "on end-of life products" which should have replaced the Waste Act. In the interministerial objections procedure on the bill, the extension of the fee was removed. The fee for older vehicles was also addressed in an analysis prepared as part of priority measure AA8.

  > Coordinator: Ministry of the Environment
  > Deadline: 01.01.2017
  > Conclusion: not achieved ☹

- **AA5 – Stimulating the use of alternative drives in road freight transport through reduced rates of road tax**

  The aim of the measure is to introduce a lower road tax for freight vehicles using CNG/LNG, electricity and hydrogen. Currently, zero road tax applies only to passenger vehicles, nevertheless, freight vehicles are already starting to appear too. National Action Plan of Clean Mobility addresses this issue in measures S14 (Modifying the schemes and rates of road tax for vehicles using CNG/LNG and electric drive over 12 t, and at the same time introducing tax reliefs for vehicles using LNG and hydrogen – responsibility of the Ministry of Finance of the Czech Republic, deadline 2017) and S28 (Analysis of charging vehicles in the Czech Republic – responsibility of the Ministry of Transport, deadline 2017). Measure S14 has not been implemented yet because the Ministry of Finance of the Czech Republic is expecting the results of the Analysis of charging vehicles in the Czech Republic, which should be drawn up by the Ministry of Transport this year.

  > Coordinator: Ministry of Finance of the Czech Republic
  > Deadline: according to the NAP Clean Mobility
  > Conclusion: The issue is addressed in the NAP Clean Mobility 😐

- **AA6 – Supporting the purchase of vehicles with alternative drive for public passenger transport**

  The call of the Integrated Regional Operational Programme (IROP), which was aimed at promoting the purchase of low-emission and emission-free vehicles for public transportation, met with enormous interest from applicants from among municipal and regional carriers providing transport service. The conditions of the call were successfully met by 35 projects of a total of 37 projects submitted. The projects approved for financing will purchase a total of 184 vehicles for public transport, of which 48 electric buses, 23 trolleybuses, 13 trams and 100 CNG buses. 6 projects are focused purely on electric vehicles (Olomouc, České Budějovice, Pardubice, Hradec Králové, Třinec), 5 projects on gas buses (Brno, Kladno, Central Bohemia) and 2 projects are combined (Hranice – Frýdek-Místek, Ostrava). In terms of the volume of the requested funds, more than 60% of the funds will be directed to the acquisition of electric road or rail vehicles.

  > Coordinator: Ministry of Regional Development
  > Deadline: continuously by 31.12.2023
  > Conclusion: implemented continuously ☺

- **AA7 – Supporting the construction of refuelling and recharging infrastructure for alternative drives in transport**

  The concept of the subsidy scheme of the Ministry of Transport under the Operational Programme Transport „Support for infrastructure for alternative fuels" was prepared in the second half of 2015. The scheme is allocated with CZK 1.2 billion. It has 4 sub-programmes which are aimed at promoting the development of both fast charging and normal charging stations and at supporting the construction of refilling stations for CNG/LNG and hydrogen. With regard to the rules of State aid, a preliminary consent of the European Commission is required to launch the programme. In the spring of last year, therefore, a request was sent to the Commission for a notification of the programme. The launch of the 1st call of the programme can be expected after the release of the notification decision by the Commission.
  > Coordinator: Ministry of Transport / Ministry of Regional Development / Ministry of Industry and Trade
  > Deadline: continuously by 31.12.2023
  > Conclusion: implemented continuously ☺

- **AA8 – Support for the purchase of environmentally friendly passenger vehicles**

  The Ministry of the Environment in cooperation with the Centre for Environmental Issues at Charles University drew up in 2017 an analysis of the feasibility of this measure. The analysis evaluated the measure to promote the purchase of environmentally friendly vehicles through a bonus and malus system. The analysis elaborated two variants of the possible proposal of the rates of the registration fee (malus). Additional reduction of exhaust emissions from the sector passenger vehicles above the level corresponding to the natural renewal of the fleet could be up to 6% for nitrogen oxides and almost 11% for dust particles. Information resulting from the analysis was noted by the government on 29 March 2017. In April 2017, Ministry of the Environment sent the analysis to the Ministry of Transport and requested that the outputs from the analysis be taken into account in its analysis of vehicle taxation in the Czech Republic. It is assumed that the analysis carried out by the Ministry of Transport will show whether the measure will or will not be implemented.
  From November 2016 to March 2017, a call was announced under the National Programme Environment to support the purchase of vehicles with alternative propulsion for municipalities, regions and their sponsored organizations. Under that call, a total amount of about CZK 37 million supported the purchase of 178 electric vehicles, 7 plug-in hybrids and 80 CNG vehicles.
  > Coordinator: Ministry of the Environment
  > Deadline: 01.07.2017
  > Conclusion: completed ☺

- **AA9 – Increasing the ceiling of the fee for a permit to enter selected places and parts of towns with motor vehicles**

  Following the approved National Emissions Reduction Programme, the Ministry of Finance of the Czech Republic included in the bill amending certain laws in the field of taxation, also an amendment to Act No. 565/1990 Coll. on local charges, which increased the rate of the fee for entrance into selected parts of towns and municipalities from the current maximum CZK 20 per day to a maximum of CZK 200 per day. A higher maximum rate of the charge for entrance permit will allow municipalities to establish resting areas, since the higher rate of the fee should ensure a reduction in the number of arrivals to selected parts of the municipalities. The amendment was approved by the Chamber of Deputies on 13 January 2017. It was later returned to the Chamber of Deputies by the Senate. On 4 April, the law was published in the collection of laws, with effect from 1 April 2017.
  > Coordinator: Ministry of Finance of the Czech Republic
  > Deadline: 01.07.2017
  > Conclusion: completed ☺

- **AA10 – Supporting the introduction of low emission zones**

  The Ministry of the Environment declared in 2016, as part of the National Programme Environment, a call with a total allocation of CZK 10 million to support feasibility studies for the introduction of low emission zones. Under call No. 2/2016, three applications were supported (Brno, Písek, Ostrava), with the deadline for drawing up the studies on 31.12.2017. The newly announced call (No. 9/2017) again supports feasibility studies. Newly, support will be provided for drawing up regulatory rules (to regulate traffic at the time of smog situations) and also the drafting of sustainable urban mobility plans which represent a comprehensive and effective transport solution leading to the elimination of its negative effects on air quality. Amendment to Act No. 201/2012 Coll., on air protection, has expanded the possibility of introducing low-emission zones with effect from 01.01.2017. Newly, they can be introduced, provided that the statutory conditions are met, in order to reduce pollution from transport in the territory of the municipality or its part anywhere, not only in especially protected areas, at spa places or territories where pollution limits have been exceeded.
  > Coordinator: Ministry of the Environment
  > Deadline: continuously
  > Conclusion: implemented continuously ☺

- **AA11 – Rationalization of charging for roads with respect to the impacts of transport on air quality in a given location**

  Amendment to Decree No. 383/2016 Coll., which amended Decree 306/2015 Coll. on the use of roads paid for through time-based charging, excluded 11 motorway sections near cities in the total length of 105 km from the toll on the motorway network, so that those roads would be used preferentially (as bypass) and to relieve the urban transport network.

  > Coordinator: Ministry of Transport
  > Deadline: 01.01.2017
  > Conclusion: completed ☺

- **BA1/CA1 – Support for priority implementation of measures to reduce emissions from stationary sources in the sector of energy, industry and agriculture**

  In the new programming period 2014–2020, support for the reduction of emissions from industrial sources is provided through priority axis 2 Improving the air quality in human settlements, specific objective 2.2. of the Operational Programme Environment. The supported activities under specific objective 2.2 are: replacement and reconstruction of the existing stationary sources of pollution, the acquisition of technology and changes in technological processes leading to the reduction of pollutant emissions or of the level of air pollution. The financial allocation set for this specific objective is CZK 3.6 billion. The call under specific objective 2.2 was announced in 2015. The call provided support to all activities and types of projects. The allocation (the maximum total subsidy from EU sources) for approved projects was announced in the amount of CZK 2.5 billion. The call received projects requesting subsidies at more than CZK 5.5 billion. In 2017, a call was announced under this specific objective with the allocation of CZK 0.5 billion.

  > Coordinator: Ministry of the Environment / Ministry of Industry and Trade / Ministry of Agriculture
  > Deadline: continuously by 31.12.2023
  > Conclusion: implemented continuously ☺

- **BA2 – Support for the implementation of measures to reduce energy consumption and to increase energy efficiency**

  Under specific objective 5.1 To reduce the energy intensity of public buildings and increase the use of renewable energy sources, two calls have been already completed. Out of call 19,425 projects are currently approved with estimated energy savings amounting to 211,628 GJ. Out of call 39,379 projects have been approved to date with estimated energy savings amounting to 175,472 GJ. The evaluation of that call has not been fully completed yet. Call 70 was announced on 03.04.2017 with the end date for receiving applications on 29.09.2017. Under specific objective 5.2 To achieve a high energy standard for new public buildings, no project was received under the closed call 20 and so the conditions of the currently running call 61 were significantly modified.

