2015

Report on the Environment of the Czech Republic

cenia

Ministry of the Environment of the Czech Republic

Prepared by
CENIA, Czech Environmental Information Agency

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ISBN 978-80-87770-10-8

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Key messages of the Report

The state of the environment in the Czech Republic in 2015, compared to 2014, has not been worsened, despite the economic growth and the associated growth of industrial production and construction, increasing the total energy consumption and transport performance in passenger and freight transport. The development of temperature and precipitation conditions led to a soil and hydrological drought that had an impact on all elements of the environment. On the territory of the Czech Republic there were only 79% of normal rainfall, and thus the drought had a great impact on the groundwater levels and even affected agriculture and the production of electricity from hydropower stations, however the water supply was not significantly disrupted.

In the field of water management drought had an impact especially on the water consumption, which significantly increased in agriculture and on the other hand has been restricted in the area of the energy industry. The water quality has improved in the long term, but year-to-year changes are not very significant. The remaining problem is mainly nitrate and phosphorus pollution caused by the increase in the consumption of manure and mineral fertilisers in agriculture, which was driven by the effort to minimise the damages of extreme drought in 2015. The result was also increase in water eutrophication.

Although the trend in the reduction of emissions of pollutants into the air continues, the air quality in the Czech Republic in 2015 was not satisfactory. Limit values for suspended particulate of fraction PM_{10} a $PM_{2.5}$, benzo(a)pyrene and ground-level ozone are still being exceeded. The primary factors that have been affecting air quality in the Czech Republic in the long term are household heating (particularly in inverse locations), transport, and industrial and energy production. Furthermore, the air quality in 2015 adversely affected the weather conditions, especially temperature extremes, which can be considered as one of the manifestations of climate change. In the long term the most serious situation is in the Moravian-Silesian region, and particularly in the agglomeration of Ostrava/Karviná/Frýdek-Místek.

The result of the intense air pollution loads over the past decades is, inter alia, the poor health of forest stands, expressed as a percentage of defoliation. However, the trend of slow convergence to a more natural structure of forest stands is positive, particularly the long-term gradual increase in the proportion of deciduous trees on the total area of the forest. Despite the fact that in the Czech Republic there is an increase in the proportion of organically farmed land, the inappropriate way of farming still prevails in the countryside, coupled with massive uniting of land plots and the absence of grassed strips, which increases the potential risk of soil erosion by water and wind. This is also reflected in the state of biodiversity, which is represented by the long-term decline in the abundance of the stocks of all common species of birds. The landscape is also affected by the increase of area of artificial surfaces associated with the development of road infrastructure, which causes a high rate of its fragmentation.

Due to the fact that the industrial production in 2015 has increased year-to-year, the final energy consumption has also increased, which was most contributed to by the industry among other sectors. On the other hand, the production of electricity decreased, even though its domestic consumption increased. This imbalance is offset by a significant decline in the export of electricity abroad. In the transport sector there has been a growth of transport performances of both passenger and freight transport, and passenger car transport has significantly increased. However, thanks to the modernisation of the fleet of road vehicles, the traffic increase has not led to an increase in emissions of VOC, CO and suspended particles from transport into the air.

Waste generation in the Czech Republic has had in the long term a rather stagnating tendency until 2015, when it was more significantly increased. The fact that waste treatment is dominated by waste recovery, especially as material, even for packaging waste, seems to be positive. In the case of municipal waste, however, landfilling still prevails, although it is gradually reduced. The problem continues to represent contaminated sites that can greatly endanger the environment, and therefore, it is necessary to pay special attention particularly during their remediation.

In 2015, there was a continued growth of public expenditure on the environmental protection, which reached 1% of GDP, both in the case of central resources, as well as local budgets. In the framework of the EU funding the successful drawing of the Operational Programme Environment sources continued and thus in 2015 it was managed to use up almost the entire financial allocation (99.7%) of Operational Programme Environment for the programming period 2007–2013. The follow-up Operational Programme Environment for the programming period 2014–2020 was also approved, in which new calls have already been announced.

The main findings of the Report

Air and climate

- In 2015 the Czech Republic was affected by a historically significant episode of drought, which peaked in mid-August. The drought had a great impact on the groundwater status and the spring yield and significantly affected agriculture and hydropower, although the water supply to inhabitants was not significantly disrupted.
- The total aggregate greenhouse gas emissions in the Czech Republic in 2014 decreased year-to-year by 3.7%, and thus were by 36.7% lower compared to 1990.
- Emissions of acidifying substances (SO_2, NO_x a NH_3), ozone precursors (VOC, NO_x, CO and CH_4) emissions of primary particles and secondary particulate precursors (NO_x, SO_2, NH_3) into the atmosphere have been dropping steadily since 1990, while there was a confirmed decline also between the years 2014–2015 (identically by 2.2% in the case of acidifying substances and ozone precursors and by 2.8% in the case of precursors of secondary particles).
- Limit values for suspended particulates, benzo(a)pyrene and ground-level ozone have been exceeded repeatedly in 2015. On two traffic-loaded locations in Prague the limit values for NO_2 were exceeded, and in one location in the Czech Republic even the limit values for cadmium were exceeded.
- In 2015 compared to 2014 there was an increase in the announcement of the number of smog situations due to high concentrations of ground-level ozone, caused by the current meteorological and dispersion conditions (extreme heat and drought).

Water management and water quality

- In 2015, the total abstraction of water dropped, while the largest decrease was recorded in the energy sector (from 713.0 mil. m^3 in 2014 to 647.9 mil. m^3 in 2015). Year-to-year, there was an increase in water abstraction for water industry (612.8 mil. m^3 in 2015 versus 602.0 mil. m^3 in 2014) and agriculture (54.3 mil. m^3 in 2015 versus 48.5 mil. m^3 in 2014).
- The reduction of the total amount of discharged waste water continues, while the year-to-year decrease amounted to 5.6%. The biggest contribution to the decrease was made by the energy industry (decrease of 10.2%) and, in particular, agriculture (decrease of 47.7%), and an important factor in the decrease was the drought.
- The proportion of the population connected to sewerage system is growing. However, 19.2% of the population is still not connected to a sewerage system ending in a waste water treatment plant. In 2015, 52.3% out of the total number of waste water treatment plants were equiped with the tertiary degree of treatment.
- The quality of the bathing water according to the rating of the Czech Republic is generally good, but year-to-year there was an increase in the sites unsuitable for swimming, in particular as a result of drought.

Nature

- In 2015 around 17% of the area of the Czech Republic was protected by means of specially protected areas, and through the Natura 2000 network it was approximately 14% of the Czech Republic. Due to the overlap of the specially protected areas and Natura 2000 approximately 22% of the total area of the Czech Republic is protected.
- Since 1982, there is a continual decline in the numbers of common species of birds in the Czech Republic. Numbers of populations of common species of birds in the Czech Republic between the years 1982–2015 dropped by 5.9%, forest bird species by 16.6% and the population of the birds in the agricultural landscape by 31.2%.

Forests

- The damage to forest stands in the Czech Republic expressed as a percentage of defoliation still remains at a high level. In the category of older stands (60 years and over) the sum of the defoliation classes 2–4 for conifers was 73.0% and for deciduous trees it was 39.3%. In the younger stands (up to 59 years), the situation is more favourable.
- The proportion of deciduous trees in the total forest area of the Czech Republic gradually increases, in 2015 it accounted for 26.5% of the total forest area. The proportion of fir in the total area of forests consistently hovers around 1%.
- Between 2014 and 2015, there was an increase in the total area of forest land by about 2,016 ha. The area of forests, which are certified in accordance with the principles of sustainable management of forests according to PEFC and FSC, dropped from 70.0% to 68.2%.

Soil and landscape

- The total acreage of agricultural land resources of the Czech Republic is decreasing. In the period 2000–2015 this was a decrease of 67.9 thous. ha, which represents 1.6% of the total area of agricultural land. In particular, agricultural land is shrinking in favour of urban and other areas.
- Although the decline in unfragmented areas is slowing down, the landscape fragmentation process still continues.
- In the Czech Republic in 2015 there was 47.3% of agricultural land potentially threatened by water erosion and 18.0% by wind erosion.
- In the Czech Republic there is less than 10,000 old environmental burdens, i.e. contaminated sites. In the territorial analytic documents there are 9,242 sites registered, including those registered in the Evidence System of Contaminated Sites (4,746 sites). Based on the database of the Evidence System of Contaminated Sites, in 2015 remediation was completed on 52 sites and 6 other remedial actions have been completed in an unsatisfactory condition. Despite the clear benefits and the amount of remedial actions 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.

Agriculture

- The consumption of plant protection products (in particular herbicides and fungicides) in 2015 dropped year-to-year by 3.3%, and on the contrary, the consumption of calcium substances increased by 7.1%, enhancing the production capabilities of soils, and the consumption of livestock manure has increased year-to-year by 4.9%.
- In 2015 there was a growth of organic farming, about 11.8% of the total cultivated acreage agricultural land resources was farmed ecologically.

Industry and energy

- The volume of the abstraction of mineral resources in the Czech Republic has been declining since 2000. 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 2015, the industrial production in the Czech Republic increased by 4.6%.
- The method of heating homes in the Czech Republic does not vary, in 2015 there was a majority of central heat supply (35.8%) and natural gas heating (34.7%). Solid fuel heating is not falling (15.0%). In 2014, the total emissions of PM_{10} were caused by home heating in 33.9%.
- The electricity production in 2015 dropped year-to-year by 2.5%, and there was also a slight decrease in electricity production from RES, that was due to the decrease in production in aquatic plants as a result of low levels of water flows.

Transportation

- The overall transport performance of passenger and freight transport are growing. Within the structure of the transport performance of freight transport, there is a continued growth of road transport, which is the least favourable from an environmental point of view.
- In 2015 emissions of VOC, CO and suspended particles from transport continued to decline and on the other hand, the consumption of energy in transport is increasing, and thus also the production of greenhouse gas emissions from transport. The PAH emissions from transport are increasing, which has a negative impact on human health.

- To levels of noise from road traffic in excess of the limit values laid down in the Czech Republic are all day exposed 2.5% of the population of the Czech Republic and 6.2% of the population in agglomerations of over 100 thousand of inhabitants. In some cities and smaller settlements significant annoyance is caused by the transit traffic on the main roads.

Waste and material flows

- Total waste generation stagnated since 2009 until 2015, when there was a more significant increase of 16.6% compared to the year 2014. The generation of municipal waste has a stagnating tendency throughout the reporting period of 2009–2015.
- The material recovery of waste significantly prevails (83.2% of the total generation of waste in 2015) in the waste treatment structure. The most common method of waste disposal is landfilling (8.6% in 2015), the share of which in the total waste generation is, however, decreasing.
- In the treatment of municipal waste landfilling prevails (47.4% in 2015), however its share in the total generation of municipal waste declines in long-term. For material recovery 35.6% of municipal waste is used.
- The generation of packaging waste is increasing, while in 2015 there was 1,084.8 thous. t packaging waste generated, however, on the other hand, the extent of recycled packaging waste is also increasing.
- The take-back of selected products is slightly increasing, especially for portable batteries and accumulators.

Financing

- In 2015 the growth of investment in environmental protection continued by significant 27.8%, reaching CZK 40.1 bil. In the context of public support in the area of environmental protection in 2015 the volume of expenditure from central resources as well as from local budgets has grown, in both cases reaching 1% of GDP. Expenditure on environmental protection from central resources have increased in 2015 by 12.2% to CZK 43.1 bil. and from the local budgets by 32.5% to the total CZK 44.9 bil.
- In the framework of the original Operational Programme Environment 2007–2013, almost the entire financial allocation (99.7%) of a total of EUR 4.6 bil. (approx. CZK 122.9 bil.) has been paid by the end of 2015, while in the evaluated year 2015 the record number of EUR 1.3 bil. (approx. CZK 35.2 bil.) was paid out from EU funds. In the context of the subsequent calls already concluded in the follow-up Operational Programme Environment, there were 1,138 project applications registered in 2015 with the value of EUR 0.5 bil. (approx. CZK 12.8 bil.) from EU funds.

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 2015 was discussed and approved by the Government on November 28th, 2016 and then provided to the 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 2015 and Reports on the Environment in the Regions of the Czech Republic 2015.

Environmental assessment using indicators

* Change since 2009.

1 Air and climate

1 | Hydrometeorological conditions

Key question

What were the temperature and precipitation conditions on the territory of the Czech Republic and related hydrological and agriculture drought in 2015?

Key messages

In terms of temperature, the year 2015 was extremely above-normal on the territory of the Czech Republic, the average annual temperature 9.4 °C was higher by 1.9 °C than long-term average in 1961–1990. Year 2015 was, together with the previous year 2014 the warmest year since 1961. Summer period was in 2015 the second warmest period since 1961, with an exceptionally warm August with the temperature deviation of 4.9 °C from the long-term average, it was one of the warmest yet recorded. In terms of precipitation, the year 2015 was significantly below normal; the average rainfall of 532 mm represents 79% of the 1961–1990 long-term average. Annual precipitation for 2015 is the second lowest since 1961.

In 2015 the Czech Republic was affected by a historically significant episode of drought, which peaked in mid-August. The deepening precipitation deficit and significantly above-average temperatures during the summer months caused the gradual drying of the soil down to the level of the soil dry. Hydrological drought has affected almost all of the territory of the Czech Republic as the lack of surface and underground water. Drought significantly affected the agriculture and hydroenergetics, however water supplies were not significantly disrupted.

References to current conceptual, strategic and legislative documents

Strategy on Adaptation to Climate Change in the Czech Republic
- mitigate the impacts of climate change adaptation, conservation of the welfare and preservation, or possibly improvements of the economic potential
- assessment of likely impacts of climate change on selected economic and environmental areas
- proposals for concrete adaptation measures, legislative and economic aspects

Resolution of the Government of the Czech Republic No. 620 to prepare the implementation of measures to mitigate the negative impact of the drought and lack of water
- 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

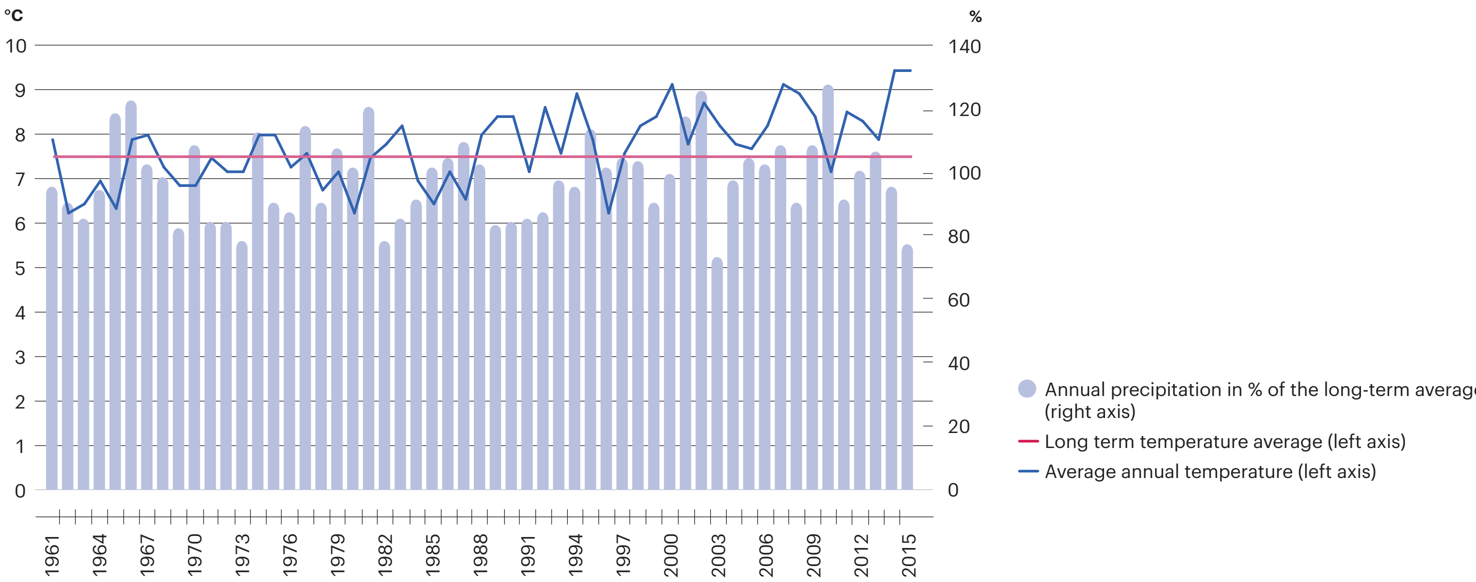
Impacts on human health and ecosystems

Major impacts on populations and ecosystems has a growing climate extremity and more frequent occurrence of dangerous hydrometeorological phenomena. High temperatures in the summer are a burden for the cardiovascular system and are associated with a higher incidence of heart attacks and with a higher mortality rate from diseases of the circulatory and respiratory system. Increased concentrations of ground-level ozone have irritant effects on the respiratory system and damage the green parts of plants, affecting agricultural production and the state of forests. Larger floods affect the quality of surface water, can contaminate drinking water and cause the spread of infectious diseases. Negative impacts on ecosystems are brought by, but not limited to, torrential rainfall (soil erosion), strong wind (damage to the forest, agricultural crops and wind erosion) and long-lasting drought (lack of moisture for plants, reducing the quantity and quality of surface waters).

Indicator assessment

Chart 1

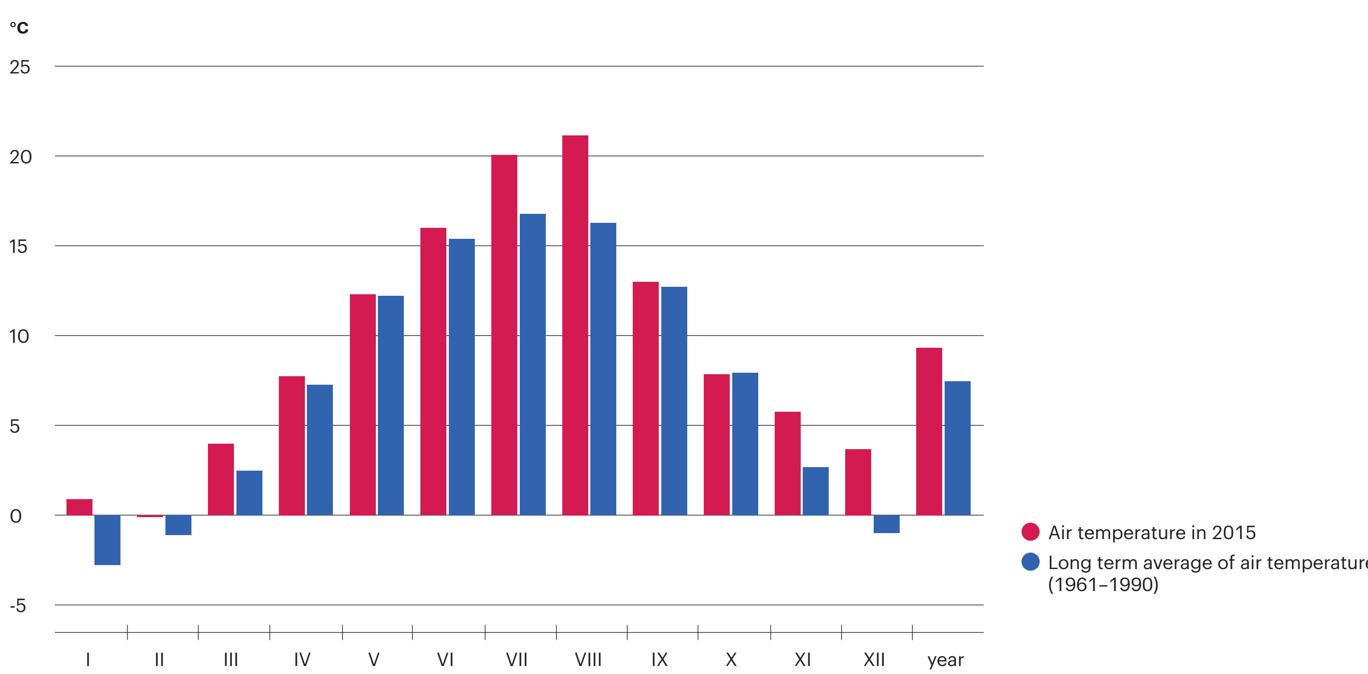
Long-term development of annual average air temperature and annual precipitation totals on the territory of the Czech Republic compared with the 1961–1990 long-term average, 1961–2015 [°C, %]



Source: Czech Hydrometeorological Institute

Chart 2

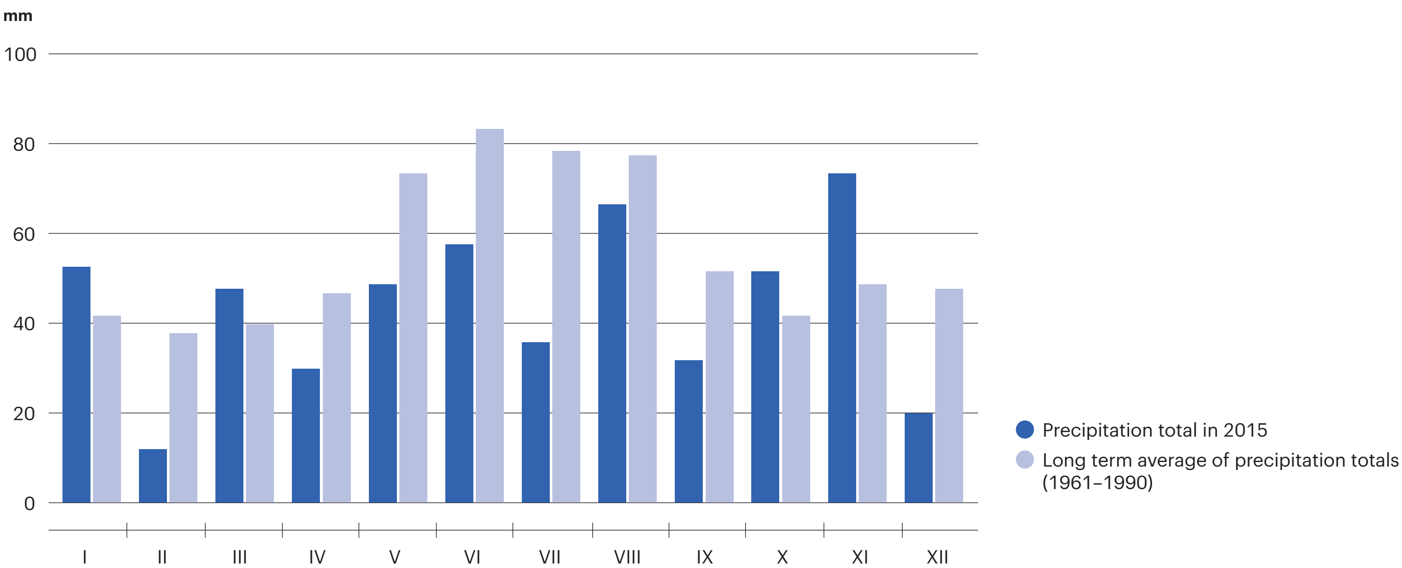
Monthly average air temperature in the Czech Republic (areal temperatures) compared with the 1961–1990 long-term average [°C], 2015



Source: Czech Hydrometeorological Institute

Chart 3

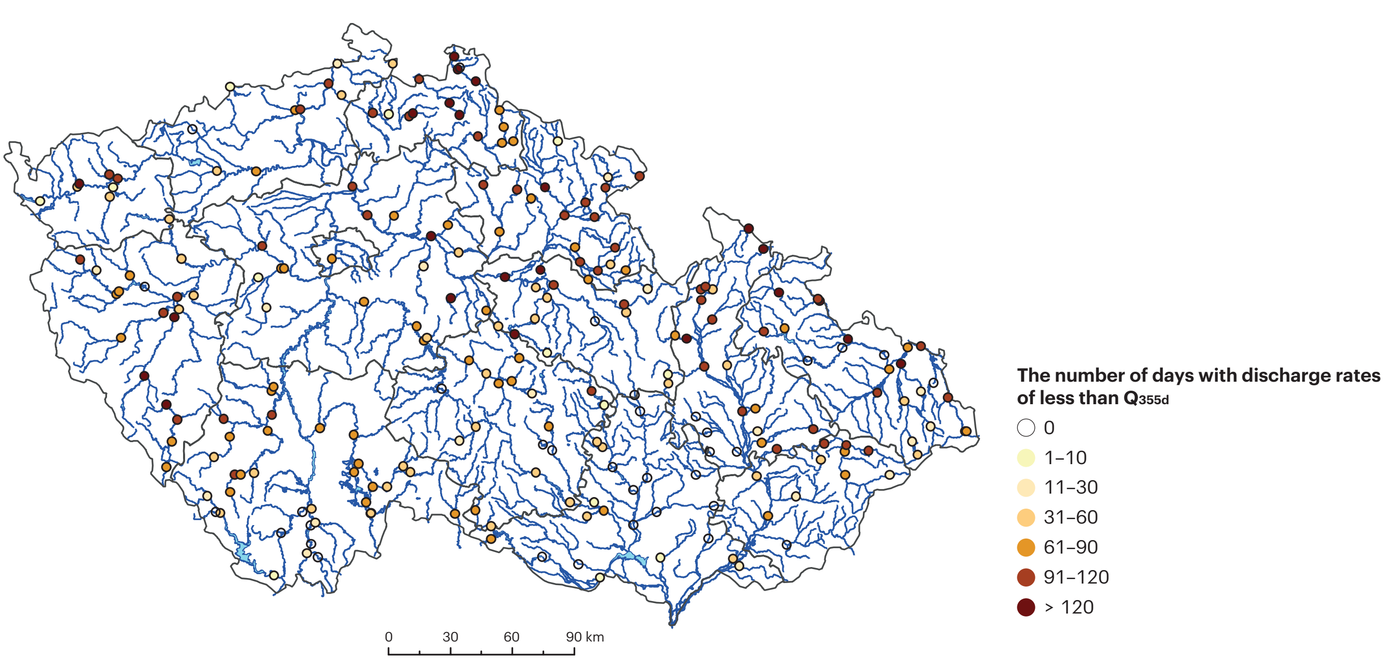
Monthly precipitation totals on the territory of the Czech Republic (territorial precipitation) in comparison with the 1961–1990 long-term average [mm], 2015



Source: Czech Hydrometeorological Institute

Figure 1

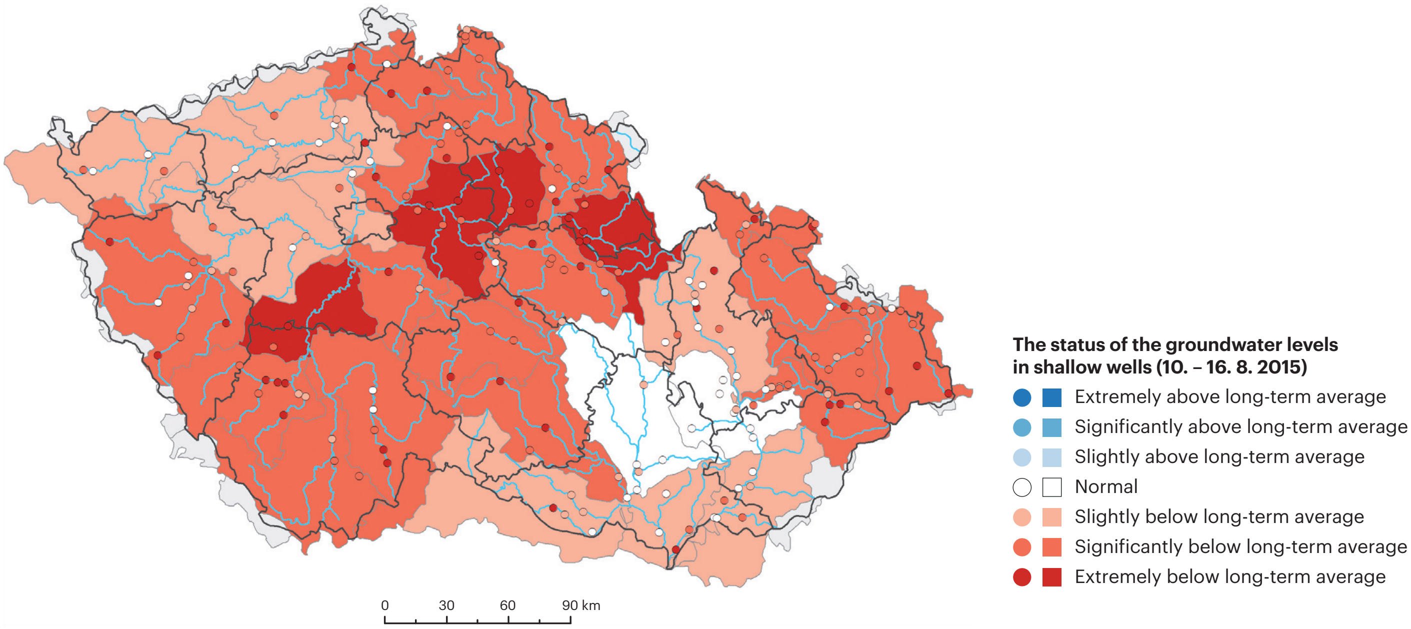
Number of days in the year 2015 with a capacity of less than the long-term 355-day discharge for the period 1981–2010



Source: Czech Hydrometeorological Institute

Figure 2

Status of the groundwater levels in shallow wells, 33rd week of 2015 (10. 8. – 16. 8. 2015)



Source: Czech Hydrometeorological Institute

In terms of temperature, the year 2015 was **extremely above normal** on the territory of the Czech Republic (Chart 1). The average annual temperature of 9.4 °C was by 1.9 °C higher than the 1961–1990 long-term average. The year 2015 together with the year 2014 with the same average annual temperature were the warmest since 1961. The average temperature in the summer months of June–August (19.2 °C) was the second highest after 2003 in the observation period from 1961. In terms of precipitation the year 2015 was **significantly below normal**; the average rainfall in the Czech Republic of 532 mm represents 79% of the long-term average for 1961–1990. The annual precipitation for 2015 was the second lowest since 1961, there was less rain only in 2003, and it was just 505 mm. For the growing season (April to September) there was an average of 272 mm of precipitation, which is the least since 1961.

January was significantly above normal in terms of temperature. The average January temperature reached the value of 0.9 °C, which is by 3.7 °C higher than the 1961–1990 long-term average (Chart 2), it was normal in terms of precipitation (126% of the long-term average for 1961–1990). Months from February to June as a whole were normal in temperature (deviations from long-term average in the individual months from +0.1 °C up to +1.5 °C). The first decade of February was the coldest period of the whole year 2015, the minimum air temperature dropped on 4th February and 5th February in mountain stations in Šumava and in the Krušné and the Jizera Mountains below –20 °C. February precipitation was **significantly below normal** in the Czech Republic, the average rainfall was only 12 mm (32% of the long-term average). More precipitation fell in Moravia (territorial average of 20 mm, i.e. 54% of the long-term average) than in the Bohemia (only 7 mm, only 19% of the normal). In March there was normal precipitation, the month of April, May and June had the precipitation under the long-term average. The precipitation activity was concentrated in short, territorially limited intense episodes that have been alternated with extended periods of almost or completely without any precipitation. In June there were significant temperature fluctuations. At the beginning of the month the Czech Republic was hit by the first heat wave already on 3rd June, which was the first tropical day, while the heat wave culminated on 13th June, after which there was an outbreak of strong thunderstorms with torrential rain and subsequent cooling. Overall, in June there was more rainfall in the Bohemia (84%) than in Moravia and Silesia (46%).

In terms of temperature, July 2015 was **extremely above normal** in the territory of the Czech Republic. In the course of the month there were two heat waves, the first from 1st to 8th July, the second from 16th to 25th July, and there was a record of up to 18 tropical days (e.g. station Brno-Žabovřesky, Lednice and Brod nad Dyjí). Precipitation in July was **significantly below normal**. The highest precipitation totals were recorded in mountainous areas and locally depending on the occurrence of rainfall associated with storms. Overall, it was the fifth driest July since 1961. The sum of area rainfall in the Czech Republic for the period from January to July in 2015, was the lowest since 1961 (289 mm).

The month of August with an average temperature of 21.3 °C and a deviation from the long-term average of +4.9 °C, was the **hottest August since 1961**. At the beginning of August the Czech Republic was hit by **a significant heat wave**. Extremely warm weather persisted for 14 days (3rd to 16th August) throughout the territory of the Czech Republic. In this period there was a continuous period of 9 days , when at least one station has recorded the maximum temperature of 37 °C and more. The highest maximum temperature for this period were measured on 8th August at the stations Husinec-Řež (40.0 °C), Dobřichovice (39.8 °C) and Ústí nad Labem, Vaňov (39.1 °C). The highest maximum temperature in Moravia and Silesia was measured on 8th August at the station in Javorník (38.2 °C). This was followed by temporary cooling, which had been followed by another very warm period at the end of the month, when the maximum daily temperature at many stations again reached above 30 °C. The highest number of tropical days in August has been recorded at the station Dobřichovice (20), the average number of **tropical days** for the entire year 2015 was 26, which exceeds the long-term average more than fivefold. From the perspective of precipitation (86% of the long-term average) August can be considered as **normal**. Most of the monthly rainfall came from precipitation in days 16th up to 18th August, when the highest daily precipitation in excess of 50 mm and in some places up to 80 mm have been reached. Although the one-day total precipitation was not significant in terms of extremity, in the case of two-and three-day rainfall even 100-year values were exceeded.

The months of September and October were generally normal in temperature, in September the temperature was higher in Moravia, the deviation from long-term average was for Moravia and Silesia 0.5 °C higher than for Bohemia. The temperature in November was significantly above normal, it was the third warmest November since 1961. From the autumn months September was dry, however, November was with above normal precipitation (Chart 3), whereas higher precipitation total was recorded in Bohemia (175% of the normal) than in Moravia and Silesia (only 112% of the normal). December was **extremely above normal** in terms of temperature, it was the warmest December since 1961. In the Czech Republic there was a deviation from the long-term average by about 1.3 °C higher than in Moravia and Silesia. The warmest period occurred around Christmas, when on 22th to 26th December the average daily air temperature in the territory of the Czech Republic was about more than 8 °C above the long-term average. In terms of precipitation December was **below normal**, precipitation occurred mainly in the first two decades of the month. The snow cover at the end of the month occurred at the highest altitudes of the Ore mountains (Labská bouda 10 cm on 31th December), the Jizera Mountains and the Šumava.

In 2015 the Czech Republic was hit by a historically **significant episode of drought**[1] caused by the combination of a deepening precipitation deficit and temperatures significantly above the average. The rainfall deficit in the Czech Republic began to manifest in the 2014 and since February 2015 it further gradually grew during the spring months. The peak of the drought was in the first half of August.

The rainfall deficit and high temperatures in the summer were reflected in the very negative **moisture balance**. The basic values of the moisture balance (the difference between precipitation and potential evapotranspiration) gradually decreased to values below –300 mm in the middle of August and this situation continued even during September. The most affected was the region of South Moravia, Haná region, Eastern Polabí and a part of the Central and South Bohemia, where deviations of the basic moisture balance from the long-term average in 1981–2010 exceeded –200 mm.

Due to the negative moisture balance the **water supply in the soil** quickly dropped. In the case of arable soil layers values up to 40 cm the levels of usable water capacity in mid-August dropped in most of the country under 30%, when it starts to significantly reduce water availability for the root system of plants and these values can be therefore considered as soil drought. On the part of the territory the value of usable water capacity in arable soil layer dropped even below 10%, which is already a wilting vegetation limit, while the worst-affected regions were the South Moravian and Central Bohemian regions.

Hydrological drought affected in 2015 virtually the entire territory of the Czech Republic. On most of the water flows, according to field measurements, the level fell for a few weeks significantly below the level of 355-day discharge (Q_{355d})[2], and for a number of flows even significantly below the level of the 364-day discharge. It is possible to name e.g. Orlice in Týniště nad Orlicí, where in 2015 there was a 355-day and lower discharge measured for 99 days and 364-day and lower discharge measured on 55 days, the Elbe in Prelouč (Q_d<Q_{355d} 126 days, Q_d<Q_{364d} 52 days) or Olše in Věřňovice (Q_d<Q_{355d} 110 day, Q_d<Q_{364d} 82 days). In some regions there was a complete drying of smaller flows. The situation was critical in particular in the basin of Czech rivers, on the Oder and upper Morava. In contrast, in most of the rivers in the Dyje river basin and Central Moravia did not reach hydrological drought and their daily discharge rates throughout the year 2015 were above the level of Q_{355d} (Figure 1).

[1] See the Evaluation of the drought in the territory of the Czech Republic, Czech Hydrometeorological Institute, 12/2015. Available at http://portal.chmi.cz/

[2] Q_{355d} is a discharge that is in the long-term average reached or exceeded for a period of 355 days a year, this is an indicator of hydrological drought. When the discharge is reduced to the values of 364-day discharge and lower, it means a very significant hydrological drought.

Water reservoirs with a significant reserve space contributed to the alleviation of the hydrological drought by increasing the minimum discharge rates. This, however, along with other influences (water abstraction from the reservoirs, reduced inflows, increased evaporation from the surface, etc.) led to a gradual decline in water levels of most reservoirs. At the end of the year 2015 the reserve spaces in many reservoirs have still been filled with less than 60%. As an example we may mention the reservoirs in Orlik, Fláje, Vranov, Těrlicko, or Šance.[3]

Drought had a significant impact also on the **level of groundwater**. In mid-August, the drought[4] was reported by a total of 59% of the shallow wells (Figure 2). Most have been affected in the northeastern and southwestern Bohemia and North-East Moravia. The likelihood of exceeding the levels in shallow wells in 2015 due to the monthly excess curve[5] for shallow wells in July in most of the river basins reached values below long-term average, in August reached in the Upper and Middle Elbe basins, the upper Vltava and Oder values significantly below long-term average (88%, 87%, and 87%). The decreasing levels of groundwater in many river basins continued in the autumn months, while an especially critical situation was in the basin of the Oder, where in December the level of the groundwater levels reached 90% probability of exceeding with respect to the monthly excess curve.

Also in the case of the **spring yield**, the drought has been recorded from the spring months. In terms of the inclusion of the spring yield to a monthly excess curve, the yield was the smallest at the end of September (week 40). The lowest spring yield was recorded in the Upper and middle Elbe basin (from August to October, 87–88% of the monthly exceedance curve and in the basin of the Oder (from July to November from 85 to 88% of the monthly exceedance curve).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[3] *The reservoirs Fláje and Šance had their level reduced for operational reasons.*

[4] *Significantly or extremely below the long-term average.*

[5] *The monthly excess curve express the probability of exceeding the levels in a well in the relevant calendar month. They are calculated for the period 1981–2010, whereas values in the range of 25–75% mean normal condition, values of 75–85% are below normal condition and values over 85% mean significantly below normal condition.*

2 | 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

The total aggregate greenhouse gas emissions in the Czech Republic in 2014[6] decreased year-to-year by 3.7%; and thus were by 36.7% lower compared to 1990. In 2014 emissions from energy processes in stationary sources significantly decreased, particularly from the energy industry and the manufacturing industry, the warm winter supported the decline in emissions from residential heating. Emission intensity of the economy of the Czech Republic is steadily decreasing.