  > Coordinator: Ministry of the Environment/ Ministry of Industry and Trade / Ministry of Agriculture
  > Deadline: continuously by 31.12.2023
  > Conclusion: implemented continuously ☺

- **BA3 – Reduction in the proportion of solid fossil fuels in combustion stationary sources outside the EU ETS**

  The Ministry of Finance has prepared an "Analysis of the possibilities and impacts of taking account of the environmental elements in the rates of consumption and energy taxes in the Czech Republic", which was submitted to the Government in December 2016, the Government adopted it in its Resolution No. 6/2017 and asked the Ministry of Finance to supplement it with further analyses and, by 31 December 2018, to submit to the Government a recommendation on taking account of the environmental elements in the rates of consumption and energy taxes in the Czech Republic.

  > Coordinator: Ministry of Finance of the Czech Republic
  > Deadline: 31.12.2016 and 2018
  > Conclusion: partially completed ☺

- **DA1 – Supporting a faster replacement of heat sources in the sector of local household heating**

  The replacements of boilers using solid fuels are supported through boiler subsidies (Operational Programme Environment, priority axis 2, specific objective 2.1), split into 3 main calls with a total allocation of CZK 9 billion. It is expected that 80–100 thousand old boilers using solid fuels will be replaced. Under the 1st call that was extended, thanks to the increased allocation, with a call only for sources using renewable energy sources, the replacement of about 25,000 boilers will be supported. The next 2nd call will be announced by regions in the autumn of 2017, the goal of this call will be 35,000 projects replacing boilers for solid fuels. In the following year, the 3rd call will be announced.

  > Coordinator: Ministry of the Environment
  > Deadline: continuously
  > Conclusion: implemented continuously ☺

Technical/technical-organizational priority measures

- **AB1 – Construction of the backbone network of roads for motor vehicle transport**
- **AB2 – Priority construction of bypasses of towns and villages**

The measure is being delivered through the following sections of the backbone network of capacity roads that were put into operation in that year.

> Year 2015:
- Structures put into service: 28.17 km of motorways and 16.49 km of class I roads
- Construction started: 46.6 km of motorways and 15.7 km of class I roads

> Year 2016:
- Structures put into service: 20.6 km of motorways and 10.63 km of class I roads
- Construction started: 31.02 km of motorways and 22.07 km of class I roads

> Coordinator: Ministry of Transport / Ministry of Regional Development
> Deadline: AB1 31.12.2023 – 31.12.2030/ AB2 31.12.2020
> Conclusion: implemented continuously ☺

- **AB21 – Renewal of the fleet of the public administration with alternatively powered vehicles**

In 2016, Government Regulation No. 173/2016 Coll. was adopted, laying down binding specifications for public procurement of road transport vehicles. A government resolution imposed that a further amendment of the above Regulation be submitted to the government, setting out a minimum percentage of vehicles with alternative drive in the total number of purchased vehicles.

The amendment to the government regulation is currently in the interministerial objections procedure. If the government regulation is approved, the contracting authorities will have to purchase, in every public contract for four cars and above, also 25% of vehicles with alternative propulsion.

> Coordinator: All central State administration bodies, their contributory organizations and enterprises with an ownership interest of the government
> Deadline: 31.12.2020 and 31.12.2030
> Conclusion: implemented continuously ☺

- **AB22 – Improving the functioning of the system of periodic technical inspections of vehicles**

Act No. 63/2017 Coll., which amends Act No. 56/2001 Coll., with effect from 01.06.2017, newly introduces the obligation of operators of emissions inspection stations to participate in the Information system of the technical inspection stations, and to enter the results of measurements to that system. Also the implementing regulation (Decree 302/2001 Coll., on technical inspections and measurement of emissions, as amended) will require, in connection with the legal changes, to keep evidence of the presence of the vehicle at emissions measuring, which is a very effective tool improving the functioning of the system of periodic technical inspections, which includes the measurement of emissions.

Act No. 63/2017 Coll. newly establishes the obligation of legal or natural persons carrying out business, who make a change to a road vehicle, which will result in its technical inability to be operated, that such person must notify the operator of the vehicle in writing before such change is made. If the implementation of such changes is offered publicly, such offer must contain a clear warning that the change will result in a technical inability of the road vehicle to be operated.

> Coordinator: Ministry of Transport
> Deadline: 30.6.2016 – 01.07.2017
> Conclusion: completed ☺

- **AB23 – Shifting the freight transport output from roads to railways**

At the beginning of 2017, the Czech government approved the Concept of the Freight Transport for the period 2017–2023 with a view to 2030 as a strategic document for the freight transport sector. The aim is to create such environment, in which the logistics and freight transport can ensure the necessary quality of services to ensure the competitiveness of the economy and at the same time an economical use of existing resources. One of the means to reduce the negative effects of freight transport on the whole society is an even division of transport work among the various modes of transport. Under the Operational Programme Transport, call was announced in 2016 under specific objective 1.3 – Modernisation and construction of transshipment terminals for combined transport.

> Coordinator: Ministry of Transport
> Deadline: 30.06.2016, 31.12.2023, 31.12.2030
> Conclusion: partially completed ☺

- **AB24 – Determining the conditions of operation of construction machinery**

  The Ministry of the Environment has prepared a draft Methodological Guideline which is currently consulted with the Ministry of Transport and the Ministry of Regional Development. The failure to fulfil this priority measure in due time was caused by its extension, based on the requirements of the members of the working groups supporting the implementation of the measures provided for in the programmes to improve air quality. The working group requested the extension of the above Methodological Guideline with other sources of dust during construction activities, with regard to the application of measures of the Air Quality Improvement Programme, called "Abatement of dust from construction activities".

  > Coordinator: Ministry of the Environment
  > Deadline: 01.01.2017
  > Conclusion: not completed by deadline; completion is expected by the end of 2017 ☹

- **AB25 – Empowerment of municipalities to issue decrees specifying the conditions of transporting bulk materials by trucks**

  The town of Přerov published on 14 June 2010 a generally binding Decree (so-called Sheeting Decree), which provided for certain obligations in the transport of bulk and similar materials in the territory of the statutory town of Přerov. On the basis of the Constitutional Court finding (file mark Pl. ÚS 1/15) it was found that municipalities cannot issue generally binding decrees that are contrary to Section 35 para. 1 the municipal establishment, because it is not a matter in the interests of the municipality and its citizens, i.e. a local matter, but rather a matter of national importance, specifically an issue which is already governed by Act No. 361/2000 Coll. on land traffic management and amending certain laws. Requirements for the transport of bulk materials must, according to the Constitutional Court, have a nation-wide application, so that the established obligations apply everywhere in the same way.

  > Coordinator: Ministry of Transport
  > Deadline: 01.07.2016
  > Conclusion: cannot be implemented due to the Constitutional Court's finding 😐

- **CB1 – Reduction of ammonia emissions from fertiliser applications to arable land and livestock production beyond the minimum requirements of good agricultural practice**

  Under call 8 of 2.2. of the Operational Programme Environment, a total of 27 projects were supported for the acquisition of technologies to reduce emissions of NH_3 from livestock farms, worth a total of CZK 36,730,000 of EU funding. Currently, call 89 was announced under 2.2. of the Operational Programme Environment, in support of the acquisition of technology to reduce emissions of NH_3 from livestock farms.

  > Coordinator: Ministry of the Environment
  > Deadline: continuously by 31.12.2023
  > Conclusion: implemented continuously ☺

- **CB7 – Reducing ammonia emissions from mineral fertilisers**

  The Ministry of Agriculture prepared the "Information on the introduction of measures to reduce ammonia emissions from the application of mineral fertilizers", which was noted by the government on 5 April 2017. In the document, the Ministry of Agriculture outlined the next steps to implement this measure, through an amendment to Act No. 377/2013 Coll. on the storage and use of fertilizers, which will determine the time for incorporation of fertilizers, conditioners and substrates upon immediate incorporation of urea after its application on the soil surface. That, in its final effect, will reduce the emissions of ammonia and fulfil the requirements of the NERP.

  > Coordinator: Ministry of Agriculture
  > Deadline: 01.01.2020
  > Conclusion: will be implemented through amendment to Decree No. 377/2013 Coll. ☺

- **DB9 – Speeding up the entry into force and any additional tightening of the parameters for the efficiency and emissions of heaters contained in the implementing regulation to Directive 2009/125/EC on eco-design**

  In 2016, Act No. 369/2016 Coll., was approved, amending the Air Protection Act, which newly in annex 10 part III of the Air Protection Act establishes minimum emission requirements for local heaters with effect from 1 January 2020, which are identical with the requirements of the European Commission (EU) Regulation 2015/1185 implementing Directive of the European Parliament and of the Council 2009/125/EC, as regards the ecodesign requirements on local space heaters using solid fuel, which will enter into force throughout the EU only in 2022.

  > Coordinator: Ministry of the Environment
  > Deadline: 31 December 2016
  > Conclusion: completed ☺

- **DB10 – Restrictions on the availability of internal combustion stationary sources with the rated thermal input lower than 300 kW designated for coal combustion**

  The Ministry of Environment is preparing materials for an analysis which will evaluate all options of restricting the consumption of brown coal in combustion stationary sources with the nominal heat output of less than 300 kW. The analysis will take into account the experience of other EU States with the introduction of additional restrictions on the products, which are regulated by the European Parliament and Council Directive 2009/125/EC.
  > Coordinator: Ministry of the Environment
  > Deadline: 31.12.2018 – 01.01.2025
  > Conclusion: under preparing 😐

Conclusion
Of the total of 23 additional priority measures, 6 have been successfully implemented so far. Another 13 priority measures have been implemented partially or are implemented on an ongoing basis according to the deadline given in the National Emission Reduction Programme (subsidy schemes, roads under construction, etc.) and only 4 priority measures have not been or could not be implemented at all.

Other key strategic documents of the Ministry of the Environment

Among other key strategic documents of the Ministry of the Environment there is the **Medium-term Strategy (by 2020) to Improve Air Quality in the Czech Republi**c, which sets priorities in the protection of air quality and in the reduction of emissions. Furthermore it assesses the existing measures to improve the air quality in areas with poor air quality, and proposes additional measures and tools to improve air quality and to achieve the limit values of concentrations of pollutants at the level of the entire State as well as at the level of the zones and agglomerations, which are laid down by the EU legislation and the Czech Republic. The strategy is the overarching conceptual document, which is followed by the above-evaluated **National Emission Reduction Programme of the Czech Republic** and ten programs to improve air quality processed for 7 zones and 3 agglomerations. The National Emission Reduction Programme of the Czech Republic analyses the state and the development of the air in the Czech Republic, causes of pollution, the emission of pollutants from individual sectors of the economy, the development of scenarios of air pollution, the international commitments of the Czech Republic and their observance. It lays down the procedures and measures to remedy the existing unsatisfactory state of the air, targets for reducing levels of air pollution and the deadlines for achieving them. The evaluation of national emission ceilings, according to the National Emission Reduction Program of the Czech Republic, and according to the Medium-term Strategy to Air Quality Improvement in the Czech Republic is presented in the Report on the Environment of the Czech Republic and the Statistical Environmental Yearbook of the Czech Republic.

The **Climate Protection Policy in the Czech Republic** replaces the National Programme to Abate Climate Change Impacts in the Czech Republic from 2004, which is no longer up-to-date. The climate protection policy is focused on defining the objectives and measures in the area of climate protection at the national level so as to ensure as far as possible meeting of the reduction targets for greenhouse gas emissions in pursuance of international agreements, the obligations arising from the legislation of the European Union and has contributed to the long-term transition to a sustainable low-carbon economy of the Czech Republic. The climate protection policy is thus complementary to Government-approved Strategy on Adaptation to Climate Change in the Czech Republic.

The **Strategy on Adaptation to Climate Change in the Czech Republic** (also Adaptation Strategy) states in the context of adaptation measures proposed under the various strategic sectoral documents and complements the directions of adaptation measures in the areas for which such measures have not been processed. The aim of the Strategy is to mitigate the effects of climate change by adapting to such change as much as possible, to maintain good living conditions and to preserve and possibly improve the economic potential for the next generation. The Adaptation Strategy introduces in a structured way the risks and assumed impacts of climate change in selected sectors, defines the general principles of adaptation measures, suggests priorities, draws attention to the cross-sectoral links and coherence with the mitigation measures and provides guidelines and examples of appropriate adaptation measures.

The **State Nature Conservation and Landscape Protection Programme of the Czech Republic** analyses the state of the natural and landscape environment and formulate long-term objectives and measures necessary to achieve them. It lays down tasks for improving the protection and sustainable use of the countryside in order to maintain its natural functions, tasks

for the management of protected areas, protection of the species and tasks in the field of legislative, economic, information tools, and in the field of work with the public.

National River Basin Management Plans of the Elbe, Oder, Danube River set out the objectives and measures for the protection and improvement of the status of surface water and groundwater and aquatic ecosystems, to reduce the adverse effects of floods and droughts, and for surface and groundwater management, and sustainable use of the waters to ensure water services, and to improve the water conditions and the protection of the ecological stability of the landscape.
Flood Risk Management Plans of the Elbe, Oder, Danube River Basins Districts are mainly used for regional planning and water-related construction proceedings. They contain measures that lead to the reduction of flood risk and the achievement of the objectives referred to in Directive 2007/60/EC on the assessment and management of flood risks, and is also used as the basis for the exercise of public administration.

The **Concept of the Solution of the Problems of Flood Protection in the Czech Republic, using technical and near-nature measures** it lays down the methods of implementation of preventive flood protection measures after 2013, including methods of optimisation of the selection of the individual measures. The system of flood control measures includes also the landscape measures and the new requirements of European legislation.

The **Waste Management Plan of the Czech Republic for the period 2015–2024** is a key document for the implementation of the long-term strategy, the treatment of waste, packaging waste and end-of-life products. The objective of the Waste Management Plan is a waste prevention and increased recycling and material recovery of wastes. It focuses on the preference of the waste treatment according to the waste hierarchy and the fulfilment of the European goals in all areas of waste treatment. Part of the Waste Management Plan is also the binding part of the Waste Prevention Programme that describes the strategic and legislative framework, the default situation in the implementation of the measures and steps related to the issue of waste prevention and further analyses the situation for selected waste streams, where need of further elaboration of waste prevention was identified.

The **State Programme of Environmental Education, Awareness and Environmental Consultancy of the Czech Republic for the period 2016–2025** is a key national document for environmental education and awareness and environmental consultancy – with visions, goals and measures, in which the stakeholders are, apart from the State administration, also regions, towns and villages, schools, including higher education institutions, centres of environmental education and environmental counselling as well as non-profit organizations, educational and research institutions, museums, ZOOs, botanical gardens, libraries. The programme focuses on priority topics: contact with nature, locally anchored learning, sustainable consumption and climate change in context.

Global context

The globalisation brings many advantages, but also concerns about the impact on the environment by the linear economy, which works on the principle of buy-use-throw away. Additional concerns are associated with the unsustainable dependency on many natural resources, the ecological footprint exceeding the capacity of the planet, external environmental impact in poorer countries and unequal distribution of socio-ecological benefits of economic globalization. To grasp the idea of what it actually means to live within the limits of the planet, is not at all easy. However, it is clear that the long-term remedy lies particularly in the transformation of key areas such as transport, energy, housing and food system.

Solutions to key issues affecting the state and development of the individual elements of the environment is closely connected to the activities that cannot be searched only on the territory of their own country or region, but the solution of which requires a comprehensive approach going beyond the country borders and in many cases even beyond continents. From this perspective, it is essential not only to cooperate between Member States of the EU, within which then a large part of the national legislation in the field of environmental protection is created, but also to cooperate at the global level. The European Environmental Agency in 2015 released the publication "The European environment – state and outlook 2015"[1]. Part of this publication, devoted to the description of the 11 global Megatrends, is introduced in this chapter as a wider global context in which the environment of Europe and the Czech Republic takes place. A similar analysis are provided by overviews of the state of the environment of UNEP (Global Environmental Outlook[2]) and the OECD (OECD Environmental Outlook to 2050[3]), the data from which are included in this chapter.

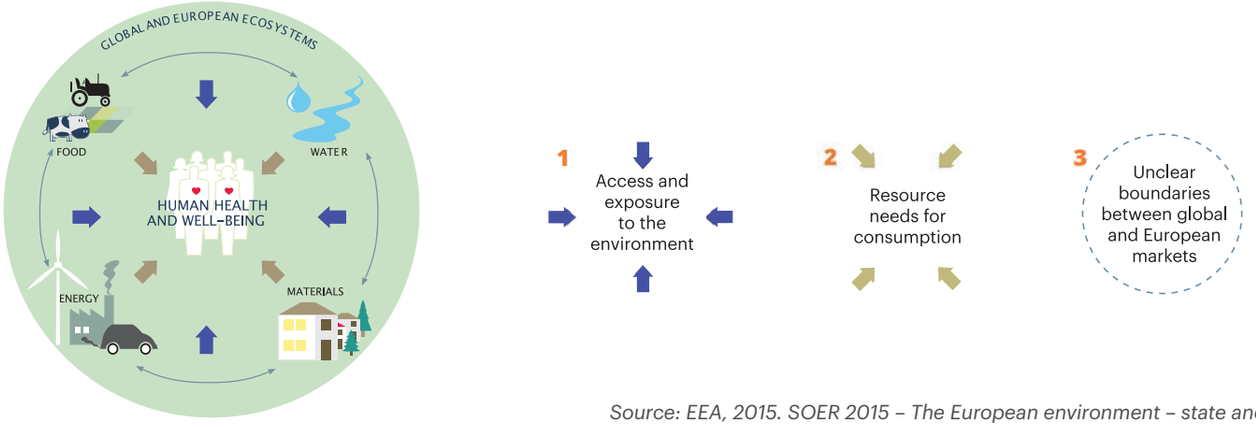
Systemic nature of many of today's environmental problems

Measures in the framework of the European environmental policy have proved to be particularly effective in addressing the local, regional and pan-European environmental burdens. However, some of the current environmental problems differ from those that we have successfully solved in the last 40 years: they have a system and cumulative nature and do not depend only on what measures Europe takes, but also depend on the global context.