After a transitional period of decline in the period of 2009–2013, emissions from transport are rising again including their share in the total aggregated emissions of greenhouse gases. The F-gases emissions are significantly growing as a result of the use of products replacing chlorofluorocarbons (CFCs), which have grown since 2000 more than tenfold. Due to the growth of industrial production the non-combustion emissions from industrial processes and the use of products are slightly increasing and the emissions from waste is slowly rising.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

The National Programme to Abate Climate Change Impacts in the Czech Republic
- 30% reduction of CO_2 emissions per inhabitant in the Czech Republic by 2020 compared to 2000
- 25% reduction of total aggregated greenhouse gas emissions by 2020 compared to 2000

Climate Protection Policy of the Czech Republic[7]
- reduction of emissions in the Czech Republic by 2020 by at least 32 Mt CO_2 eq. in comparison with the year 2005
- reduction of emissions in the Czech Republic by 2030 by at least 44 Mt CO_2 eq. in comparison with the year 2005
- reaching the indicative level of 70 Mt CO_2 eq. emissions released in 2040
- reaching the indicative level of 39 Mt CO_2 eq. emissions released in 2050

Strategy on Adaptation to Climate Change in the Czech Republic
- mitigate the impacts of climate change by means of adaptation, conservation of the welfare and preservation, or possibly improvements of the economic potential

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

[7] *Adopted by the Government on 22. 6.2016. During 2015 the Climate Protection Policy of the Czech Republic was in the preparation and at the same time being discussed within the Ministry of the Environment and outside environmental sector, incl. industry and NGOs.*

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)

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

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

Europe 2020 – A European strategy for smart, sustainable and inclusive growth
- 20/20/20 targets for 2020 – 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%

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

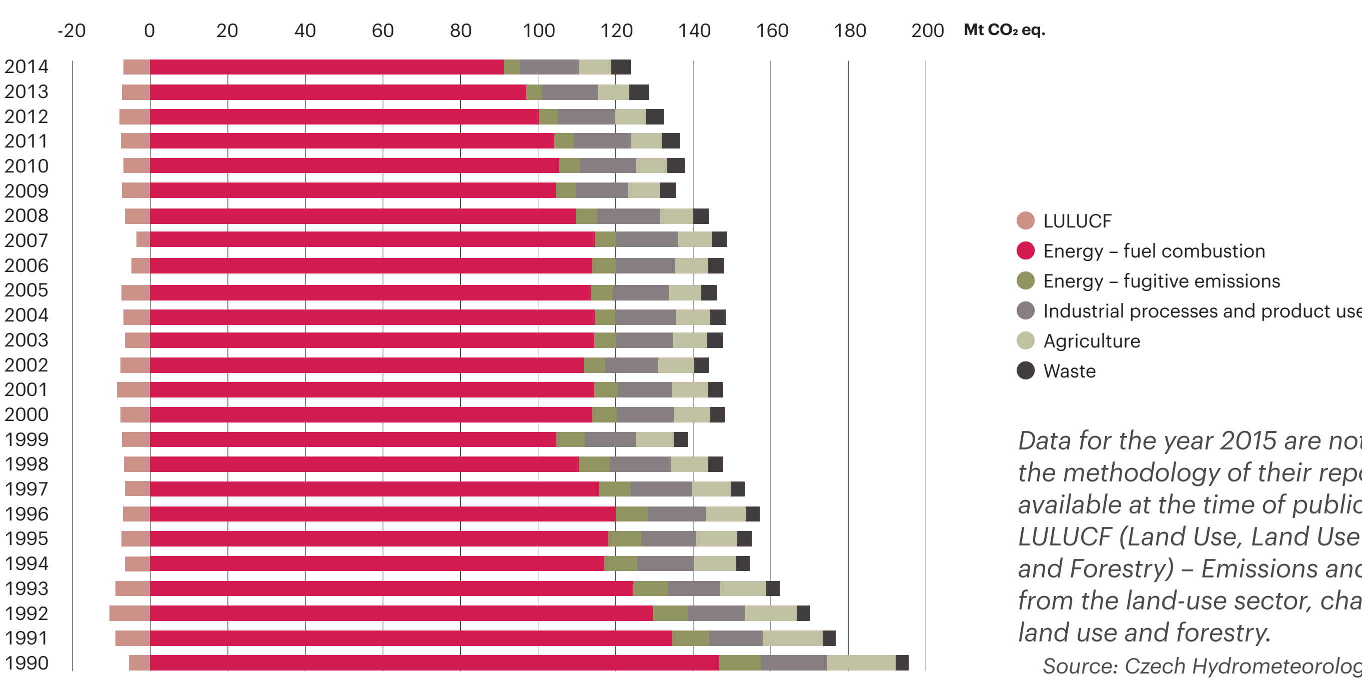
Impacts on human health and ecosystems

The anthropogenic production of greenhouse gas emissions and the climate change associated with it is one of the largest global environmental issues, causing significant impacts on ecosystems and the human civilisation. Increasing the atmospheric concentrations of greenhouse gases intensifies the greenhouse effect of the atmosphere, thus disrupting the energy balance of the climate system. The manifestations of climate change, including rising temperatures, higher spatial and temporal variability of precipitation and more frequent occurrence of dangerous hydrometeorological phenomena, such as extremely high temperatures, floods and droughts, represent a threat for human health, ecosystems, and the national economy.

Indicator assessment

Chart 1

Development of aggregated greenhouse gas emissions by sectors [Mt CO_2 eq.], 1990–2014

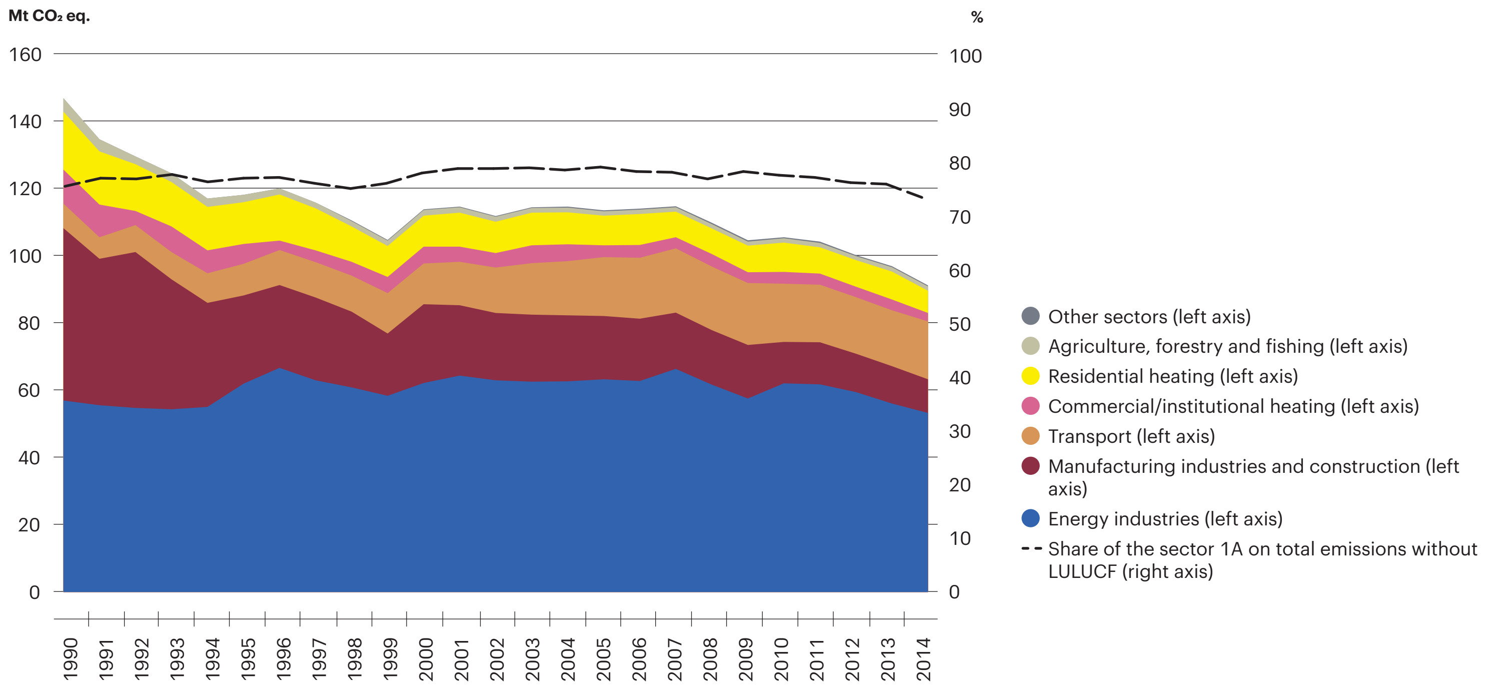


Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication. LULUCF (Land Use, Land Use Change and Forestry) – Emissions and removals from the land-use sector, changes in land use and forestry.

Source: Czech Hydrometeorological Institute

Chart 2

Development of aggregate greenhouse gas emissions from the energy sector – combustion processes and the share of this sector in the total aggregated emissions [Mt CO_2 eq., %], 1990–2014

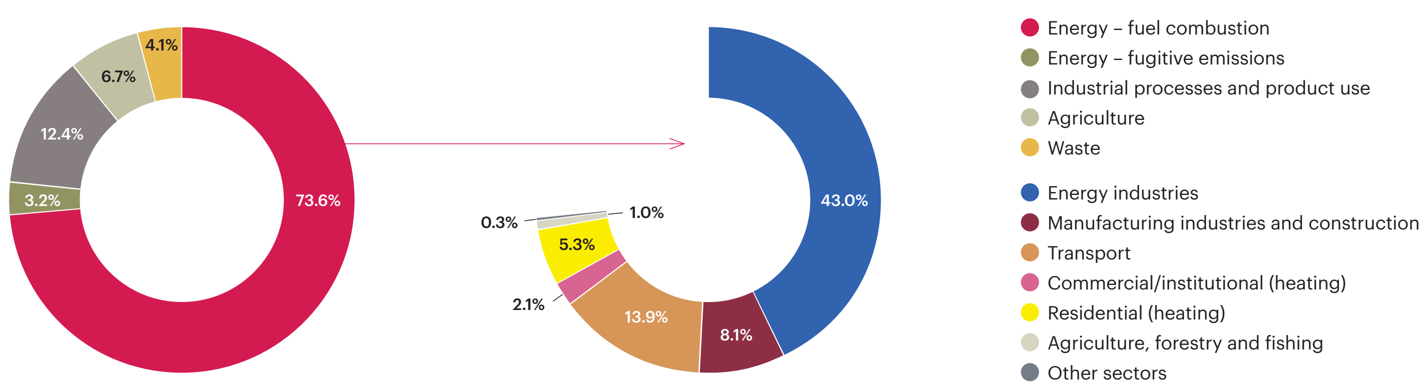


Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

Chart 3

Structure of greenhouse gas emissions by major source categories [%], 2014 (excluding LULUCF)

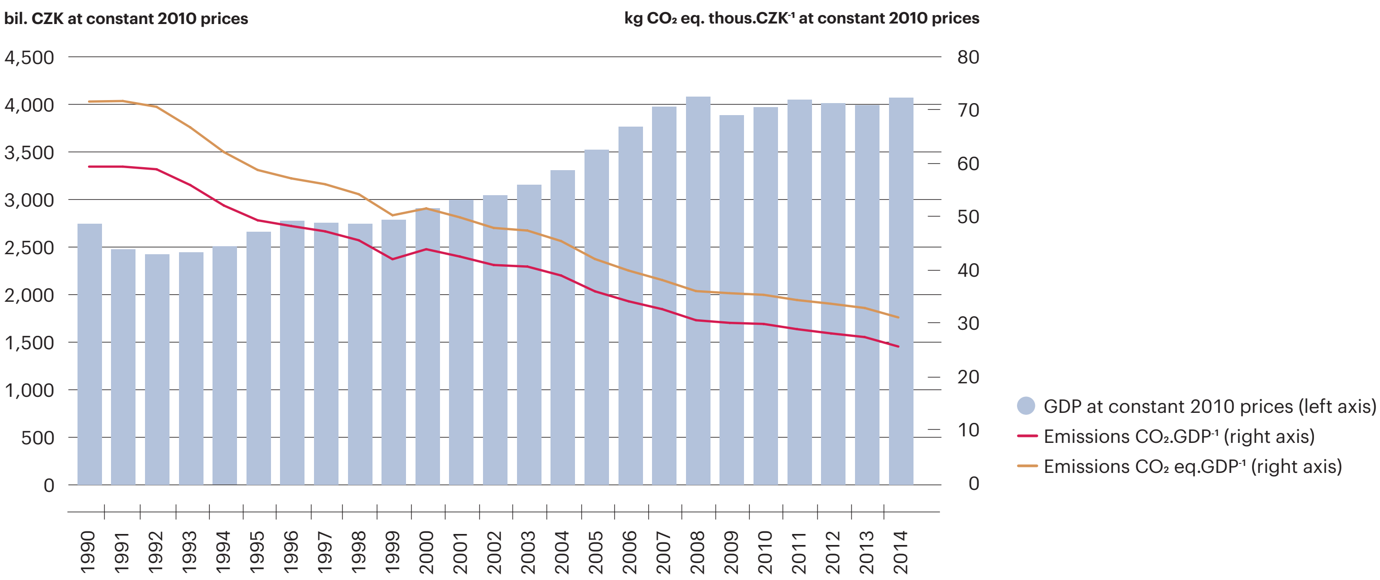


Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

Chart 4

Evolution of the emission intensity of the economy of the Czech Republic [kg CO_2 eq.thous. CZK^{-1} at 2010 constant prices] and GDP [bil. CZK, at 2010 constant prices], without the LULUCF sector, 1990–2014



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

Source: Czech Hydrometeorological Institute, Czech Statistical Office

The total **aggregated greenhouse gas emissions** declined in the Czech Republic in 2014[8] by 3.7% (4.7% Mt CO_2 eq.) to 123.7 Mt CO_2 eq. (without LULUCF), and were by 36.7% lower than in the reference year of 1990 (Chart 1). The objective of the second commitment period of the Kyoto Protocol, setting the drop in emissions by 20% by 2020 compared to 1990, is thus fulfilled with a reserve. After 2000 emissions initially fluctuated and their development was affected by economic growth, since 2007 there is a trend of decreasing emissions, year-to-year decrease in 2014 was the second highest since 2000. In the period 2000–2014 the aggregate emissions dropped by 16.4%.

The development of total emissions of greenhouse gases during the entire reporting period, especially in its end, substantially influenced the decrease in emissions from the **energy sector – combustion processes** (CRF sector 1A, Chart 2), the share of which in the total aggregated emissions in 2014 was 73.6%. In the period 2000–2014 emissions from this sector decreased by 20.0%, in 2014 in the interannual comparison by 5.9%. Emissions from the **energy industry** have started dropping more significantly since 2010, dropping in 2014 by 5.1%. The positive development of emissions is influenced by the decrease in the consumption of primary energy sources and by reducing the share of solid fuels and a growing share of low-emission sources (nuclear, hydroelectric and other REZ) in the structure of electricity generation, which in 2014 reached 27.5%. Emissions from **combustion processes in the manufacturing industry and construction** are significantly and steadily falling, in the period 1990–2014 fell by 80.4%, i.e. to about one-fifth, since 2000 by about 57.1%, in 2014 in the yearly comparison by 9.7%, in spite of the growth of industrial production in this year.

Emissions **from transport** have a growing trend that was most pronounced at the beginning of the 21st century. The decline in emissions in the period 2007–2013 was only temporary, in 2014 the emissions from transport increased in the year-to-year comparison by about 3.0%. Emissions from **residential heating in households and commercial buildings** vary according to the development of the temperature conditions in the winter seasons. Due to the warm winter the consumption of fuels for heating, and thus the production of emissions in 2014, has decreased in comparison with the previous year by substantial 20.1%. The long-term evolution of greenhouse gas emissions from local incinerators is declining, there is a gradual change in the composition of fuels for heating (a shift from coal to natural gas and RES), the efficiency of technologies for heating is growing and the energy demands of buildings are decreasing. In the period 2000–2014 emissions from this sector decreased by 35.8%.

[8] *Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.*

Fugitive emissions from the mining and transport of fuels are falling, in the period 2000–2014 fell by 38.3%, mainly due to a decrease in fugitive emissions from coal mining. Emissions from **industrial processes and the use of products** vary according to the development of industrial production, in 2014 they increased by 4.7%, when the industrial production index rose this year by 5.0%. A significant increase in emissions of F-gases is recorded from the use of products replacing chlorofluorocarbons, which have increased during this period more than tenfold.

The decline in emissions from **agriculture** stopped, the emissions have risen in 2014 in the year-to-year comparison of 3.1%, but they were about 11.6% lower than in 2000, and at about half the level in comparison with the year 1990. Emissions from **waste** are slowly and steadily increasing, in 2014 they increased by 1.3%, since 2000 by about 35.2%. In the LULUCF sector during the whole period 2000–2014 the carbon storage in biomass (especially the forestry sector) dominated over emissions, in 2014 the removals in **LULUCF** reached 7.8 Mt CO_2 eq., indicating a decrease of 1.6% year to year.

In the **structure of the emissions per source categories** there is the largest share of the energy industry (Chart 3). Shares of the non-combustion source categories (industrial processes and the product use, agriculture and waste) and transport on the total emissions are increasing slowly. In the structure of the **aggregated emissions per greenhouse gases** in 2014 the share of CO_2 was 81.8%, the share of CH_4 was 10.7% and the share of N_2O was 5.1%. While the share of CO_2 emissions after the year 2010 started to decline (in the period 2009–2014 drop by 2.3 percentage points), the share of emissions of CH_4 and N_2O started slightly increasing. The share of F-gases in the same period grew significantly in 2000 took up 0.2%, and by 2014 rose to 2.4%. The largest source of CH_4 emissions is waste with a 35.4% share on the total CH_4 emissions in 2014; the largest source of N_2O emissions is agriculture with a 71.1% share.

CO_2 emissions from installations falling under the **European Emission Trading System** (EU ETS) in 2015 in the year-to-year comparison stagnated and reached 66.5 Mt CO_2, which is by 18.0% less than in 2005. The pace of decline in overall emissions in the EU ETS, which was the most pronounced in the years 2007–2013, is gradually slowing, but the development is directed toward the achievement of the objectives of the EU climate and energy package towards 2020. A decisive share in the EU ETS emissions in 2015 had the category of combustion processes with 80.1% share, the share of emissions from EU ETS on the total CO_2 emissions declared in the national inventory (without LULUCF) in 2014 amounted to 65.8%.

The greenhouse gas emissions per capita in 2014 reached 11.7 $t.capita^{-1}$ (without LULUCF) and were by 17.8% lower than in 2000 and by 38.2% lower than in 1990. **The emission intensity of the economy of the Czech Republic** is decreasing steadily. The specific emissions per unit of GDP decreased in the period 1990–2014 to less than a half (by 57.4%). Since 2000 they decreased by 40.4% and in 2014 they decreased interannually by 5.6% to 30.5 kg CO_2 eq. thous. CZK^{-1} at 2010 constant prices (Chart 4). The downward trend in the emission intensity is linked to a decrease in energy and material intensity of the economy of the Czech Republic.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

3 | Emissions of acidifying substances

Key question

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

Key messages

Emissions of acidifying substances (SO_2, NO_x and NH_3) in the air have been decreasing steadily since 1990. Since 1990 the total emissions of acidifying substances decreased by 85.4%, since 2000 by 37.2% and then in the last year-to-year comparison of 2014–2015 by 2.2%.
Of the total aggregate emissions of acidifying substances in 2015 emissions of NH_3 participated by 35.4%, SO_2 by 33.4% and NO_x emissions by 31.2%.
Total emissions of acidifying substances get closer to the limit values of national emissions for 2020.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

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}, i.e. 8.28 kt.year^{-1} in the equivalent of acidification[9]
- establishment of national emission ceilings for NO_x: 286 kt.year^{-1}, i.e. 6.22 kt.year^{-1} in the equivalent of acidification
- establishment of national emission ceilings for NH_3: 80 kt.year^{-1}, i.e. 4.71 kt.year^{-1} weighed by the acidifying equivalent

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 dust into the air from medium-sized combustion plants 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

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 areas with an excessive degree of acidification in Europe
- establishment of new emission ceilings for the year 2020 set as a percentage reduction in emissions compared to the state in 2005: for SO_2 the emission reduction is set to 45%, for NO_x it is 35% and for NH_3 it is 7%

[9] All the data on emissions, presented both in the texts and charts are based on the values expressed using the so-called acidifying equivalent (acidification). The acidifying equivalent factors are as follows for the below substances: for NO_x = 0.02174; for SO_2 = 0.03125 and for NH_3 = 0.05882. The total emissions equal the sum of total annual emissions of the individual substances expressed in tonnes and multiplied by their respective acidifying equivalent factors.

The European Commission's package of 18th December 2013 with the title "A Clean Air Programme for Europe"
- 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

State Environmental Policy of the Czech Republic 2012–2020
- meeting the national emission ceilings valid since 2010 and the reduction of the total emissions of SO_2, NO_x, NH_3 by 2020 in line with the commitments of the Czech Republic

Medium-term strategy (by 2020) to improve air quality in the Czech Republic
- from 2020 no exceedance of the values of the national emission ceilings laid down on the basis of the New National Scenario with additional measures
- the progressive creation of conditions to meet future national commitments to reduce emissions by 2025 and 2030

National Emission Reduction Programme of the Czech Republic
- meeting the specified non-excess values of national emissions for SO_2 (92 $kt.year^{-1}$, i.e. 2.88 $kt.year^{-1}$ in the equivalent of acidification), NO_x (143 $kt.year^{-1}$, i.e. 3.11 $kt.year^{-1}$ in the equivalent of acidification), NH_3 (64 $kt.year^{-1}$, i.e. 3.76 $kt.year^{-1}$, i.e. in the equivalent of acidification)
- 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

Operational Programme Environment 2014–2020
- reduce 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)
- reduce emissions from stationary sources contributing to the population's exposure to excessive concentrations of pollutants

Impacts on human health and ecosystems

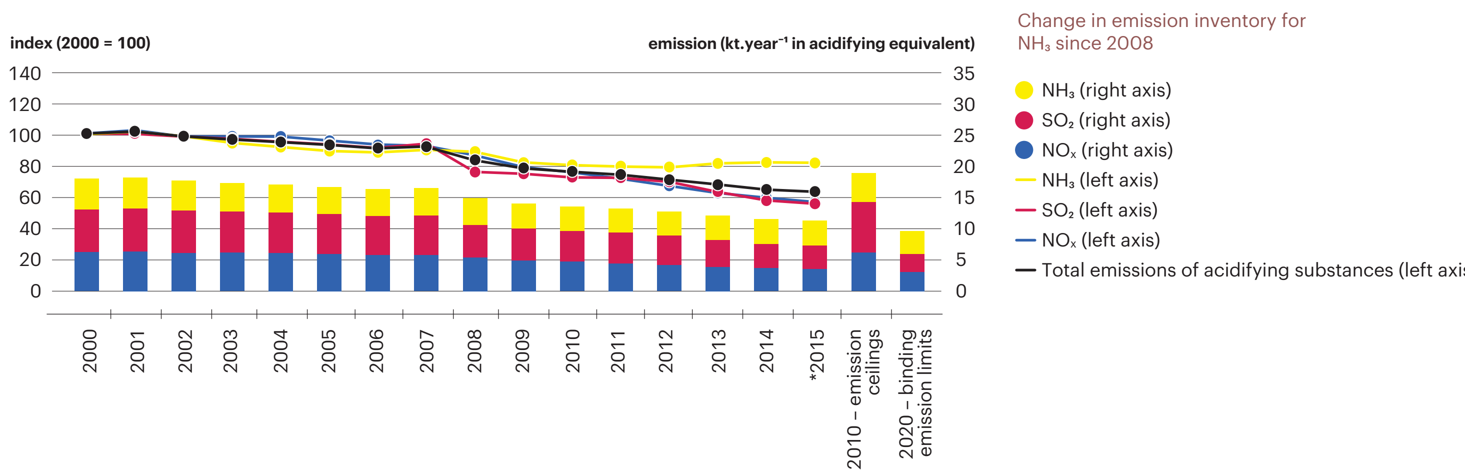
Acidifying substances produce long- and short-term health problems. Even a short-term exposure to acidifying substances causes irritation of the respiratory system which may limit its functions and also reduce the organism's resistance to infectious diseases in long-term. Short-term and long-term exposure to acidifying substances also aggravates the problem of asthmatics and allergy, while the highest risk presents from the point of view of human health NO_x (NO_2), the long-term exposure to which exacerbates the illness of the respiratory system especially for sensitive population groups, such as children, the elderly and the sick.

Emissions of acidifying substances increase the hydrogen ion concentration in all elements of environment, which leads to the reduction of pH and the subsequent leaching of toxic metals (Al, Cd, Pb and Cu). There is also the deterioration of the flows of nutrients, which may lead to the violation of the root system and a distorted outlet mode. As a result of the increased acidity of the environment there is a decreased biodiversity and unstable individual ecosystems.

Indicator assessment

Chart 1

Development of total emissions of acidifying substances in the Czech Republic and the level of national emission ceilings for 2010 and the binding emissions limits from 2020 [index, 2000 = 100]; [kt.year⁻¹ in acidifying equivalent], 2000–2015

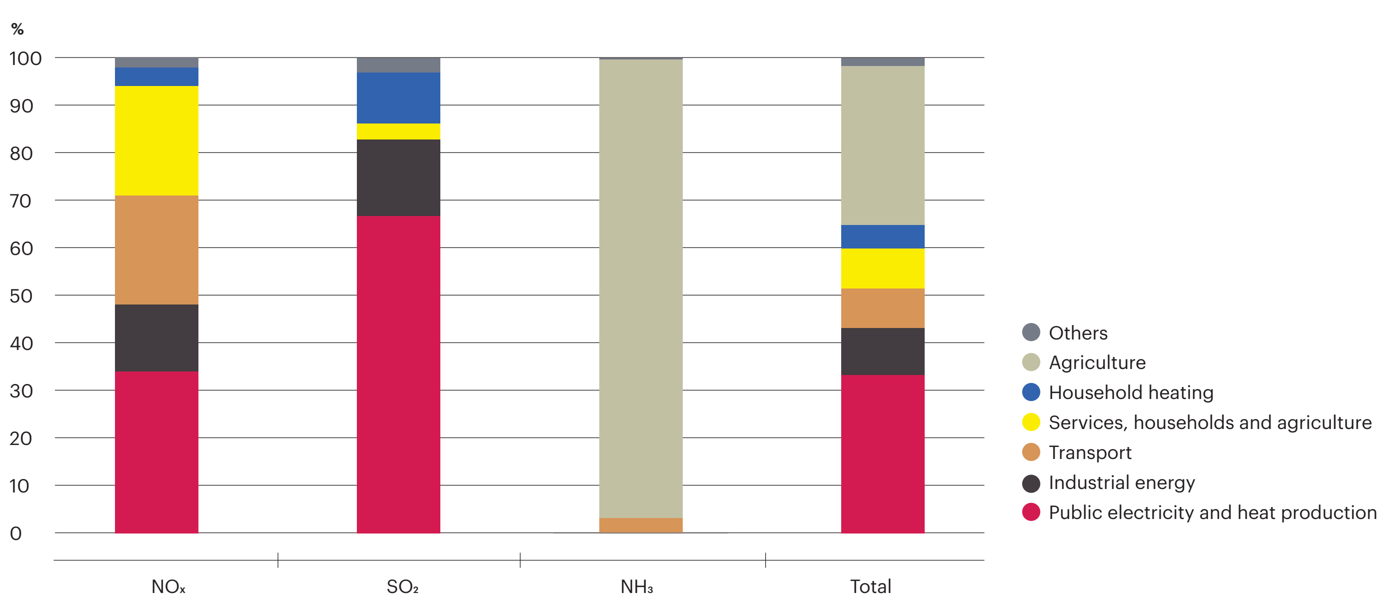


**Preliminary data.*
Emissions from the use of nitrogen fertilisers have been included in the NH_3 emission balance since 2008.
The correction of emission inventories was carried out for the presented period 2000–2015 due to the adjustments of emission factors.

Source: Czech Hydrometeorological Institute

Chart 2

Sources of emissions of acidifying substances in the Czech Republic [%], 2014



Emissions of NH_3 from agriculture come from livestock breeding and the use of mineral nitrogen fertilisers.
Emissions in the sector of services, households and agriculture come from mobile and stationary combustion sources (excluding residential heating).
The correction of emission inventories was carried out for the presented period due to the adjustments of emission factors.
Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

Emissions of acidifying substances (SO_2, NO_x and NH_3) have been declining in the long-term; between the years **1990–2015** they experienced an overall decrease by 85.4%, i.e. from 79.0 to 11.5 $kt.year^{-1}$ in acidifying equivalent. In this period emissions of SO_2 dropped by 93.4% (from 57.8 to 3.8 $kt.year^{-1}$), NO_x emissions by 70.1% (from 12.0 to 3.6 $kt.year^{-1}$) and NH_3 emissions by 55.6% (from 9.2 to 4.1 $kt.year^{-1}$) in the acidification equivalent. The most significant decrease in all emissions of acidifying substances was recorded in the 1990s particularly at the beginning, as a result of structural changes in the national economy.

Between **2000–2015** the trend of reducing acidifying substances continued, and in this period there was a decline by 37.2%. The most important decreases occurred between 2007 and 2008 (by 10.1%), and also between 2008 and 2009 (by 5.8%), due to the decline of the national economy caused by the economic crisis. In the period 2000–2015 SO_2 emissions decreased by 45.1%, NO_x emissions by 43.4% and emissions of NH_3 by 18.4%. In the period **2005–2015** SO_2 emissions decreased by 41.0%, NO_x emissions by 40.9% and emissions of NH_3 by 8.0%.

In 2015 the total emissions of acidifying substances also fell, by 2.2%, which is the lowest annual decline since 1990. This decrease was mainly caused by the reduction of SO_2 emissions by 3.5% and NO_x emissions by 3.3%. NH_3 emissions are stagnating.

Emissions of acidifying substances were for the year 2015 for the whole of the Czech Republic **below the national emission ceilings for 2010**. To achieve the binding emission limits **from 2020** it is required to reduce the emissions of SO_2 by 33.5%, NO_x emissions by 15.3% and emissions of NH_3 by 8.3% (Chart 1).

Based on the 2014[10] data, the **main sources of emissions of acidifying substances in the Czech Republic** (Chart 2) were the sector of agriculture (33.5%, i.e. 3.9 $kt.year^{-1}$ in acidifying equivalent), public electricity and heat production (33.3%, i.e. 3.9 $kt.year^{-1}$ in acidifying equivalent) and industrial energy sector (9.9%, i.e. 1.2 $kt.year^{-1}$ in acidifying equivalent).

However, the representation of individual emissions of acidifying substances varies. The main producer of emissions of **SO_2** in 2014 was particularly public electricity and heat production (66.8%, i.e. the 2.7 $kt.year^{-1}$ in the acidification equivalent), and also industrial energy (16.0%) and residential heating (10.7%).

NO_x emissions in 2014 were mostly produced in the sector of public electricity and heat production (34.0%, i.e. 1.3 $kt.year^{-1}$ in the acidification equivalent), an important source is the transport sector in the long term (23.0%) and combustion processes in the sector of service, households and agriculture (without the inclusion of the category of residential heating).

Emissions of **NH_3** in 2014 came mainly from the agricultural sector (96.5%, i.e. 3.9 $kt.year^{-1}$ in the acidification equivalent), and especially from the livestock and from the application of nitrogen mineral fertilisers.

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, in the 1990s connected with particularly the desulphurisation of coal fired power plants, the use of fuels with a lower sulphur content and the reduction of the energy demands in economy. A significant role in the present also represents the diversification of electricity production, i.e. the decrease in production of electricity in coal-fired power plants and on the contrary, the increase in electricity

[10] *Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.*

generation from nuclear and RES, and also an overall decrease of its production (in 2015, the annual decline by 2.6%) and also the obligation to meet the legislative requirements given by the transposition of Directive of the European Parliament and of the Council 2010/75/EU on industrial emissions into Czech legislation[11]. An important negative factor in the production of SO_2 and NO_x emissions is, however, the long-term pro-export term nature of electricity generation (in 2015 it was on its long-time minimum, indicator 31 – Electricity and heat generation), especially in the case that most of the electricity is produced in steam plants for solid fuels. The quantity of produced emissions of SO_2 and NO_x in the residential heating sector is significantly affected by the metrological conditions in the heating season in individual years and also the prevailing method of residential heating, which, however, does not change in the long term in the Czech Republic.

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, albeit slow modernisation and replacement of the vehicle fleet, and also due to the decline in transportation emissions.

Stagnation or a slight decrease in the emission of **NH_3** is associated in particular with agricultural policy of the Czech Republic and with the implementation of the Common Agricultural Policy. The reduction of emissions of NH_3 in the long term is, however, contributed to by the decline of livestock, especially swine.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[11] Deviations from the emission ceilings for each substance group of acidifying substances are listed in the Statistical Environmental Yearbook of the Czech Republic for 2015 in the environmental chapter in the thematic chapter 3.2 Air, Section 3.2.1 Air Emission situation.

4 | Emissions of ozone precursors

Key question

Is it succeeded in reducing emissions of precursors of ground-level ozone, which negatively affects human health and vegetation?

Key messages

Emissions of ozone precursors (VOC, NO_x, CO and CH_4) decreased in the period 1990–2015 by 68.7% in the period of 2000–2015 by 42.0%. The decline in the total amount of emissions of ozone precursors has been confirmed even in 2015, when it decreased by 2.2%.
The emissions of ozone precursors in 2015 were mostly contributed to by NO_x emissions by 50.7%, VOC emissions by 33.9% and CO emissions by 13.8% and emissions of CH_4 by 1.9%.
Total emissions of ozone precursors get closer to the limit values of national emissions for 2020.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

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 NO_x: 286 $kt.year^{-1}$, i.e. 349 $kt.year^{-1}$ in tropospheric ozone formation potential[12]
- establishment of national emission ceilings for VOC: 220 $kt.year^{-1}$, i.e. 220 $kt.year^{-1}$ in tropospheric ozone formation potential

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 2020 as a percentage reduction in emissions compared to the state in 2005: for VOC the emission reduction is set to 18%, for NO_x it is 35%

The European Commission's package of 18th December 2013 with the title "A Clean Air Programme for Europe"
- 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

[12] All data on emissions presented in the charts and texts are based on emission values expressed as the so-called tropospheric ozone formation potential (TOFP). The tropospheric ozone formation potential factors are as follows for the following substances: VOC = 1; NO_x = 1.22; CO = 0.11 and CH_4 = 0.014.

State Environmental Policy of the Czech Republic 2012–2020
- meeting the national emission ceilings valid since 2010 and the reduction of the total emissions of NO_x and VOC by 2020 in line with the commitments of the Czech Republic

Medium-term strategy (by 2020) to improve air quality in the Czech Republic
- from 2020 no exceedance of the values of the national emission ceilings laid down on the basis of the New National Scenarios with additional measures
- the progressive creation of conditions to meet future national commitments to reduce emissions by 2025 and 2030

National Emission Reduction Programme of the Czech Republic
- fulfilling the determined limit values of national emissions for NO_x (143 $kt.year^{-1}$, i.e. 174.46 $kt.year^{-1}$ v TOFP), and VOC (129 $kt.year^{-1}$, i.e. 129 $kt.year^{-1}$ v TOFP)
- 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

Operational Programme Environment 2014–2020
- reduce 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)
- reduce emissions from stationary sources contributing to the population's exposure to excessive concentrations of pollutants

Impacts on human health and ecosystems

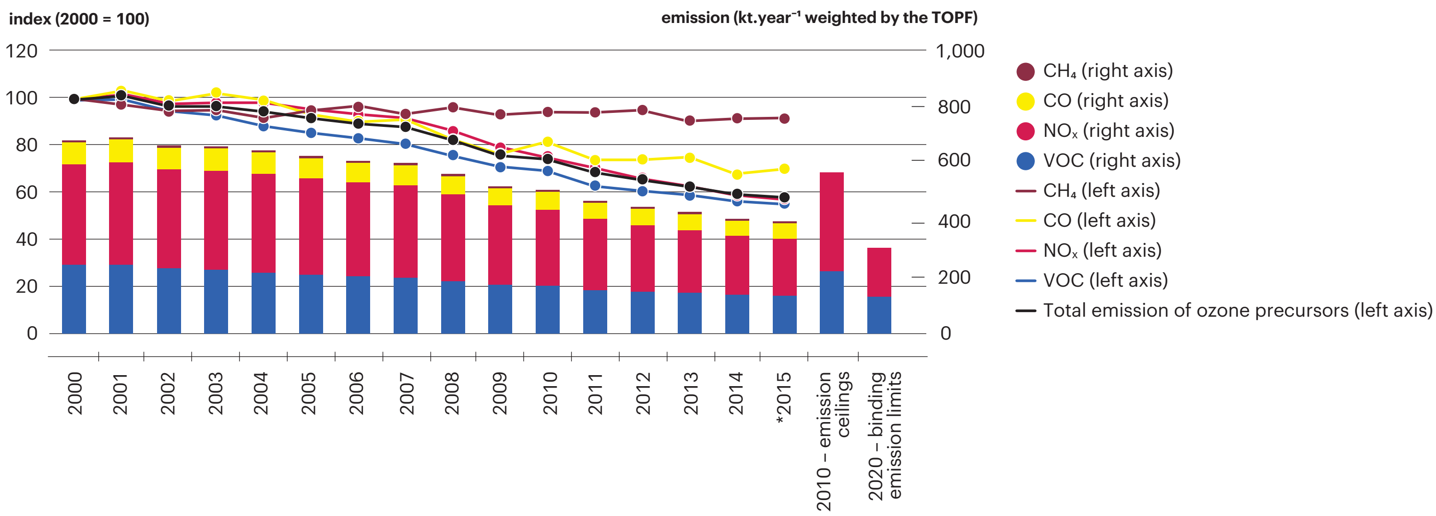
The existence of ozone in the atmosphere is of vital importance for living organisms. While stratospheric ozone protects the earth's surface and the living organisms against negative influence of ultraviolet solar radiation, tropospheric (ground-level) ozone, resulting from the chemical reactions of so called precursors together with their precursors, are considered as an important pollutant and a strong oxidising agent. Exposure to increased concentrations of ground-level ozone causes headaches and breathing problems, and worsens respiratory and cardiovascular problems. Emissions of ozone precursors cause nervous system disorders, liver and kidney damage, reduce the body's immunity.

Ground-level ozone damages the assimilation organs of plants and thus has a negative impact on the forest, meadow and farm stands. The vegetation is consequently less resistant to biotic and abiotic pests, which also affects the habitats of animal species. Ground-level ozone also interferes with artificial materials, thus causing property damage.

Indicator assessment

Chart 1

Development of total emissions of ozone precursors in the Czech Republic and the levels of the limit national emission ceilings (pro VOC a NO_x) for 2010 and the binding emissions limits from 2020 [index, 2000 = 100]; [kt.year^{-1} weighted by the TOPF], 2000–2015

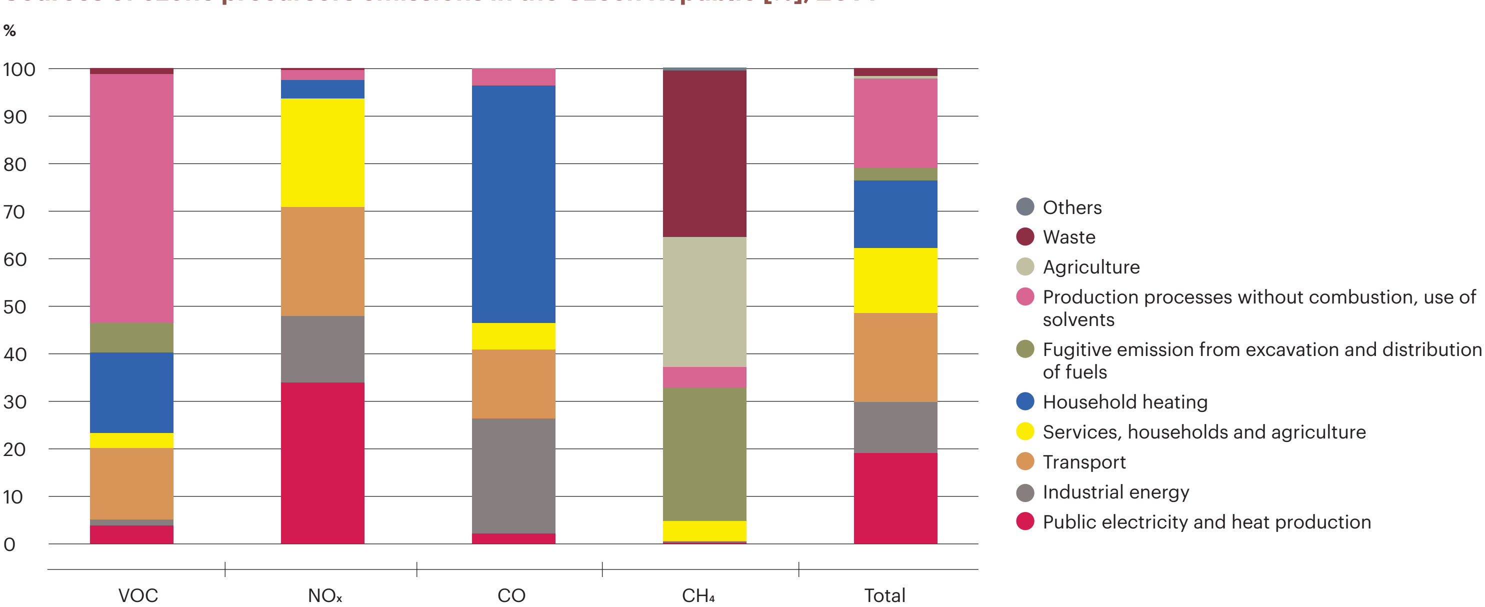


**Preliminary data.*
The correction of emission inventories was carried out for the presented period 2000–2015 due to the adjustments of emission factors.

Source: Czech Hydrometeorological Institute

Chart 2

Sources of ozone precursors emissions in the Czech Republic [%], 2014



CH_4 emissions from agriculture come from manure manipulation and enteric fermentation.
Emissions in the sector of services, households and agriculture come from stationary and mobile combustion sources (excluding residential heating).
The correction of emission inventories was carried out in the reporting year due to the adjustments of emission factors.
Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

Emissions of ozone precursors[13] (VOC, NO_x, CO and CH_4) between **1990–2015** recorded an overall decline by 68.7%, from 1,265.8 to 396.4 $kt.year^{-1}$ in TOFP. In this period emissions of each ozone precursors have also been reduced – NO_x emissions have decreased by 70.1% (from 672.2 to 201.1 $kt.year^{-1}$ in TOFP), VOC by 69.6% (i.e. from 441.0 to 134.1 $kt.year^{-1}$ in TOFP) and CO by 61.7% (i.e. from 140.3 to 53.8 $kt.year^{-1}$ in TOFP). At least the CH_4 emissions decreased, which dropped by 39.7% (from 12.4 to 7.5 $kt.year^{-1}$ in TOFP). The most important decreases occurred in particular in the early 1990s as a result of the restructuring of the national economy.

The trend of reducing ground-level ozone precursor emissions continued between **2000–2015**, when there was a record of an overall decrease by 42.0%. The most important decreases occurred between the years 2007–2008 (by 6.4%), and also between the years 2008–2009 (by 7.7%), due to the decline of the national economy caused by the economic crisis. In this period the individual emissions of precursors also decreased, most of all emissions of CO by 53.8%, VOC by 44.8%, NO_x by 43.4% and the least emissions of CH_4 by 8.4%. In the period **2005–2015** then the total emissions dropped, NO_x emissions by 40.9%, VOC emissions by 35.4%, CO by 25.5%, CH_4 emissions by 3.5%.

In 2015, there was a year-to-year decline of the total emissions of precursors of ground-level ozone by 2.2%. This was contributed to most by the reduction of NO_x emissions by 3.3% and VOC by 2.4%, while emissions of CO in 2015 recorded a slight increase year-to-year by 2.8%, and emissions of CH_4 a stagnation.