Many of today's environmental problems are typical for its complexity that pervades the various areas of the environment and society (Figure 1).

Figure 1

Three system characteristics of environmental problems



Source: EEA, 2015. SOER 2015 – The European environment – state and outlook 2015

[1] *EEA, 2015. SOER 2015 – The European environment – state and outlook 2015. European Environment Agency, Copenhagen, Denmark*

[2] *UNEP: Global Environmental Outlook. United Nations Environment Programme, Nairobi, Kenya*

[3] *OECD, 2012, OECD Environmental Outlook to 2050. Organisation for Economic Cooperation and Development, Paris, France*

The three system characteristics that link many of today's environmental problems, are especially important:

- fundamental differences in the rate of exposure to environmental factors such as pollutants in the environment, hazardous hydrometeorological phenomena and the disappearance of habitats, or loss of function of whole ecosystems
- models of consumption and use of resources, that have a major impact on human well-being and the environment (water, energy, materials and soil), the exploitation of which is closely linked[4]
- the evolution of the rate of exposure to environmental factors and the development of consumption and resource use depends not only on the regional development, but also on the global megatrends (see summary of Megatrends); This connected global context makes it difficult for individual countries to make unilateral solutions to environmental problems; and even large group of countries acting together (like the EU) cannot solve these problems alone (Box 1).

Global megatrends

Globalisation and slowly occurring global trends imply that the European environmental conditions and related policies cannot be fully understood or properly managed – regardless of global influences.
Global megatrends will change the future of the European models of consumption and affect the European climate and the environment. By estimating this development we can better plan and take advantage of the opportunities that the future brings. These megatrends relate to demographics, economic growth, patterns of production and trade, technological progress, degradation of ecosystems, and climate change (Box 1).

Box 1

Global megatrends

Diverging global population trends: From the 1960s, the population doubled to 7 billion and should continue to grow (until 2050 to 9.6 billion), even though the population in advanced economies is aging, and even reduces at some places. On the contrary, in the least developed countries, the population increases rapidly.

Towards a more urban world: Half the world's population lives in urban areas. By 2050, thanks to megacities and slums it will be 67% of the population. Smart investments can, along with urbanisation, strengthen innovative solutions of environmental problems, but the use of resources and the production of pollution can also increase.

Changing disease burdens and risks of pandemics: The risk of exposure to new, newly emerging and reoccurring diseases and new pandemics is associated with poverty and grows with the climate change and the increasing mobility of people and goods.

Accelerating technological change: New technologies are radically changing the world – nanotechnology, biotechnology, information and communication technologies. The technological development allows more efficient use of raw materials, but also brings risks and uncertainty.

Continued economic growth: While the recent economic recession in Europe still dampens economic optimism, most studies assume a steady economic growth for the coming decades – accelerating consumption and use of resources, especially in Asia and Latin America.

An increasing multipolar world: In the past, it had a dominant influence on the global production and consumption of a relatively small number of countries. Today there is a significant realignment of economic forces, while particularly Asian countries come to the foreground, which has an impact on international trade and economic interdependence.

Intensified global competition for resources: With the growth of the economy there is also the growth in consumption of renewable and non-renewable biological resources stocks of minerals, metals and fuels. This increase in demand is contributed to by the development of industry and the changing patterns of consumption. The consumption of materials has increased 10 times since 1900, and by 2030 it will most probably be doubled. In recent years there is a mass acquisition of the land, most frequently rich countries are buying land in developing countries. Between 2000 and 2050, global water consumption will increase by 55%, mainly due to industrial production.

[4] *For example, the replacement of fossil fuel by energy crops can help to solve problems in energy, but this process is, on the other hand, associated with deforestation and the conversion of the soil at the expense of natural areas, which is influenced by the area of land available for food crops. Because of the interconnectedness of global food markets this effect is reflected on the price of food. The result is that the deterioration of the environment has serious implications for the security of the current and future access to key resources.*

Growing pressures on ecosystems: The growth of the human population, and therefore the production of food and energy, will continue to be at the expense of global biological diversity and natural ecosystems – which shall most of all influence poor citizens of developing countries. By 2050, the biodiversity will be reduced by 10% and 13% of long-lived forests will be lost.

Increasingly severe consequences of climate change: Warming of the climate is unequivocal. Many of the changes observed since the 1950s have not been seen in recent decades to millennia. How climate change manifests itself slowly, the serious consequences are expected for ecosystems and human society (including food security, the occurrence of droughts and extreme weather events).

Increasing environmental pollution: Around the world today ecosystems are subjected to a critical level of pollution with the increasingly complex components. Human activity, population growth in the world and changes in consumption patterns are the main incentives of such growing environmental burden.

Diversifying approaches to governance: A mismatch between a still longer-term global challenges and more and more limited possibilities of effective measures creates a demand for new approaches to management, where businesses and civil society will play a greater role. These changes are necessary, but raise concerns with regard to coordination, efficiency, and accountability.

Source: SOER 2015 – The European environment – state and outlook 2015

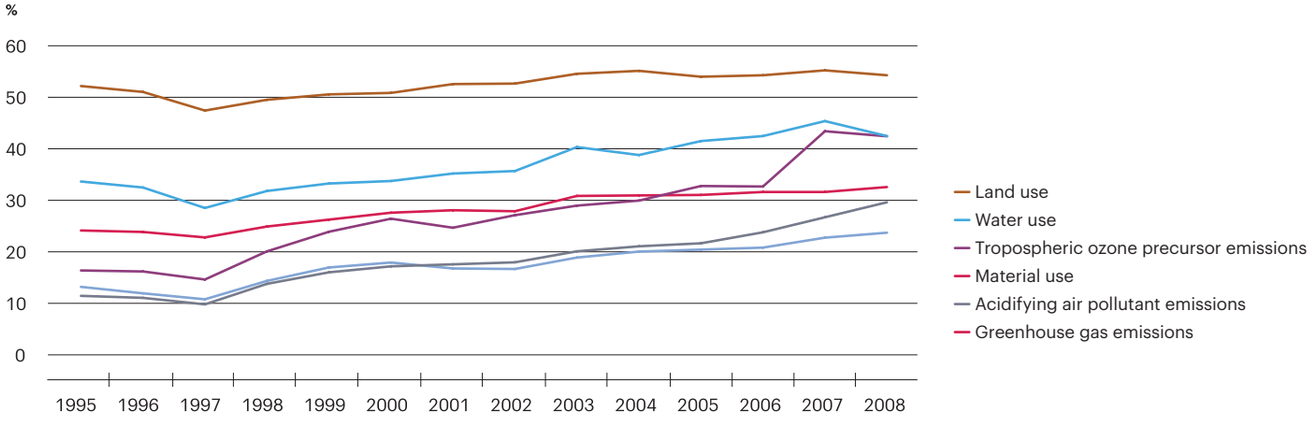
Influence of European production and consumption patterns on the European and the global environment

The environmental consequences of European production and consumption can be viewed from two different perspectives. The view of "production" focuses on the burdens caused by the use of resources, emissions and the degradation of ecosystems in Europe. On the other hand, the view of "consumption" is more focused on the burden on the global environment caused by the consumption of goods and services in Europe.

A considerable share of environmental burden associated with consumption in the EU is expressed outside the territory of the EU. Depending on the burden, 24–56% of the total related environmental footprint is expressed outside of Europe. For clarity: the land needed for the production of products consumed in the EU is estimated to be located outside the territory of the EU from 56%. The share of ecological footprint of the EU demand beyond its borders has increased over the last decades in soil, water, use of materials as well as emissions into the air (Figure 2).

Figure 2

Total ecological footprint beyond the EU associated with the end customer demand of EU27



The ecological footprint includes the total end consumer demand including household consumption and government institutions as well as capital investments.

Source: SOER 2015 – The European environment – state and outlook 2015

In the case of carbon dioxide emissions in the EU are emerging as a result of higher consumption than the emissions generated during production. In the period 1995–2010 there was a decreasing trend in the EU'S emissions production, while consumer emissions, after the initial increase in 2010, were slightly higher than in 1995. Global CO_2 emissions for the same period increased and the share of European consumption and production emissions on the global emissions of CO_2 from the production of goods has been reduced from 20% to 17%, from 15% to 12%. However, the volume of global emissions rises. In addition, carbon dioxide emissions are rising in the BRICS countries (Brazil, Russia, India, South Africa, People's Republic of China) linked to the production of goods ordered from the world's richest countries. The OECD'S analysis showed that between 1995 and 2005 the emissions from the domestic production increased in OECD countries by 1.1% per annum, whereas emissions emissions from the demanded production (including import) by 1.6% per annum. This distribution of production centers and consumption centers in the world explains why in 2005, 7% of the world's greenhouse gas emissions were produced on demand from OECD countries in the BRICS countries.

As regards the use of water resources, the difference between the burdens from production and consumption is similar. Here the difference reveals itself when comparing water usage on the European territory with trade with "virtual water" (contained in the products demanding for the consumption of water, such as agricultural commodities). The concept of "virtual water", expresses the volume of fresh water used to produce goods that are traded internationally. It is estimated that the number of business relations and the volume of water related to the global trade with foods in the period of 1986–2007 has almost doubled.

At the aggregate level the difference between the burden of production and consumption is illustrated through the "stop" principle. For example, the "ecological footprint" is an indicator evaluating land use, renewable material resources consumption and consumption of fossil fuels. According to this data, most European countries currently exceeds the capacity of the available biological active territory, or "biocapacity". Available estimates suggest that the total global consumption exceeds the ability to regenerate the planet by more than 50%. These different ways of seeing the differences between the burdens caused by production and consumption show that European consumer habits have an impact on the environment globally. So the question arises whether the European consumer habits were sustainable, if they were taken over by the whole world – in particular with regard to the global environmental problems today.

International environmental management

The Czech Republic has gradually built a position of an active and respected participant of international relations in the field of environmental protection and sustainable development in a number of international organisations (see below). The most important of them in terms of monitoring the State of the environment is the United Nations Environment Programme (UNEP), which issues reports on the state of the environment in the world. Global Environmental Outlook (GEO-6 is scheduled for 2019). In addition to UNEP, a report on the state of the environment is also issued by the Organisation for Economic Cooperation and Development (OECD). Its latest release is from 2012 and covers the period up to 2050.

United Nations Environment Programme (UNEP)

- UNEP is the leading environmental authority indicating the global environmental agenda. In particular, it promotes the coherent implementation of the environmental dimension of sustainable development within the United Nations system and serves as the voice of the world's environment.

UNEP's work includes:

- analysis of global, regional and national trends and state of the environment,
- developing international and national environmental instruments,
- strengthens the institution for wiser management of the environment.

Organisation for Economic Co-operation and Development (OECD)

- The main mission of the OECD is to provide the governments of the Member States a scope to allow comparison with the experience of the implementation of government policies and the search for answers to common problems. The Ministry of the Environment is represented in the Committee on the environment and the Committee on chemicals, while within the committees working groups are created, which is also an active member of the Ministry of the Environment.

European Environment Agency (EEA)

- It is an agency set up in the framework of the EU, its members are also some non-EU countries. The aim of the EEA is to promote sustainable development through providing and sharing information, knowledge and capacity building in the

field of the environment. The national coordinator for cooperation is CENIA, the Czech Republic is represented in the Management Board by Ministry of the Environment.

Information provided by the EEA is from a wide spectrum of sources of the EIONET, which is made up of individual experts, the so-called NRC, and European thematic centers, the so-called ETC. In 2015, there was a total of 6 ETC, each with representation of the Czech Republic, which is exceptional in the European context:

- European Topic Centre on the Inland, Costal and Marine Waters (ETC/ICM)
- European Topic Centre on Air Pollution and Climate Change Mitigation (ETC/ACM)
- European Topic Centre on Spatial Information and Analysis (ETC/SIA)
- European Topic Centre on Biological Diversity (ETC/BD)
- European Topic Centre on Climate Change Impact, Vulnerability and Adaptation (ETC/CCA)
- European Topic Centre on Waste and Materials in a Green Economy (ETC/WMGE)

Visegrad Group (V4)

- Within the Visegrad Group, comprised of the Czech Republic, Hungary, Poland, Slovakia, there is a mutual cooperation on the basis of consultations and regular meetings at various levels (presidential, prime, at ministerial level, at the level of experts, etc.). Countries of V4 primarily coordinate their positions to presented proposals for EU legislative and policy documents, and in the area of the environment often work together with Bulgaria and Romania.

The Czech Republic presided over the V4 from 1 July 2015 to 30 June 2016, when in the field of the environment the Ministry of the Environment continued to in the discussions of the core of European activities, which include, in particular: the issue of circular economy and changes to European legislation in the field of waste, the framework of the EU climate and energy policy up to 2030, the international negotiations on climate protection, the legislative package on the air and the fulfilment of the objectives of the EU strategy for biological diversity.

The Czech Republic is a contracting party to several dozen important multilateral and bilateral environmental agreements. The treaties, negotiated very often in the framework of international organisations with environmental segment, are a specific manifestation of the responsibility of the States for the state and development of the environment at the global, regional and subregional levels. States ratifying the treaties bind to fulfil their objectives. The Czech Republic currently has 72 bilateral agreements concluded with a total of 32 countries of the world (see Statistical Environmental Yearbook of the Czech Republic 2016). In terms of multilateral relations at the international level, the Czech Republic is active in the framework of the treaties aimed at:

- climate change: United Nations Framework Convention on Climate Change, the Kyoto Protocol;
- nature and landscape protection: European Landscape Convention, the Framework Convention on the Protection and Sustainable Development of the Carpathians, the Convention on Wetlands of International Importance, especially as Waterfowl habitats, the Antarctic Treaty – Czech Antarctic station, the Protocol on environmental protection to the Antarctic Treaty, the Convention on biological diversity, the United Nations Convention to Combat Desertification, the Nagoya Protocol on access to genetic resources and the fair and equal sharing of the benefits arising from their use;
- species protection: the agreement on the conservation of African-Eurasian Migratory Waterbirds, Convention on the Conservation of European Wildlife and Natural Habitats, the Convention on International Trade in Endangered Species of Wild Fauna and Flora, the Agreement on the Conservation of Populations of European Bats, a Memorandum of Understanding and Management of the Middle-European Population of the Great Bustard (Otis tarda), a Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia, the International Convention for the Regulation of Whaling;
- air protection: Convention on Long-Range Transboundary Air Pollution;
- protection of the ozone layer: Vienna Convention for the protection of the ozone layer and the Montreal Protocol on substances that Deplete the ozone layer;
- water protection: Convention on the Protection and Use of Transboundary Watercourses and International Lakes;
- chemical substances and the risks to the environment: the Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade, the Stockholm Convention on Persistent Organic Pollutants, the the Minamata Convention on Mercury, the Cartagena Protocol on Biosafety;
- waste: the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal;
- of an industrial accident: the Convention on the Transboundary Effects of Industrial Accidents;
- horizontal issues – public access to environmental information, the environmental impact assessment: the Convention on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters, the Protocol on Pollutant Release and transfer Registers, Protocol on Strategic Environmental Assessment to the Convention on Transboundary Environmental Impact Assessment in a Transboundary Context.

List of abbreviations

AOT40 Accumulated Ozone exposure over a Threshold of 40 ppb
AOX Adsorbable Organic Halogens
B(a)P benzo(a)pyrene
BAT Best Available Techniques
Bio-ETBE Ethyl tert-butyl ether produced from bioethanol
BOD_5 biochemical oxygen demand over five days
BRICS grouping of Brazil, the Russian Federation, India, China, South Africa.
BRIICS grouping of Brazil, the Russian Federation, India, Indonesia, China, South Africa.
BSM Basal soil monitoring
c.p. current prices
CENIA CENIA, Czech Environmental Information Agency
CLRTAP Convention on long-range Transboundary Air Pollution
CNG Compressed Natural Gas
COD_{Cr} potassium dichromate digestion to chemical oxygen demand
Cp the protective factor of the influence of vegetation
CRF The Common Reporting Format
CSN Czech state standard
CZ-NACE Nomenclature generale des Activities economiques dans les Communautes Europeennes (in Czech Republic)
CZK Czech crowns
DE Domestic Used Extraction
DDD dichlorodiphenyldichloroethane
DDE dichlorodiphenyldichloroethylene
DDT dichlorodiphenyltrichloroethane
DMC Domestic Material Consumption
EC European Community
EC European Commission
EEA European Environment Agency
EEA33 the cooperating countries of the European Environment Agency
EEC The European Economic Community
EMEP European Monitoring and Evaluation Programme - a co-operative programme for monitoring and evaluation of the long-range transmission of air pollutants in Europe
ETC/BD European Topic Centre on Biological Diversity EU European Union
EU European Union
EU ETS The European Union Emission Trading System
EU27 Member States of the European Union as at 31 December 2012
EU28 Member States of the EU27 + Croatia (integrated on 1 July 2013)
EUA European emission allowances (European Union Allowances)
EUAA European emission allowances allocated to aircraft operators (European Union Aviation Allowances)
Eurostat European Statistical Office
FAME Fatty Acid Methyl Esters
FC thermotolerant (fecal) coliform bacteria
FSC Forest Stewardship Council certification system
GDP Gross Domestic Product
GVA Gross Value Added
HCB hexachlorobenzene
HCH hexachlorocyclohexane
ICP Forests International co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests
IED Industrial Emissions Directive
ISPA Instrument for Structural Policies for pre-accession – financial assistance instrument in support of investment projects
IUCN International Union for the Conservation of Nature