Emissions of ozone precursors were for the year 2015 for the whole of the Czech Republic **below the national emission ceilings for 2010**. To achieve the binding emission limits from **2020** it is required to reduce the emissions of NO_x by 15.3% and emissions of VOC by 3.9% (Chart 1).

The main sources of ozone precursors emissions (Chart 2) in the Czech Republic in 2014[14] are the sectors of public electricity and heat production (19.1%, i.e. 77.0 $kt.year^{-1}$ in TOFP), non-combustion production processes and the production of solvents (18.9%, i.e. 76.5 $kt.year^{-1}$ in TOFP), and the transport sector (18.9%, i.e. 76.2 $kt.year^{-1}$ in TOFP).

For individual substances of precursors, however, the representation of the different sources varies. The most significant source of **VOC** emissions is long term sector of manufacturing processes without combustion and the use of solvents (52.1%), and a major producer is also residential heating (17.0%) and transportation (15.1%).

The most important producer of **NO_x** emissions is a public electricity and heat production (34.0%), transportation and the service sector, households and agriculture (both sectors equally 23.0%).

CO emissions in 2014[15], came the most from residential heating (50.2%) were emitted industrial energy (24.3%) and transportation (14.6%).

CH_4 emissions arise particularly in the waste landfilling (35.2%), these are the fugitive emissions from the mining and distribution of fuels (28.2%) and agriculture (27.5%).

The reduction of emissions of **CH_4** in the past was related to a change of the structure of the waste treatment, and since 2009 there is a gradual decline in the proportion of landfill in the total waste generation. CH_4 emissions from agriculture are associated in particular with the implementation of the Common Agricultural Policy and the related numbers of livestock.

The long-term evolution of the ozone precursor emissions is closely linked with the development of the national economy. The decrease in **NO_x** emissions is related to the overall decrease in electricity production as a whole, and also the decrease in the production of electricity in coal-fired power plants and to the obligation to carry out legislative measures given by the transposition of the directive of the European Parliament and Council Directive 2010/75/EU on industrial emissions into Czech legislation[16]. The decline in these emissions is also related to the gradual restoration of transport and fleet by reducing the emission intensity of transport.

[13] Volatile organic compounds, nitrogen oxides, carbon monoxide and methane are among the so-called precursors of ground-level ozone, which is formed secondarily in the atmosphere. It has been proved that ground-level ozone has adverse effects on human health and vegetation.

[14] Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

[15] Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

[16] Deviations from the emission ceilings for each substance group of acidifying substances are listed in the Statistical Environmental Yearbook of the Czech Republic for 2015 in the environmental chapter in the thematic chapter 3.2 Air, Section 3.2.1 Air Emission situation.

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. VOC and CO emissions from the sector of residential heating reflect the development of the meteorological conditions in the heating season in that year and also are significantly influenced by the type of fuel used in household furnaces.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

5 | Emissions of primary particulate matter and precursors of secondary particles

Key question

Is it succeeded in reducing air pollution by suspended particulates that adversely affect human health?

Key messages

Emissions of primary particulate matter and secondary particulate matter matter precursors (NO_x, SO_2, NH_3)[17] have been decreasing since 1990s. Between 1990–2015, the emissions of the precursors of secondary particulate matter decreased by 83.9%, between 2000–2015 by 40.7%. Emissions of primary particulate matter PM_{10} in 2014[18] have dropped year-to-year by 7.5%.
Emissions of each of the precursors meet in the long term the specified values of the national emission ceilings for 2010, and at the same time there is also a gradual approximation to the national emission ceilings laid down for the year 2020, which, however, have not yet been achieved.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

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 $kt.year^{-1}$, i.e. 143 $kt.year^{-1}$ weighted by the particulate matter formation potential[19]
- establishment of national emission ceilings for NO_x: 286 $kt.year^{-1}$, i.e. 252 $kt.year^{-1}$ weighted by the particulate matter formation potential
- establishment of national emission ceilings for NH_3: 80 $kt.year^{-1}$, i.e. 51 $kt.year^{-1}$ weighted by the particulate matter formation potential

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)
- establishment of new emission ceilings for the year 2020 set as a percentage reduction in emissions compared to the state in 2005: for SO_2 the emission reduction is set to 45%, for NO_x it is 35% and for NH_3 it is 7% and for $PM_{2.5}$ it is 17%

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[17] *Primary particulate matter PM_{10} represents particulate matter emitted directly from a source, both from natural (e.g. volcanic activity) and anthropogenic sources (e.g. burning fossil fuels, abrasion of tyres). Precursors of secondary particulate matter (NO_x, SO_2 and NH_3) are pollutants of anthropogenic origin, from which these particulate matter can be formed in the atmosphere.*

[18] *Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.*

[19] *All data presented in the charts and the text are based on emissions expressed as the particulate matter formation potential. The particulate matter formation potential factors are as follows for the below substances: PM_{10} = 1; NO_x = 0.88; SO_2 = 0.54 and NH_3 = 0.64. The value of the indicator equals to the sum of total annual emissions of primary PM_{10} and secondary particulate matter precursors in tonnes, multiplied by their respective particulate matter potential factors.*

The European Commission's package of 18th December 2013 with the title "A Clean Air Programme for Europe"

- 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

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 ($PM_{2.5}$) by 2020 in line with the commitments of the Czech Republic

Medium-term strategy (by 2020) to improve air quality in the Czech Republic

- from 2020 no exceedance of the values of the national emission ceilings laid down on the basis of New National Scenarios with additional measures
- the progressive creation of conditions to meet future national commitments to reduce emissions by 2025 and 2030

National Emission Reduction Programme of the Czech Republic

- meeting the specified non-excess values of national emissions for SO_2 (92 $kt.year^{-1}$, i.e. 49.68 $kt.year^{-1}$ weighted by the particulate matter formation potential), NO_x (143 $kt.year^{-1}$, i.e. 125.84 $kt.year^{-1}$ weighted by the particulate matter formation potential), NH_3 (64 $kt.year^{-1}$, i.e. 40.96 $kt.year^{-1}$ weighted by the particulate matter formation potential) and $PM_{2.5}$ (19 $kt.year^{-1}$)
- 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

Operational Programme Environment 2014–2020

- reduce 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)
- reduce emissions from stationary sources contributing to the population's exposure to excessive concentrations of pollutants

Impacts on human health and ecosystems

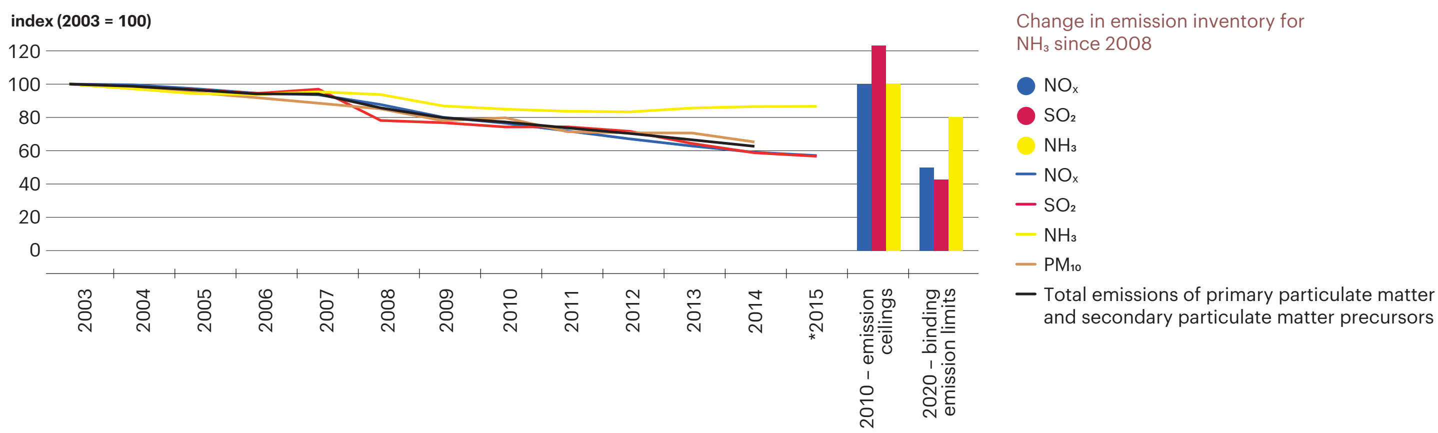
Suspended particulates are among the most dangerous substances emitted into the atmosphere. Despite their proven negative impacts, on human health, no threshold concentration of these substances has been established yet. The severity of the health effect of particulate matter depends on their size, composition and origin. Suspended particulates penetrate into the upper and lower respiratory tract, the finer fraction $PM_{2.5}$ then penetrate the alveoli, increasing respiratory and cardiovascular morbidity and mortality. Exposure to suspended particulate matter exacerbates problems for asthmatics and allergy and has a negative effect on reproduction. PAH bind to the ultra fine suspended particulate matter, having a mutagenic and carcinogenic effects.

Suspended particulates also affect ecosystems. It causes their mechanical dusting which reduces the plants' active area, thereby decreasing photosynthesis. They enter into the respiratory tract f animals, affecting their health. Solid particulates depending on the chemical composition, absorb or reflect the sun rays, which affect the energy balance of the Earth.

Indicator assessment

Chart 1

Development of emissions of primary particulate matter and secondary particulate matter precursors in the Czech Republic and the national emission ceilings (for NO_x, SO_2 and NH_3) for 2010 and the binding emission limits from 2020 [index, 2003 = 100], 2003–2015

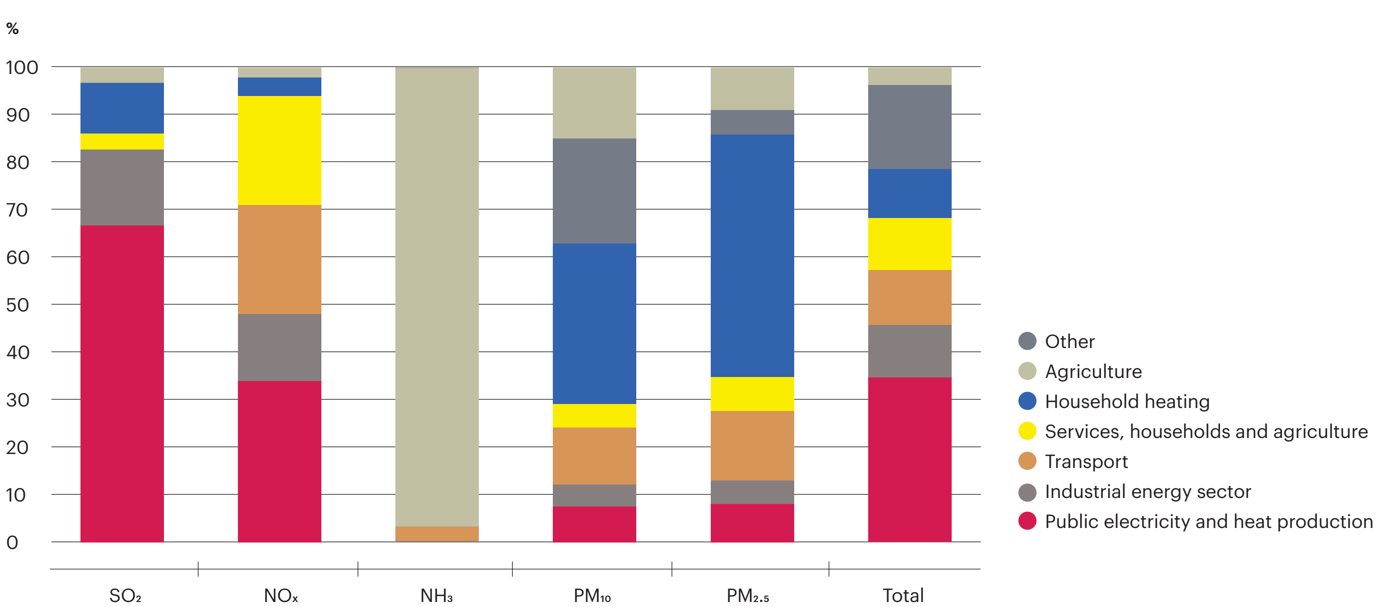


**Preliminary data.*
Emissions from the use of nitrogen fertilisers have been included in the NH_3 emission balance since 2008.
The correction of emission inventories was carried out for the presented period 2003–2015 due to the adjustments of emission factors.
Data for the year 2015 are not, due to the methodology of their reporting, available for PM_{10} at the time of publication.

Source: Czech Hydrometeorological Institute

Chart 2

Emission sources of primary particulars and secondary particular precursors in the Czech Republic [%], 2014



PM_{10} emissions in the agricultural sector come from livestock breeding and field work.
NH_3 emissions come from livestock breeding and the use of mineral nitrogen fertilisers.
Emissions in the sector of services, households and agriculture come from mobile and stationary combustion sources (excluding residential heating).
A correction of emission inventories was carried out for the period due to the adjustments of emission factors.
Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

The emissions of the precursors of secondary particulates (SO_2, NO_x and NH_3) are falling in the long term, between **1990–2015** they dropped by 83.9% from 1,583.7 kt to 255.7 kt weighted by the particulate matter formation potential. As regards the development of precursors, SO_2 emissions decreased by 93.4% (from 999.0 kt to 66.3 kt weighted by the particulate matter formation potential), the NO_x emissions by 70.1% (from 484.9 kt to 145.1 kt weighted by the particulate matter formation potential), and NH_3 emissions by 55.6% (from 99.8 kt to 69.3 kt weighted by the particulate matter formation potential). The most significant decrease in all emissions of secondary particulate matter precursors was recorded in the 1990s particularly at the beginning, as a result of structural changes in the national economy.

Between 2000–2015 the trend of reduction of emissions of secondary particulate matter precursors continued, when there was an overall decrease of about 40.7%. The most important decreases was recorded between the years 2007–2008 (by 9.3%), and also between the years 2008–2009 (by 6.7%), due to the decline of the national economy caused by the economic crisis. As regards individual precursor emissions of secondary particulate matter throughout the reporting period 2000–2015, SO_2 emissions decreased by 45.1%, NO_x emissions by 43.4% and emissions of NH_3 by 18.4%. PM_{10} emissions in the period 2003–2014 dropped by 34.4%. In the period **2005–2015** emissions have generally dropped, then in the case of secondary particulate matter precursor emissions of SO_2 by 41.0%, NO_x emissions by 40.9%, and emissions of NH_3 by 8.0%. PM_{10} emissions in the period 2005–2015 dropped by 31.0%.

Total emissions of secondary particulate matter precursors have decreased also in 2015, when they dropped year-to-year by 2.8%. What most contributed to this decline was the year-to-year reduction in SO_2 emission by 3.5% and reduction of NO_x by 3.3%, while on the other hand NH_3 emissions were stagnant. PM_{10} emissions year-to-year 2013–2014[20], decreased by 7.5%.

Emissions of secondary particulate matter precursors were for the year 2015 for the whole of the Czech Republic **below the national emission ceilings for 2010**. To achieve the binding emission limits from **2020**[21] it is required to reduce the emissions of SO_2 by 33.5%, NO_x emissions by 15.3% and emissions of NH_3 by 8.3% (Chart 1).

The main sources of emissions of secondary particulate matter precursors and primary particulate matter PM_{10} and $PM_{2.5}$ in the Czech Republic (Chart 2), in 2014[22], the public electricity and heat production (34.7%) and the agriculture sector (17.8%). Another important sector is the transportation (11.6%) and industrial energy (11.1%).

For individual precursors and suspended particulate matter, however, the representation of the different sources varies. Emissions of particulate matter PM_{10} originate mainly from the combustion of fuels and other industrial activities, and were therefore in 2014 mostly emitted from residential heating sector (33.9%). A major source of emissions of **PM_{10}** are field and agricultural work (22.1%) and in the long term also the transportation sector (12.1%), where these emissions arise particularly by resuspension and abrasion of tyres and brakes. Similarly it is in the case of particulate matter **$PM_{2.5}$** that come mostly from the residential heating sector (51.2%), from the transportation (14.7%) and also from the public energy and heat production (8.1%).

NO_x emissions in 2014 were mostly produced in the sector of public electricity and heat production, an important source is the transport sector in the long term (23.0%) and combustion processes in the sector of service, households and agriculture (without the inclusion of the category of residential heating, likewise 23.0%).

The main producer of emissions of **SO_2** in 2014 was particularly public electricity and heat production (66.8%), and also industrial energy (16.0%) and residential heating (10.7%).

Emissions of **NH_3** in 2014 came mainly from the agricultural sector (96.5%), and especially from the livestock and from the application of nitrogen mineral fertilisers.

The decline in emissions of precursors of secondary particulate matter (**SO_2** and **NO_x**) and emissions of primary particulate matter **PM_{10}**, was caused in the early 1990s due to the application of end technology in coal power plants. It is currently supported in particular by the use of fuels with a lower sulphur content and also by changing the structure of electricity production, when long-term experience a drop in production in the coal-fired power plants in favor of nuclear power plants and the production of renewable energy. The decline in emissions of precursors and primary particulate matter **PM_{10}** is also

[20] Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

[21] Deviations from the emission ceilings for each substance group of acidifying substances are listed in the Statistical Environmental Yearbook of the Czech Republic for 2015 in the environmental chapter in the thematic chapter 3.2 Air, Section 3.2.1 Air Emission situation.

[22] Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

caused by the implementation of BAT and the necessity of implementation of legislative measures given by the transposition of Directive of the European Parliament and the Council 2010/75/EU on industrial emissions into Czech legislation. Their production is significantly influenced by meteorological conditions, which also predetermine the length of the heating season. In addition the PM_{10} emissions are affected by the development of the industrial production (year-to-year 2013–2014 there was an crease by 5.0%, between the years 2014–2015 it was by 4.6%), in particular the development of the construction industry.

The production of **NO_x** emissions from transportation develop depending on the renewal of the car fleet and its emission intensity, energy consumption in the transportation sector, and last, but not least also on the transmission performance of transport.

The development and stagnation of the emission of **NH_3** is closely associated with the implementation of the strategic objectives of the national agricultural policy and the common European agricultural policy. The tendency of NH_3 emissions trend also reflects the evolution of the size of the conditions of farm animals, while the decline in these emissions is in long-term influenced by the decline of swine.

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

Key messages

In 2015, the limits for benzene, arsenic, nickel and lead were not exceeded in any of the monitored sites. The limit values for sulphur dioxide and carbon monoxide have not been exceeded. Year-to-year, there has been a decline in the number of stations, on which the exceeding of the limit value has been observed for suspended particulate matter, benzo(a)pyrene, and nitrogen dioxide.

Limit values for suspended particulates PM_{10} a $PM_{2.5}$, benzo(a)pyrene and ground-level ozone have been exceeded repeatedly on part of the territory in 2015. On two traffic-loaded locations in Prague the limit values for NO_2 were exceeded, and in one location (just like in 2014) even the limit values for cadmium were exceeded. In 2015 compared to 2014 there was an increase in the announced number of the smog situations due to high concentrations of ground-level ozone and high concentrations of PM_{10}.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

7th Environmental Action Programme until 2020
- protection of the Union's citizens from environment-related pressures and risks to their health and living conditions
- promotion of a high level of environmental protection and higher quality of life and social well-being of citizens
- the achievement of a level of air quality that does not have significant negative impacts or poses a risk to human health and environment

Health for All in the 21st Century
- reduction of the exposure of the population to health risks associated with the pollution of water, air and soil, and the systematic monitoring and assessment of the air quality indicators and indicators of the state of health (implementation of the programme is monitored in yearly intervals)

The European Commission's package of 18th 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

State Environmental Policy of the Czech Republic 2012–2020
- improvement in air quality in places where pollution limits are exceeded and at the same time maintaining air quality in the territories where pollution levels are not being exceeded

Act No. 201/2012 Coll., on air protection
- full adoption of limit values 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
- establishment of upper and lower limits for the assessment of pollution levels for the protection of health

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
- the achievement of the limit values 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 limit values

National Emission Reduction Programme of the Czech Republic
- 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 limit values 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

Programs to improve air quality for each zone and agglomeration
- the achievement of the limit values throughout the territory of all zones and agglomerations for pollutants

Operational Programme Environment 2014–2020
- reduce 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)
- reduce emissions from stationary sources contributing to the population's exposure to excessive concentrations of pollutants
- improve the system of monitoring, evaluation and forecasting of the air quality trends and related meteorological aspects

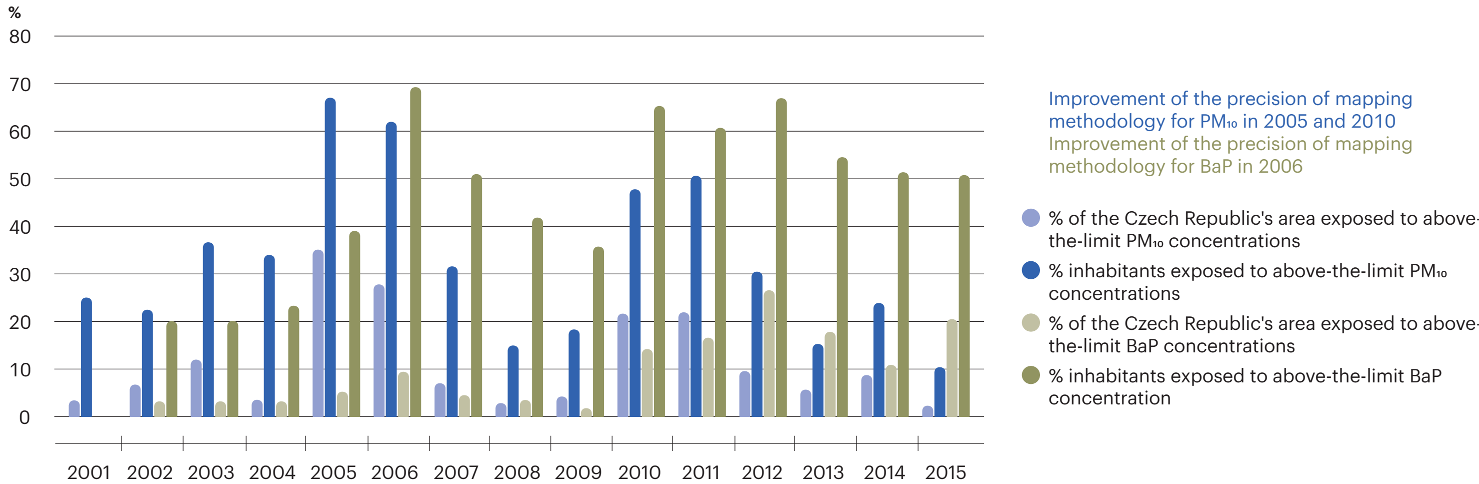
Impacts on human health and ecosystems

Suspended particulate matter with fraction PM_{10}, $PM_{2.5}$, including ultra-fine particulate matter of fractions smaller than 0.1 μm belong among the most serious pollutants in relation to human health in the long-term. PAHs, expressed as benzo(a)pyrene, are bound to the fine fraction of suspended particulates. The main source of these substances is imperfect combustion of fossil fuels, namely emissions from local furnaces, transportation and coke and iron production technologies, but also the abrasion of tires, or from re-suspension of particulates such as those caused by transportation. The quantity of these emissions is also significantly influenced by meteorological conditions. The exposure to a mixture of suspended particulates corresponds to the extent of air pollution and the population's lifestyle and its severity depends on the size, shape and chemical composition of the particulates. Despite the demonstrable negative effects of suspended particulates on human health, no threshold concentration has been determined yet. 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 in relation to heart and blood vessels diseases, diseases of the respiratory system, and increase of infant mortality and worsened problems of asthmatics. Ultrafine 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. It damages especially the respiratory system and irritates the respiratory tract. A short-term effect of high NO_x concentrations causes respiratory problems; long-term exposure to NO_x is associated with an increase in overall cardiovascular and respiratory mortality and the worsening of asthmatic problems. The impact of benzene, arsenic, nickel and cadmium consists in their toxic, mutagenic, and carcinogenic properties and in their ability to accumulate in the individual environmental media and in living organisms.

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 BaP [%], 2001–2015

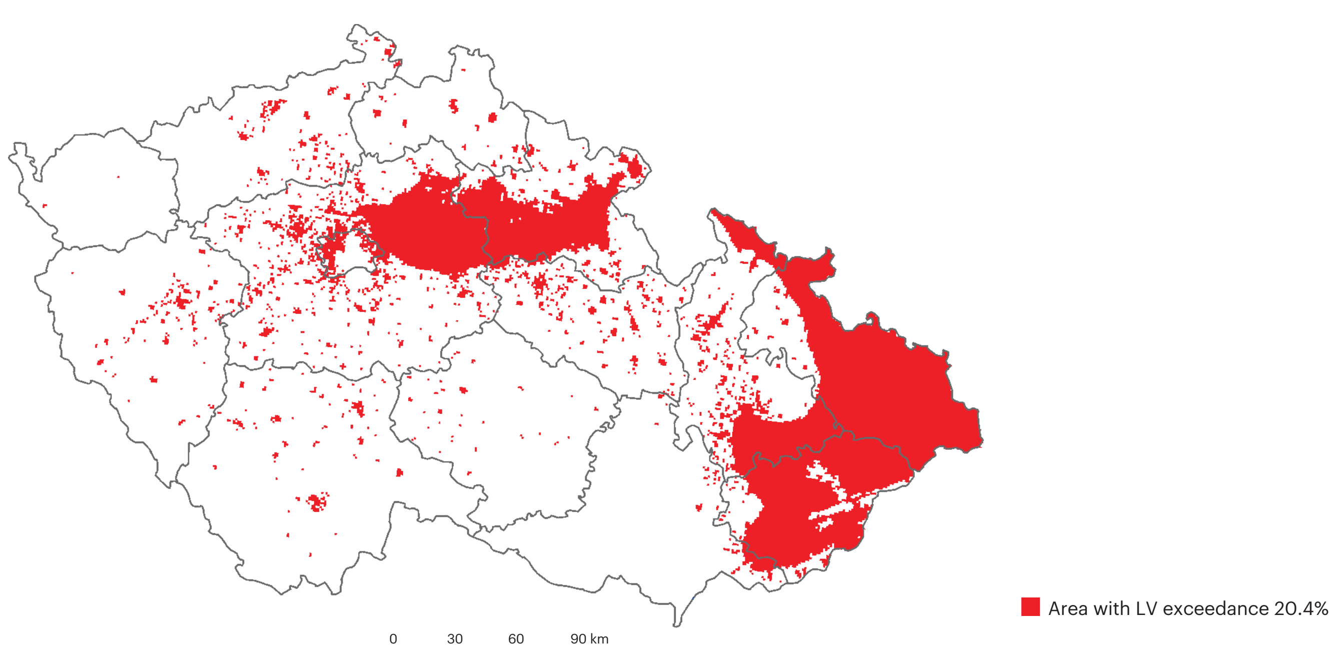


In 2005, a refinement of the mapping methodology was carried out and a model that combines the SYMOS model, the European EMEP model and the altitude data with the measured concentrations at rural background stations was first used in the construction of maps of PM_{10} concentration fields. In the year 2009, the methodology was refined again by applying the CAM_x 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 CAM_x models. Between the years 2002–2007, the benzo(a)pyrene mapping methodology 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 cities and towns were subsequently included in the territory with an exceeded BaP limit value.

Source: Czech Hydrometeorological Institute

Figure 1

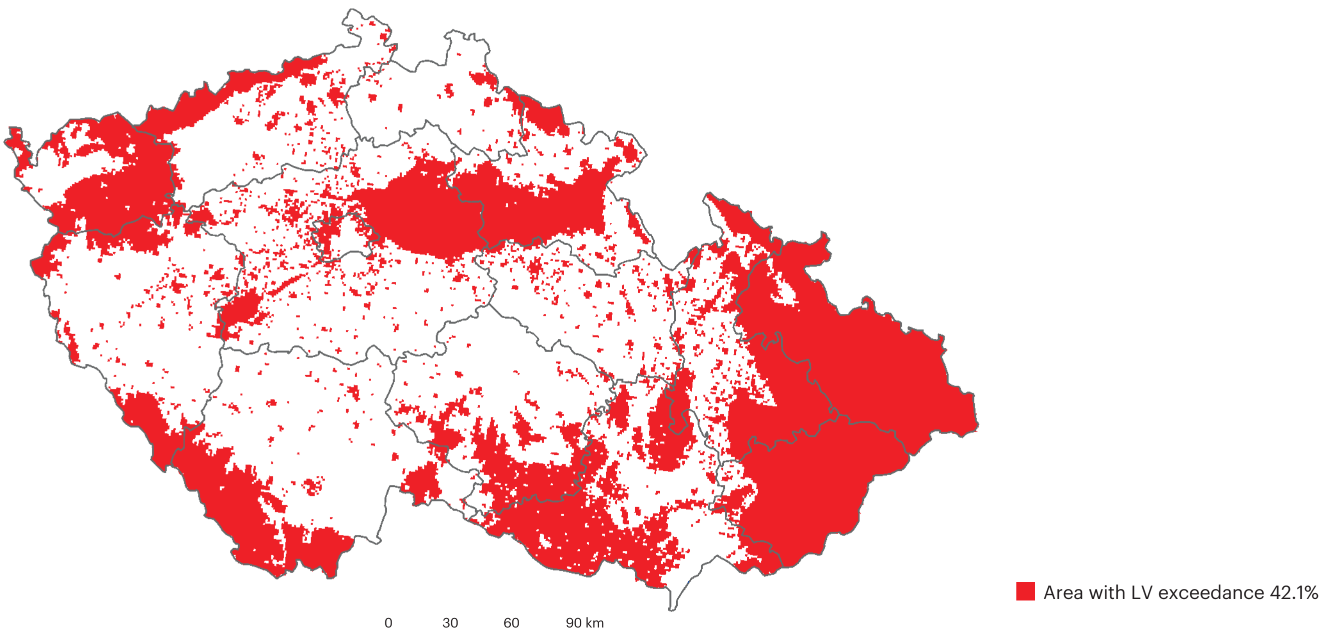
Areas within the Czech Republic with exceeding of the health protection limit values (excluding ground-level ozone), 2015



Source: Czech Hydrometeorological Institute

Figure 2

Areas within the Czech Republic with exceeding of the health protection limit values (including ground-level ozone), 2015



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 localities, 2006–2015

PM_{10} (75% representation of the $PM_{2.5}$ fraction)	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Estimated mean value for the Czech Republic	8,189	5,726	5,224	5,540	6,108	6,815	5,888	6,040	5,842	5,540
Estimated mean value for normal urban environment (*)	6,842	4,623	4,306	4,816	5,346	6,354	5,888	6,040	5,371	4,773

**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 $PM_{10} \leq 13.3$ μg.m^{-3} for 75% representation of the $PM_{2.5}$ fractions) were evaluated as 0. The values of the total annual death rate 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; supposing 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 10^2.

Source: National Institute of Public Health

Table 2

Range of values of individual carcinogenic risk (ILCR) for benzo(a)pyrene in evaluated types of sites with over 5,000 inhabitants*, 2010–2015

	2010		2011		2012		2013		2014		2015		2006–2015	
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	3.1	94.2
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	3.5	39.0
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	4.4	39.0
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	8.2	98.8

** 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 make a more detailed resolution for the evaluation of burden imposed on population in small settlements (< 5,000 inhabitants to approximately 5 mil. inhabitants).
BaP, 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

In the 1990s, there was a major drop in emissions of all the basic pollutants and a subsequent drop in air pollution. Despite the steady decline in emissions at the beginning of 21st century, 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 dispersion conditions. Limit values are exceeded at the measuring stations in 2015 particularly in the context 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 values for PM_{10} 24-hour concentration (50 $\mu g.m^{-3}$, the maximum number of exceedances per calendar year is 35) was exceeded in 2015 in the total of 29 stations from the total of 124, i.e. at 23.4% stations. Year-to-year, there has been a decrease in exceedances, as in 2014, the 24-hour pollution limit was exceeded on 57 stations out of a total of 133, i.e. 42.9%. The highest values were measured in 2015 on the station of Ostrava-Radvanice (152.3 $\mu g.m^{-3}$), where the highest concentrations are achieved in the long term. Among the most exposed regions, in which stations were located that were exceeding the limit values, there is the Moravian-Silesian region and Olomouc region.

The annual limit values for PM_{10} (40 $\mu g.m^{-3}$) was exceeded in 2015 at 3 stations from the total of 132, i.e. a total of 2.3% stations. In contrast to the previous year 2014, when the limit value was exceeded at 7.1% of locations, there was a decrease in exceedances. The highest value was, as in the case of the 24-hour concentration measured at the station of Ostrava-Radvanice (42.2 $\mu g.m^{-3}$).

Limit value for the 24-hour concentration of PM_{10} (Chart 1) was exceeded in 2015 at 2.5% of the territory (in 2014 at 8.1% of the territory). In 2015 10.4% of the population in the Czech Republic was exposed to above-limit concentrations (in 2014 it was 24.4% of the population), therefore the situation was improved compared to the year 2014. The limit value for the annual average concentration of PM_{10} was exceeded in 2015 by 0.02% of the territory of the Czech Republic (in 2014 to 0.5%).

In 2015 in the entire territory of the Czech Republic there was a total of 9 smog situations declared due to high PM_{10} concentrations, with a total duration of 17 days and 10 hours (418 hours). In 2015 no regulation was declared, since no regulation exceeded the regulatory threshold value laid down in annex 6 of the Act No. 201/2012 Coll., on air protection. Compared to the previously evaluated year 2014, there was no change in the number of smog situation, but there was a reduction in the length of their duration (a total of 9 smog situations in 2014 with duration of 501 hours), and on the other hand there was a decline in the declaration of a regulation (1 regulation in 2014). The smog situations were in 2015 most often declared in the territory of the Ostrava/Karviná/Frýdek-Místek agglomeration, excluding the Třinec region (the total of 3 of declarations). To the most extensive declaration was in the period from 5 November to 8 November 2015, when it the smog situation with different duration was declared simultaneously in 7 regions of the Czech Republic. 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.

According to the estimate carried out by the National Institute of Public Health, 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 2006–2015. 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 (2006–2015) 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 in average between 6 to more than 8 thous. people per year. In 2014, it was approximately 5.5 thous. people all over the Czech Republic, respectively, roughly 4.8 thous. people in the ordinary urban environment (Table 1).

The annual limit values for $PM_{2.5}$ (25 $\mu g.m^{-3}$) was exceeded in 2015 at 6 stations out of a total number of 48, i.e. at 12.5%, which, as in the case of fractions PM_{10}, represents a decrease compared to the previously evaluated year 2014, when the annual concentration was exceeded at 11 stations of the total of 52, i.e. 21.2%. The highest average concentrations were measured at the stations in the Moravian-Silesian region (total of 5), while the highest concentrations were once again recorded at the station in Ostrava-Radvanice (34.6 $\mu g.m^{-3}$).

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, the measurement of PM_1 was carried out in the Czech Republic at 9 locations, in 2015 at 11 locations. The highest annual average concentrations in 2015 were achieved at the station in Brno-Svatoplukova (21.9 $\mu g.m^{-3}$), and the maximum 24-hour concentration was achieved at Otrokovice-město (128.3 $\mu g.m^{-3}$), while both of these sites are traffic sites. 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.

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 2015, the limit values of 120 $\mu g.m^{-3}$ for a three-year period 2013–2015 was exceeded at 22.2% stations (16 out of a total number of 72). In 2014, the limit 120 $\mu g.m^{-3}$ was exceeded at 9.7% of the sites (6 out of a total number of 62), which represents in year-to-year comparison for 2014–2015 the growth in exceedances. The development of the ground-level ozone concentrations was significantly influenced by an exceptionally hot summer 2015.

In 2015, the limit value ground-level ozone for the protection of human health was exceeded in 26.8% of the Czech Republic's territory and 9.5% of the population were exposed to above-limit concentrations. In 2014, the limit values is exceeded on 5.6% of the territory of the Czech Republic, with 0.8% of the population, and thus there was a deterioration of the situation.

In 2015, due to high concentrations of ground-level ozone there were the total of 25 smog situations declared, with a total duration of 102 days and 9 hours (i.e. 2,457 hours in total), which represents a significant increase compared to 2014, from the total of 2 smog situations with a total duration of 42 hours. Smog situations in 2015 were often announced on the territory of the Prague Agglomeration (4 declarations), and in the territory of the zone of Central Bohemia (3 declarations). The most extensive declaration was in the period from 6 August to 17 August 2015, when the smog situation with different duration was declared simultaneously in 15 regions of the Czech Republic. The occurrence of the smog situations coincided with the frequent incidence of high air temperatures, low clouds and little wind speeds throughout the summer 2015.

As in 2014, in 2015 a number of towns and smaller settlements were classified as areas with exceeded limit values for benzo(a)pyrene. This concerns about 20.3% of the territory where 50.8% of the population live (Chart 1).

The limit value (1 $ng.m^{-3}$) for annual average concentrations of BaP in 2015 was exceeded at 61.8% of stations (i.e. 21 out of 34 total stations), and there was, therefore, a slight improvement from the previous year 2014, when the annual limit value was exceeded at 74.2% of stations. The highest annual average value was measured, just like in previous years, at the station in Ostrava-Radvanice FOV (7.8 $ng.m^{-3}$), compared to the year 2014 (when the measured value is 9.3 $ng.m^{-3}$) was, however, recorded a year-to-year decrease.

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 BaP has been stagnating in the long term; in 2015 it ranged from 3.1 to about 8 occurrences of the disease per 100,000 inhabitants according to the type of urban localities. In localities with traffic load the impact of BaP 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).

The map of areas with exceedance of at least one limit value, excluding ground-level ozone,[23] provides comprehensive information on ambient air quality in the territory of the Czech Republic in 2015. In this year, 20.4% of the territory of the Czech Republic (Figure 1) was marked.

In 2015, the limit value was exceeded for PM_{10}, $PM_{2.5}$ (see above), NO_2 (2 locations in Prague 2-Legerova and Prague 5-Smíchov with traffic burden from a total of 93 monitored stations). The limit value for BaP was also repeatedly exceeded (see above). In 2015, the annual limit value for cadmium (Cd) was exceeded at 1 of 55 monitored stations (Tanvald-školka). The limit values for benzene, SO_2 and CO, for arsenic (As), nickel (Ni) and lead (Pb) were not exceeded at any of the monitored stations in 2015.

After the inclusion of ground-level ozone in 2015[24], 42.1% of the area of the Czech Republic was defined (Figure 2), which has exceeded the value of limit value for at least 1 or more pollutants. In 2014, it was just about 19.1% of the territory.

The air quality in the Czech Republic is monitored through a network of measuring stations for air pollution monitoring. The location of the stations and their numbers are set on the basis of national and European legislation to ensure measurement throughout the territory of the Czech Republic. According to the EU Directive 2008/50/EC results of the stationary measuring air pollution monitoring stations in the creation of pollutant mapsmay be supplemented by modelling techniques and indicative measurements so that the resulting estimates provide sufficient information about the spatial distribution of concentrations of pollutants in the atmosphere. The ME publishes maps of five-year averages of the contamination level of the Czech Republic, which contain in each square of 1 × 1 km the value of the moving average of the concentration for the preceding 5 calendar years for all the pollutants, for which the limit value is determined. The biggest uncertainty in the prediction of the spatial distribution of concentrations of pollutants is loaded with the determination of the annual concentration of benzo(a)pyrene, mainly due to the low number of measurement stations in small settlements and the specific layout of the sources of benzo(a)pyrene, which are mainly local furnaces. In settlements with a population of up to 10 thous. there is in the Czech Republic almost half of the population (in 2015 it was 48.1% 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. The total of 33.9% of all emissions of PM_{10} came just from the local household heating furnaces come in 2014[25]. In addition, in the case that in the local furnaces burned waste or other illegal fuel is burnt, there is an increased emission of dangerous dioxins.

Detailed indicator assessment and specifications, data sources

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[23] 201/2012 Act No. 1 Coll., on air protection, Annex No. 1, section 1+2+3, exceedance of the 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)

[24] 201/2012 Act No. 1 Coll., on air protection, Annex No. 1, section 1+2+3+4: exceedance of the limit value including 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, O_3)

[25] Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

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

Key question

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

Key messages

The limit values for annual average SO_2 concentration for annual and winter was not exceeded at any rural locality in 2015 and the annual limit value for NO_x for the protection of ecosystems and vegetation was not exceeded either.

In 2015 the ozone limit value for protection the ecosystems was exceeded on the 5 sites from a total of 35 sites ranked as rural or suburban, and compared to 2014, there was an increase in the number of sites with exceedance. The total atmospheric deposition of sulphur, nitrogen, and hydrogen ions has not dropped significantly since 2002 and its highest values are achieved in the area of the Ore mountains.