LPG Liquified Petroleum Gas
LPIS Land Parcel Identification System
LULUCF Land Use, Land Use Change and Forestry
LV Limit Value
MA ISOH Car Wrecks Module of the Waste Management Information System
N/A information is not available
NECD National Emission Ceilings Directive
NERP National Emission Reduction Programme of the Czech Republic
NUTS Nomenclature of Units for Territorial Statistics
OECD The Organisation for Economic Co-operation and Development
p.p. percentage point
PA Priority Axis
PAH polycyclic aromatic hydrocarbons
PCB Polychlorinated Biphenyls
PE Population equivalent
PEFC Programme for the Endorsement of Forest Certification Schemes
PES Primary energy sources
pkm passenger-km
PM suspended particles (Particulate Matter)
POPs persistent organic pollutants
ppb parts per billion
PPS Purchasing Power Standard
PTB Physical Trade Balance
R&D&I Research, Development and Innovation
RES Renewable Energy Sources
RUSLE the revised universal soil loss equation
SHARES Short Assessment of Renewable Energy Sources
tkm tonne-kilometre
TSP total suspended particles
UAT Unfragmented Areas by Traffic
UNEP United Nations Environment Programme
UNFCCC United Nations Framework Convention on Climate Change
USLE Universal Soil Loss Equation
VAT value added tax
VOC Volatile Organic Compound
WEEE waste electrical and electronic equipment
WEI Water Exploitation Index
WHO World Health Organization
WISE-SoE Water Information System for Europe, an information system
WMO World Meteorological Organization
WWTP Wastewater Treatment Plant

Glossary of terms

Acaracides. Plant protection products intended to control mites.
Acidification. It is a process in which elements of the environment are acidified. It consists in increasing the acidity. Primarily it affects air and secondarily water and soil. Acidification is caused by the emissions of acidifying substances (i.e. sulphur oxides, nitrogen oxides and ammonia) into the air.
Agricultural Land Fund. The agricultural land fund or resources consist of land that is cultivated in agriculture, i.e. arable land, hop-gardens, vineyards, gardens, fruit orchards, meadows, pastures (i.e. "agricultural land") and land that was and should continue to be cultivated by agriculture, but is not cultivated at present (i.e. "temporarily uncultivated land"). The agricultural land fund also includes ponds to breed fish and water poultry and non-agricultural land required for the provision of agricultural production, such as field paths, plots with irrigation devices, irrigation reservoirs, drainage furrows, dams to protect against flood or water logging, anti-erosion terraces etc.
Air pollution. Pollutant contained in the air that gets in contact with the recipient (human, plant, animal, material), and acts on it. It is formed by a physico-chemical conversion of emission.
AOT40. The limit value for ground-level ozone levels from the perspective of ecosystem and vegetation protection. It refers to the accumulated ozone exposure over the threshold of 40 parts ppb. The AOT40 cumulative exposure to ozone is calculated as the sum of the differences between the hourly ozone concentration and the threshold level of 40 ppb (= 80 $\mu g.m^{-3}$) for each hour in which the threshold value was exceeded. According to the requirements of Government Regulation No. 597/2006 Coll., the AOT40 is calculated over a three month period from May to July from ozone concentration measurements taken every day between 8.00 and 20.00 CET.
AOX. Adsorbable organically-bound halogens. The summary indicator AOX is expressed in chlorides as the equivalent weight of chlorine, bromine, and iodine contained in organic compounds (e.g., trichloromethane, chlorbenzene, chlorophenols etc.) which, under certain conditions, adsorb onto activated carbon. The main source of these substances is the chemical industry. While poorly degradable and water-soluble, these compounds are soluble in fats and oils, and thus easily accumulate in adipose tissues.
Areal temperatures and precipitation totals. Values of individual weather elements related to a particular territory, representing the mean value of the element in this area.
Assimilatory organs. Parts of plants ensuring photosynthesis (most often leaves, needles).
Bactericides. Antimicrobially active substances intended to exterminate bacteria.
Best Available Techniques. In accordance with Act No. 76/2002 Coll., on integrated prevention, the best available techniques are the most efficient and advanced stages of development of the applied technologies and activities as well as their means of operation, which show practical suitability of certain techniques designed to prevent, and if it not possible, to reduce emissions and their environmental impacts. What is meant by techniques is both the technology used and the way in which the installation is designed, built, operated, maintained and put out of operation. What is meant by available techniques are techniques developed on a scale that allows their implementation in the relevant industrial sector under economically and technically acceptable conditions, taking into account the costs and benefits, whether they are reasonably accessible to the operator, regardless of whether they are used or produced in the Czech Republic. What is meant by best techniques is the most efficient technique of achieving a high level of protection of the environment. In determining the best available techniques, standpoints referred to in Annex 3 to this Act must be taken into account.
Biodegradable municipal waste. Biodegradable municipal waste is a biodegradable component of municipal waste, such as food and garden waste, and paper and cardboard, which undergoes anaerobic or aerobic decomposition.
Biogeographical area. Large territorial unit of the Earth, significantly different in biota from the other units. In the territory of the Czech Republic, there is a continental biogeographical area (most of the territory) and the Pannonian biogeographical area (the greater part of South Moravia).
Biomass. As a general concept, biomass includes all organic material that participates in the energy and element cycles within the biosphere. It includes mainly substances of plant and animal origin. For the purposes of the energy sector, biomass is considered plant material that can be utilised for energy (e.g. wood, straw, etc.) and biological waste. The energy accumulated in the biomass originates from the sun, similar fossil fuels.
Birds of the agricultural landscape. Birds in this group include: white stork, common kestrel, grey partridge, lapwing, European turtle dove, barn swallow, common skylark, barn sparrow, meadow pipit, Wester yellow wagtail, whinchat, stonechat, common whitethroat, red-backet shrike, rook, European starling, tree sparrow, European serin, common linnet, yellowhammer, corn bunting.
BOD_5. Biochemical oxygen demand measured over a five day period. BOD20 represents the amount of oxygen consumed

by microorganisms during the biochemical oxidation of organic substances over five days under aerobic conditions at a temperature of 20°C. It is thus an indirect indicator of the amount of biodegradable organic pollution in water.

Circular economy. The sustainable development strategy, which creates functional and healthy relationships between nature and the human society. With a perfect closing of the flows of materials in long-running cycles, it opposes the current linear system where raw materials are transformed into products, sold and after the end of their life incinerated or landfilled. It represents a comprehensive system optimizing the manufacturing processes and technology, consumption and treatment of natural resources and waste. Instead of the extraction of minerals and growing landfills, it supports waste prevention, it reuses products, recycles them and transforms them into energy.

Climatic conditions (climate). This is the long-term weather trend that is determined by the energy balance, atmospheric circulation, the character of the active surface and human activities. Climate is an important component of natural conditions of any specific location. It affects the landscape and its use for anthropogenic activities. It is geographically contingent and it reflects the latitude, altitude and degree of ocean influence.

CO_2 eq. This carbon dioxide emission equivalent measures aggregating greenhouse gas emissions. It expresses any greenhouse gas unit recalculated to CO_2 radiation efficiency that is counted as 1, other gases have higher coefficients.

COD_{Cr}. Chemical oxygen demand determined by the dichromate method. COD_{Cr} is the amount of oxygen consumed in the oxidation of organic substances (including substances biochemically non-degradable) in water through an oxidizing agent potassium dichromate under standard conditions (two hours of boiling in a 50% acid with a catalyst). It is therefore an indirect indicator of the amount of all organic pollution in water.

Common species of birds. Birds in this group are: common chaffinch, common treecreeper, great tit, dunnock, house sparrow, great spotted woodpecker, common blackbird, goldcrest, yellowhammer, garden warbler, common starling, European goldfinch, chiffchaff, black redstart, blackcap, Eurasian collared dove, blue tit, jaybird, common skylark, common wood pigeon, nuthatch, common pheasant, common house martin, hawfinch, coal tit, Eurasian wren, European robin, common whitethroat, tree pipit, bullfinch, willow warbler, Eurasian siskin, European greenfinch, white wagtail, European serin, crested tit, tree sparrow, fieldfare, song thrush, marsh warbler, barn swallow, and short-toed treecreeper.

Contaminated site. A severe contamination of the rock environment, groundwater or surface water, soil or building structures and soil air, which occurred due to negligent handling of dangerous substances in the past and which might endanger the health of humans and the environment. The discovered contamination can be considered an old environmental burden only if the originator of the contamination does not exist or is not known, and this rule must be respected even in the case of the legal successor to the originator of the contamination. Contaminated sites may be of different nature – they may be landfills, industrial and agricultural areas, small retail outlets, unsecured warehouses of hazardous substances, former military bases, areas affected by mining of mineral resources or abandoned and closed mining waste repositories posing serious risks.

CORINE Land Cover. An EU programme aimed at collecting information about the environment. The CORINE Land Cover database describes the land cover using remote sensing methods.

Cross Compliance. A conditionality check-up system, which, on one hand allows the use of European financial support, and on the other hand, specifies the requirements and standards concerned with this use of financial support which have to be complied with. All these requirements and standards are based on valid European and national regulations and their fulfilment was monitored within national checkups prior to the introduction of the Cross Compliance System.

Day-degrees. It is a unit of characterizing the heating season. It is calculated as the product of the number of heating days and the difference between the average indoor and outdoor temperature. Therefore, it shows how cold or warm a given period of time was and how much energy is needed to heat the buildings.

DDT. Dichlorodiphenyltrichloroethane is a chlorinated pesticide. Production and use of DDT is now prohibited in most countries of the world. This is particularly due to bioaccumulation, toxicity, carcinogenic effects and effects on fertility reduction.

Decade. In climatology this term is referred to a set of ten consecutive days within a month. The first decade always begins on the first day of the month and each month is therefore divided into three decades. In general terms, the decade is a set of ten consecutive years.

Decoupling. The separation of the economic growth curve from the environmental pressure curve. Decoupling reduces the specific environmental pressure per unit of economic output. It can be either absolute (performance of the economy grows while the pressure decreases) or relative (economic output grows, while the pressure also grows, yet at a slower rate).

Defoliation. The relative loss of assimilation capacity in the tree crown compared to a healthy tree growing in identical vegetation and habitat conditions.

Desiccants. These are products used for the removal of excess moisture.

Digestate. The residue from the anaerobic fermentation process occurring in biogas production. Digestate fertilisation is similar to the organic fertilisation. Nevertheless, it is always advisable to take into account the actual nitrogen content. Compared to organic fertilisers, digestates usually have higher total nitrogen content in the original mass.

Domestic material consumption. This term covers all materials that are consumed in the economy. It is calculated as the sum of Domestic Used Extraction and imports, i.e. direct material input, from which exports are subtracted. Domestic Material Consumption is expressed in mass units and includes raw materials, semi-finished products and products.

Ecological stability. The ability of an ecosystem to counterbalance changes due to external factors and to maintain its natural features and functions.
Ecological Valence. The ability of the organism to exist in the presence of a certain range of conditions, i.e. conditions to which the organism can adapt.
Ecosystem Services. Ecosystem services are the benefits that people obtain from ecosystems. They are divided into provisioning services (food, wood, medicines, energy), regulating services (regulation of floods, drought and diseases, land degradation), supporting services (soil formation and nutrient cycling) and cultural services (recreational, spiritual and other nonmaterial benefits).
Emissions. The discharge or release of one or more pollutants into the environment. These substances may originate from natural sources or human activities.
EPA PAH. Priority polycyclic aromatic hydrocarbons according to the methodology of the United States Environmental Protection Agency.
Equivalent noise level. Equivalent noise level A is the average energy of the instantaneous levels of acoustic pressure A and is expressed in dB. Equivalent noise level is hence a constant noise level with approximately the same effect on the human organism as time-varying noise.
Erosion. A complex process involving the disruption of the soil surface, its transmission and sedimentation of the loosened soil particles. Under normal conditions, it is a process which is natural, gradual, fully in accordance with the soil-forming process. Human activity, however, creates the triggering conditions for the so-called anthropogenically conditioned accelerated erosion of agricultural land.
EU ETS. The European Union Emission Trading System in GHG emission allowances. One of the key instruments of the EU greenhouse gas emission reduction policy. The system should help reduce emissions in a cost-effective way and to enable the member states as well as the whole EU to comply with the obligations to reduce greenhouse gas emissions specified by the Kyoto Protocol. The system covers large industrial and energy businesses, its legislative basis is laid down in the Directive 2003/87/EC of the European Parliament and of the Council.
Eutrophication. The process of enrichment of water by nutrients, especially by nitrogen and phosphorus. Eutrophication is a natural process, in which the main nutrient sources are nutrients washed from soil and the decomposition of dead organisms. Excessive eutrophication is caused by human activities. Nutrient sources include fertiliser use, sewerage discharge etc. Excessive eutrophication leads to the overgrowth of algae and cyanobacteria in water and subsequently to the lack of oxygen in water. Soil eutrophication distorts its original communities.
Evidence System of Contaminated Sites. Evidence System of Contaminated Sites is a public database which contains information on sites, where old environmental burdens are present, i.e. contaminated sites addressed especially by projects of the Ministry of Finance of the Czech Republic, Ministry of the Environment, Operational Programme Environment, and also information on the removal of the contaminated sites resulting from Soviet army residence in the Czech Republic and priority locations addressed by the Czech Environmental Inspectorate. It also includes test data from the district authorities existing at the time of the database inception in 2004 and landfill sites closed before the adoption of Act No. 238/1991 Coll., on waste. The Evidence System of Contaminated Sites database does not include information on remedial actions implemented by the regions, State Environmental Fund of the Czech Republic, other ministries and does not record any private investors.
Exercise price. The agreed price at which the transaction is to be carried out in the future.
Forest species of birds. Birds in this group include: common chiffchaff, Eurasian blackcap, nuthatch, coal tit, tree pipit, willow warbler, song thrush, common treecreeper, dunnock, goldcrest, jaybird, hawfinch, Eurasian wren, Eurasian bullfinch, crested tit, Eurasian siskin, and short-toed treecreeper.
Frost day. A day with a minimum daily temperature equal to or lower than 0 °C.
Fungicides. Plant protection products intended to control fungi.
Government institutions. All institutional units whose competency extends either on the whole economic territory of the Czech Republic (central government, e.g. ministries or state funds) or on certain defined territory of the Czech Republic (local government, such as: territorial self-governing units represented by the regional, urban and municipal authorities or associations of municipalities).
Greenhouse gases. Gases that are naturally present in the atmosphere or produced by humans which have the ability to absorb long wave radiation emitted by the Earth's surface, thus influencing the climates energy balance. The action of greenhouse gases results, in part, in an increased daily average temperature near the Earth's surface. The most important greenhouse gas is water vapour, which accounts for 60 to 70% of the total greenhouse effect in mid-latitudes (excluding the effect of clouds). The most important greenhouse gas affected by humans is carbon dioxide.
Halophytic habitats. Habitats with high levels of salinity.
Hazardous waste. Waste showing one or more of the hazardous properties listed in annex of the directly applicable European Union legislation on hazardous properties of the waste (Commission Regulation (EU) No. 1357/2014 of 18 December 2014, replacing Annex III to European Parliament and Council Directive 2008/98/EC on waste and repealing certain directives).
Heating season. It is characterized by the unit day-degree, which is the product of the number of heating days and the average

difference between indoor and outdoor temperature. The day-degree thus illustrates how cold or warm it was for a certain period of time and the quantity of energy needed to heat the buildings.

Herbicides. Products intended for the disposal of unwanted plants, such as weeds or invasive plants.

Icy day. A day when the temperature does not rise above the freezing point, the maximum daytime temperature is lower than 0 °C.

Indirect greenhouse gas emissions. CO_2 and N_2O emissions which are produced by chemical reactions in the atmosphere from NO_x, NH_3, CO and NMVOCs. These emissions are therefore quantified in the emission inventories and are included in the national emissions balance.

Insecticides. Plant protection products intended to control insects.

Investments in environmental protection (= investment expenditure). Investment expenditure on environmental protection includes all expenditure for the acquisition of tangible fixed assets, spent by the reporting entity in order to acquire tangible fixed assets (by purchase or their own activities), together with the total value of tangible fixed assets acquired free of charge, or not transferred under applicable legislation, or reassigned from private use to business use.

Lime fertilisers. Calcium for the production of lime fertilizers is obtained from carbonate rocks and magnesium carbonate rocks that naturally formed from calcium that had been released from minerals. Another source of lime fertilisers are waste materials from industry – carbonation sludge, cement dust, phenol lime etc., and natural lime fertilisers of local importance. Lime material is used as fertiliser either directly (possibly after mechanical processing) or in the form of fertilisers produced through a chemical process (burnt lime, slaked lime, etc.).

Livestock manure. Fertilisers in the form of livestock excrements, including plant residues, compost, straw, tops and green manure. Their main component are organic substances of plant and animal origin (carbohydrates, cellulose, amino acids, proteins, etc.). Along with these substances, organic fertilisers also contains nutrients (N, P, K, Ca, Mg and other).

LULUCF. The category covering emissions and sinks of greenhouse gases resulting from land use, land use changes and forestry. This category is usually negative for countries with high forest cover and low levels of logging, and positive for countries with low forest cover or where rapid changes in landscape towards cultural landscape are taking place.

Material Intensity of GDP. The amount of materials that a given economy needs to produce a unit of economic output. High material intensity indicates high potential pressure of the economy on the environment and vice versa. Material Intensity of GDP.

Megatrend. The long-term development trend, which is made up of many sub trends and has a significant impact on the environment.

Meteorological conditions. The physical state of the atmosphere in a certain place and at a given time. The developments of meteorological conditions may affect some economic activities (e.g. energy) and the state of the environment (air quality). The term should not be confused with climatic conditions (climate).

Mineral fertilisers (inorganic, industrial, chemical fertilisers). Fertilisers containing nutrients in the form of inorganic compounds obtained through extraction and/or physical and/or chemical industrial processes.

Mixed municipal waste. It is the waste that remains after the separation of usable components and hazardous components from municipal waste, sometimes also called "residual" waste.