Overall assessment of the trend

Change since 1990 N/A

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

The protocols to the Convention on Long-range Transboundary Air Pollution (CLRTAP), the Protocol to Abate Acidification, Eutrophication and Ground-level Ozone

- limitation of ground-level ozone precursor emissions (NO_x and VOC)

The European Commission's package of 18th 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

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

- establishment of limit values and the upper and lower limits for the assessment of pollution levels to protect ecosystems and vegetation for ground-level ozone, expressed as AOT40[26] exposure index, for SO_2 and for NO_x

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

[26] *For the purposes of the Act No. 201/2012, AOT40 means the sum of the differences between the hourly concentration greater than 80 μg.m^{-3} (= 40 ppb) and the value 80 μg.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).*

- from 2020 no exceedance of the values of the national emission ceilings laid down on the basis of the New National Scenarios of with additional measures
- the progressive creation of conditions to meet future national commitments to reduce emissions by 2025 and 2030

National Emission Reduction Programme of the Czech Republic
- the reduction of risks arising out of the air pollution on human health and the 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
- measures to reduce emissions and to improve air quality at the national level

Programs to improve air quality for each zone and agglomeration
- the achievement of the limit values 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

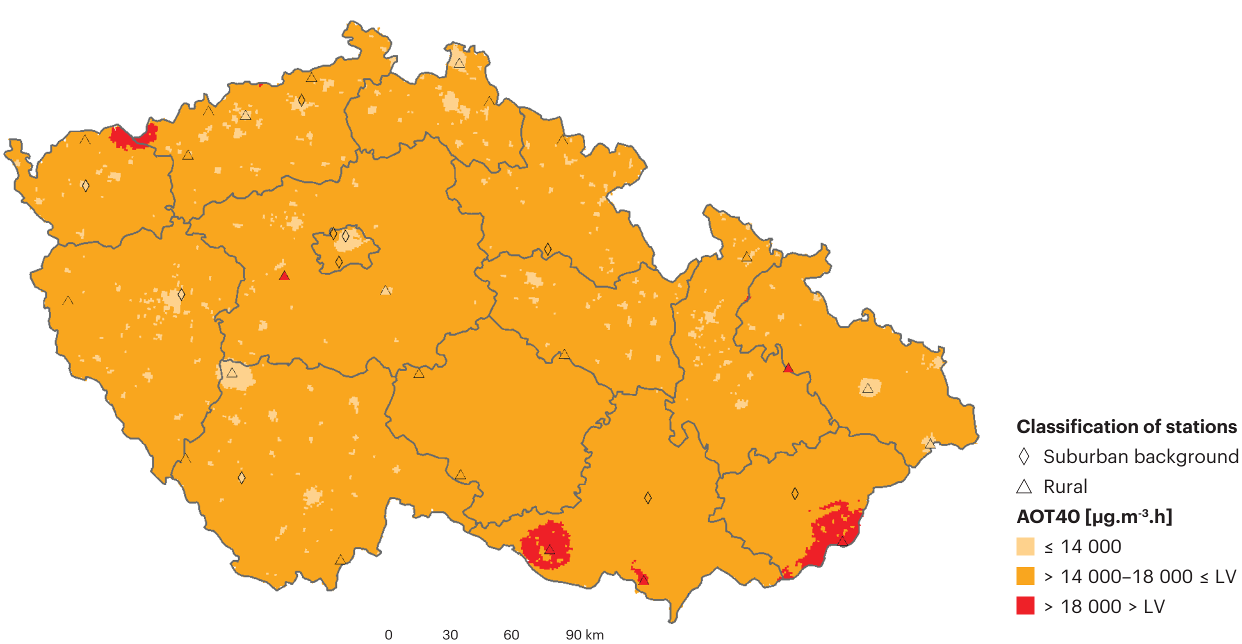
Impacts on human health and ecosystems

Polluted air, together with atmospheric deposition, has a negative impact not only on humans, but also on ecosystems and vegetation. Elevated concentrations of ground-level ozone lead to headaches, burning eyes and negatively affects the respiratory system, and in the case of vegetation the ground-level ozone has negative affects on the biochemical, cellular and physiological level. The result is the negative impact on the state of health of entire ecosystems, which can consequently have an impact on human society, for example by reducing the yields of agricultural crops and by decreasing the health of forest stands. Extensive areas of the Czech Republic are threatened by acidic atmospheric deposition. As a result of direct exposure to high concentrations of pollutants in the air, the acidification of soils and the subsequent extensive acidification of aquatic ecosystems takes place which leads to the disruption of the health of ecosystems. Atmospheric deposition and ground-level ozone reduces the resistance of vegetation to adverse external influences and also affect the water regime and biodiversity.

Indicator assessment

Figure 1

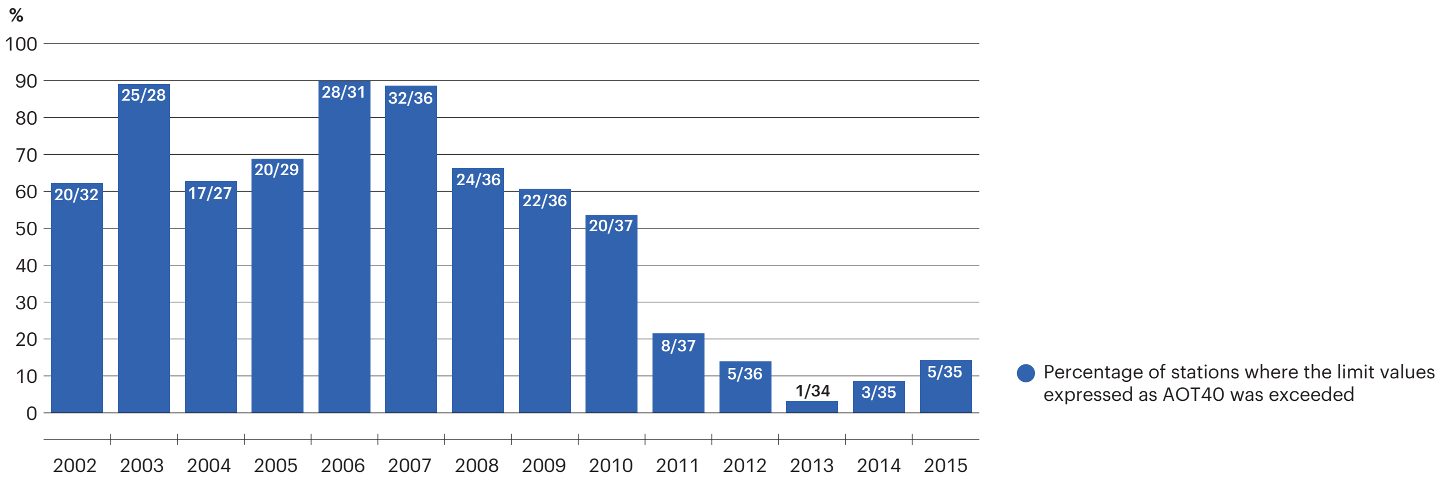
Field of AOT40 exposure index values, 5-year average [μg.m⁻³.h], 2011–2015



Source: Czech Hydrometeorological Institute

Chart 1

Percentage of stations at which the limit values, expressed as AOT40 (5-year average) for the protection of ecosystems and vegetation was exceeded [%],2002–2015

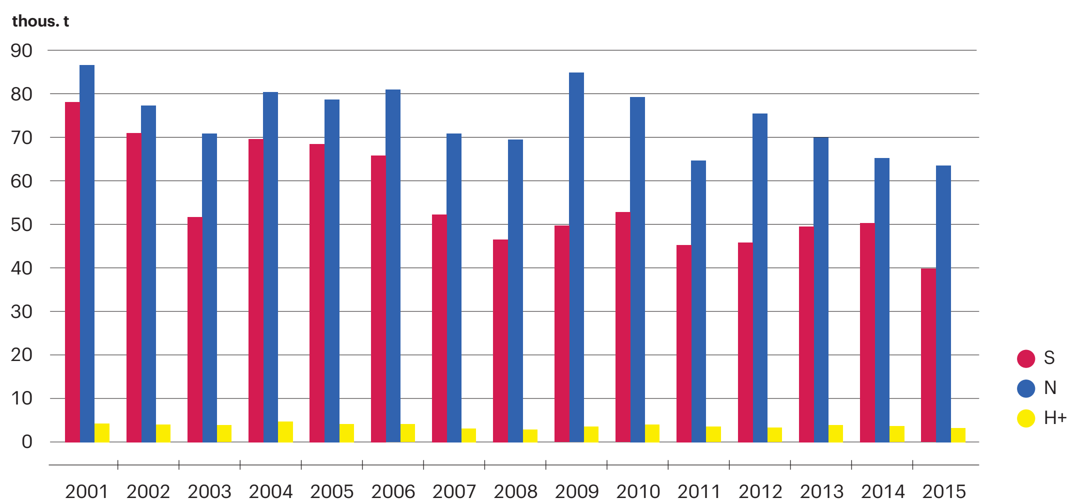


The number in the chart indicates the number of stations at which the limit value was exceeded (before the slash) out of the total number of stations (after the slash). These are rural and suburban stations for which the AOT40 calculation is relevant under the legislation.

Source: Czech Hydrometeorological Institute

Chart 2

Trends in the total atmospheric deposition of sulphur, nitrogen and hydrogen ions in the Czech Republic [thous. t], 2001–2015



Source: Czech Hydrometeorological Institute

In 2015, the ozone (AOT40) limit value for the protection of ecosystems and vegetation was not exceeded in most of the territory of the Czech Republic (Figure 1). In comparison with the previous assessed period 2010–2014, the situation has not changed significantly.

Out of the total number of 35 rural and suburban stations, the ozone limit value to protect ecosystems and vegetation (18,000 μg.m^{-3}.h) was exceeded at five sites, according to the 2015 evaluation (i.e. the average for 2011–2015). One of them is also Štítná n. Vláří, that achieves in the long-term the highest concentrations, and in 2015 has reached the highest values exceeding 21,583.0 μg.m^{-3}.h. Compared to the year 2014 (average for the years 2010 to 2014), there was an increase in the number of sites where exceedance was recorded, because in 2014 the ozone limit value for the protection of ecosystems and vegetation was exceeded only at 3 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. The decline in the value of the exposure index of AOT40 for 2015 was recorded on a total of 8 sites (22.9% of the sites, in 2014, it was only 8.6% of the sites), while the increase occurred at 26 locations (74.3% of the sites, in 2014 it was a 91.4% of sites). Only at a single site in Frýdlant-Údolí in both 2014 and 2015 the same value of the exposure index was measured (13,474.0 $\mu g.m^{-3}.h$). If the situation is assessed in a particular year, then in the period of 2011–2015 the highest values were achieved in 2011.

Limit values for the protection of ecosystems and vegetation for the annual average **NO_x** concentration (30 $\mu g.m^{-3}$) was not in 2015, the same as in the year 2014, exceeded in any site (from a total of 16) classified as rural. The highest annual average concentrations were achieved at the site in Věřňovice (22 $\mu g.m^{-3}$).

In the rural localities in 2015 the **limit values for SO_2**, for the protection of ecosystems and vegetation (20 $\mu g.m^{-3}$) were not exceeded, both in the case of the annual average concentration (measured on a total of 16 stations) and in the case of the winter average concentrations, i.e. in the period October–March (measured in total to 19 stations). The highest annual average SO_2 concentration was measured in 2015 at Horní Lomná (15.5 $\mu g.m^{-3}$), the highest winter average concentration of SO_2 was measured on site of Krupka (13.2 $\mu g.m^{-3}$).

The 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 2015, the total atmospheric deposition of sulphur amounted to 39,658 t of sulphur for the total area of the Czech Republic and thus has reached lower values in 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 from transport, industrial production and energy generation. In 2015, the total deposition of nitrogen was equal to 63,292 $t.year^{-1}.km^{-2}$ (oxidised + reduced forms). In the case of total hydrogen ion deposition the value reported in 2015 was 3,210 $t.year^{-1}$ for the area of the Czech Republic, which is, as in the case of the atmospheric deposition of sulphur and nitrogen, the lowest value since 2001. The highest values of the total nitrogen deposition and hydrogen ions were measured in the Ore Mountains (Krušné hory).

Detailed indicator assessment and specifications, data sources

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Air and climate in the global context

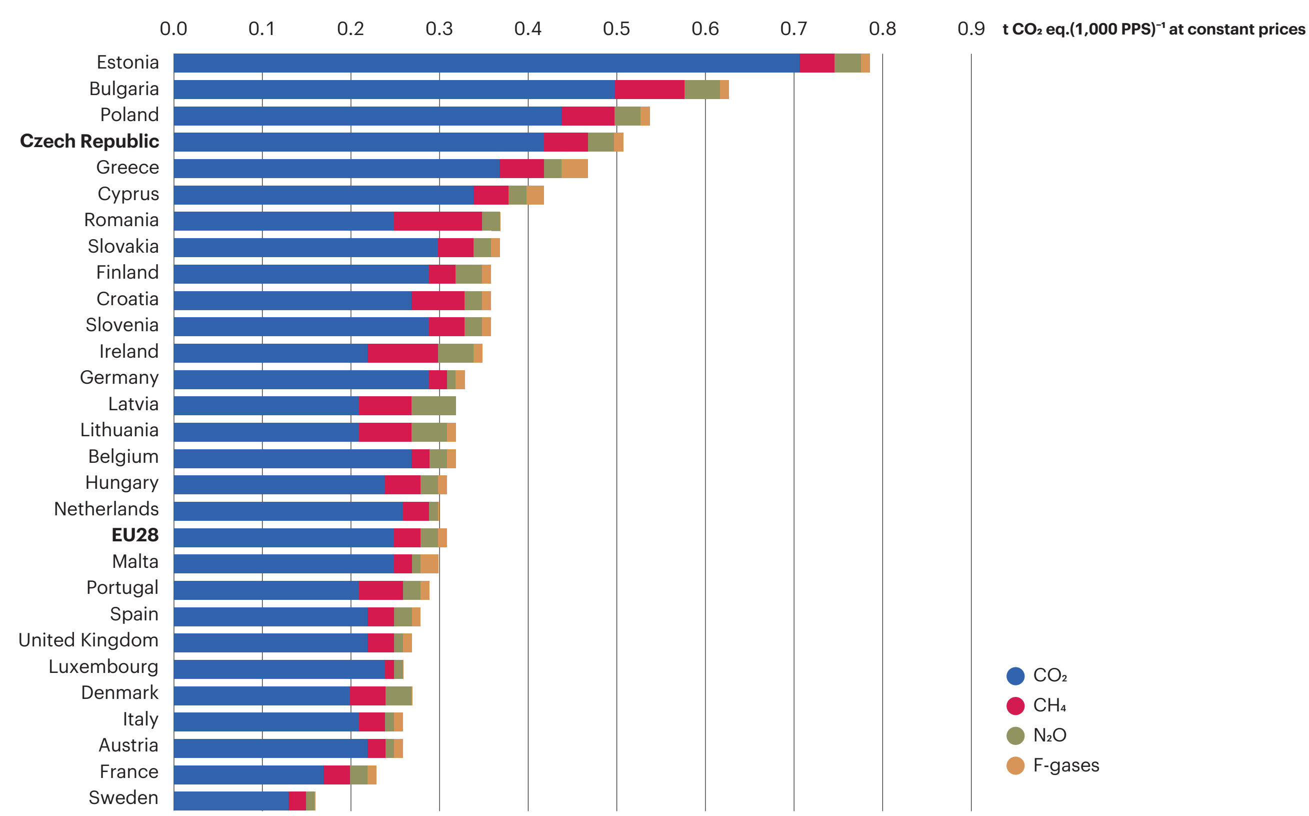
Key messages

- Year 2015 was, from the global perspective, the hottest in the history of observation.
- Greenhouse gas emissions in the EU28 decreased in the period of 1990–2014 by 24.4%, in the Czech Republic emissions decreased by 36.7%.
- 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 2014 was 66.8% higher than the EU28 average.
- Despite the decrease in emissions of polluting substances in the last ten years a significant proportion of Europe's urban population was exposed to upper concentrations of pollutants. In 2012, nearly 20% of the population was exposed to above-limit annual concentrations of benzo(a)pyrene.
- Limit values for the protection of ecosystems and vegetation for ground-level ozone in 2012 were exceeded in approximately 30% of European countries, especially in South and Central Europe. In comparison with previous years 2009–2011 there was an increase in the area with the above-limit values.

Indicator assessment

Chart 1

Emission intensity of the economy, without LULUCF sector [t CO_2 eq.(1,000 PPS)$^{-1}$, at constant prices], 2014

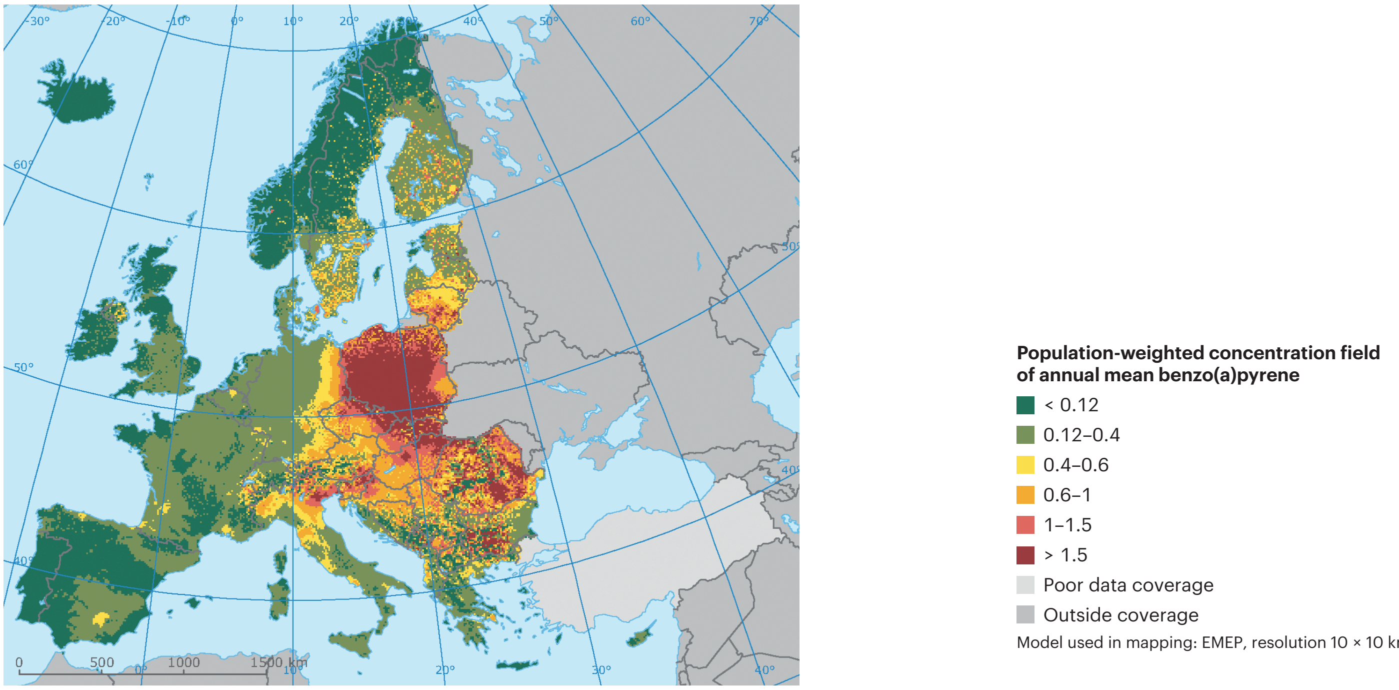


Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Environment Agency, Eurostat

Figure 1

The average annual concentration of benzo(a)pyrene in Europe [ng.m^{-3}], 2012

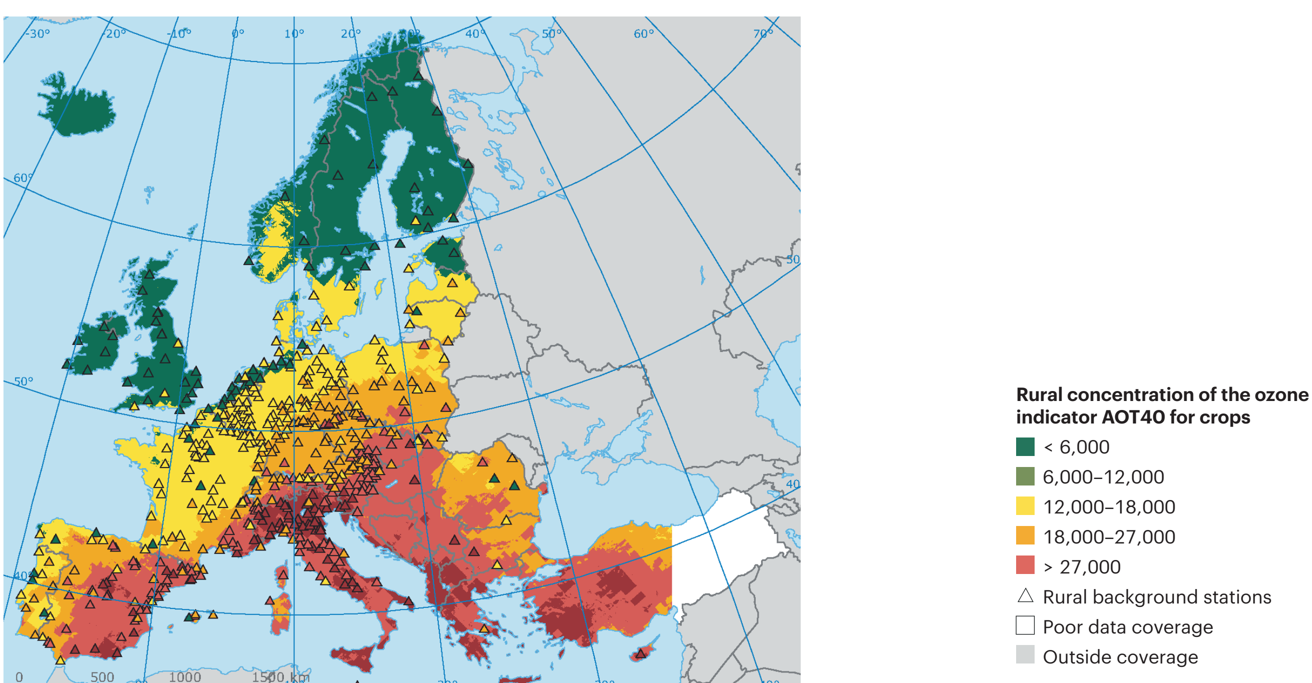


Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: European Environment Agency

Figure 2

Fields of the AOT40 index values in Europe [μg.m^{-3}.h], 2012



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

Source: European Environment Agency

According to the WMO report on the state of the climate, the **global temperature of the Earth's surface** was by about 0.76 °C ± 0.09 °C higher in 2015 compared to the long-term average (1961–1990) which is 14.0 °C. The year 2015 was, from the global perspective, the warmest over the past 165 years of instrumental measurements. A temperature record was observed due to a combination of high temperatures of the mainland (comparable to the years 2005, 2007 and 2010) and the surface of the ocean. In many countries, for example in the Russian Federation, China, or in some European countries, such as in Estonia, Finland, Spain and also in the Czech Republic (see indicator 1 – Hydrometeorological conditions), the year 2015 was the warmest of the year so far recorded. In Europe as a whole, this year was the second warmest after 2014. Rainfall distribution was on a regional and local scale very uneven. While in the regions, which include for example southern USA, Mexico, southern Brazil, northern Argentina, and North and South-Eastern Europe, fell unusually high amounts of precipitation, southern and Central Europe, including the Czech Republic, and as well for example Central America, North Africa, and northeast of the South American continent, suffered from a significant drought.

Global CO_2 emissions in 2013 were estimated at 35.3 Gt, the largest world producers of CO_2 emissions were China (29%), the USA (16%) and the EU28 (11%). The total aggregated greenhouse gas emissions in the **EU28** countries (without LULUCF and indirect CO_2) decreased in the period 1990–2014 by 24.4% (1,379.2 Mt CO_2 eq.) to 4,278.0 Mt CO_2 eq. The EU is therefore on the way to successfully meet the objectives of the second control period of the Kyoto Protocol and the climate-energy package. The reduction of emissions during this period was mostly 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 in the period 1990–2014 has reduced greenhouse gas emissions by 71.7 Mt CO_2 eq. (36.7%) which is 2.9% of the total aggregated emissions of EU28.

In 2014, the **greenhouse gas emissions per capita** in the Czech Republic were the fourth highest in the EU28 when they reached 11.8 t CO_2 eq.capita^{-1}, which is 39.4% above the European average. **The emission intensity of the economy** in the Czech Republic (0.51 t CO_2 eq.(1,000 PPS)$^{-1}$ at constant prices) was in 2014 higher by 66.8% than the average of the EU28 (Chart 1). Economies with the smallest emission intensity are countries of Western and Northern Europe with high economic performance (Luxembourg, Sweden) and the countries with energy based on non-fossil energy sources (France, Austria). On the contrary, most emissions per unit of GDP are produced by countries with lower economy output and a high per capita emissions, which include Estonia, Bulgaria and Poland.

Despite the continued downward trend in the emission of pollutants into the air, the polluted air remains to be in European countries with a significant risk to human health and ecosystems. In 2013[27], around 17% of the urban population in the EU28 average was exposed to above-limit 24-hour PM_{10} concentrations (50 μg.m^{-3}), approximately 9% of the urban population was exposed to above-limit annual concentrations of **$PM_{2.5}$** (25 μg.m^{-3}), and approximately 15% of the urban population was in 2013 exposed to ground-level ozone **O_3** concentrations higher than the specified limit values. Approximately 9%, or 25–28% of the urban population of EU28 has been exposed to above-limit annual average concentrations of **NO_2** (40 μg.m^{-3}) and **benzo(a)pyrene** (1 ng.m^{-3}).

[27] *Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.*

Benzo(a)pyrene, which belongs to the group of polycyclic aromatic hydrocarbons, in general represents a significant problem in Europe. Concentrations of polycyclic aromatic hydrocarbons in Europe in the last decade increased, as a result of the increase in emissions from the local residential heating. In 2012, approximately 20% of the population was exposed to above-limit annual concentrations of **benzo(a)pyrene**. The most exposed population in the region of Central and Eastern Europe, including the Baltic countries and the countries in the Balkans, where the annual average concentration exceed the value of 1.5 ng.m^{-3} (Figure 1).

A serious damage to vegetation in the long term presents the **ground-level ozone**, expressed as AOT40. Limit values for the protection of vegetation for ground-level ozone (18,000 μg.m^{-3}.h) was exceeded in 2012 at around 30% of the area of the European countries, respectively 27% of the area or countries EU28, particularly in the areas of southern and Central Europe (Figure 2), with the highest values measured in Italy (47,000 μg.m^{-3}.h). The development of concentrations of ground-level ozone reported a significant year-to-year variability caused particularly by meteorological conditions during the growing season (May to July). In comparison with previously reviewed years 2009–2011 there was an increase in the areas for which the limit value was exceeded, as in those years it fluctuated between 19–26% (18% of the area in 2011). On the contrary, the decrease was recorded compared to the period 2005–2008, when the share of the area with the exceeded limit values fluctuated in different years in the range of 36 to 69%.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

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2 Water management and water quality

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 abstractions have dropped. This trend was particularly contributed to by the reduction of surface water abstraction, while the largest decrease was recorded in the energy sector – from 710.4 mil. m^3 in 2014 to 645.7 mil. m^3 in 2015.
Year-to-year, the number of inhabitants connected to the water supply systems successfully increases, even if the proportion of the total number of the population remains the same as in 2014 (94.2%).

Year to year, there was an increase in water abstraction[1] for water industry (612.8 mil. m^3 in 2015 vs. 602.0 mil. m^3 in 2014) and agriculture (54.3 mil. m^3 in 2015 vs. 48.5 mil. m^3 in 2014), which was caused by hydrometeorological conditions in 2015.
Compared to 2014 there was a slight increase in water loss in pipe-network from 16.6% to 16.8% in 2015.
There was a slight increase in the specific consumptive use of water produced (165.4 $l.inhabitant^{-1}.day^{-1}$ in 2015 vs. 158.9 $l.inhabitant^{-1}.day^{-1}$ in 2014) and also the household consumption (87.9 $l.inhabitant^{-1}.day^{-1}$ in 2015 vs. 87.3 $l.inhabitant^{-1}.day^{-1}$ in 2014). The price of water continues to rise.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

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)
- promote sustainable water use

National Development Plan for Water Supply and Sewerage Systems
- presents the drinking water supply concept until 2015, including the definition of drinking water sources

Regional Development Plans for Water Supply and Sewerage Systems
- construction and renovation of water management infrastructure

International River Basin Management Plans (Elbe, Oder, Danube)
- cover the individual National River Basin Management Plans

[1] *That is the sum of the abstractions of surface water and groundwater.*

National River Basin Management Plans
- support connecting residents in outlying areas of municipalities and residents of small villages to the public water supply 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

River Basin District Management Plans
- proposals for concrete measures for the gradual elimination of the most important water issues

Conception of Water Management Policy of the Ministry of Agriculture until 2015
- ensure the development of drinking water supply and address the sufficiency of water resources for water supply systems

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 storm water and non-drinking quality water on site

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

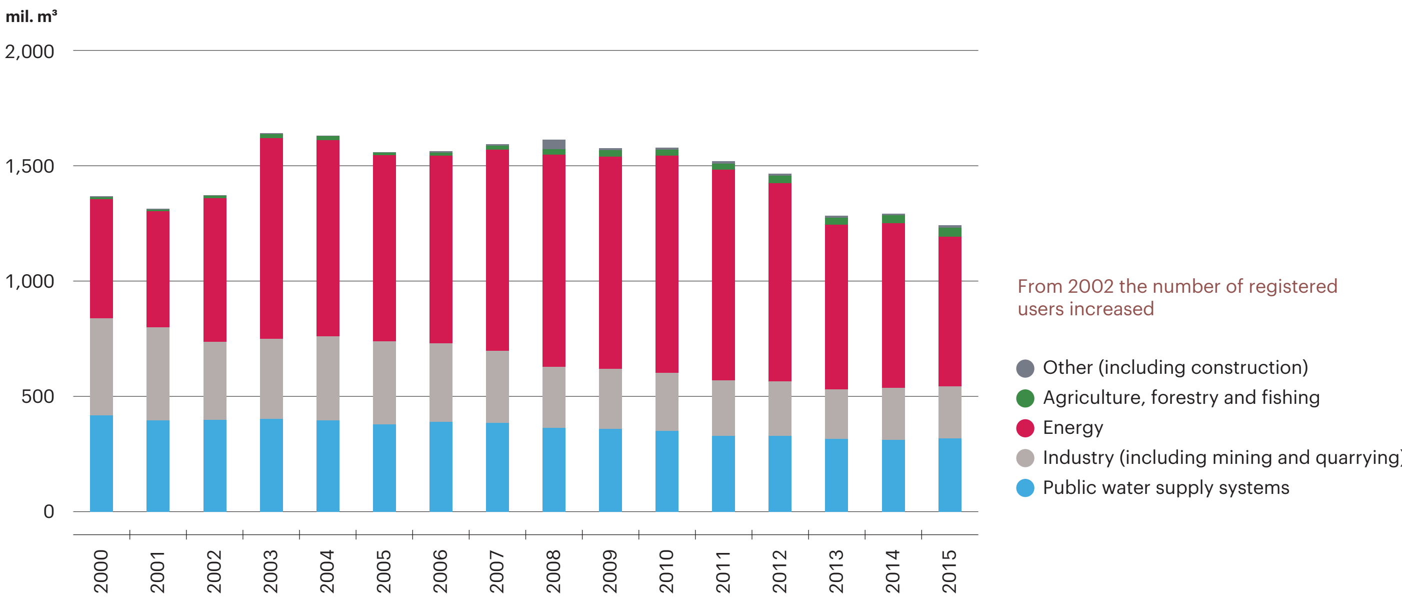
Impacts on human health and ecosystems

The water abstractions must comply with the requirements for a good condition and ecological limits of water bodies, so as to avoid damage due to the overexploitation of water resources or associated ecosystems. In connection with climate change, the pressure on surface water resources, and particularly on groundwater, will be growing in future, especially in the context of rising demands for water abstraction in agriculture due to more frequent occurrence of drought episodes. At the same time, however, the recharge of water into the soil decreases and thus also the long-term replenishment of groundwater reserves. In this case, both the negative impact of drought solidifying the parched land and hindering the infiltration of subsequent intense rainfall and of the growing proportion of built-up areas prevent infiltration and accelerate surface runoff. The long-term nationwide monitoring shows that the quality of drinking water in public water supply systems in the Czech Republic does not, with a few exceptions, represent a health risk. The relatively numerous findings of non-compliance with the limit values of certain indicators, however, occur in samples from public and commercial wells, where the effect of runoff of pollutants from agriculture takes place.

Indicator assessment

Chart 1

Surface water abstraction by individual sectors in the Czech Republic [mil. m³], 2000–2015

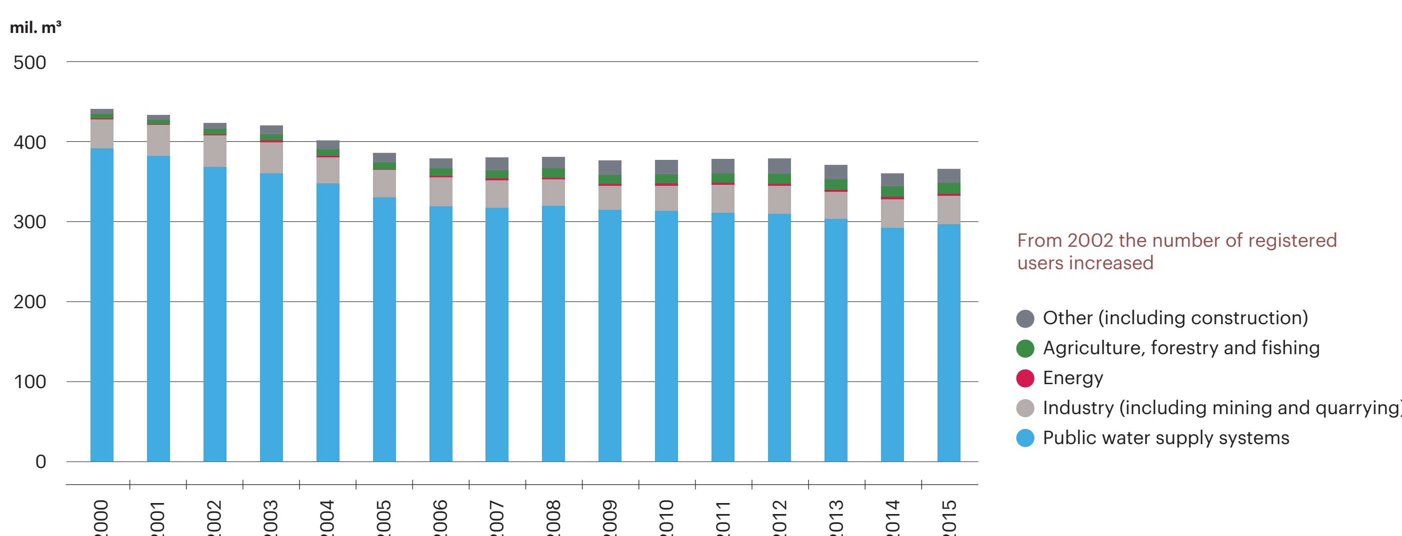


Until the year 2001 water abstraction exceeding 15,000 m³ per year or 1,250 m³ per month was registered. From the year 2002 abstraction by users over 6,000 m³ per year or 500 m³ per month was registered – pursuant to Section 10 of the Decree of the Ministry of Agriculture No. 431/2001 Coll.

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

Chart 2

Groundwater abstraction by individual sectors in the Czech Republic [mil. m³], 2000–2015

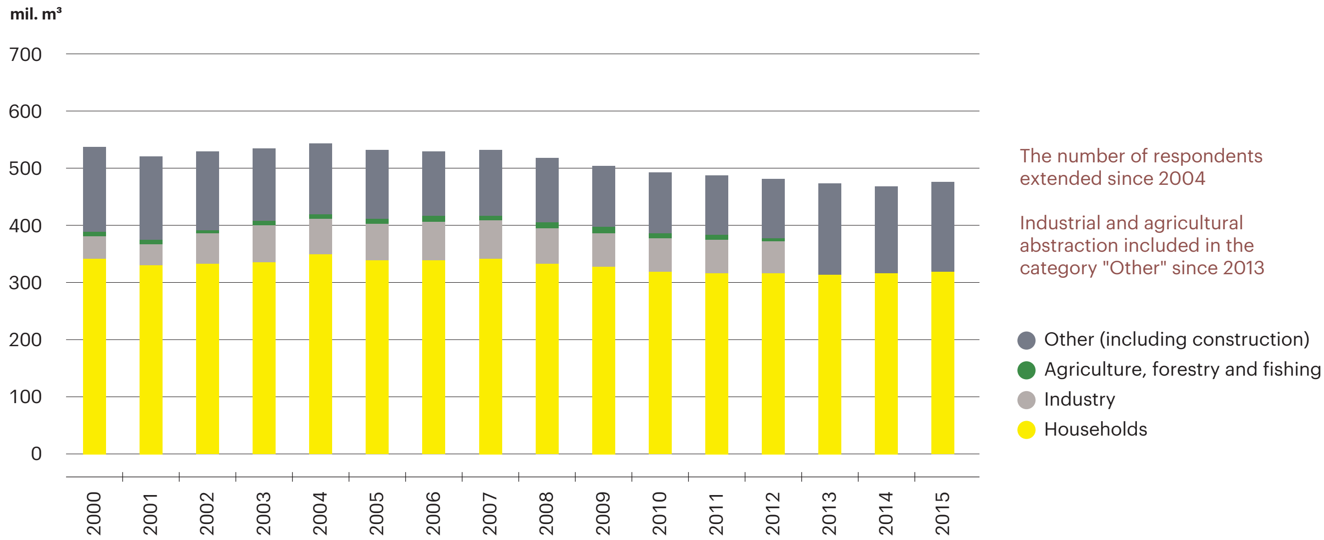


Until the year 2001 water abstraction exceeding 15,000 m³ per year or 1,250 m³ per month was registered. From the year 2002 abstraction by users over 6,000 m³ per year or 500 m³ per month was registered – pursuant to Section 10 of the Decree of the Ministry of Agriculture No. 431/2001 Coll.

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

Chart 3

The use of drinking water from public water supply systems by individual consumers in the Czech Republic [mil. m³], 2000–2015

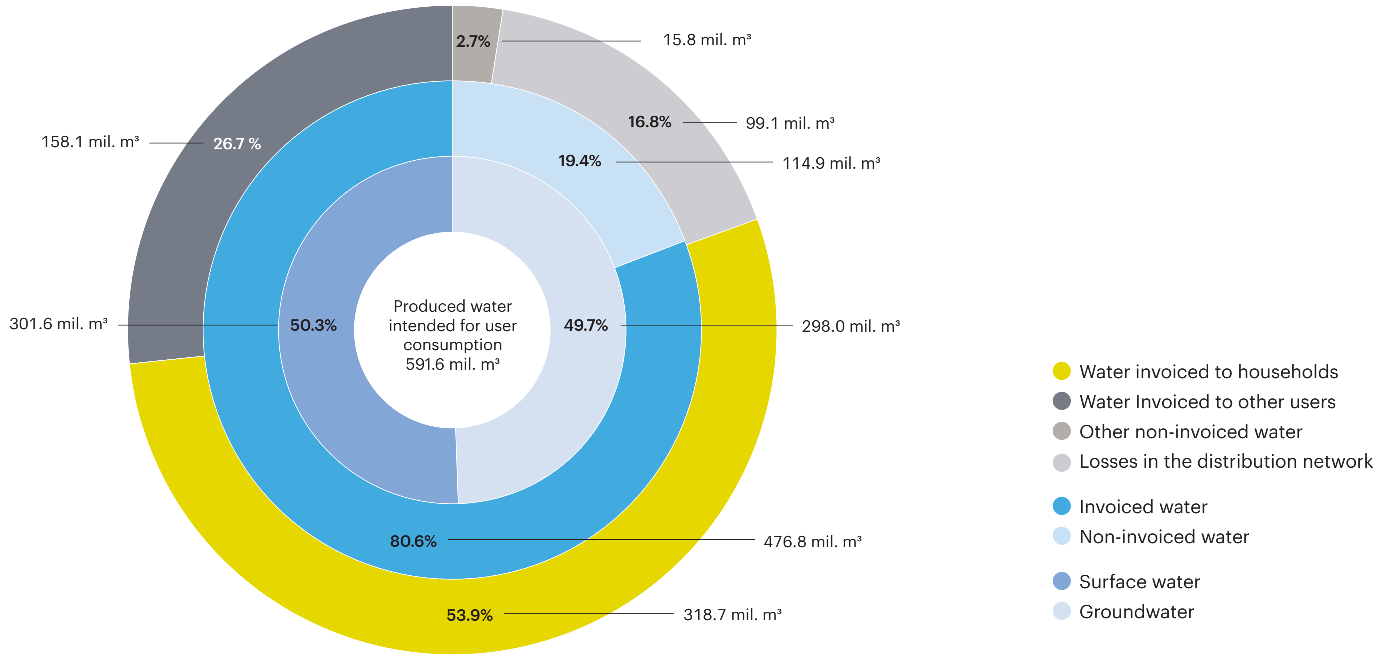


Until 2003, only data for the main operators are provided. In 2013, reporting of invoiced water was simplified (industrial and agricultural abstraction is included in the category "Other" which includes construction, services and other users connected to the public water supply systems).