Mollusscicides. Plant protection products intended for controlling molluscs, mainly slugs and snails.

Motorisation. This term indicates the number of motor vehicles per 1,000 inhabitants. Together with other indicators (the age of the fleet, the composition of the fleet based on drive types etc.), motorization measures the extent to which the vehicle fleet influences the environment. The indicator is most frequently used for passenger cars; in that case, it is also referred to as automobilisation.

Municipal waste. Are all of the waste generated in the territory of the community during activities of natural persons who are listed as municipal waste in the Waste Catalogue, with the exception of waste arising from legal entities or natural persons authorised to undertake business.

Non-hazardous waste. Waste not showing any of the hazardous properties listed in annex of the directly applicable European Union legislation on hazardous properties of the waste (Commission Regulation (EU) No. 1357/2014 of 18 December 2014, replacing Annex III to European Parliament and Council Directive 2008/98/EC on waste and repealing certain directives).

Non-investment costs on environmental protection. Common or operating expenses, which include payroll costs, payments for material and energy consumption, repairs and maintenance etc. and payments for the services whose main purpose is the prevention, reduction, modification or removal of pollution and pollutants etc. or other degradation of the environment, which are generated by the production process of a given enterprise.

Normality of temperature and precipitation. Indicates to what extent the course of temperature and precipitation in a reporting period is different from the climatological normal (30-year period 1961–1990, while it is prepared to move to the period 1981–2010) and the probability (repetition time) with which the measured values of the temperatures and precipitation occur. The values of the deviations from normal temperatures and normal rainfall between 25 and 75 percentile are referred to as normal values, the values between 25 and 10 as below-normal, values between 75 and 90 percentile as above-normal, values below 10 and over 90 percentile as strongly below/above-normal and values below 2 and above 98 percentile as an extremely below/above-normal. Statistically thus a normal year (month) occurs every 2 years, whereas exceptionally below/above-normal once every 50 years.

Organic food. Food produced from organic farming produce under the conditions stipulated by legislation. It meets specific requirements for quality and health safety (e.g. without using artificial fertilisers, harmful chemical sprays or genetically modified organisms (GMOs). It does not contain chemical additives, preservatives, stabilisers, artificial dyes etc.

Organochlorine pesticides. A group of substances known as organochlorine pesticides includes DDT, HCH (hexachlorocyclohexane) and HCB (hexachlorobenzene) derivatives and others. These are persistent lipophilic substances which were once used as pesticides.

PCBs. Polychlorinated biphenyls is the collective term for 209 chemically related compounds (congeners) which differ in the number and position of chlorine atoms bound to the biphenyl molecule. They had a wide range of commercial use in the past. Their production was banned due to their persistence and bioaccumulation ability. The most harmful effects of these substances include carcinogenic effects, damage to the immune system and liver and reduced fertility.

PEFC and FSC certification. The concurrent certification systems based on the principles of sustainable management in forests. In terms of international recognition, both systems are considered equal.

POPs. Persistent organic pollutants are substances that remain in the environment for a long period of time. They accumulate in the fatty tissues of animals and enter human organisms through the food chains. Even in very small doses, they can cause reproductive disorders, affect hormonal and immune functions and increase the risk of cancer.

Population equivalent. Population equivalent is a number expressing the size of a municipality as a pollution source through converting pollution from facilities and other pollution sources to the amount of population that would be needed to produce the same amount of pollution. One population equivalent corresponds to the production of 150 l waste water and 60 g BOD_5 (organic pollution) per day.

Preventive value. The contents of the risk elements and substances in the soil are evaluated according to Decree of Ministry of the Environment No. 153/2016 establishing the details of the protection of the quality of agricultural soils in the two-step system – based on preventive and indicative values. Preventive values represent the upper limit of geogenic and anthropogenic background contents of substances in the soil and their excess can threaten soil functions. When the indicative values are exceeded, it may put at risk the health of humans, animals and the quality of crops.

Primary energy sources. These sources are the sum of domestic or imported energy sources, expressed in energy units. Primary energy sources are one of the basic indicators of energy balance.

Private non-financial corporations. All non-financial corporations, which are not controlled by governmental institutions, i.e. are privately owned. They are commercial companies, non-profit companies or non-profit institutions providing services for non-financial corporations (association of entrepreneurs, etc.).

Public non-financial corporations. All non-financial corporations, which are controlled by government institutions. They are mainly state-owned enterprises and enterprises with the prevailing state participation (companies), a Fund of Market Regulation (or the State Agricultural Intervention Fund), a Support and Guarantee Fund for Farmers and Forestry and contributory organisations, public benefit companies and public companies, which are market manufacturers.

Q_{355}. The flow rate of a watercourse, which is reached or exceeded on average on 355 days of the year.

Renewable energy sources. These sources are called "renewable" because they constantly replenish themselves thanks to solar radiation and other processes. From the perspective of human existence, direct sunlight and some of its indirect forms are "inexhaustible" energy sources. RES include wind energy, solar energy, geothermal energy, water energy, soil energy, air energy, biomass energy, landfill gas energy and sludge gas and biogas energy.

Rodenticides. Chemical substances intended to control rodents.

RUSLE. A mathematical model describing the process of water erosion of the soil, which is used to calculate the average long-term loss of the soil.

Sorption capacity. The ability of the soil to bind (to sorb) ions or entire molecules of different compounds from soil solution into the solid particulates of the soil. Depending on the type and intensity of sorption, the sorbed substances (nutrients) are protected against wash-out, creating a reservoir of nutrients easily accessible for plant and allowing a gradual nutrient intake during the vegetation period and at the same time substantially reducing the undesirable increase of salt concentration in the soil solution.

Spatial analytical data. The obligation to create spatial analytical documents is imposed by Act No. 183/2006 Coll., on spatial planning and building code (the Building Act). According to Annex 1 to Decree No. 500/2006 Coll., on spatial analytical data, planning documentation and methods of recording of planning activities, as amended by Decree No. 458/2012 Coll., this is phenomenon No. 64 – old environmental burden areas and contaminated sites. The first data for local analytical planning documents were submitted to the authorities of spatial planning in 2007. In accordance with the Building Act, also the ongoing database updates of Evidence System of Contaminated Sites (http:www.//sekm.cz/) are promptly and immediately made available to the spatial planning authorities.

Steam power plant for solid fuel. Steam power stations are generally those that use steam to drive the generator of electricity, whereas water vapour is extracted by heating the water that occurs by burning fuels or nuclear reactions. In this document, however, the category of steam power plants for solid fuel is taken from the statistics of the ERO (where it is referred to as the "steam" category) and includes thermal power plants that burn, in our conditions, particularly brown coal. Nuclear power plants are listed in a separate category.

Summer day. A day with a maximum daily temperature equal to or higher than 25 °C.
Suspended particles. Solid or liquid particles that remain in the atmosphere for a long time due to their negligible stalling speed. Suspended particles in the air pose a significant risk factor for human health.
Territorial system of ecological stability. It is a mutually interconnected set of natural and altered, yet near-natural ecosystems which maintain a natural balance. A distinction is made between local, regional and supra-regional systems of ecological stability. The basic building parts of TSES are bio-centres, bio-corridors and interactive elements.
Thermal energy supply system. A system made up of interconnected source or sources of heat energy and a heat distribution equipment supplying thermal energy for heating, cooling, hot water and technological processes, if it is operated under a license for the production of thermal energy and a license for the distribution of thermal energy. The equivalent of "thermal energy supply within the system of thermal energy supply" is the term "district heating" only in the case of the supply of energy for space heating and domestic hot water.
Total eligible expenditure. In the context of the OPE, it is a sum of funding from the CF, ERDF, other (national) public sources and private sources of financing.
Transport output. The number of passengers or the weight of cargo transported over a distance of 1 kilometre. It is measured in "passenger-kilometres" (pkm) and "tonne-kilometres" (tkm).
Transport volume. The number of passengers or the weight of the cargo transported by a given mode of transportation during the monitored period (usually a day or a year).
Tropical day. A day with a maximum daily temperature higher than 30 °C.
Unfragmented Areas by Traffic. It is a method of determining "areas that are unfragmented by traffic", i.e. areas which are delimited by roads with traffic intensity higher than 1,000 vehicles per 24 hours or multi-track railways with an area larger than 100 km^2.
Urbanization. The process of the concentration of population in cities and the related changes to culture in the broadest sense of the word.
Vehicle fleet. All vehicles belonging to the monitored category. A distinction is made between static and dynamic composition of the vehicle fleet. The static vehicle fleet comprises all vehicles registered on the given date in the Central Vehicle Register. The dynamic fleet includes only vehicles in actual operation on roads.
Waste. Each movable thing that a person discards or intends or is obliged to discard.
Weather. The terms referring to the state of the atmosphere above a certain point on the earth's surface at a certain time. Weather is described using a set of meteorological parameters (temperature, pressure, precipitation, wind speed and direction, and more), including the vertical profiles of these parameters, and meteorological phenomena (generally unquantifiable ice, fog, storm, hail, etc.).
Zoocides. Plant protection products intended against animals.

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