Source: Czech Statistical Office

Chart 4

Produced water from public water supply systems in the Czech Republic [mil. m³], 2015

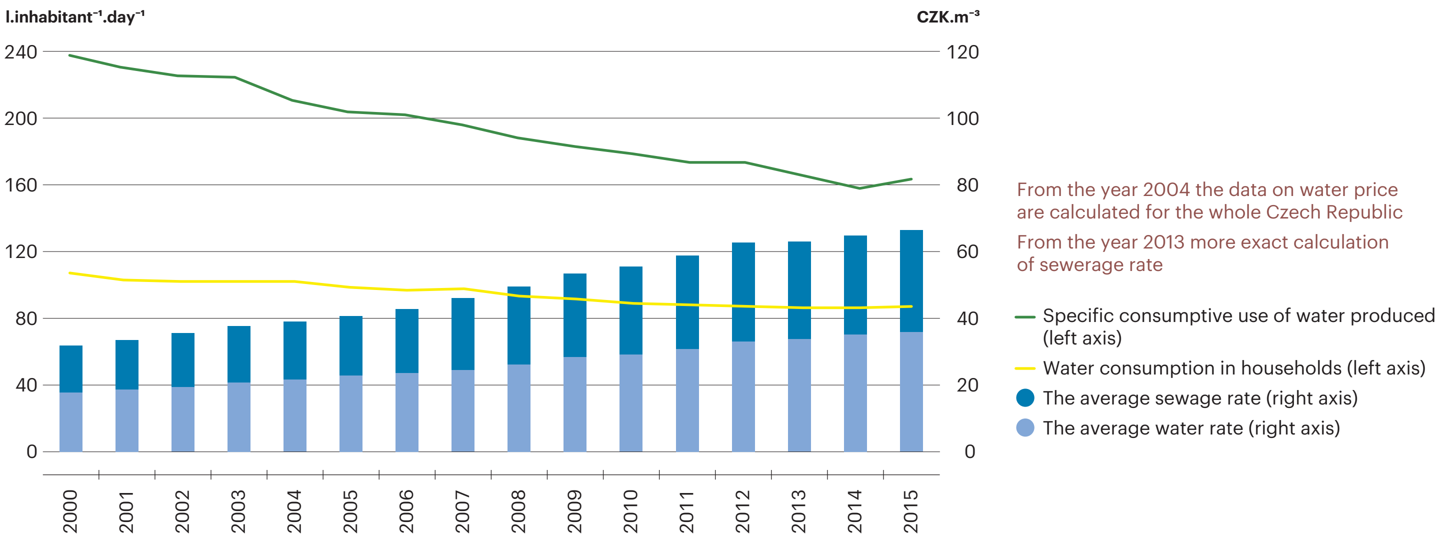


The diagram shows the use of produced water intended for user consumption. Data on the proportion of non-invoiced and invoiced drinking water are determined from the total volume of produced drinking water intended for user consumption. The non-invoiced water includes losses in the distribution network, own water consumption etc. The data on abstracted groundwater and surface water are related to the total production of drinking water (599.6 mil. m³ in the year 2015).

Source: Czech Statistical Office

Chart 5

Water consumption in the Czech Republic [l.inhabitant^{-1}.day^{-1}] and the price of water [CZK.m^{-3}], 2000–2015



Until 2003, the water rates 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. Since 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 m³ is not fully comparable with the previous years since 2013.

Source: Czech Statistical Office

Total abstractions of surface and underground waters reflect the development of the economy and the behavior of households. More significantly, this trend was manifested in the early 90s of the 20th century, when it first was associated primarily with the changes in the structure of the industrial and agricultural production, and subsequently with the decreasing demand of industrial technologies for water, increasing price of water, and the reduction of water consumption in households. After the sudden increase in surface water abstraction between the years 2002 and 2003 (change in the scope of reported data and concurrent abstraction of cooling water for the Temelín nuclear power plant), water abstraction stagnated. After the period 2011–2013, when there were repeated declines in abstraction, a stagnation occurred again in 2014. In 2015 there was once again a slight reduction in abstractions – 1,236.8 mil. m³ compared to 1,288.7 mil. m³ in 2014. It was caused by unfavourable weather conditions in 2015 in the form of drought. In the case of groundwater abstraction, at the beginning of the millennium there was a drop, followed in the years 2006–2012 by a stagnation and after a slight decrease in the years 2013 and 2014, there was a slow rise in abstractions in 2015 from the value of 361.0 mil. m³ to 366.4 mil. m³. Out of the total volume of water abstracted, 77.1% share of abstraction was from surface sources.

Of the total water abstraction, the greatest part is made in the **energy** sector (40.4%, 647.9 mil. m³ in 2015). In the vast majority of these cases the abstraction is for water in flow through cooling of steam turbines, so 99.7% of the abstraction for the energy sector (645.7 mil. m³) is drawn from surface waters (Chart 1). After stagnation in 2014, in 2015 the water abstraction for energy was decreased again (by 9.1%, which corresponds to a reduction of 65.1 mil. m³ compared to 2014). The reduction of abstractions was a result of low levels of watercourses.

For the public **water supply systems** a total of 612.8 mil. m³ was drawn in 2015. Public water supply systems are the most important consumer of the groundwater (Chart 1, Chart 2). The amount of 296.8 mil. m³, i.e. 81.0% of groundwater abstraction was used for that due to higher quality of the groundwater, and hence lower need for treatment for the production of drinking water. Generally, 38.2% of all abstractions in the country are carried out for the purpose of water collection, treatment and supply by public water supply systems. Year-to-year, there was an increase of 1.8% in abstractions, i.e. 10.8 mil. m³.

Overall, the third largest consumer of water in the year 2015 was the **industry** (16.3%, i.e. 261.8 mil. m³). Water abstraction for the industry accounted for 18.3% of the abstraction from surface sources and only 9.8% from groundwater sources (Chart 1, Chart 2). After a decline in abstractions in 2013 and the increase in 2014, there was an apparent stagnation in 2015. The abstraction for the industry (including mining and quarrying) exhibits a long-term decline (since 2000 by 42.8%). 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.

Consistently low abstractions in the Czech Republic are reported by **agriculture** (3.4% of the total abstractions in 2015, i.e. 54.3 mil. m^3). In the long term the increase in abstractions can be seen, but the overall rating cannot be completely accurate. By law only part of the abstracted water is subject to fees. However, for the purposes of compiling the water balance all abstracted water has to be reported and the fluctuations are partly caused by the reporting discipline. The annual variation of abstraction for crop production is dependent on the course of temperatures and precipitation during the growing season. Between 2014 and 2015, water abstraction for agriculture increased by 12%, i.e. 5.8 mil. m^3. The water abstractions thus reflected high temperature averages and low precipitation totals for the year 2015 (see indicator 1 – Hydrometeorological conditions).

A significant part of the abstracted water is intended for the production of drinking water. In the year 2015, 591.6 mil. m^3 of water intended for consumption were produced. **Drinking water** invoiced to households and other customers accounted for 476.8 mil. m^3 (Chart 3, Chart 4). Since 2007, the amount of the invoiced drinking water decreased until 2014, when the decline stopped, and in 2015 there has been a slight increase again – for households by 0.9% (from 316.0 mil. m^3 to 318.7 mil. m^3) and for other customers by 3.5% (152.7 mil. m^3 to 158.1 mil. m^3). This increase was cased by the extreme drought in the year 2015. In the year 2015, 9.93 mil. inhabitants, respectively 94.2% of the Czech Republic population, were supplied by water from public water supply systems.

The losses of drinking water in the water supply systems, which are caused by accidents and leaks from the public water supply, recorded a slight year-to-year increase in 2015 – from 16.6% in 2014 from the total volume of produced water intended for user consumption to 16.8%. Since 2000, when the losses were 25.2%, there was a significant drop, but losses are still considerable and there is a need to continue to pay close attention to their reduction.

Water consumption per inhabitant supplied by water from the public water supply system, out of the total quantity of produced water, was 165.4 $l.inhabitant^{-1}.day^{-1}$, which is by 4.1% more than in 2014 (Chart 5). The consumption in households in 2015 was 87.9 $l.capita^{-1}.day^{-1}$, which represents a slight increase compared to the year 2014 (87.3 $l.capita^{-1}.day^{-1}$), however from the long-term perspective, the consumption in recent years has been rather stagnant. Further reducing of the consumption of water in households is probably not realistic without introducing systems to utilize rain water and similar measures.

In the long-term, **water and sewerage rates** continue to increase (Chart 5). The price increase is affected by inflation, the investment in renewal of the water infrastructure, which is often oversized, and often also by the growing profits of foreign water companies.

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 reduction of the total amount of discharged waste water continues. The year-to-year decrease amounted to 5.6%. The decrease was caused largely by the energy industry (decrease by 10.2%) and, in particular, agriculture (decrease by 47.7%), which can be seen as a consequence of the exceptional hydrometeorological conditions in 2015. There was a reduction in the volume of emitted nitrogen ($N_{inorg.}$) by 3.4% to 9,888 t and phosphorus (P_{total}) by 2.3% to 1,130 t, although the amount of pollution produced slightly increased year-to-year.

The amount of organic pollution expressed by indicators BOD_5, COD_{Cr} and suspended solids has annual stagnant or slightly upward trend – for BOD_5 increased by 0.3% to 5,325 t, for COD_{Cr} by 1.1% to 36,967 t and for suspended solids by 3.2% to 9,936 t. There was also an increase in the amount of pollution expressed by these indicators.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

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

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

National Development Plan for Water Supply and Sewerage Systems
- minimize nutrient and hazardous substances water pollution by establishing emission limits for the individual pollution indicators

International River Basin Management Plans – for the international river basins (Elbe, Danube, Oder)
- cover the individual National River Basin Management Plans

National River Basin Management Plans
- 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

River Basin District Management Plans
- summary of the specific objective and program measures for the improvement of surface water and groundwater quality

Operational Programme Environment 2014–2020
- 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)

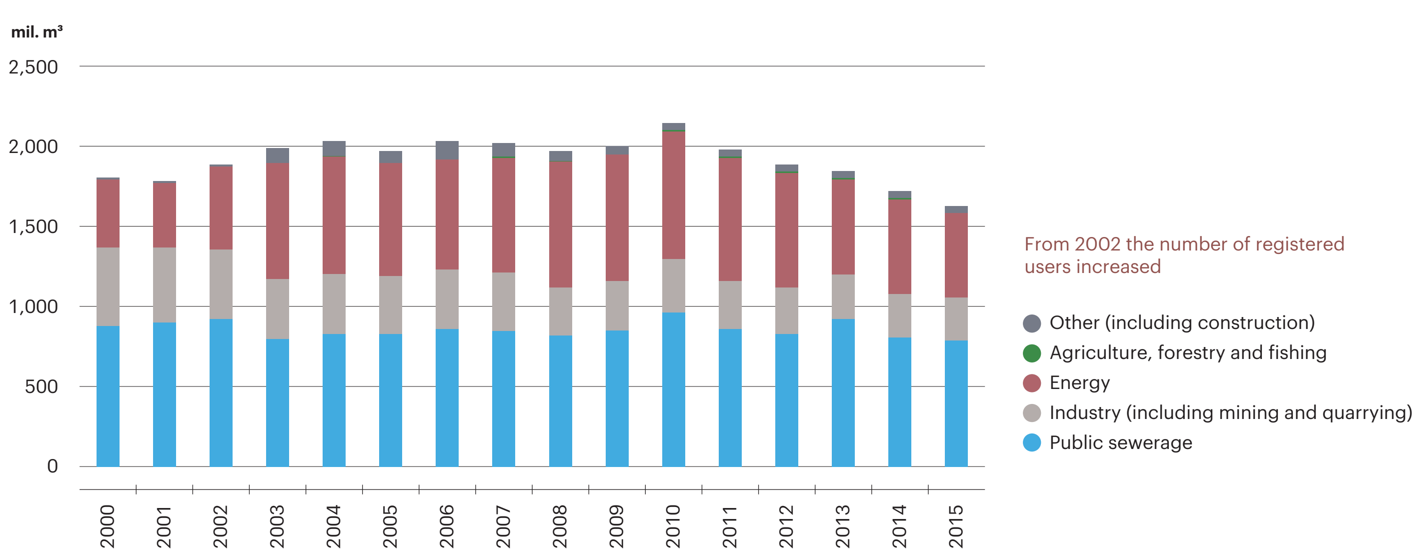
Impacts on human health and ecosystems

The quantity of waste water, produced pollution and pollution discharged into surface water directly affects its quality, and thus also the ecosystems bound to the aquatic environment. The most important components of waste water pollution are the organic compounds, nutrients (especially phosphorous and nitrogen) and hazardous substances. The nutrients (particularly phosphorus) contained in waste water contribute together with the diffuse sources to the excessive eutrophication of watercourses and reservoirs. The polluted water can also be a source of infectious diseases such as viral hepatitis A, dysentery, salmonella, etc. The aquatic environment is every year affected by pollution releases which are dangerous primarily because of their unpredictability and high level of hazard from the released substances. Of importance are mainly those toxic substances that pollute drinking water sources (especially groundwater), and substances that accumulate in the soil and sediments from where they get into plant and animal tissues, and thus into the food chain of animals and humans, where they can occur even a long time after their release.

Indicator assessment

Chart 1

Quantity of waste water discharged into surface water in the Czech Republic [mil. m³], 2000–2015

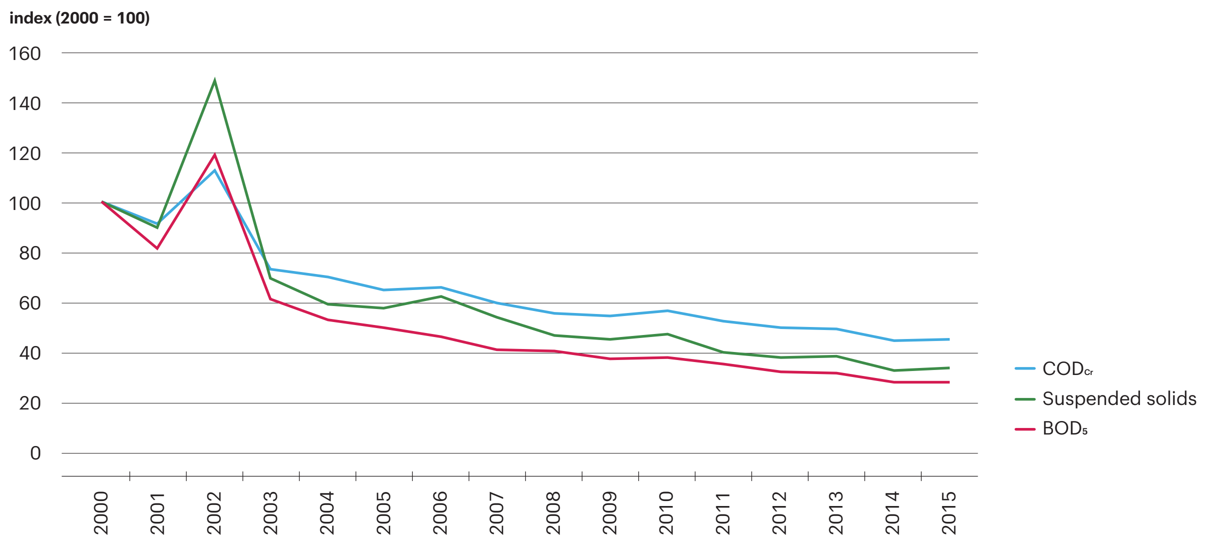


Until the year 2001 waste water and mine water discharges exceeding 15,000 m³ per year or 1,250 m³ per month were recorded. From the year 2002 discharges exceeding 6,000 m³ per year or 500 m³ per month are recorded – pursuant to Section 10 of the Decree of the Ministry of Agriculture No. 431/2001 Coll.

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

Chart 2

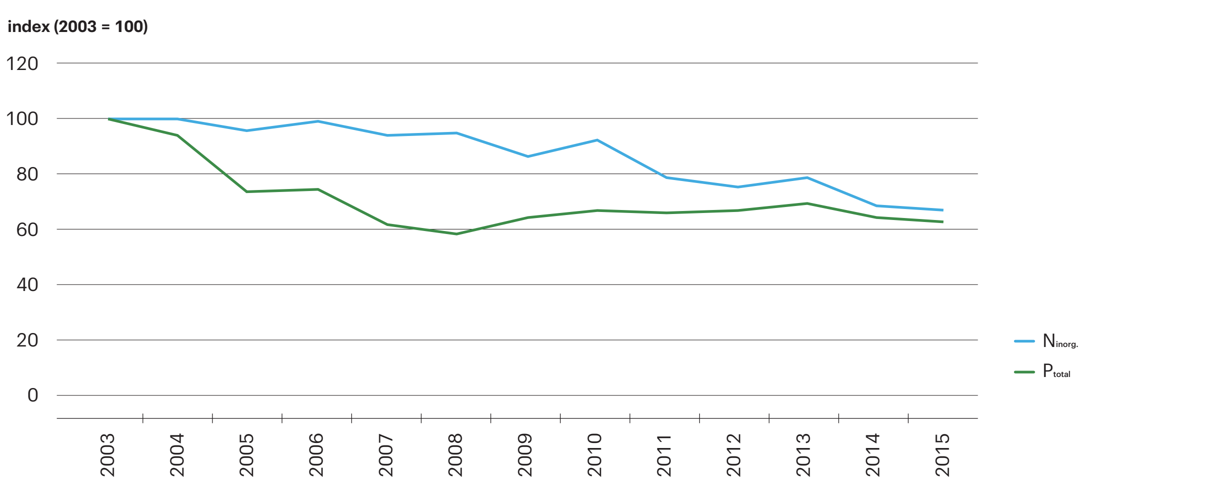
Relative representation of pollution discharged from point sources expressed in BOD_5, COD_{Cr} and suspended solids indicators in the Czech Republic [index, 2000 = 100], 2000–2015



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

Chart 3

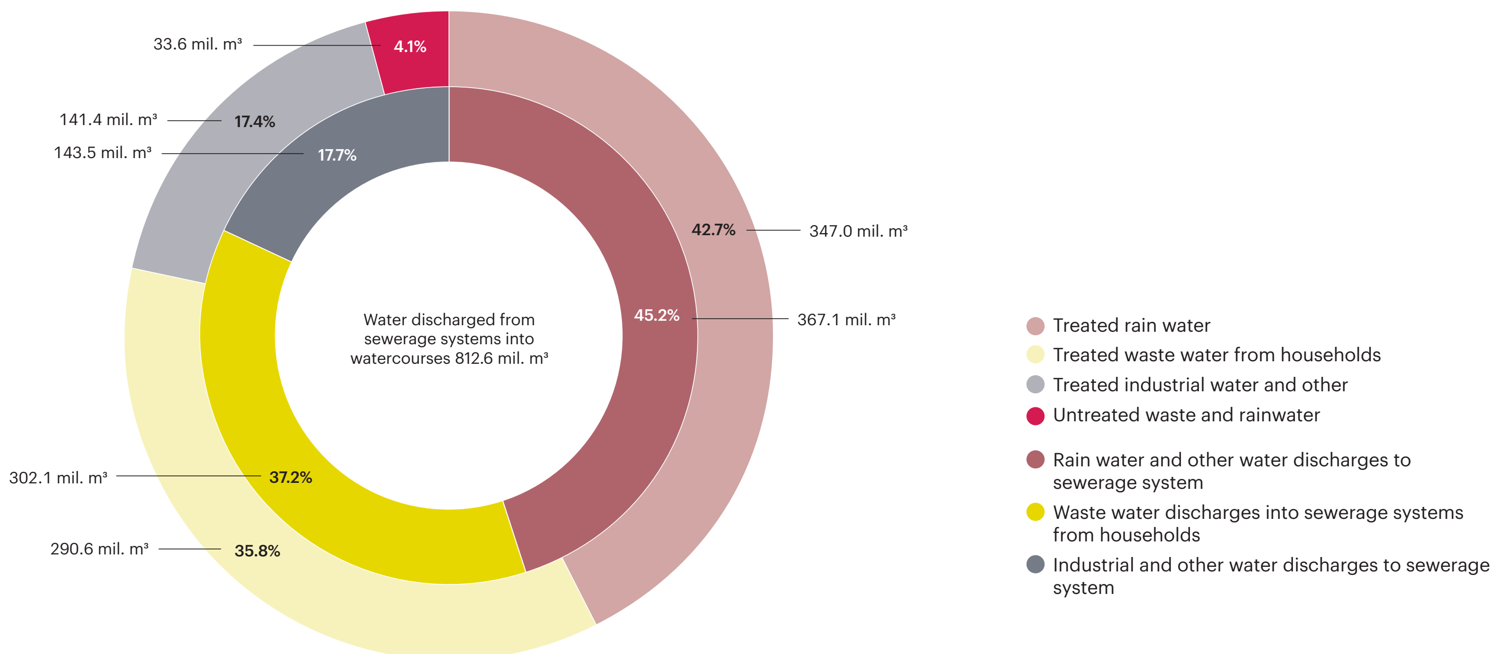
Relative representation of pollution discharged from point sources expressed in $N_{inorg.}$ and P_{total} indicators in the Czech Republic [index, 2003 = 100], 2003–2015



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

Chart 4

Quantity of water discharged from sewerage systems into surface water in the Czech Republic [mil. m³], 2015



Source: Czech Statistical Office

As with water abstraction, the **total volume of discharged waste water** exhibits since the 80s and 90s of the 20th century a downward trend, with only occasional occurrence of a year-to-year increase in volume. The change in the trend occurred in 2002, when compared to the previous year, the quantity of waste water discharged increased. This was also the case in the following two years (Chart 1). This increase coincided with a change in the boundaries of the registered quantity of discharged water and with the increase in discharges of waste water from the energy sector, which was due to start of abstractions of the cooling water for Temelín nuclear power plant and the increase in abstraction for Mělník power plant. After the year 2004 the total volume of discharged waste water stagnated at around 2 bil. m³ per year. An exception was the year 2010, when there was a significant increase in discharges (7.4% to 2,142.1 mil. m³), mainly from the public sewerage systems. This was caused by higher precipitation which increased the volume of discharged rain water. From 2010, the volume of water discharged each year is decreasing each year. In 2015, the total volume of discharges from point sources was 1,621.4 m³, which is less by 5.6% than in 2014. The decrease was caused largely by the energy industry (decrease by 10.2%) and, in particular, agriculture (decrease by 47.7%), which can be seen as a consequence of the exceptional hydrometeorological conditions in 2015. The reduction of the volume of waste water discharged in the energy sector correlates with the reduction of the water abstraction (see indicator 08 Water abstraction) and the reduction of the volume of water discharged in the agricultural sector was influenced especially by the evaporation due to high temperatures.

In the overall perspective of the **structure of the waste water discharge** reflects the structure of customers. The largest proportion is the public sewerage (48.5%, i.e. 786.8 mil. m³) and energy (32.5%, i.e. 527.1 mil. m³). The municipal waste water discharges, which dropped year-to-year by 2.6%, represent significant point sources of pollution, mainly organic. 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** (16.5%, i.e. 268.0 mil. m³), which is a source of not only organic pollution, but also of pollution by e.g. heavy metals and specific organic substances. Discharges from the industry (including mining), compared with the previous year decreased by 1.5%. Among the largest producers of industrial waste water are the chemical, paper, mining, and food industries. A specific surface water polluter is the **agriculture**, which discharges only a small volume of waste water from the point sources (in 2015 it was 3.4 mil. m³, which was 0.2% of the total volume of waste water discharged), but even then it belongs among the major sources of pollution in the Czech Republic. Most of the pollution from agriculture to surface waters is not from point sources, but from diffuse pollution by runoff from farmland (some activities within the plant or animal production, such as sprays, medicines, fertiliser application, unsuitable composition of crops, soil processing increasing the risk of soil erosion, compaction of the layer under topsoil, grazing, etc.). This type of pollution is not recorded overall, but is significantly reflected in the resulting quality of surface water and groundwater. The diffuse pollution is a major source of nitrates, pesticides and causes acidification. In the category "Other", where there is also the construction industry, in 2015 a decrease was recorded in the volume of discharged water by 16.4% compared to the previous year to the value of 36.1 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. Since 2000 the decline of the amount of the discharged organic pollution from point sources was less pronounced than it was in the 90s of the 20^{th} century, but despite that there is a significant decreasing trend. Yet the lowest values were achieved in 2014. There was a slight year-to-year increase in 2015 – for organic pollution expressed by the BOD_5 by 0.3% to 5,325 t, for COD_{Cr} by 1.1% to 36,967 t and suspended solids by 3.2% to 9,936 t (Chart 2). **The volume of pollution is increased** compared to the previous assessed year – for BOD_5 by 4.3% to 261,008 t, for COD_{Cr} by 4.9% to 591,075 t and for suspended solids by 10.8% to 280,866 t. While in the 90s of the 20^{th} century the reduction of pollution reflected the decline in industrial production and the increasing volume of treated water, in recent years, the effect is primarily caused by the extensive construction and modernisation of municipal and industrial WWTPs. The deviation in 2002 was caused by the extreme floods.

By contrast, **the amount of nutrients discharged** in the longer perspective has a more fluctuating trend, however, year-to-year, in the case of nitrogen ($N_{inorg.}$) there was a reduction in volume by 3.4% to 9,888 t, for phosphorus (P_{total}) by 2.3% to 1,130 tonnes (Chart 3), even though the **amount of produced pollution** slightly increased in the year-to-year comparison (by about 2.5% for $N_{inorg.}$ to 29,625 t, for P_{total} by 6.2% to 6,630 t). In the longer term perspective, since 2003, the quantity of $N_{inorg.}$ decreased by 33.9% and P_{total} even by 37.6%. The long-term decrease is influenced by the reduction of the quantity of phosphates used in detergents and in recent years especially by the 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

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 gradual long-term increase in the number of inhabitants connected to public sewerage systems continues. In 2015, 84.2% of the population was connected to public sewerage systems, of which 95.9% were connected to a WWTP.
The volume of waste water discharged into the sewerage system (both including and excluding the rainwater subject to discharge fees) is stagnant, but the difference compared to the past is considerable – for discharges into public sewerage system excluding rain water there was a decrease by 22.7% compared to the year 2000. A total of 97.0% of the waste water discharged into the sewerage systems was treated.
In 2015, the number of WWTPs with tertiary treatment stage increased by 68 to the total of 1,304. They form 52.3% of the total number of WWTPs. Only the mechanical treatment stage remained in 39 WWTPs (1.6%). The average efficiency of WWTPs, measured by the concentration of the basic indicators of pollution, ranges from 78.1% for N_{total} up to 98.3% for BOD_5.

The proportion of the population connected to sewerage system is growing slowly. For this reason, 19.2% of the population have not yet been connected to a WWTP although the number of the new and intensified WWTPs is gradually increasing.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

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

State Environmental Policy of the Czech Republic 2012–2020
- finalize construction and reconstruction of missing WWTPs in communities over 2,000 population equivalents
- ensure support to the construction and reconstruction of WWTPs with sewerage systems in communities below 2,000 population equivalents

Operational Programme Environment 2014–2020
- increase the quantity of treated waste water to 321 mil. m³ by the year 2023

National River Basin Management Plans
- increase the number of inhabitants connected to public sewerage networks with emphasis on small communities
- ensure quick finalization of capital investment projects related to the connection of communities over 2,000 population equivalents to a WWTP

National Development Plan for Water Supply and Sewerage Systems
- support of construction and reconstruction of WWTPs in communities over 2,000 population equivalents
- increase the proportion of inhabitants connected to public sewerage systems and to public sewerage systems connected to a WWTP

Regional Development Plans for Water Supply and Sewerage Systems
- construction and renovation of water management infrastructure

Conception of Water Management Policy of the Ministry of Agriculture until 2015
- ensure secondary treatment of municipal waste water in the so-called sensitive areas according to the Nitrate Directive, mainly by the construction of missing WWTPs and sewerage systems, reconstruction and improvement of technology for waste water treatment in all agglomerations over 2,000 population equivalents

Impacts on human health and ecosystems

The reduction of pollution discharged in municipal and industrial waste water is an essential assumption for decreasing pressure on the aquatic environment. The availability of sewerage systems for the residents and waste water treatment represents a measure of the maturity of the society and its relationship to the environment. Developed water management infrastructure ensures safe sewerage drainage and reduces the health risk of infections and epidemics of infectious diseases. Inadequate drainage of sewerage and its treatment may result in an impairment of the use of water for drinking purposes or for recreation.

The degree of treatment of drained waste water which affects the quantity and nature of the discharged pollutants has a direct impact on water quality and the related ecosystems. The problem may be both the toxicity of substances contained in waste water, as well as the content of nutrients (especially nitrogen and phosphorus), which can lead to eutrophication of waters. A growing risk appears to be the content of the residues of medicinal products, which are not yet effectively eliminated or sufficiently monitored in the WWTP and may pose a threat to the health of humans and aquatic organisms.

Indicator assessment

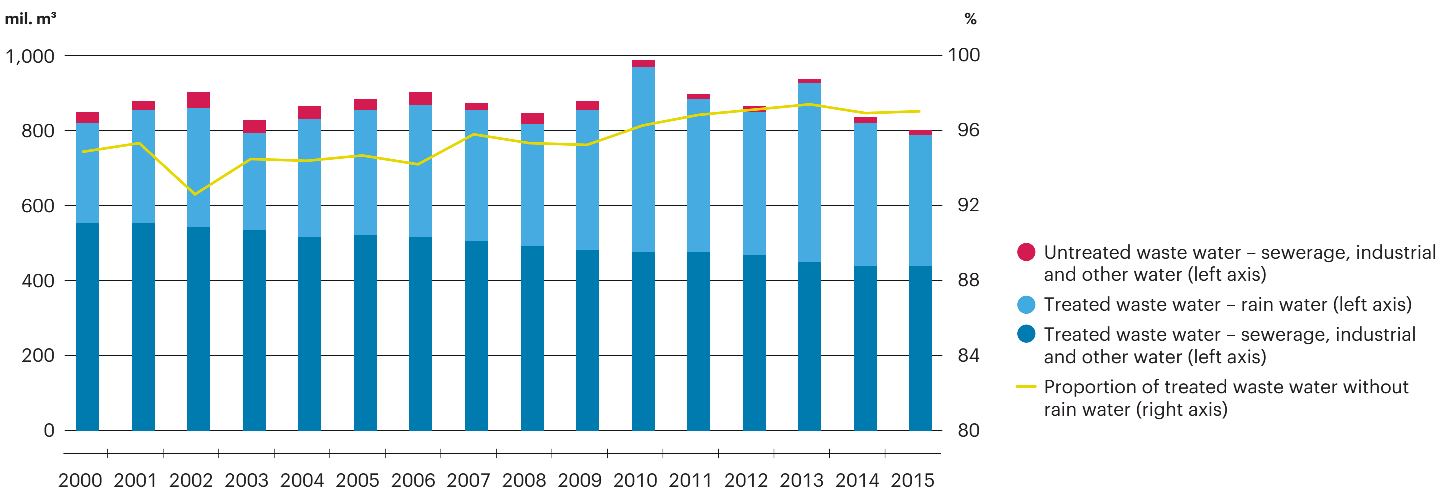
Chart 1

Proportion of the population connected to sewerage systems and to sewerage systems connected to WWTPs in the Czech Republic [%], 2000–2015

Source: Czech Statistical Office

Chart 2

Treatment of waste water discharged into sewerage systems in the Czech Republic [mil. m³, %], 2000–2015

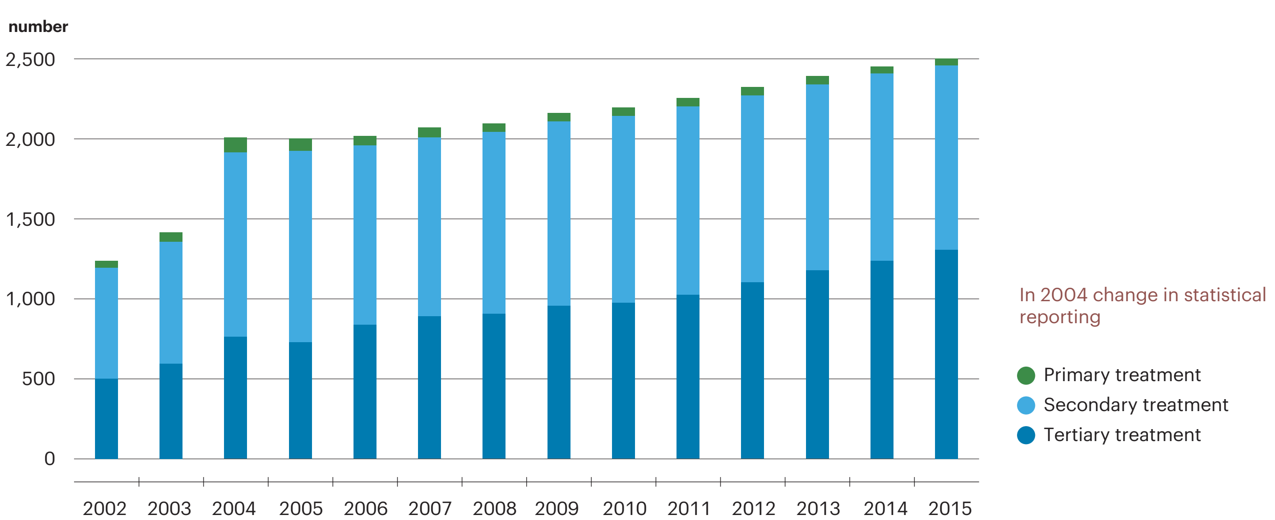


Until 2003 data are provided for the main operators of sewerage systems only. The number of respondents extended since 2004. The data series shown is impacted by changes in statistical reporting and the transformation of the former water supply and sewerage companies into the ownership of towns and communities.

Source: Czech Statistical Office

Chart 3

Number of waste water treatment plants according to treatment stages in the Czech Republic, 2002–2015



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

The development of infrastructure for the collection and treatment of sewerage was radically influenced by the accession of the Czech Republic to the EU and the subsequent compliance with the European legislation and the drawing on the European subsidies. Compared to 2003, the last year before joining the EU, **the proportion of the Czech population connected to the sewerage networks** increased from 77.7% to 84.2% in 2015 (Chart 1). Primarily positive was the increase in the proportion of the population connected to the sewerage systems connected to a WWTP. Year-to-year increase in the proportion of the population connected to the sewerage system is in recent years gradual. This is caused by the fact that the sewerage systems and waste water treatment plants in the larger conurbations have been already built and it is now needed to cover the smaller communities, where the population is less concentrated and where the budgets lack funding. Waste water produced by 19.2% of the population in 2015 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 the rain water subject to discharge fees, has been stagnating since 2013. In the year 2015, it was about 515.6 mil. m^3, taking the annual increase was only 0.4 mil. m^3. Also, the volume of water discharged to the public sewerage system without rain water has been stagnating. In 2015, the 445.5 mil. m^3 (from this volume, there was 432.0 mil. m^3 of treated and 13.5 mil. m^3 of untreated, Chart 2), which is about 0.6 mil. m^3 less than in 2014. This amount represents almost half the volume in 1990 and a decrease of 22.7% compared to the year 2000.

Nevertheless, **the proportion of treated waste water** out of the water discharged into the sewerage systems was very satisfactory in 2015 and amounted to 97.0%, whereas in 1990 it was only 75.0%. In the long-term perspective the magnitude of the share has fluctuated from the year 2000 between 94 and 98% (Chart 2). The lower value than the above range was recorded only in 2002 and was influenced by the limitations of waste water treatment operation affected by the floods. 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 2015, when the rainfall amounted to only 79% of the long-term mean, 347.0 mil. m^3 were treated. This is a volume about 33.0 mil. m^3 lower than in 2014 and compared to the average in the years 2000–2014 slightly below average, but not nearly the lowest – in the years 2000, 2001 and 2003, the volume of polluted rainwater has not reached even 300 mil. m^3.

The total number of WWTPs for public use in the Czech Republic has more than doubled since the year 2002 to 2,495 (i.e. on the average 1 WWTP per 4,226 inhabitants). Year-to-year the number of WWTPs grew by 2.0% (Chart 3). Due to the influence of construction and reconstruction of WWTP, compared to 2014, the total number of WWTP with removal of nitrogen and/or phosphorus (tertiary treatment) increased by 68 WWTPs. The number of WWTPs with basic mechanical treatment remained in 2015 only 39, i.e. 1.6% of all WWTPs.

The average efficiency of WWTPs (the quantity of pollution removed) in the Czech Republic is very high, for BOD_5 in 2015 it has reached 98.3%, for suspended solids 97.9%, for COD_{Cr} 94.6%, for P_{total} 86.1% and for N_{total} 78.1%. The values of treatment efficiency of organic pollution are similar as in the previous assesed years, which is related to the completed reconstruction of most large WWTPs and the stabilized trend in produced pollution in different areas. The efficiency of nutrient removal increased year-to-year by 1.2 percentage points for N_{total} and for P_{total} by 1.9 percentage points.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

11 | Water quality

Key question

Is the quality of the surface water affecting water organisms and the use of water improving?

Key messages

In comparison with the year 2000 there has been a decrease in the concentration of phosphorus (by 42.2%), BOD_5 (by 29.4%), and cadmium (by 78%). In year-to-year comparison, there has been a decrease in the concentration of phosphorus by 2.7% and FC by 14.4%. Exceedances of the environmental quality standards in 2015 were successfully avoided, especially for $N\text{-}NO_3^-$ and cadmium, and partially also for COD_{Cr} and BOD_5.

According to the cumulative assessment of the basic indicators tracked by CSN 75 7221 the quality of the water in rivers of the Czech Republic is satisfactory, but still a big part of streams is assessed by III. class (polluted water) and worse.
COD_{Cr} concentration in watercourses in the period 2000–2015 more or less stagnated.
The quality of the bathing water according to the rating of the CR is generally good, but year-to-year there was a decrease in the number of sites suitable for swimming and increase in the number of sites unsuitable for swimming.

Year-to-year there was an increase in the average concentrations of $N\text{-}NO_3^-$ by 3.6%, cadmium by 27.9% and chlorophyll 'a' by 1.8% (compared to the year 2000, an increase by 18.2%). Values of other indicators stagnated or increased slightly.
The objective of achieving at least a good ecological status, respectively ecological potential is met by only 19.4% of the surface water bodies.
A good chemical status is achieved by 61.1% of surface water bodies and 27.0% of groundwater bodies.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

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)
- the achievement of at least good water status and non-deterioration of their condition by 2015, with exceptions until 2027

Directive 2008/105/EC of the European Parliament and of the Council on environmental quality standards in the field of water policy
- water protection from priority hazardous substances – achieving the standard obligations by the end of the year 2015

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 2006/7/EC of the European Parliament and of the Council concerning the management of bathing water quality
- defined manners of monitoring and classification of bathing water quality

State Environmental Policy of the Czech Republic 2012–2020
- 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

National River Basin Management Plans
- preventing deterioration of the status of surface water bodies, achieving good status of water bodies using the set objectives
- reduction of nitrate pollution of water bodies in sensitive areas, achievement of the requirements on the quality of the water taken from the water sources for the purposes of the treatment to drinking water

River Basin District Management Plans
- contain specific objectives and program measures for the improvement of water quality

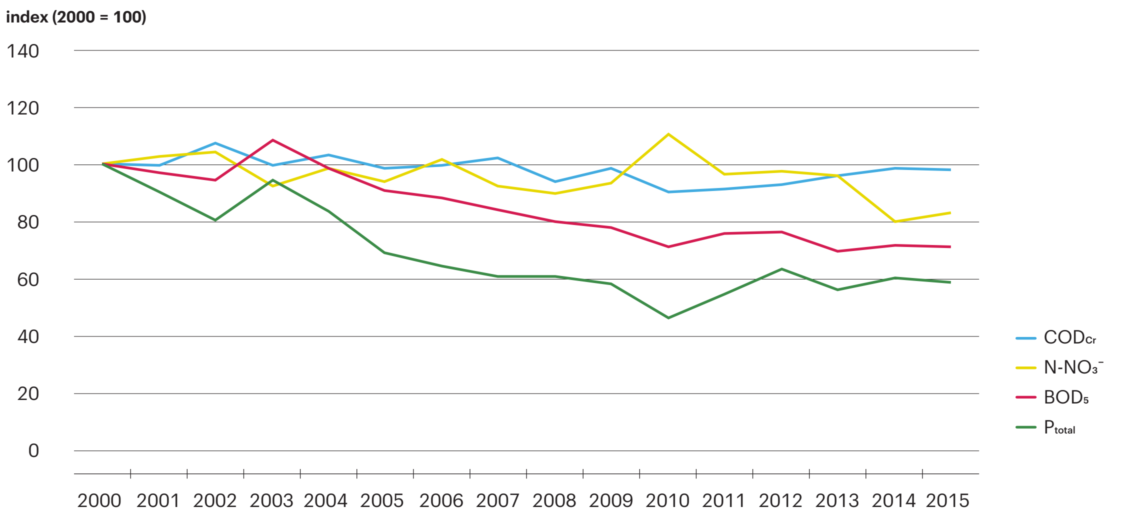
Impacts on human health and ecosystems

The quality of surface water has a direct impact primarily on aquatic and water-bound organisms, but also affects other adjacent ecosystems (e.g. the floodplains). An excessive quantity of nutrients (particularly phosphorus) entering the aquatic environment contributes to the eutrophication of water, which can lead to a reduction in the number of plant and animal species (deterioration of the ecological status) and also has a negative impact on the possibility of human water use. Eutrophication causes problems when using water for drinking purposes and poses a direct health risk when using surface water for bathing. The main health risks associated with exposure and ingestion of polluted water include infection by infectious diseases and skin rashes. Hazardous substances contained in surface waters (e.g. Hg, Ni, Cd, DDT) may subsequently accumulate in sediments and tissues of aquatic animals and thus enter the food chain of a wide range of other organisms, including humans. During flood situations the sediments are suddenly loosened up and so are the sedimented hazardous substances.

Indicator assessment

Chart 1

Development of concentrations of pollution indicators in watercourses in the Czech Republic [index, 2000 = 100], 2000–2015

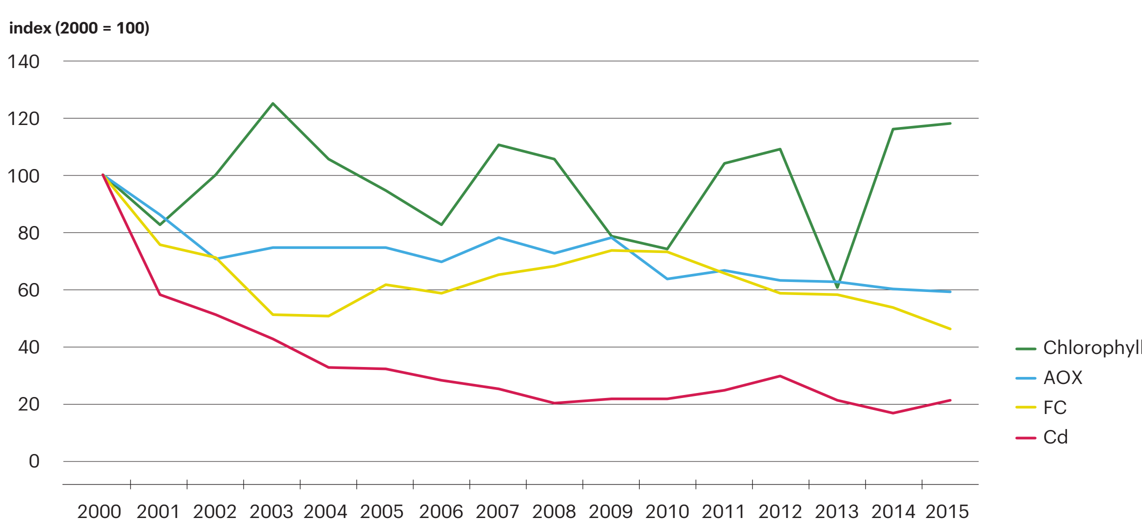


The indices for the individual indicators relating to the selected base year were calculated from arithmetic averages for each year, using annual average values for 69 selected profiles within the Eurowaternet network. The number of stations for the different years and different indicators changes depending on the availability of data. The water quality assessments for BOD_5, COD_{Cr}, $N\text{-}NO_3^-$ and P_{total} were carried out for the period 2000–2015, most frequently for a set of 68 stations, in 2015 for 64 stations, with the exception of BOD_5, which was measured at 63 stations.

Source: Czech Hydrometeorological Institute, Povodí, state enterprises

Chart 2

Development of concentration of pollution indicators in watercourses in the Czech Republic [index, 2000 = 100], 2000–2015

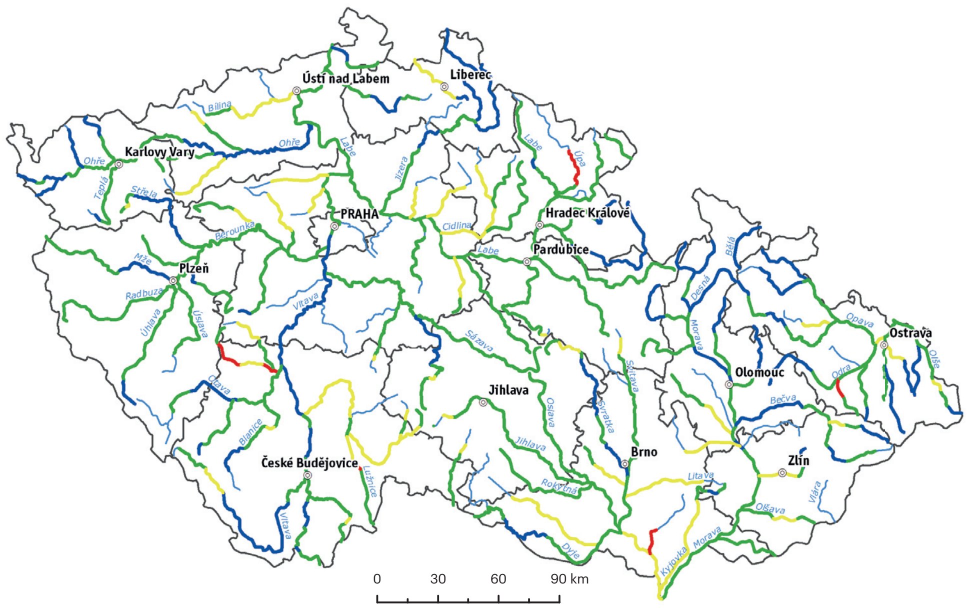


The indices for the individual indicators relating to the selected base year were calculated from arithmetic averages for each year, using annual average values for 69 selected profiles within the Eurowaternet network. The number of stations for the different years and different indicators changes depending on the availability of data. The water quality assessments for these indicators: AOX (29–61 stations, 48 stations in 2015), Cd (42–58 stations, 47 stations in 2015), FC (44–69 stations, 58 stations in 2015) and chlorophyll 'a' (46 to 69 stations, 48 stations in 2015) was carried out for the period 2000–2015.

Source: Czech Hydrometeorological Institute, Povodí, state enterprises

Figure 1

Water quality in watercourses in the Czech Republic, 2014–2015



Assessments pursuant to CSN 75 7221

Class

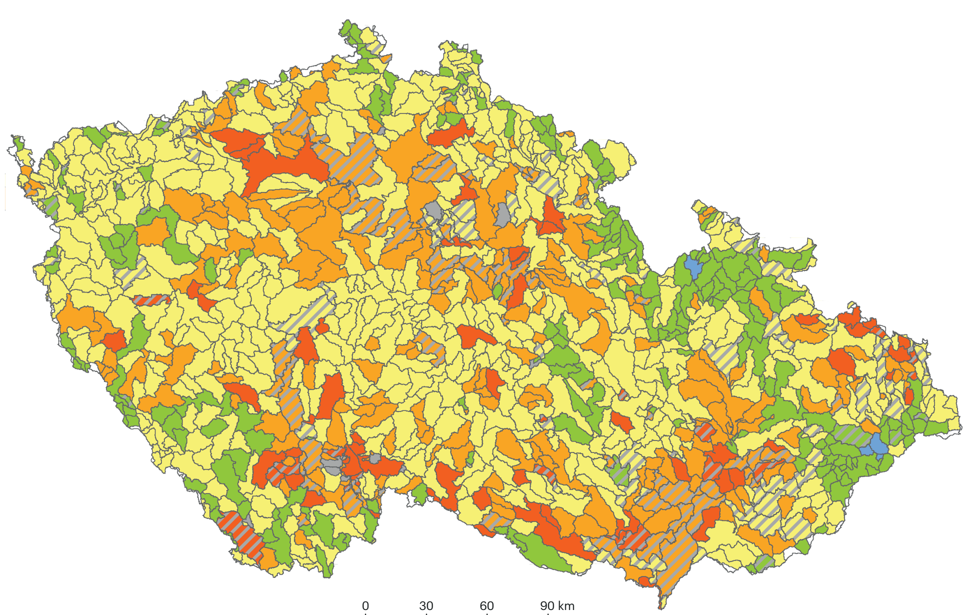
- I. and II. – unpolluted or slightly polluted water
- III. – polluted water
- IV. – heavily polluted water
- V. – very heavily polluted water

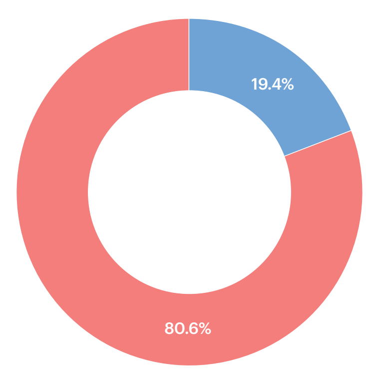
Summary evaluation of the indicators BOD_5, COD_{Cr}, $N\text{-}NH_4^+$, P_{total} and saprobic index of zoobenthos.

Source: T. G. Masaryk Water Research Institute, public research institution

Figure 2

Ecological status and potential of surface water bodies in the Czech Republic as at 2015





- High or good
- Worse than good, unknown

Ecological status or potential

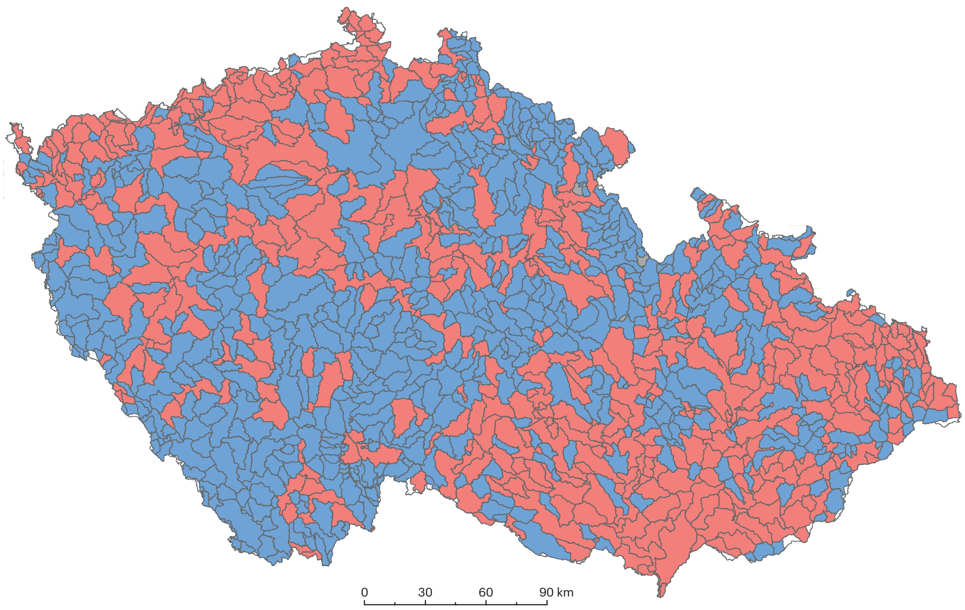
- High status
- Good status
- Moderate status
- Poor status
- Bad status
- Good and above potential
- Moderate potential
- Poor potential
- Bad potential
- Unknown status or potential

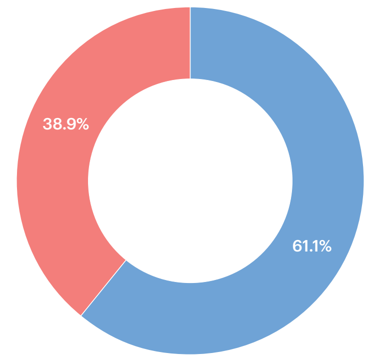
The evaluation refers to the year 2015, has been processed on the basis of data obtained from monitoring programs in representative profiles in the period 2010–2012 and it was accompanied by a forecast to the year 2015 according to the measures implemented.

Source: T. G. Masaryk Water Research Institute, public research institution

Figure 3

Chemical status of surface water bodies in the Czech Republic as at 2015





Chemical status

- Good
- Failing to achieve good status
- Not classified

The evaluation refers to the year 2015, has been processed on the basis of data obtained from monitoring programs in representative profiles in the period 2010–2012 and it was accompanied by a forecast to the year 2015 according to the measures implemented.

Source: T. G. Masaryk Water Research Institute, public research institution

For the improving of the quality of surface water and groundwater it is important to reduce the pollution emitted from point and diffuse sources. In the 90s and at the beggining of the 21st century the development of concentration of the evaluated indicators[2] in the Czech Republic was influenced particularly by the changes related to the quantity of discharged waste water, access to sewerage treatment and the socioeconomic and political development (industrial restructuring, raising of living standards, accession to the EU). In recent years the quantity of pollution discharged from point sources has not been changing so significantly and the annual fluctuations of surface water quality are mostly influenced by climatic conditions of the year. In the regional context the concentration of industrial activities is important, so as the existence of contaminated sites or the intensity of agricultural activities. At present, the diffuse and non-point nutrient pollution, pollution by substances difficult to remove from point source discharges and accidental pollution are now considered as important sources of pollution of surface water and groundwater in the Czech Republic.

In the long-term perspective, in the period 1993–2015 the Czech Republic managed to successfully reduce the river pollution by BOD_5 and P_{total} (average decrease in concentration of 59.3%, respectively 56.4%). The concentration of COD_{Cr} and $N\text{-}NO_3^-$ for this period did not fall so dramatically (decrease by 38.4%, respectively by 28.0%). To the reduction of the average concentration of **organic pollution** in watercourses (Chart 1), which originates mainly from municipal waste water, contributes not only the decrease in production of this type of pollution, but also the high efficiency of removal at WWTPs. From the four above-mentioned indicators, it is the COD_{Cr}, which is produced and subsequently released from the WWTPs into the watercourses over the long-term in the highest volume even though its removal efficiency in WWTPs is very high (94.6% in 2015) and only slightly lower than in case of BOD_5 (98.3%). In 2015, the average concentration of COD_{Cr} in the Czech Republic's watercourses reached 18.8 $mg.l^{-1}$ and BOD_5 2.5 $mg.l^{-1}$, whereas year-to-year it meant a stagnation.

[2] *Development of a watercourse's quality is assessed within the indicator on the basis of average annual concentrations of eight selected basic indicators of pollution for selected Eurowaternet profiles. Organic pollution is expressed as BOD_5, COD_{Cr} and nutrients are represented by $N\text{-}NO_3^-$ and P_{total}. Chlorophyll was selected as a biological indicator and cadmium as a heavy metal indicator, adsorbable organohalogens (AOX) represent the general indicators and thermotolerant (faecal) coliform bacteria (FC) belong to the microbiological indicators.*

In the long term perspective the average concentration of total **phosphorus**, which in 2015 reached in rivers 0.14 $mg.l^{-1}$ (Chart 1), decreases. The lowest concentration of phosphorus in watercourses was indeed achieved in 2010, but still the values from the period 2010–2015 are below the long-term average. 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 pollution was supported by the restrictions in the use of phosphates in detergents[3]. A further reduction of the concentration of phosphorus in surface water is hampered by the lack of mandatory limits for phosphorus in WWTPs below 2,000 population equivalent, the benevolent limits for waste water discharge from large WWTPs and the existence of the so-called diffusion pollution sources such as reliever chambers of the unified sewerage system and other untracked untreated waste water outlets. Part of phosphorus in surface waters comes from non-point sources of pollution, mainly from erosion soil loss. In comparison to the non-point 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 GAEC.

The concentration of **nitrate nitrogen** had a rather fluctuating trend (Chart 1). After 17.1% decline between the years 2013 and 2014, in 2015 there was a slight rise in average concentration by 3.6% to 2.65 $mg.l^{-1}$. The mineral nitrogen fertilisers, the consumption of which has risen in 2015, are a major source of nitrogen, in addition to atmospheric deposition and municipal waste water. Overall, however, the average concentration of $N\text{-}NO_3^-$ is decreasing, between 2000 and 2015 there was a reduction of 17.4%. With regard to the developments since the 90s, the long-term trend of reducing nitrate pollution is also related to the reduction of emissions of nitrogen from livestock farms (decline of pig and poultry farming), besides other influences.

Among the other assessed indicators (Chart 2) the biggest drop of the concentration in the watercourses of the Czech Republic since 2000 was recorded for **cadmium**, which shows a wide range of toxic effects, has been associated with carcinogenicity, and also has a significant ability to accumulation in the food chain. Yet the lowest concentration of cadmium was reached in 2014, i.e. 0.06 $\mu g.l^{-1}$, which is about 82.8% less than in 2000. In year-to-year comparison, there has been a rise in the average concentration to 0.07 $\mu g.l^{-1}$, but EQS of 0.3 $\mu g.l^{-1}$ has been exceeded only in two locations in the Ostrava region, where water quality is affected by the pollution from industry.

The average concentration of **AOX** in the years 2000 to 2010 decreased, from 2010 the trend is already rather stagnant. In 2015, the average concentration of the monitored profiles was 20.0 $mg.l^{-1}$, which is by 1.1% less than in 2014, but the proportion of profiles non-compliant with EQS (25 $\mu g.l^{-1}$) is the second highest from the assessed indicators (after the total phosphorus) and reaches 22.9%. The reason is the fact that this pollution comes for instance from paper and chemical industries, municipal waste waters, but partly also from natural sources and is difficult to degrade.

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, precipitations). In 2000–2004, the concentration of FC was dropping in the monitored profiles, then there was a period of growth and since 2010 the situation improves again. In 2015, the average concentration of FC was 29.1 $CFU.ml^{-1}$ in watercourses of the Czech Republic, whereas there was a year-to-year drop by 14.4%.

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). For the reasons given, the average concentration of chlorophyll 'a' on the monitored profiles in the Czech Republic was therefore rather volatile year-to-year in the period since 2000. The higher values recorded in the reporting period were reached in 2003 and 2014 and were associated with the significantly below-average precipitation and above-average temperature conditions. In the year 2015 the second highest average concentration of chlorophyll 'a' (18.3 $\mu g.l^{-1}$) during the reporting period (Chart 2) was achieved, due to the influence of above-normal temperatures (especially in the summer months) and strongly below-normal precipitation (see indicator 01 Hydrometeorological conditions). Although it is necessary to take into consideration the impact of local conditions and the associated differences between the measured profiles, the situation regarding eutrophication is generally little satisfactory and the pollution of water by nutrients, especially compounds of phosphorus, should be permanently reduced.

The reduction of concentrations and prevention of **exceedances of environmental quality standards** is relatively successful. EQS in 2015 was the least often exceeded for nitrate nitrogen (on one profile) and for cadmium (on two profiles). In the case of

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

indicator BOD_5, EQS was exceeded for 6.3% profiles and in the case of COD_{Cr} for 12.5% of the profiles. The largest proportion of exceedances of EQS was recorded for AOX (22.9%) and for total phosphorus (28.1%).

On the basis of comparison of water quality maps assembled by a summary evaluation of the basic indicators monitored according to the Czech standard **CSN 75 7221** (Classification of surface water quality) continuously since the 1991–1992 period, the satisfactory water quality of watercourses in Czech Republic is obvious. Nevertheless, on short sections of watercourses Class V still occur (Figure 1). Since the year 2000, the number of sections included in Class V was reduced. The number of sections of unpolluted and slightly polluted water has increased. Class V applies in the long-term to Trkmanka, which is the manifestation of intense agricultural activity, and a section of Lužnice below the confluence with Nežárka (however, there was a slight improvement compared to 2014). In comparison with the two-year period 2013–2014, two sections of Lomnice, middle part of Úpa and lower part of Jičínka degraded to pollution Class V. On the other hand, the water quality improved in Litavka (from Class V and IV to Class III), in Bystřice (from Class V to Class I–II) and Vlkava (from Class V to Class IV). Also the quality of water in the other watercourses in the mutual comparison with the evaluated period varies.

The **status of surface water and groundwater bodies** in the Czech Republic, according to the evaluations[4] based on the requirements of the Water Framework Directive, is to a large extent unsatisfactory. At least good ecological status or ecological potential (in case of strongly influenced and artificial bodies) was achieved only in 19.4% of surface water bodies (Figure 2). Good chemical status was achieved by a total of 61.1% of surface water bodies (Figure 3). In the assessment of groundwater chemical status, 27.0% of groundwater bodies were satisfactory and 69.0% of groundwater bodies had a satisfactory quantitative status. When converting to the area, in 2015 a good chemical status was in 37.3% of the area of groundwater and a good quantitative status in 89.2% of the area of the bodies[5].

In the Czech Republic, the **bathing water quality** is systematically monitored and evaluated in five quality categories. According to the national assessment, 252 sites of bathing waters were monitored in the Czech Republic in 2015. The number of sites reported to the EU and assessed under the Directive 2006/7/EC (until 2011 under Directive 76/160/EEC), was 153 in 2015. In the bathing season 2015, 44.8% of bathing waters were placed in the best category according to the quality evaluation by the Czech Republic, which is a decrease of 5.8% compared to the year 2014. In contrast, the proportion of sites where water was rated as unsuitable for bathing, increased from 6.0% in 2014 to 13.5% in 2015. This change can be attributed to high temperatures and drought in 2015, that have a negative impact on water quality. In other categories, compared to the year 2014, there were no significant changes, bathing ban was announced only at 11 sites. According to the EU evaluation, 79.1% of bathing waters were placed in the best category of water quality and only 3 sites reached the limit for a bathing ban.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[4] The evaluation is carried out in six year intervals (2009, 2015, 2021 and 2027). The above results are from 2nd Planning period that applies to the year 2015. The evaluation shown was performed in the year on the basis of monitoring data in the representative profiles for the period 2010–2012 (in exceptional cases the data were supplemented by data from the years 2008, 2009 or 2013). The implementation and manifestation of the effect of some of the measures proposed in the 1st Planning period take place in the period 2013–2015, which was at least partly included in the assessments in the form of the forecast. Still, it can be expected that yet in some water bodies there will be a change in some indicators between 2012 and 2015, or even an overall change in status beyond this forecast. The assessment of the status of water bodies is performed by a synthesis of individual indicators monitored, using the principle one-out, all-out (i.e. in the event that any of the monitored indicators of any assessment component exceed the limit value, the evaluation of entire body is classified as noncompliant, resp. achieves the worst value of the monitored indicator).

[5] Detailed assessments for the Czech part of basin of the Elbe, Danube and Oder and the measures for the protection and improvement of the status of surface water and groundwater is reported in National River basin management plans.

Water management and water quality in the global context

Key messages

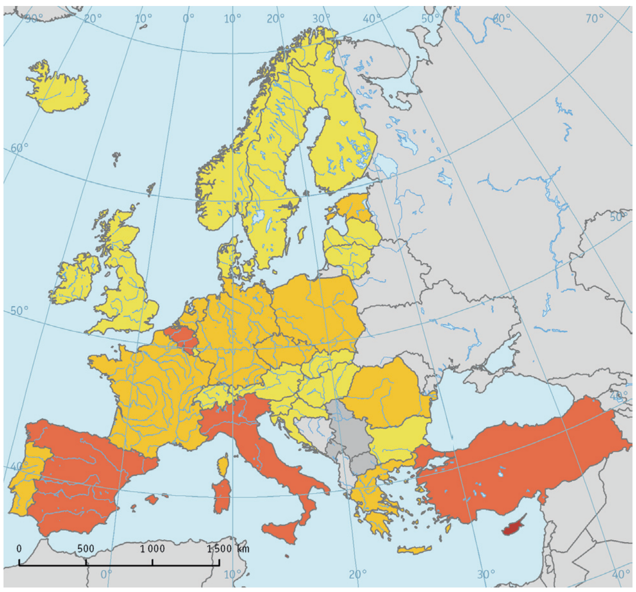
- Most European countries do not suffer from water shortages. The most favourable situation is in northern Europe, Austria and Slovakia. The Czech Republic ranks amongst the countries with relatively sufficient quantity of water sources and below-average total water abstraction. The water shortage in the most vulnerable countries in Europe in terms of water resources (southern Europe, Turkey and Belgium) occurs as a result of both unfavourable natural conditions and inefficient utilisation and increase in abstractions, primarily for agricultural production.
- Most European countries achieve[6] 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 the agglomerations over 2,000 population equivalent. An average of 92% of waste water within the European Union and approximately 87% in the Czech Republic were subject to the secondary treatment according to the requirements of 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 54% compliance with the requirement for the tertiary level waste water treatment.
- In terms of water quality in watercourses in the years 1993–2012, there was a significant decrease in the concentration of BOD_5 (by 52.7%) and orthophosphate (by 59.0%), 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 BSK_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 assessment, in 2015 84.3% of EU sites reached an excellent water quality, 9.1% a good quality, 2.6% an sufficient quality and 1.6% of the sites a poor quality. The best results were achieved in the bathing waters of Luxembourg, Cyprus, Malta, Greece and Croatia. In the Czech Republic 79.1% of the sites had an excellent quality of water, 12.4% good quality, 1.3% sufficient quality and 2% of sites poor quality.

[6] *Data are valid as of the year 2012. More current data are not, due to the methodology of their reporting, available at the time of publication.*

Indicator assessment

Figure 1

Water stress expressed using the WEI index (Water Exploitation Index) [%]



WEI Index

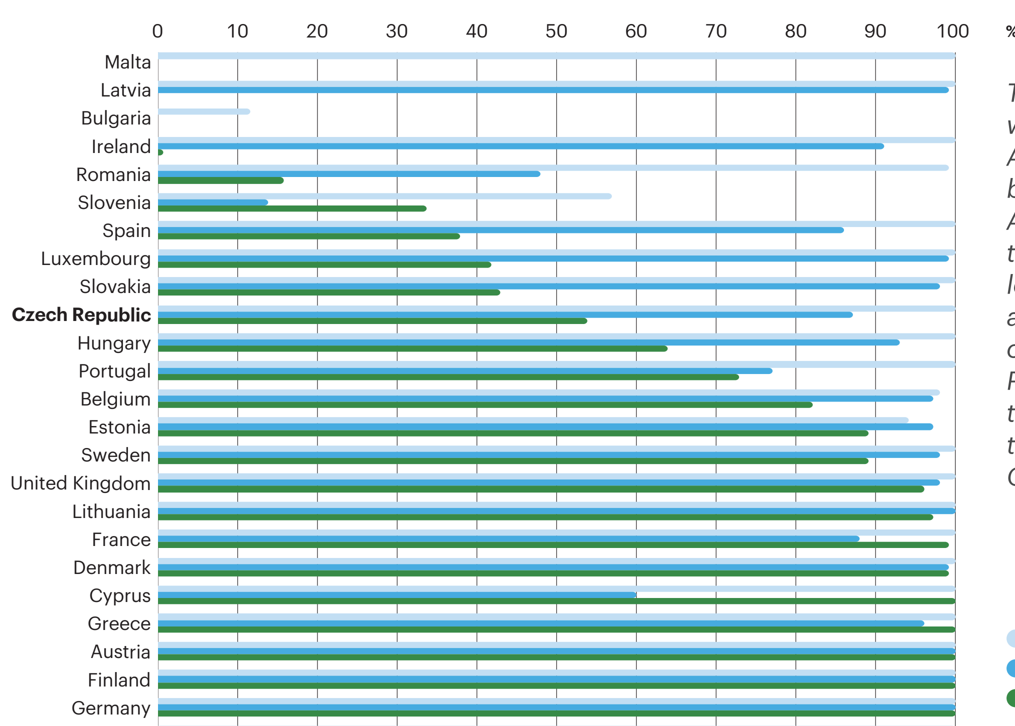
- <10% without stress
- 10.1-20.0% without stress
- 20.1-40.0% water stress
- >40.0% extreme water stress
- No data available

Index values refer to the most recent year depending on the availability of data (2014 – Slovakia, Iceland; 2013 – Bulgaria, Czech Republic, Estonia, Croatia, Cyprus, Latvia, Luxembourg, Malta, Poland, Romania, Slovenia, Serbia; 2012 – Denmark, Spain, France, Lithuania, Hungary, the Netherlands, the United Kingdom, Switzerland, Turkey; 2010 – Germany, Sweden; 2009 – Belgium; 2007 – Ireland, Greece, Norway; 2006 – Finland; 1999 – Austria; 1998 – Italy, Portugal).

Source: Eurostat

Chart 1

Compliance of EU countries with the Article 3 (discharge), Article 4 (secondary treatment) and Article 5 (treatment according to the more stringent requirements) of Council Directive 91/271/EEC on urban waste water treatment [%], 2012



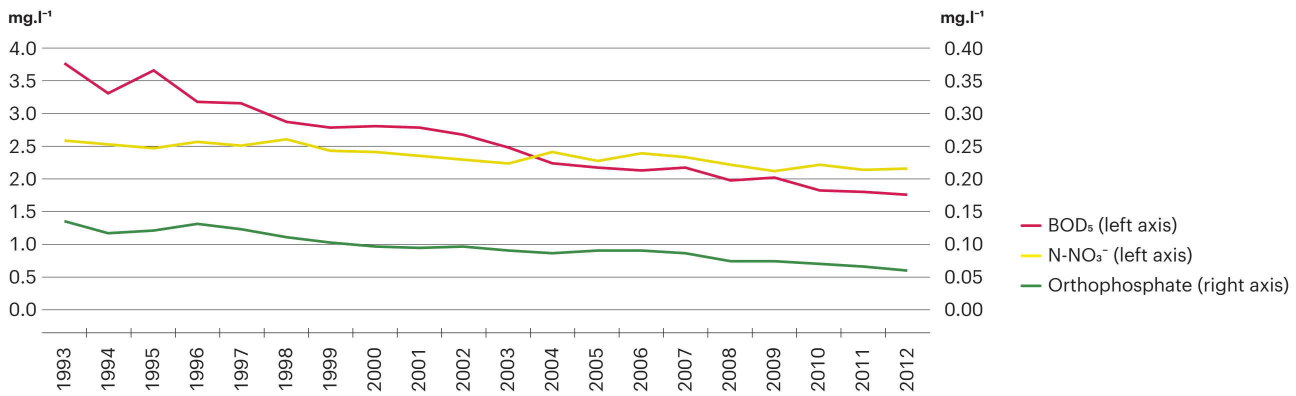
The first mentioned are the countries with the lowest rates of compliance with Article 5 and the countries are sorted by increasing rates of compliance. A lower level of compliance referred to in article 4 in comparison with the level of compliance in accordance with article 5 is possible, since article 5 refers only to sensitive areas. Data for Italy and Poland have not been assessed due to their insufficient quality. The obligation to achieve compliance did not apply to Croatia until 2012.

Source: European Commission

- Article 3
- Article 4
- Article 5

Chart 2

Development of pollution level indicators in European watercourses [mg.l⁻¹], 1993–2012

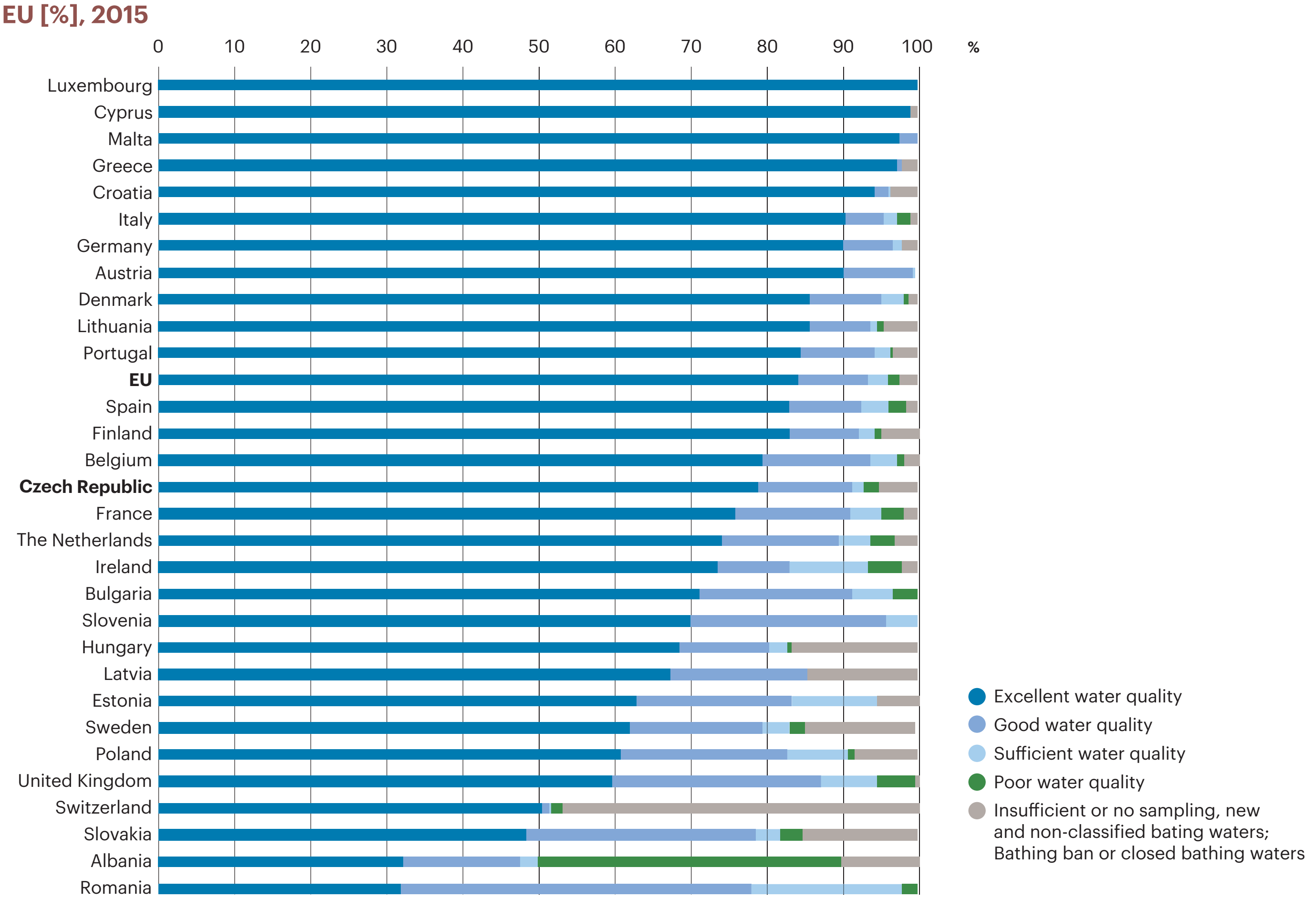


Concentration is expressed as average values of BOD_5 from 539 stations, $N\text{-}NO_3^-$ from 1,059 stations and orthophosphate from 874 stations. In countries where BOD_5 was not monitored, BOD_7 has been converted into BOD_5 where BOD_7 = 1.16 BOD_5. Nitrate concentration is expressed as nitrate 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).

Source: European Environment Agency

Chart 3

Bathing water quality in EU Member States, Albania and Switzerland in each category according to the assessment of the EU [%], 2015



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**[7] (Figure 1) are Cyprus, Malta, Italy, Spain, Turkey and Belgium. 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. As a consequence, the uneconomical use of water and increase in abstraction, especially for agricultural production (e.g. in Spain, Cyprus), has a greater impact on the overall water balance in these regions than in countries with enough water resources. In countries with more favourable ratio of water abstractions to the volume of renewable water supplies, such as Northern countries, Slovakia, or Austria, this condition is clearly influenced by the natural conditions (higher precipitation, river network density, number of lakes, water flow rate in streams). The Czech Republic ranks amongst the countries with relatively sufficient quantity of water resources in relation to the demands for their consumption. The total water abstraction in the Czech Republic calculated per capita (in 2013 reached 157.0 m^3.$inhabitant^{-1}$.$year^{-1}$), belongs in Europe to lower.

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. To the reference year 2012, most Member States discharged a significant part of the waste water through the sewerage systems, while the average rate of compliance reached 98% (Chart 1). However, there are still countries in which waste waters are discharged only partially and in a relatively high proportion the individual or other compliant systems (IAS[8]) are used. For the Czech Republic, the fulfilment of the requirements of the directive referred to in Article 3 was met for all reported agglomerations. Article 4 requires that municipal waste waters entering sewerage systems shall be subject to secondary treatment or other equivalent treatment before discharge. Within the EU an average of 92% of waste water has undergone this degree of treatment. Sixteen EU countries reached a rate of compliance of 90–100%, the Czech Republic has reached 87% compliance with the requirements under 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. Almost 75% of the territory of the EU is currently identified as a sensitive area. Fifteen EU countries, including the Czech Republic, defined all its territory as a sensitive area, and thirteen Member States defines as "sensitive" only certain water bodies. The Czech Republic reached 54% compliance with Article 5 of the Directive.

Concerning **water quality in watercourses** (Chart 2), 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 (orthophosphate indicator) 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

[7] 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%. The WEI index is used in assessments by international organisations such as UNEP, OECD or Eurostat.

[8] Individual or appropriate systems = other compliant systems that achieve the same level of protection for the environment as the sewerage systems.

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 western Europe.

In European countries the **quality of the water at the sites also intended for bathing**[9] is monitored each year. In the season of 2015, bathing sites in all member countries of the EU28 and also in Albania and Switzerland, were assessed for the first time under this directive (Chart 3). In the bathing season of 2015, 21,609 of bathing water sites were monitored, out of which 68.8% were coastal sites, and 31.2% inland sites. In Croatia, Estonia, Greece, Latvia, Luxembourg, Slovenia, Cyprus 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, Croatia, Italy, Germany and Austria). Overall, in the EU28 the highest category was reached in 84.3% of bathing water sites, in the Czech Republic it was 79.1%. In contrast, the poor water quality was reached by a total of 385 monitored sites in 2015, while their highest proportion was recorded in the United Kingdom (4.9%), Ireland (4.4%), the Netherlands (3.4%) and Bulgaria (3.2%). A high proportion of sites with poor water quality was also recorded in Albania (39.7%). Here, however, the result of the assessment was affected the fact that most of these sites are located on the coast of the city of Durres, where the sewerage system has not yet been satisfactorily resolved. In the Czech Republic in 2015 the poor water quality was found in 3 sites, which is 2% of the total.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[9] *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.*

3 Nature

12 | 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 2015, 16.8% of the Czech Republic's area was protected by means of specially protected areas, whereas the number and size of small-scale Special Protection Areas is growing. Through the Natura 2000 14.1% of the Czech Republic was protected in 2015.

In the year 2015 there were only 8 rescue programs realised for the most endangered specially protected species.

Overall assessment of the trend

Changes of nature and landscape are slow and take a long time, and it is not possible to use automated technical equipment to acquire data which their monitoring would be based on. 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 and natural habitats of Community interest and species of birds naturally occurring in the territory of the EU Member States, carried out for the purposes of reporting to the European Commission (see Indicator 13 and 14).

References to current conceptual, strategic and legislative documents

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. 2009/147/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

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

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

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

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 European Union

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

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

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

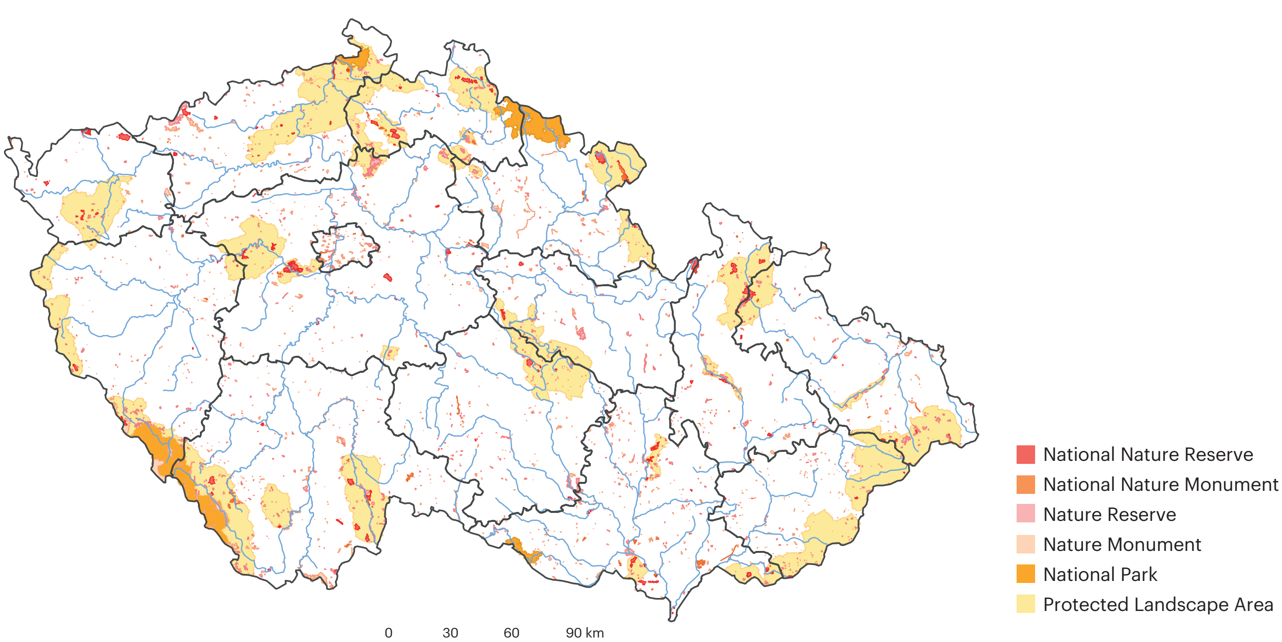
Impacts on human health and ecosystems

An unfavourable-inadequate and unfavourable-bad status of the nature, landscape and biological species results in a reduced ecological stability of the landscape, reduction of genetic resources and deterioration of productive capabilities of the agricultural and forest landscape. The result is a negative impact on the living environment and the quality of human life.

Indicator assessment

Figure 1

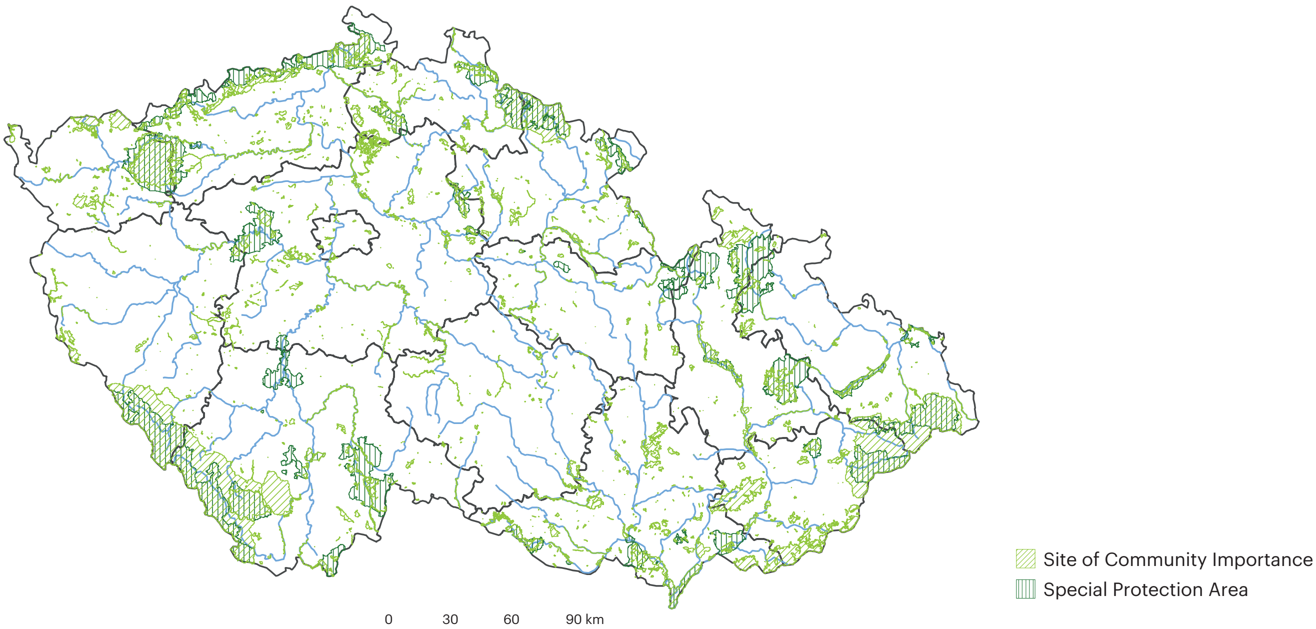
Large-size and small-size specially protected areas in the Czech Republic, 2015



Source: Nature Conservation Agency of the Czech Republic

Figure 2

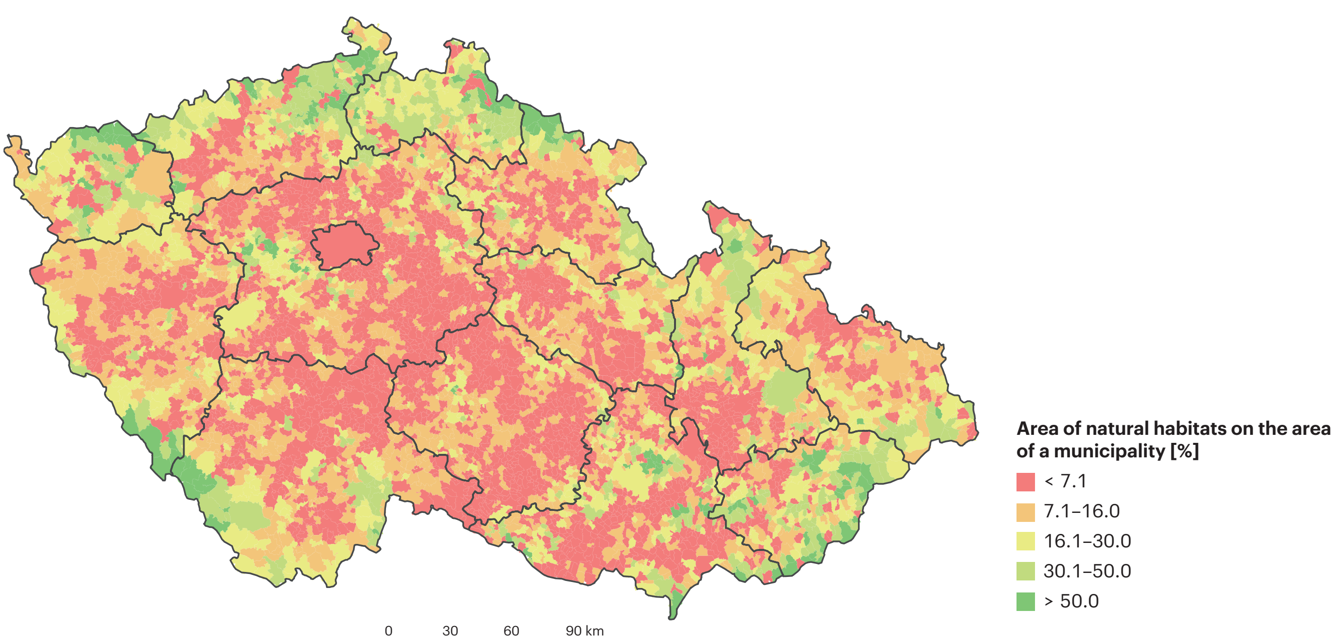
Natura 2000 sites, 2015



Source: Nature Conservation Agency of the Czech Republic

Figure 3

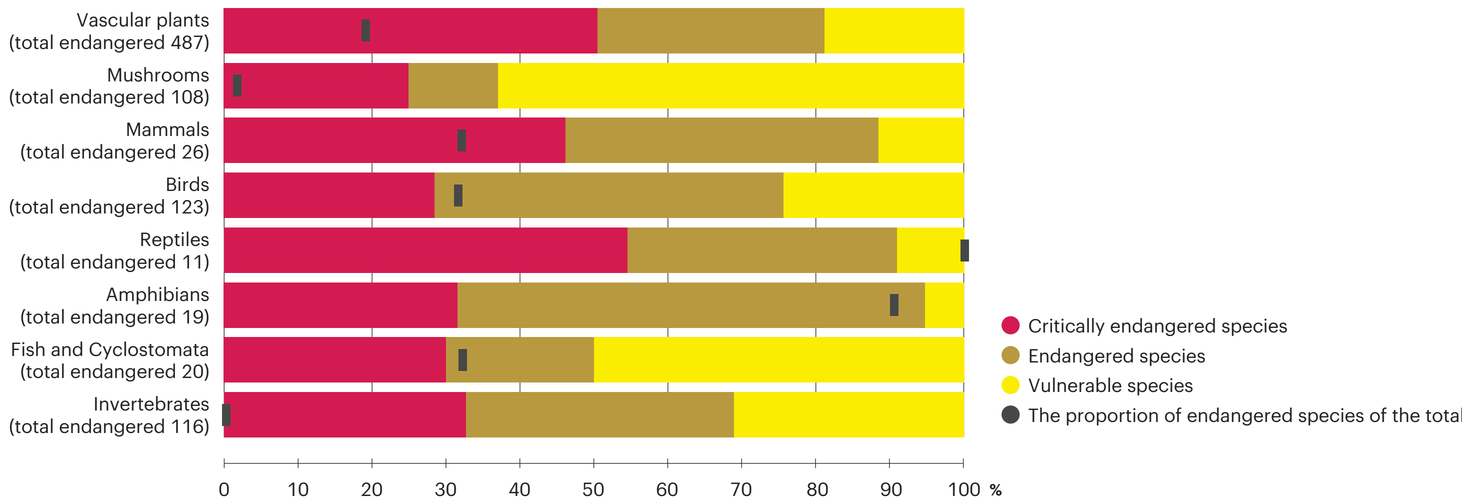
The proportion of natural habitats on the area of a municipality in the Czech Republic [%], 2015



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, %], 2015



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 2015 was 1,220.3 thous. ha, i.e. 15.5% 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). Since March 2010, a process which will ultimately result in the establishment of a fifth national park in the central part of the Protected Landscape Area Křivoklátsko has been underway. There are 25 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-size specially protected areas** (which include National Nature Reserves, Nature Reserves, National Nature Monuments and Nature Monuments) accounted for 114.4 thous. ha, i.e. 1.5% of the Czech Republic's territory, in 2015[1]. The most frequent changes occur in the category of small-size specially protected areas, the reason being the declaration of new areas, predominantly for the purpose of protecting Sites of Community Importance. In 2015 there were reregistered or newly recognize 38 small-scale specially protected areas with the area of 2,213 ha, of which 34 natural monuments, 3 nature reserves, 3 national nature monuments, and on the other hand there were 2 national nature reserves less.

The Natura 2000 system is a system of protected areas of European importance, which is being built in the territory of EU member states. It comprises two types of protected areas – Special Protection Areas and Sites of Community Importance. As of 2015, the territory of the Czech Republic included 41 Special Protection Areas (Figure 2) the aggregate area of which was 703.4 thous. ha, i.e. 8.9% of the Czech Republic's territory. Sites of Community Importance (Figure 2) in 2015 it was the total of 1,075, occupying an aggregate area of 786,576 ha, i.e. 10.0% of the Czech Republic's territory[2], and thus the state has not changed since 2014. Due to mutual overlap Special Protection Areas and Sites of Community Importance, the area of the Natura 2000 occupied a total of 14.0% of the territory of the Czech Republic.

The protected area through large-scale and small-scale specially protected areas and areas protected by the Natura 2000 network is a significantly overlapping and thus the total area of protected areas in the Czech Republic accounts for 21.6% of the territory of the Czech Republic.

General protection of the territory is provided through Territorial Systems of Ecological Stability, Significant Landscape Elements (either existing under relevant legislation, or declared, including forests, alluvial flats, wetlands, other water elements

[1] *However, more than a half of the small-size specially protected areas are found within a Landscape Protection Area or a National Park.*

[2] *In 2015, the preparations for the issue of the amendment to Government Regulation No. 318/2013 Coll., laying down a national list of SCI. Overall, the proposal contained 50 new SCIs, 356 existing SCIs were revised (the object of protection added or eliminated, boundaries modified, the name changed, etc.) and 10 SCIs were cancelled.*

etc.), and other tools. The definition and functionality of different constituents of Territorial Systems of Ecological Stability in the Czech Republic vary over a broad range, and therefore do not tell much about the actual state of ecological stability of landscape. However, the ecological stability can be better assessed according to the coefficient of ecological stability. The average proportion of the natural habitats per the area of municipalities in the whole Czech Republic is 18.1%. 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 specially protected areas (Figure 3).

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 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 2015 the rescue programmes were implemented for 4 plant species: Marsh Angelica/*Angelica palustris*; Stone Pink/*Dianthus arenarius subsp. bohemicus*; Long–stalked Pondweed/*Potamogeton praelongus;* Gentian/*Gentianella praecox subsp. bohemica,* and for 4 animal species: Freshwater Pearl Mussel/*Margaritifera margaritifera*; Scarce Fritillary/*Euphydryas maturna*; Aesculapian Snake/*Zamenis longissimus*; and European Ground Squirrel/*Spermophilus citellus*.

In 2015 there was registered 487 endangered species of 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 level of threat is divided into vulnerable, 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 lowest for mushrooms (1.8%) and invertebrates (0.3%).

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 invasive plant species[4] include, for example: Giant Hogweed/*Heracleum mantegazzianum*; Knotweeds/*Reynoutria japonica, sachalinensis* and *bohemica*; Indian Balsam/*Impatiens glandulifera*; Garden Lupin/*Lupinus polyphyllus*; or Tree of Heaven/*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*; Sika Deer/*Cervus nippon*; a number of fish species (e.g. Topmouth Gudgeon/*Pseudorasbora parva*; Gibel Carp/*Carassius gibelio*; Brown Catfish/*Ameiurus nebulosus*; Black Bullhead/*Ameiurus melas* etc.); or North American Crayfish species (Eastern Crayfish/*Orconectes limosus* and Signal Crayfish/*Pacifastacus leniusculus*) that spread Crayfish plague.

The overall assessment of the state of nature and landscape also needs to consider partial assessments of the condition of forests, soil, agricultural and forestry management, and ecological state of aqueous ecosystems. These assessments can be found in the context of other indicators.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

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

[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.*

13 | State of animal and plant species of Community interest in 2006 and 2012[6]

Key question

What are the state and development of plant and animal species of Community interest[7] in the territory of the Czech Republic?

Key messages

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 interest.
In 2007–2012, 25.3% of animal and plant species of Community interest 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 interest 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.

Overall assessment of the trend

The state of animal and plant species and habitats of Community interest is evaluated in six-year intervals that are laid down in Directive 92/43/EEC. In 2007, an assessment was made for the period ending in 2006 (the beginning of the period was open); as to the 2007–2012 period, the assessment was made in 2013. The assessment is based on an evaluation of data obtained by monitoring the state of biotopes and species in the whole territory of the Czech Republic; the assessment of the state of species is based on an extensive set of activities and projects, ranging from systematic monitoring and mapping to the use of citizen science.

References to current conceptual, strategic and legislative documents

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 European 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

[6] *The evaluation of the status of animals and plants species of Community interest 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.*

[7] *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 interest, 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 interest 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 interest. For an approximate assessment as the one indicated above, the set of species of Community interest 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.*

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

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

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

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

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

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

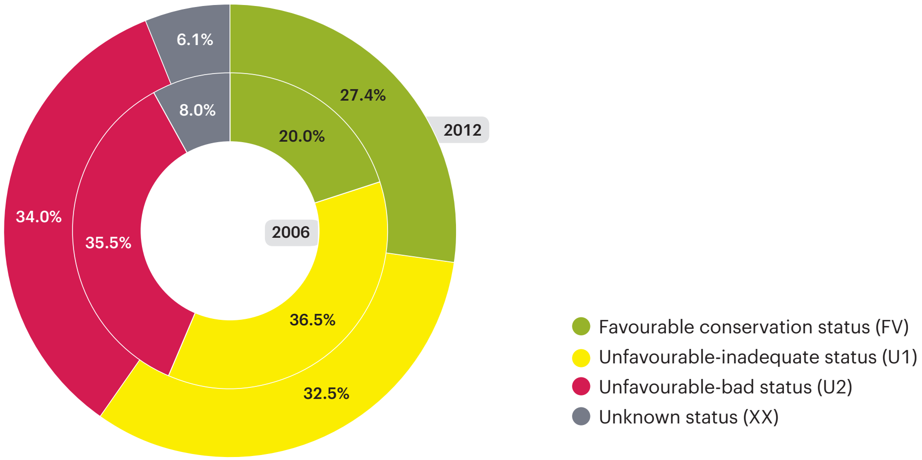
Impacts on human health and ecosystems

The state of important animal and plant species reflects the condition of biodiversity and ecosystems, including ecosystem services extensively used by the human society for its existence. An unfavourable-inadequate and unfavourable-bad status of the important animal and plant species results in a reduced ecological stability of the landscape and inappropriate modes of its use, and adverse biodiversity impacts. The unsatisfactory state influences, in particular, regulatory, supply and supporting ecosystem services and cultural and aesthetic functions of the landscape, thus affecting the quality of human life.

Indicator assessment

Chart 1

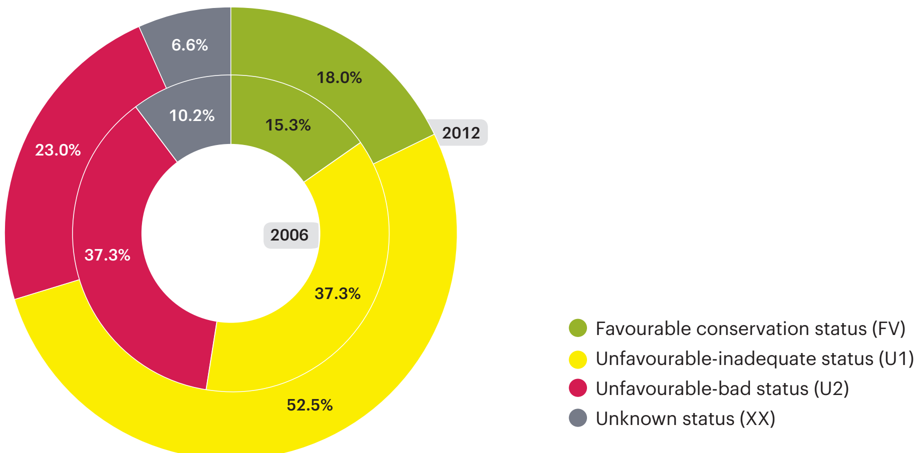
State of animal species of Community interest in the Czech Republic [%], 2000–2006, 2007–2012



Source: Nature Conservation Agency of the Czech Republic

Chart 2

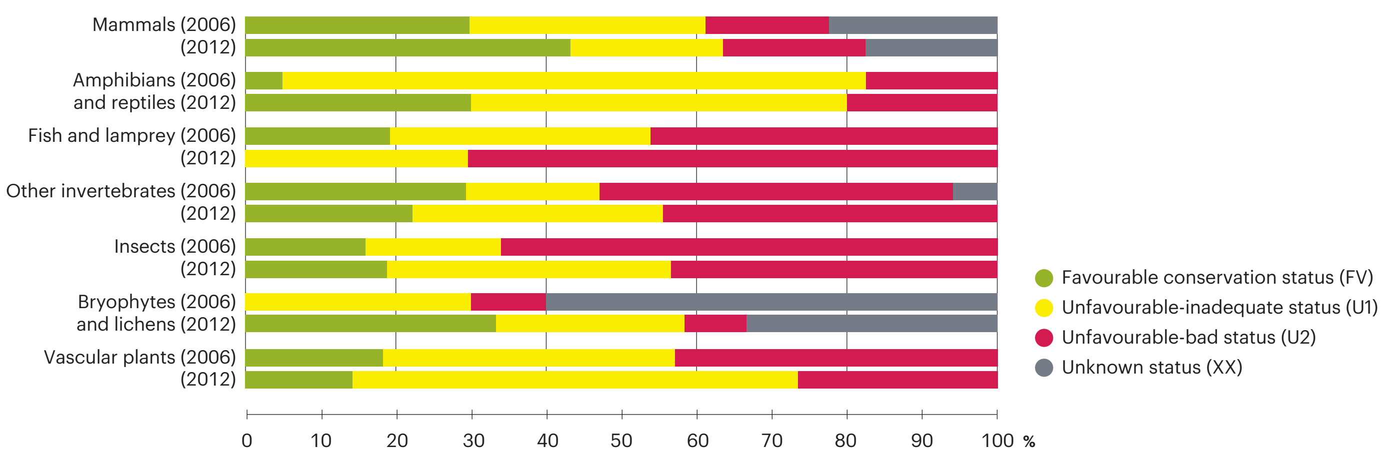
State of plant species of Community interest in the Czech Republic [%], 2000–2006, 2007–2012



Source: Nature Conservation Agency of the Czech Republic

Chart 3

State of animal and plant species of Community interest in the Czech Republic by 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.

The status of approximately one third of **animal species of Community interest in the Czech Republic** is assessed as unfavourable-bad, another third is assessed as unfavourable-inadequate, and their habitats are probably more or less in disarray (Chart 1). 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 much less abundant in forests of the Czech Republic)

[8] *The state of animal and plant species of Community interest 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 interest.*

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 interest 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 interest** 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 interest** 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 interest; 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 species of insects and other invertebrates falling into the unfavourable-bad category showed a significant decrease, and the proportion of species of mammals, amphibians and reptiles increased. 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 and bryophytes and lichens, i.e. non-vascular (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. Insofar as vascular plant species that have a long history of research are concerned, a significant decrease of species falling into the unfavourable-bad category in favour of the better 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

14 | State of natural habitats of Community interest in 2006 and 2012[9]

Key question

What is the state and development of natural habitat types of Community interest[10] in the territory of the Czech Republic?

Key messages

A comparison of results for the 2000–2006 and 2007–2012 periods indicates an improvement of the state of natural habitat types of Community interest in the Czech Republic. The percentage of habitats rated as unfavourable-has dropped from 74.2% to 26.9%, while the number of favourable reviews increased from 11.8% to 16.1%. A significant improvement is attributable to a changed methodology with respect to one of the parameters entering into the assessment.

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

Overall assessment of the trend

According to Directive No. 92/43/EEC, the statuses of natural habitat types of Community interest is assessed for a six-year period. In 2007, an assessment was made for the period ending in 2006 (the beginning of the period was open); as to the 2007–2012 period, the assessment was made in 2013. The assessment is based on an evaluation of data obtained by monitoring the statuses of biotopes and species in the whole territory of the Czech Republic. In the case of natural habitats, it is based on an analysis of data obtained by the mapping of biotopes of the Czech Republic, which covers the whole territory of the country (organized by the Nature Conservation Agency of the Czech Republic).

References to current conceptual, strategic and legislative documents

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 European 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

[9] *The evaluation of the status of natural habitats of Community interest 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.*

[10] *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.*

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

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

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

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

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

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

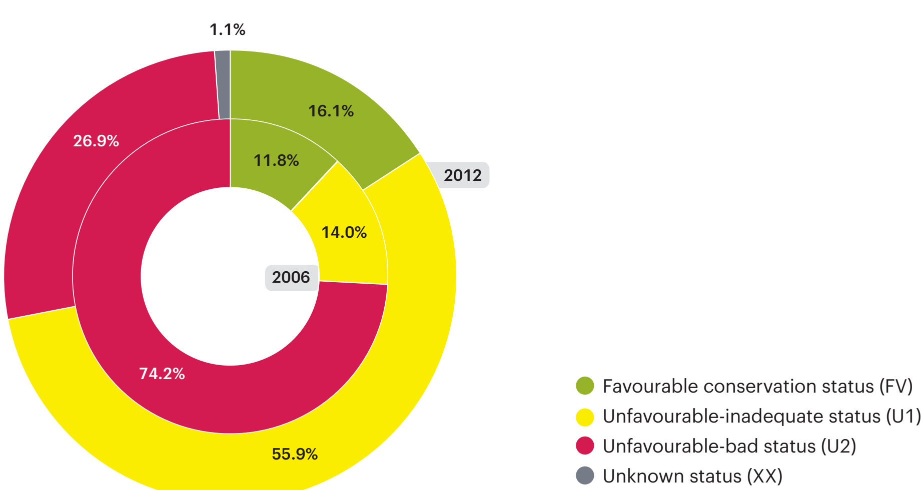
Impacts on human health and ecosystems

The state of different natural habitat types is an important indicator of biodiversity which, thanks to the scope of the natural habitat types being monitored, provides very representative information on the quality of the natural environment in the Czech Republic. The unfavourable status of natural habitats is due to a reduced ecological stability of the landscape, anthropogenic pressure on natural habitats and disruption of ecosystem services which are indispensable for the human society.

Indicator assessment

Chart 1

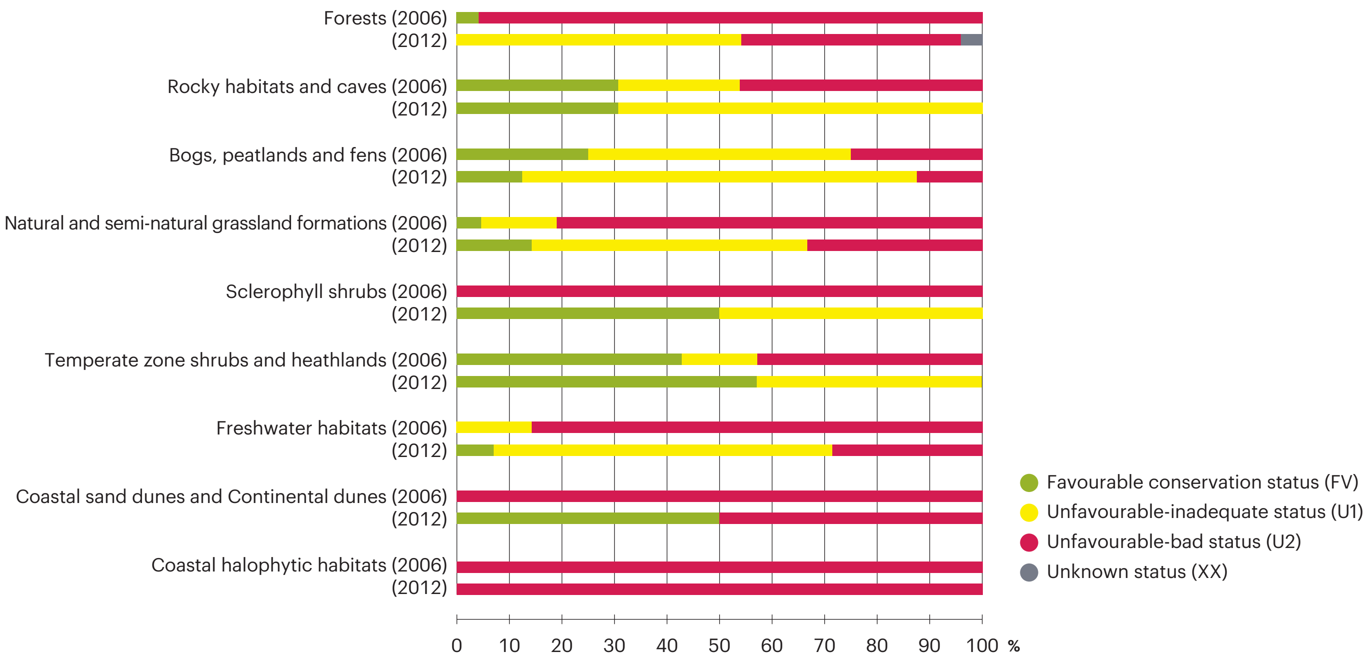
State of natural habitats of Community interest in the Czech Republic [%], 2000–2006, 2007–2012



Source: Nature Conservation Agency of the Czech Republic

Chart 2

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



Source: Nature Conservation Agency of the Czech Republic

The state of **natural habitat types of Community interest** can also help assess the overall state of natural biotopes in the Czech Republic, although the indicator deals only with Sites 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 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).

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

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

15 | Common bird species indicator

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 abundance of populations of common bird species in the Czech Republic have continued to decline, and in overall, between the years 1982–2015 decreased by 5.9%. The abundance of populations of woodland bird species decreased by 16.6% and numbers of populations of the birds in the agricultural landscape dropped by 31.2%. 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-to-year change

References to current conceptual, strategic and legislative documents

Directive No. 2009/147/EC of the European Parliament and of the Council on the conservation of wild birds
- protection and conservation of all wild bird species in the territory of EU member states
- creating and declaring Special Protection Areas, which together with Sites of Community Importance form the Natura 2000 system

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

Biodiversity Action Plan
- halting the loss of biodiversity by 2010

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

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

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

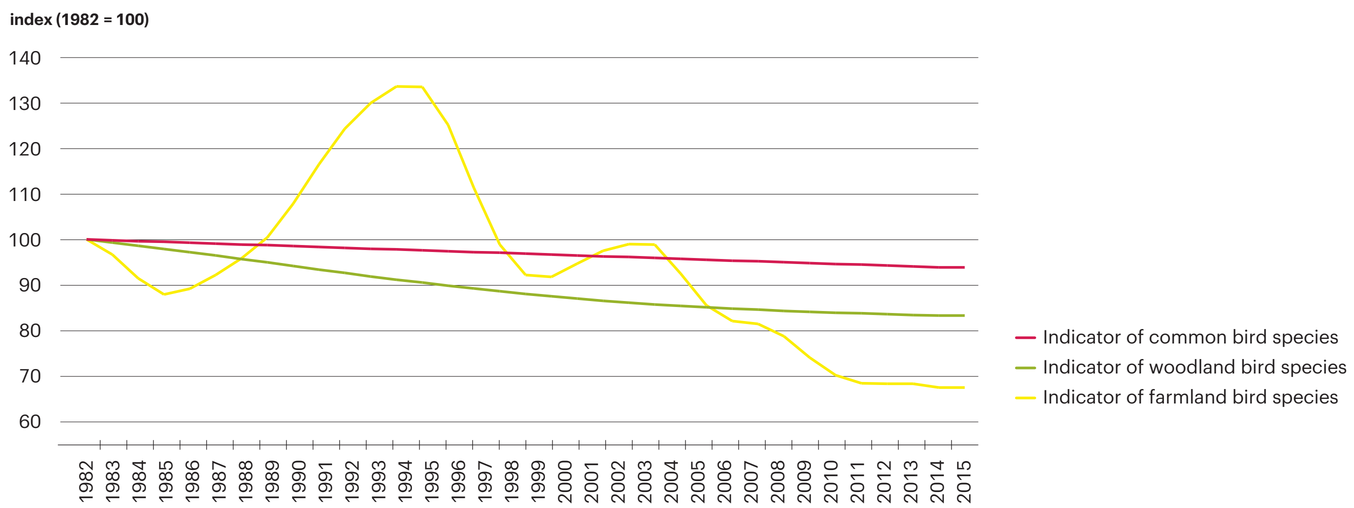
Impacts on human health and ecosystems

The state of different natural habitat types and the related development of populations of the individual bird species is an important indicator of biodiversity which, thanks to the scope of the natural habitat types being monitored, provides very representative information on the quality of the natural environment in the Czech Republic. The unfavourable status of natural habitats is due to a reduced ecological stability of the landscape, anthropogenic pressure on natural habitats and disruption of ecosystem services which are indispensable for the human society.

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], 1982–2015



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 5.9%, whereas the numbers of populations of farmland bird species have dropped by 31.2% and the numbers of populations of woodland bird species by 16.6%. 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. 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].

[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.*

The abundance of **woodland species** is reduced roughly at a steady rate throughout the track without significant fluctuations to 83.4% in 2015 (from 1982). 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 2015, the abundance is down to 94.1% 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 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

[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: Stav ptactva České republiky 2009. Sylvia 45: 1–38.*

[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: Stav ptactva České republiky 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 in the global context

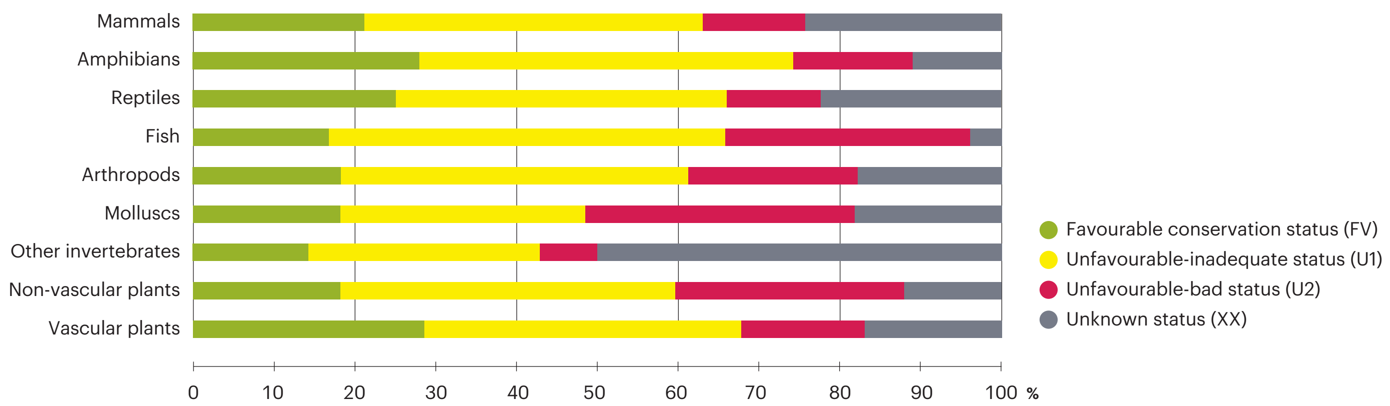
Key messages

- Between 2007 and 2012, only about 23% of animal and plant species of Community interest and approximately 16% of habitats of Community interest 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 interest and roughly 16% of habitats of Community interest.
- Between 1990 and 2012, the populations of common bird species, woodland bird species and farmland bird species dropped by approximately 12%, 8% and 30%, respectively.
- Between 1990 and 2011, the populations of meadow butterflies showed a significant decline of about 50%.

Indicator assessment

Chart 1

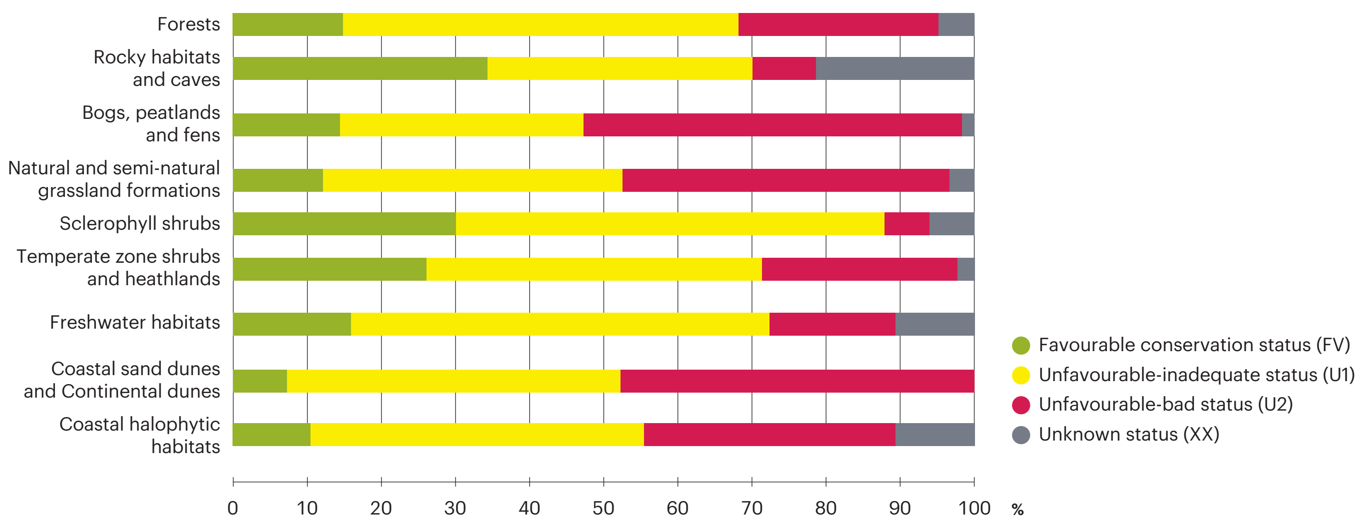
State of animal and plant species of Community interest in EU25 according to taxonomic groups [%], 2007–2012



Source: ETC/BD

Chart 2

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



Source: ETC/BD

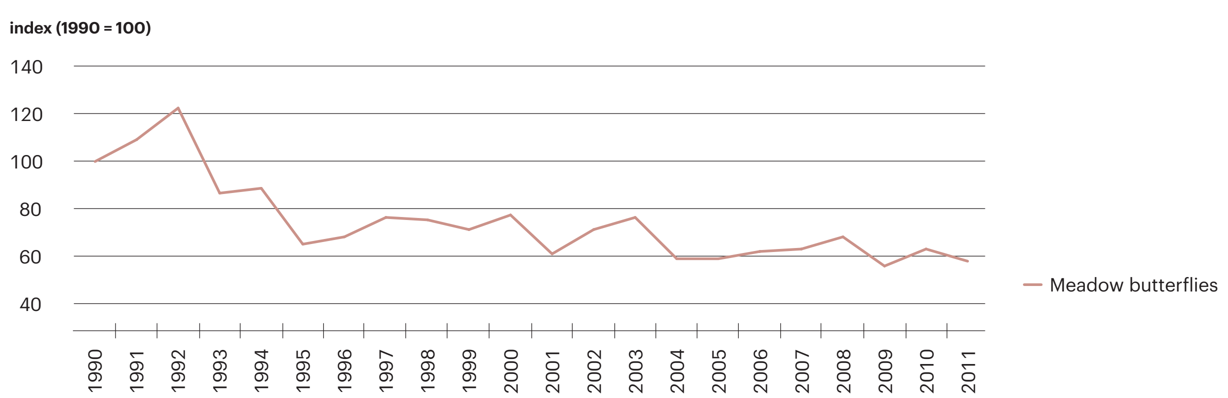
Chart 3

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], 1990–2012

Source: European Environment Agency

Chart 4

Development of the indicator of meadow butterflies in Europe [index, 1990 = 100], 1990–2011



Source: European Environment Agency

From the international perspective, the statuses of animal and plant species and of natural habitat types that are important to the European Community can be compared at several levels. At the international level, at the level of biogeographical regions, or if appropriate, at the European level.

Between 2007 and 2012, only 23.1% of all **animal and plant species of Community interest** found in the territory of EU25 were assessed as being in a favourable status (Chart 1); the percentages of animal and plant species of Community interest 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 interest found in the territory of EU25 were assessed as being in a favourable status; the percentages of natural habitat types of Community interest 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 2). 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).

In spite of the step-by-step levelling of the declining trend, the abundance **of all common bird species and common woodland species** in Europe has declined since 1990 (between 1990 and 2012 by approximately 12% and 8%, respectively). The decline of the abundance of common farmland bird species between 1990 and 2012 was even more significant – almost 30% (Chart 3). 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 **meadow butterflies** (the considerable year-to-year fluctuations notwithstanding), the population of which has decreased by some 50% since 1990 (Chart 4). The main reason is a changed use of land, 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.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz


4
Forests

16 | 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[1] still remains at a high level, but 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 and over) the sum of the defoliation classes 2–4 for conifers was 73.0% and for deciduous trees it was 39.3%. In younger stands (up to 59 years), the situation is more favourable, in the case of conifers 25.6% of stands dropped to class 2 and 4, and for deciduous trees it was 22.7%. After the improvement in the second half of the 90s of the 20th century it is possible to track the dynamics of oscillating defoliation after the year 2000, which meant in 2015 a mild annual deterioration in all categories, except for older deciduous trees.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

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

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

National forestry programme for the period up to 2013[2]
- 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 nature tree species composition
- develop monitoring of forests

[1] *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%).*

[2] *The content of this program is still current and the implementation of a series of proposed measures took place also in 2015.*

National Biodiversity Strategy of the Czech Republic
- 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

State Nature Conservation and Landscape Protection Programme of the Czech Republic
- 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

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

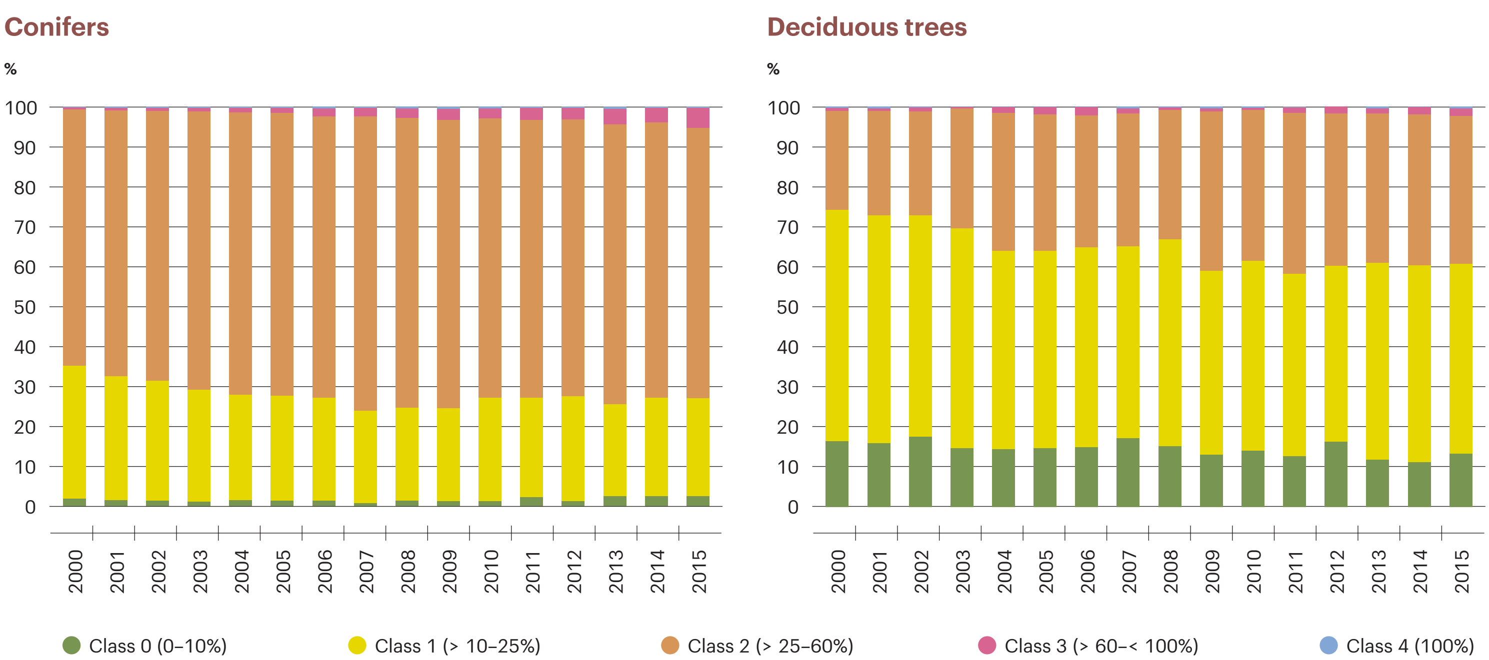
Impacts on human health and ecosystems

Good forest health is crucial both to maintain sustained production of timber and other products and to fulfil the non-production functions (protecting soil from erosion, supporting water system, nature protection, air quality, floods and drought control, sanitary-hygienic function, recreational and spiritual functions). The deterioration of forest health therefore has an impact not only on forest ecosystems and species living therein, but on the whole of human society.

Indicator assessment

Chart 1

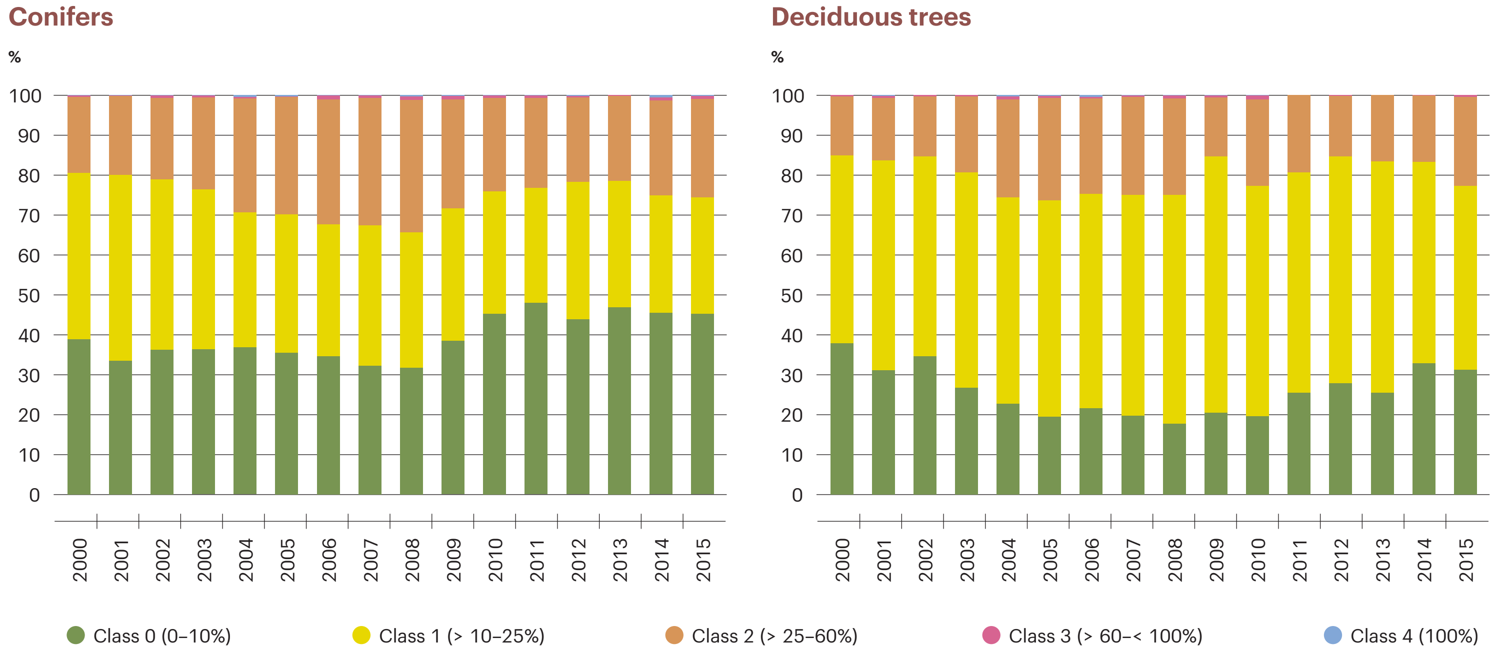
Defoliation of older conifers and deciduous trees (stands over 60 years of age) in the Czech Republic according to classes [%], 2000–2015



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

Chart 2

Defoliation of younger conifers and deciduous trees (stands up to 59 years of age) in the Czech Republic according to classes [%], 2000–2015



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

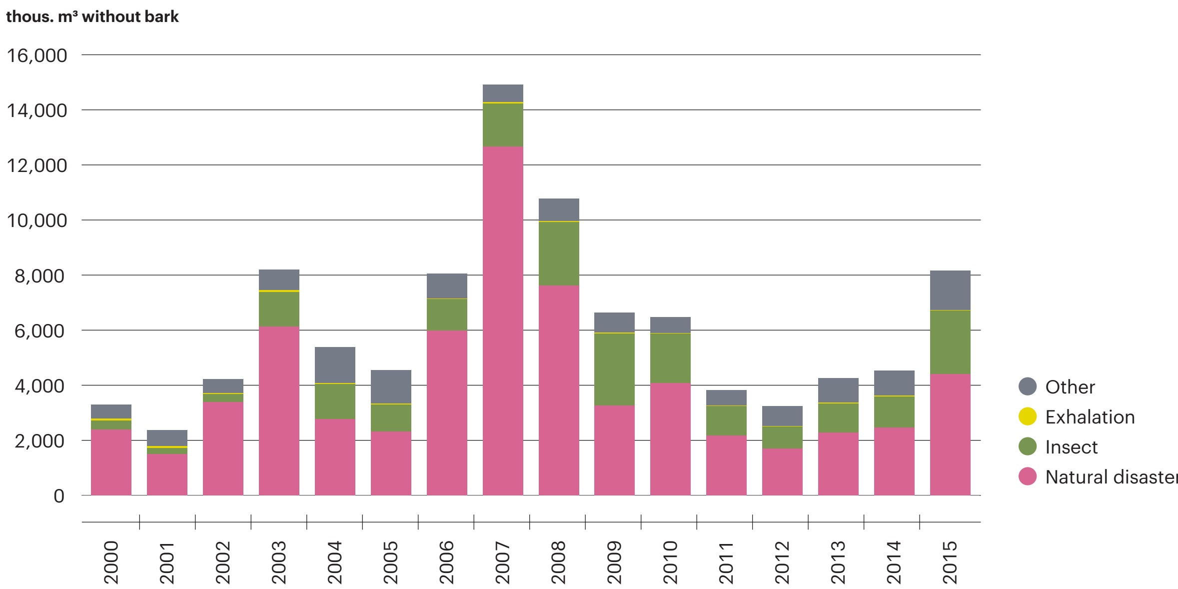
Chart 3

Defoliation of basic tree species in the Czech Republic, by classes [%], 2015

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

Chart 4

Salvage felling by causes in the Czech Republic [thous. m³ without bark], 2000–2015



Source: Czech Statistical Office

Forest damage is caused not only by natural harmful 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 assimilation organs) and secondary (indirect, chronic damage, caused by change of environmental factors, e.g. soil acidification, climate change etc.). The indicator assesses the health status of the coniferous and deciduous stands, divided into two categories according to their age – older (60 years and older) and younger (up to 59 years). 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 80s of the 20th century, and in the 1st half of the 90s of the 20th century. Followed by stabilization, 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). This trend occurs for both coniferous and deciduous trees. It was mainly the period between the years 2007–2009, when the consequences of Kyrill hurricane affected the state of health of the stands. After the improvement of the situation in 2010, the situation of conifers in the defoliation class 2 to 4 is stagnant, their share in the long term still exceeds 70% – in 2015 it was 73.0% (in 2014 it was 72.9%). 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 2014 and 2015, there was a slight decline from 39.7% to 39.3%. The deciduous trees are generally more resistant to defoliation due to the complete the annual renewal of the assimilation system.

In the **evaluation of individual trees** aged 60 years and over the value of defoliation in the sum of the classes 2 to 4 are the highest for pine in case of conifers – in 2015 it was 90.1%, for larch (81.2%) and spruce (61.9%). Among the deciduous trees, a significant degree of defoliation is apparent for oak, a total of 65.4% trees in class 2 to 4 in 2015 (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**), 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 2014 and 2015, however, a repeated increase is recorded.

In the **evaluation of individual tree species** up to the age of 59 years, in the case of conifers there is the least favorable situation repeatedly for pine, which is sensitive to drought, temperature extremes and sudden weather changes. In 2015 for classes 2 to 4 the value of defoliation was 75.1% (year-to-year increase by 2.0 p.p.). A more favourable status, compared to older stands, is observed in the case of spruce (only 8.7% in class 2 to 4). In the deciduous stands of the younger age category, the higher degree of defoliation applies mainly to oak, with 39.6% (Chart 3), whereas the year-to-year increase was substantial 13.7 p.p.

A direct consequence of the poor health of forests is their reduced ability to resist environmental stress. In the long term, the most important factor causing the need for salvage felling (Chart 4) are the abiotic factors (especially wind, frost, snow, and drought) and biotic (pest and pathogenous organisms). In 2015, the amount of salvage felling was 8,153 thous. m^3 without bark (4,527 thous. m^3 without bark in 2014). The year-to-year increase is caused by droughts, windbreaks and the subsequent attack by bark beetle. The share of salvage felling, caused by abiotic influences does not have a clear trend, since it is subject to unpredictable extreme meteorological events. Insect damage, which is the second most common reason for carrying out salvage felling, follows the natural damage by its dynamics, since windbreaks are affected in the following season by insect attacks and 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

17 | 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 the year 2015 it accounted for 26.5% 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-to-year change

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
- emphasising the need for the availability and comparability of the data collected at national level

National forestry programme for the period up to 2013[3]
- 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 nature tree species composition
- reducing the impacts of global climate change and extreme weather events
- preservation and enhancement of biodiversity in forests
- develop monitoring of forests

State forest policy principles
- conserving forest and forest land for future generations
- increasing the competitiveness of forest management
- increasing biodiversity in forest ecosystems and their ecological integrity and stability

[3] *The content of this program is still current and the implementation of a series of proposed measures took place also in 2015.*

• reinforcing the importance of forests and forest management for the economic development of rural areas
• reinforcing the importance of education, research and innovation in forestry

Operational Programme Environment 2014–2020
• improvement of the species, age and spatial structure 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 trees consolidating and draining soil in the regeneration of forests and afforestation
• the update of the National Forestry Programme (NFP) after 2013
• keeping the current proportion of state owned forests with nature-friendly forms of preference management while respecting competitiveness

State Nature Conservation and Landscape Protection Programme of the Czech Republic
• 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

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

Impacts on human health and ecosystems

The importance of forests is given in their ability to perform their productive functions (production of timber or other forest products) and non-productive functions (protection against erosion, water regime protection, nature conservation, recreation etc.). 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, contend with poor health, and therefore are no longer able to all perform all their functions in a satisfactory manner.

Indicator assessment

Chart 1

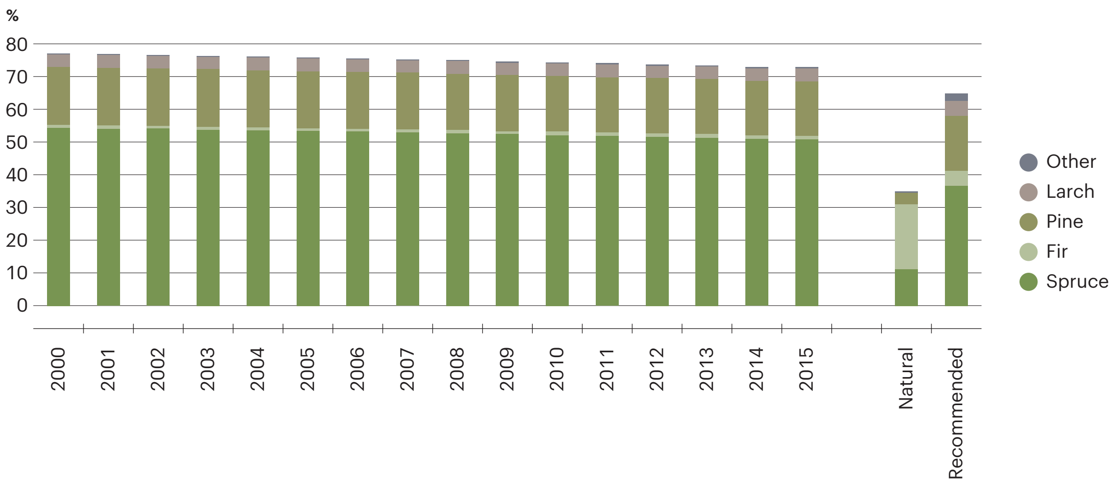
Development of the proportions of coniferous and deciduous stands in total forest area, Czech Republic[4] [%], 2000–2015

Source: Forest Management Institute

[4] *The reconstructed natural 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.*

Chart 2

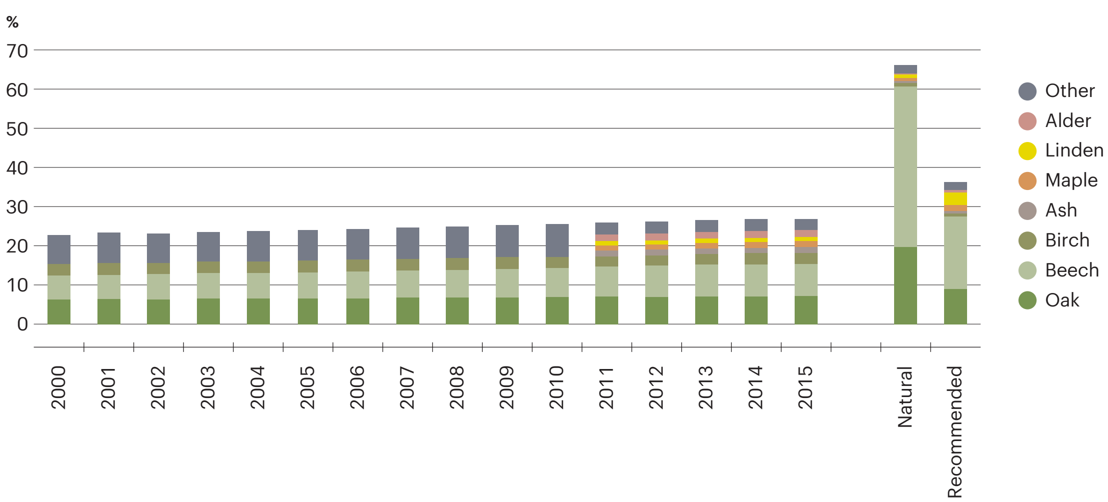
Development of species composition of coniferous stands in the Czech Republic, reconstructed natural and recommended composition [%], 2000–2015



Source: Forest Management Institute

Chart 3

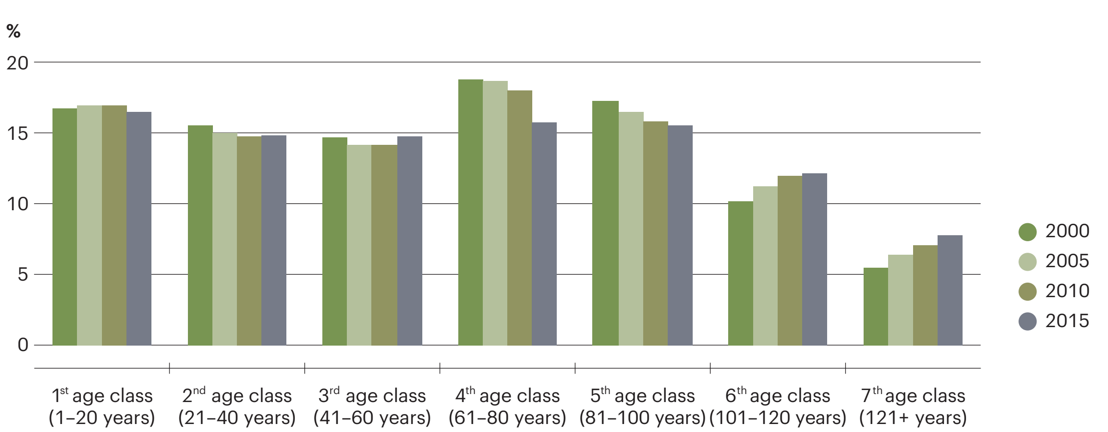
Development of species composition of deciduous stands in the Czech Republic, reconstructed natural and recommended composition [%], 2000–2015



Source: Forest Management Institute

Chart 4

Development of the age structure of forest stands in the Czech Republic [%], 2000–2015



Source: Forest Management Institute

The **current composition of the forests of the Czech Republic** significantly differs from the **reconstructed natural and recommended** (Charts 1–3), due to the widespread planting of spruce and pine monocultures in the past, it is represented by the predominantly coniferous forests, often inappropriate ecotypes. These even-aged monocultures 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 corresponds to the natural conditions of the habitat and 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-economic functions of forests, and recently also the knowledge related to the adaptation to climate changes. In the context of this composition it anticipates the reduction in the proportion of coniferous trees (Chart 1) from the current 72.3% to 64.4% (in the case of spruce from 50.6% 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 8.2% to the targeted 18.0%), and then 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 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 26.5% in 2015 (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 2015. The growth of young forest stands remains to be a problem, mainly as a result of foraging in areas with excessive population of cloven-hoofed game.

The **proportion of spruce** in the total forest area in the long-term steadily decreases, between the years 2000–2015 it decreased from 54.0% to 50.6% (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 total area of forests is consistently around 1% (in 2015 it formed 1.1%), even though its share in reforestation steadily rises (currently about 5%). The failure of efforts to increase the proportion of fir in forest stands is mainly attributed to the high damage caused by cloven-hoofed game.

The share of beech trees in the composition of forests is increasing, between 2000–2015 it has increased from 6.0% to 8.2% of the total area of forests. The increase, although slower, was recorded also in oak, which since 2000 has increased from 6.3% to 7.1% in 2015 (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[5] is very slow. Area of stands under the age of 60 years is subnormal, 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. Conversely there is a further downward trend year-to-year. In the year 2015, in the 1st age class 16.5% were recorded, in the 2nd class 14.8%, and the 3rd class 14.8% of the forest 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, the proportion of areas of elderly to overaged stands of the 6th and 7th age class is rising. Despite a slight decline in the last year, their share is permanently increasing since 1990. In the year 2015, in the 6th age class 12.1% (12.3% in 2014) were recorded, in the 7th class 7.8% (7.8% in 2014) of the forest 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

[5] 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.

18 | 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 2014 and 2015, there was an increase in the total area of forest land by about 2,016 ha. The area of forests, which are certified in accordance with the principles of sustainable management of forests according to PEFC and FSC, dropped from 70.0% to 68.2% (66.3% pursuant to PEFC and 1.9% pursuant to FSC). The classification of forests into categories according to their principal function does not exhibit significant changes. There is a decrease in the area of commercial and protection forests, and on the contrary, the area of special purpose forests is increasing. A long-term problem is the considerable damage foraging of regenerated stands caused by the cloven-hoofed game with its excessive population, which is not succeeded in effectively reducing. This problem is particularly significant for fir because, despite its growing proportion in planting, an increase of its overall representation in forest stands is not achieved in the long-term.

Thanks to the increasing proportion of deciduous trees in the long term in the regeneration of forest stands, the proportion of deciduous trees on a total area of forests of the Czech Republic is rising very slightly, but steadily. A growing trend of natural forest regeneration in the period 2007–2013 has stopped and from 2014 its area and share of the total afforestation is decreasing. The total forest stock has been increasing over the long term.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

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

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

National Forestry Programme
- 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 nature tree species composition
- preservation and enhancement of biodiversity in forests

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

National Biodiversity Strategy of the Czech Republic
- 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

State Nature Conservation and Landscape Protection Programme of the Czech Republic
- 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

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

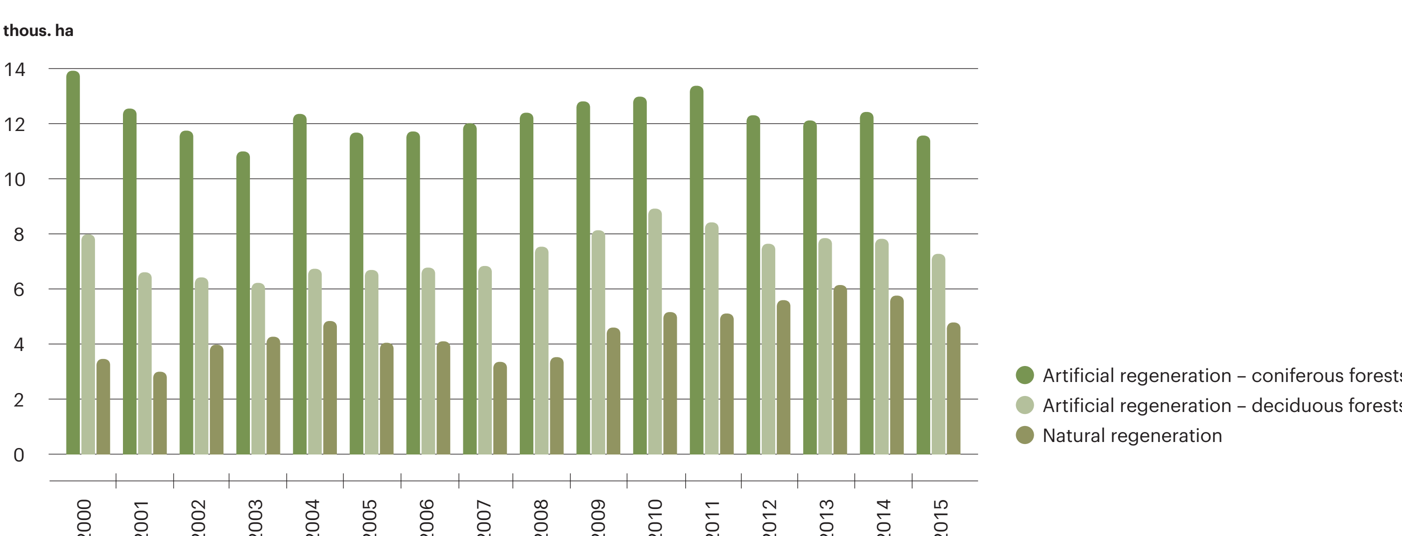
Impacts on human health and ecosystems

The result of the responsible forest management is particularly the improvement of production and non-production functions of forests, which are important for forest ecosystems themselves, for habitats outside of the forest and for the human society. The nature-friendly methods of forest management (e.g. planting trees consolidating and draining soil) supports improvement of the water regime, prevents the degradation of forest soils and enhances the ecological stability, which is important e.g. in reducing the impact of extreme weather events and climate change.

Indicator assessment

Chart 1

Forest renewal in the Czech Republic [thous. ha], 2000–2015

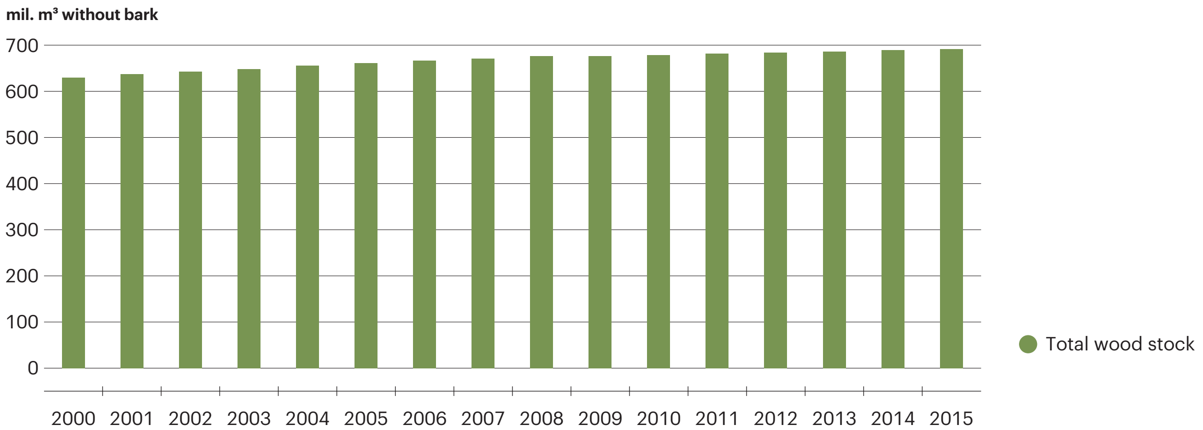


Since 2002, due to changes in the methodology the natural regeneration includes also the recovery under the trees (originally only a renewal of bare areas was included).

Source: Czech Statistical Office

Chart 2

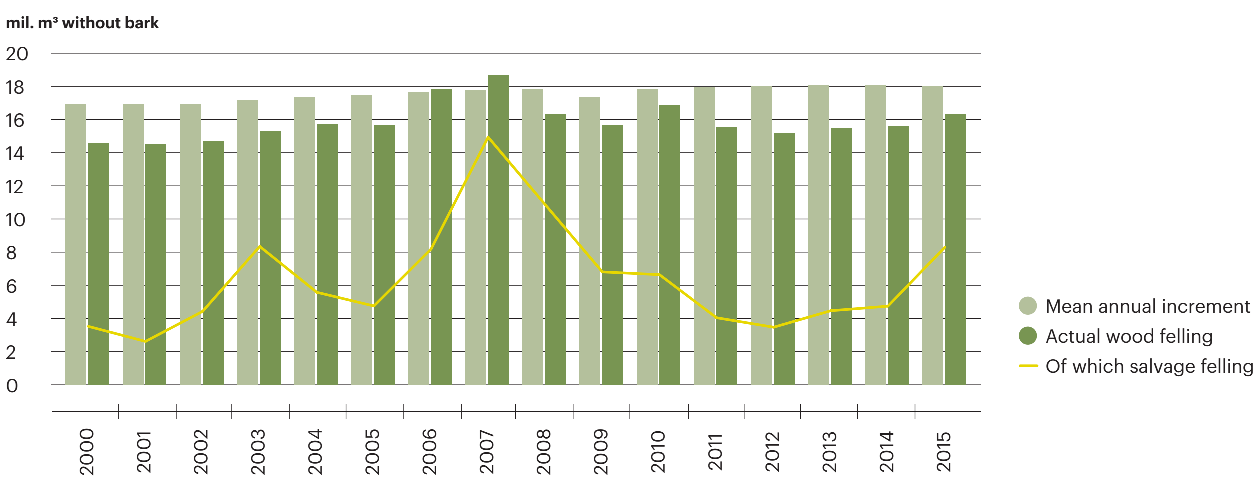
Total wood stock development (in stands) in the Czech Republic [mil. m³ without bark], 2000–2015



Source: Forest Management Institute

Chart 3

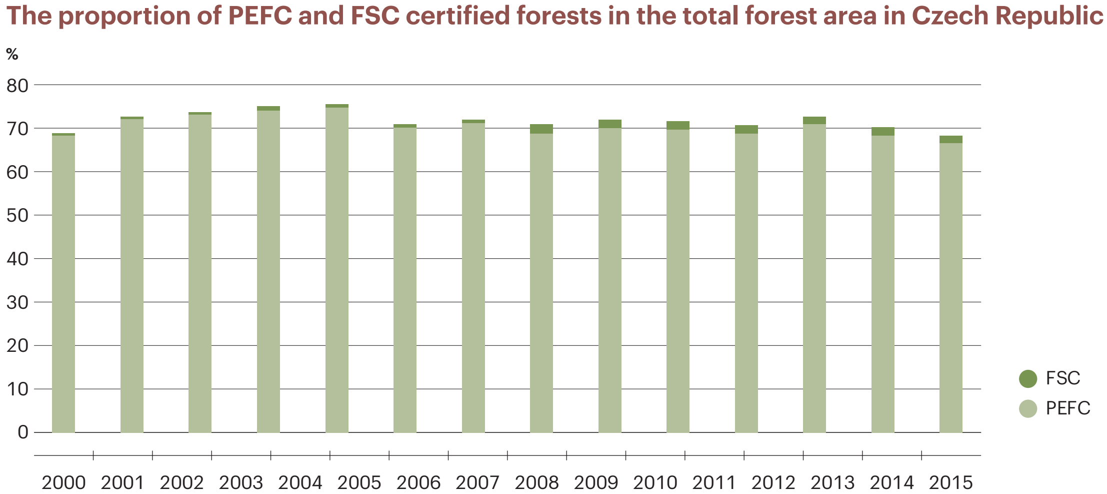
Comparison of wood felling and mean annual increment in the Czech Republic [mil. m³ without bark], 2000–2015



Source: Czech Statistical Office

Chart 4

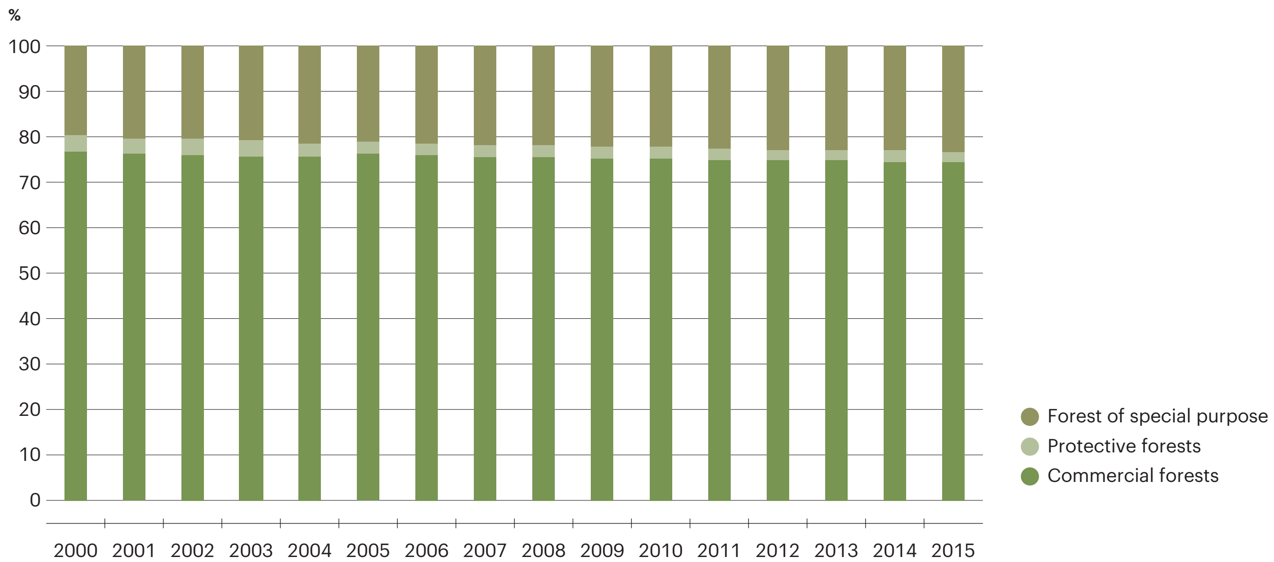
The proportion of PEFC and FSC certified forests in the total forest area in Czech Republic [%], 2002–2015



Source: FSC Czech Republic, PEFC Czech Republic

Chart 5

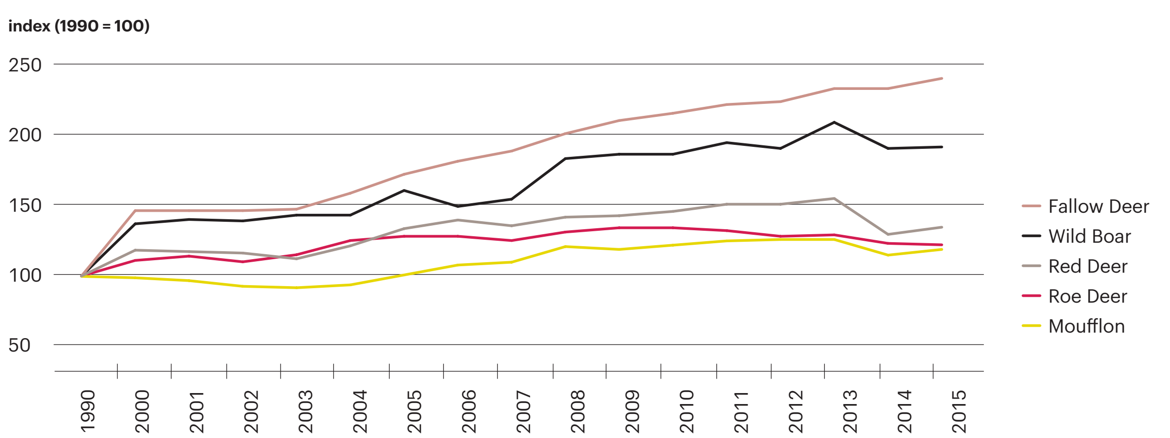
Proportions of the single forest categories in the Czech Republic's total forest area [%], 2000–2015



Source: Forest Management Institute

Chart 6

Spring stocks of game (selected species) in the Czech Republic [index, 1990 = 100], 1990–2015



Balance at 31 March of that year.

Source: Czech Statistical Office

Since 2000, it is possible to observe a slight approximation to the natural, or recommended forest composition, thanks to the reduction of the proportion of coniferous trees in favor of deciduous trees in the context of the **forest renewal** (Chart 1). New established stands were in 2015 from 61.5% made up of coniferous trees, but they also made 89.0% of the total felling, which led to the strengthening of the mutual representation of deciduous trees. 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 and from 22% in 2014 to 20% in 2015. At present the area, at which the natural regeneration takes place, accounts for 4,749 ha (compared to 5,726 ha in 2014).

The total standing wood stock has been increasing constantly (Chart 2). In 2015, the standing stock amounted to 692.6 mil. m³. 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 protective 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 mean annual increment only twice, in 2006 and 2007, mainly as a result of processing of wood damaged by the Kyrill hurricane and the subsequent Spruce Engraver Beetle (bark beetle) calamity (in 2007 salvage felling accounted for 80.5% of the total felling).

In the long term the **total logged volume** has been greater than 15 mil. m³ without bark, from 2012, continued to grow from 15.1 mil. m³ to 16.2 mil. m³ in 2015. The proportion of salvage (calamity) felling on the total felling in 2015 accounted for 50.4%, 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. m³ without bark, and in 2015 it was 17.8%.

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)[6], 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. 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, 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 commercial forests, protective forests, or special purpose forests** (Chart 5). In the long-term there is a gradual decline proportion of forests categorised as commercial, from 76.7% of the total area of the forests in 2000 to 74.4% in 2015, and on the other hand the proportion of special purpose forests in the same period increased from 19.8% to 23.5%. The permanent decrease in the area of protective 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 2015 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 boars** 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 the game overgrowth is the reduced or the complete absence of natural regulation. After a short improvement in 2014, in 2015 the state of the monitored animals was again increased, with the exception of roe deer, the states 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

[6] *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.*

forest property, the plans for breeding and hunting, and their supervision based on the approval with the hunting holder,must be carefully prepared 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, linked to the agricultural landscape, are improved. A separate chapter is the persistent problem of mutual interbreeding between the Crevus Nippon and European deer.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

Forests in the global context

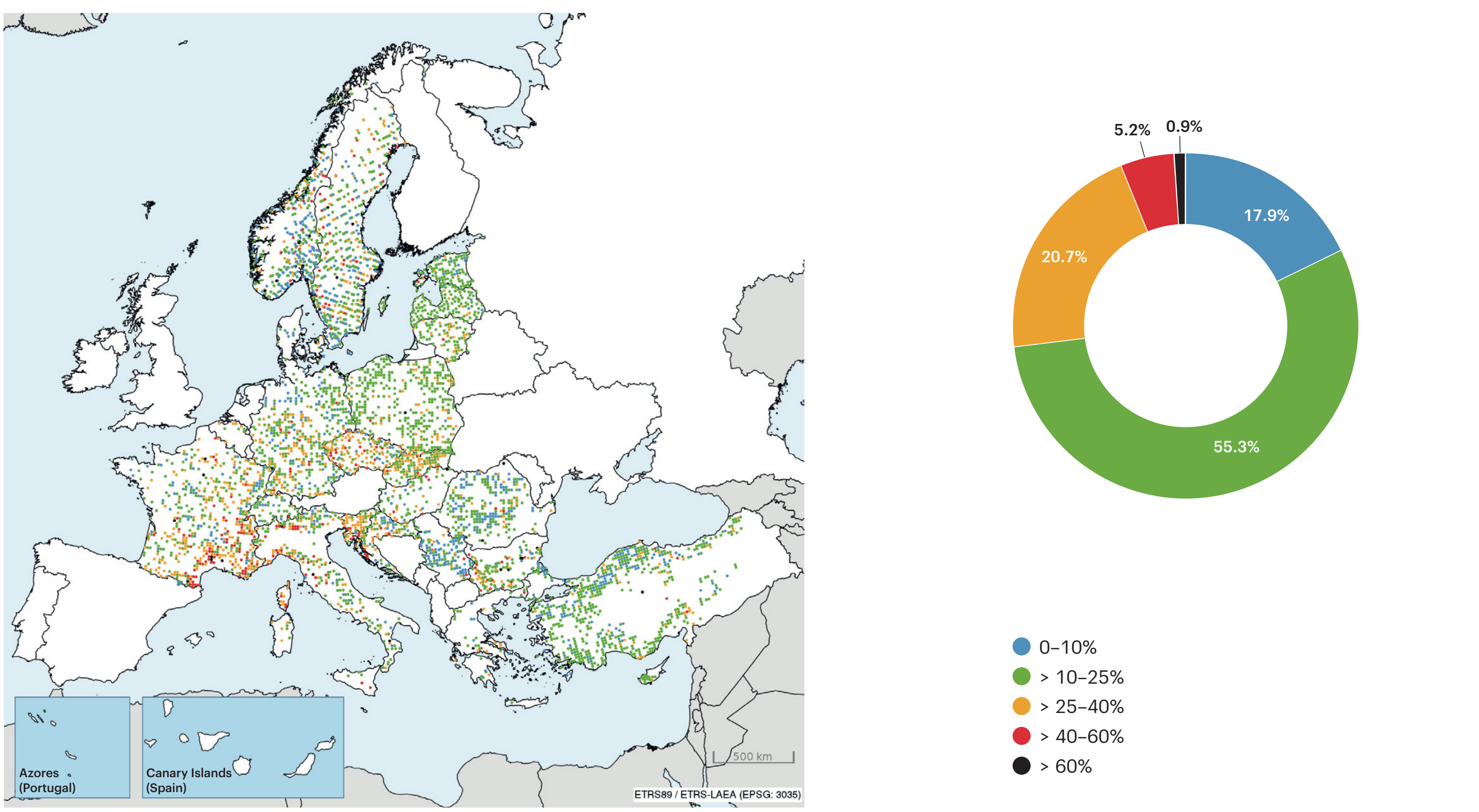
Key messages

- 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 are facing increasing pressure caused by human activity, increasing the risk of forest soil acidification and eutrophication of the landscape. The health condition of forest stands in Europe is also not satisfactory. In 2015, for a total of 23.3% of assessed trees, the defoliation rate exceeded 25% and trees 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, and the related dominant way of reforestation remain a problem.

Indicator assessment

Figure 1

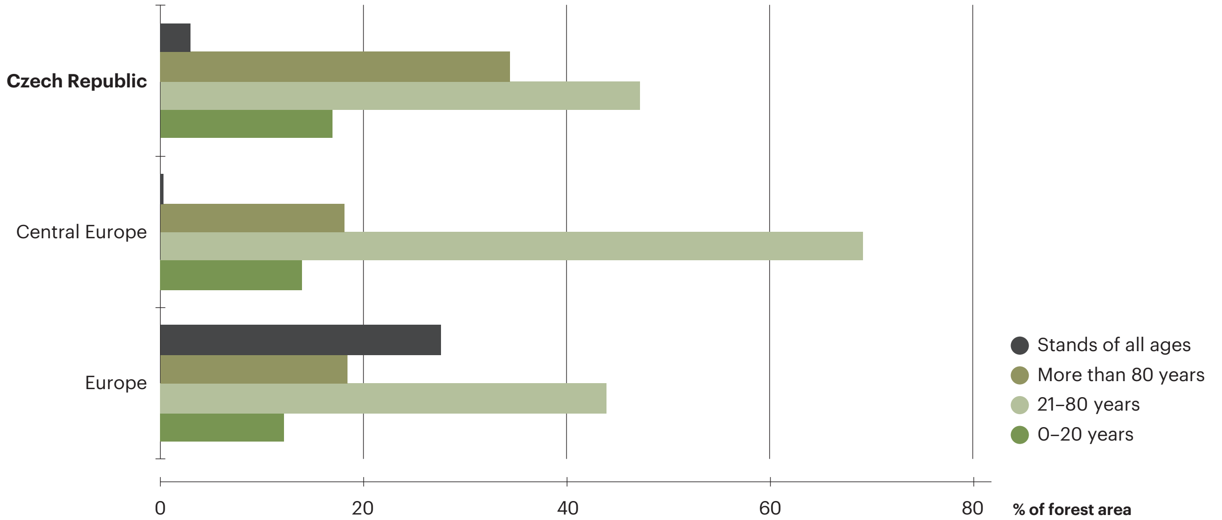
Defoliation on the main monitoring sites of all tree species [%], 2015



Source: ICP Forests

Chart 1

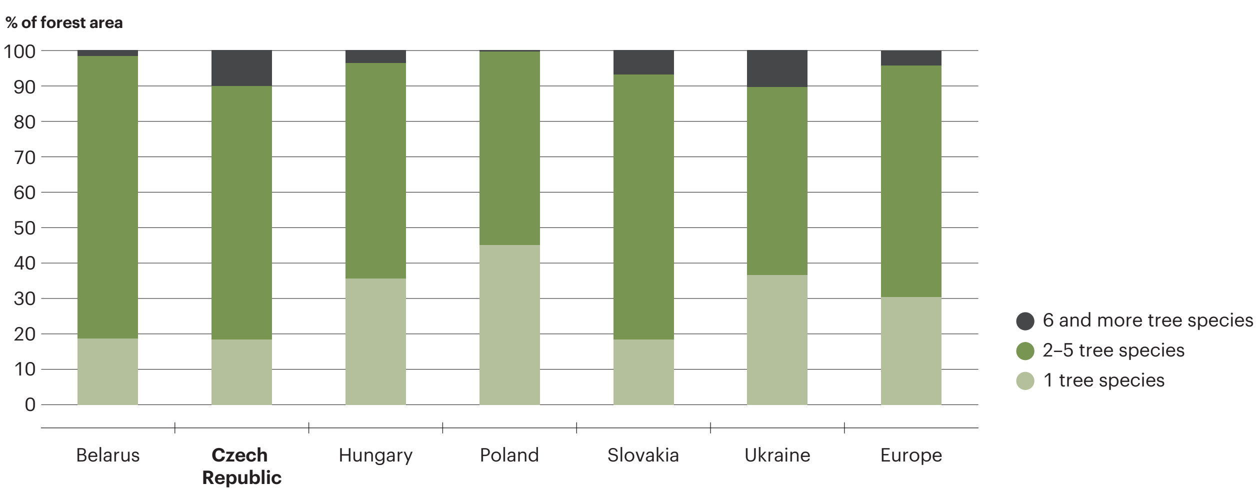
Age structure of forest stands [% of forest area], 2010



Source: State of Europe's Forests 2011

Chart 2

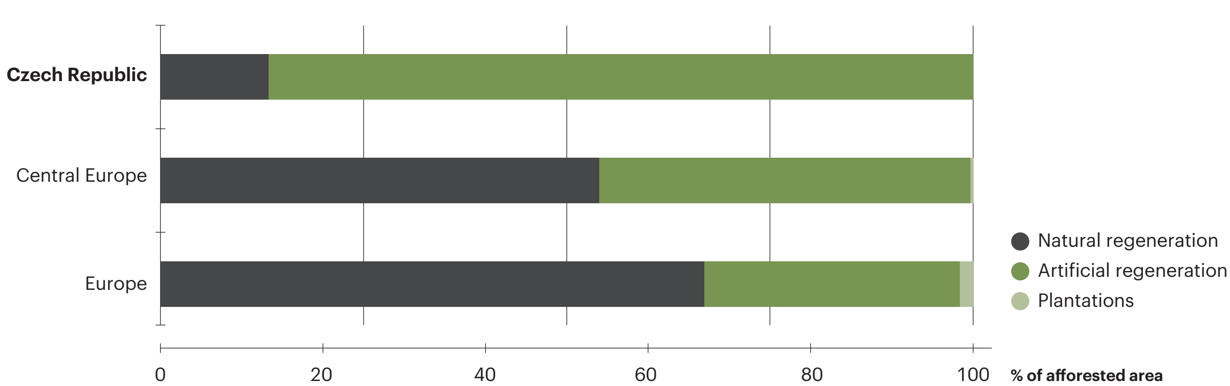
Species structure of forest stands in selected countries [% of forest area], 2005



Source: State of Europe's Forests 2011

Chart 3

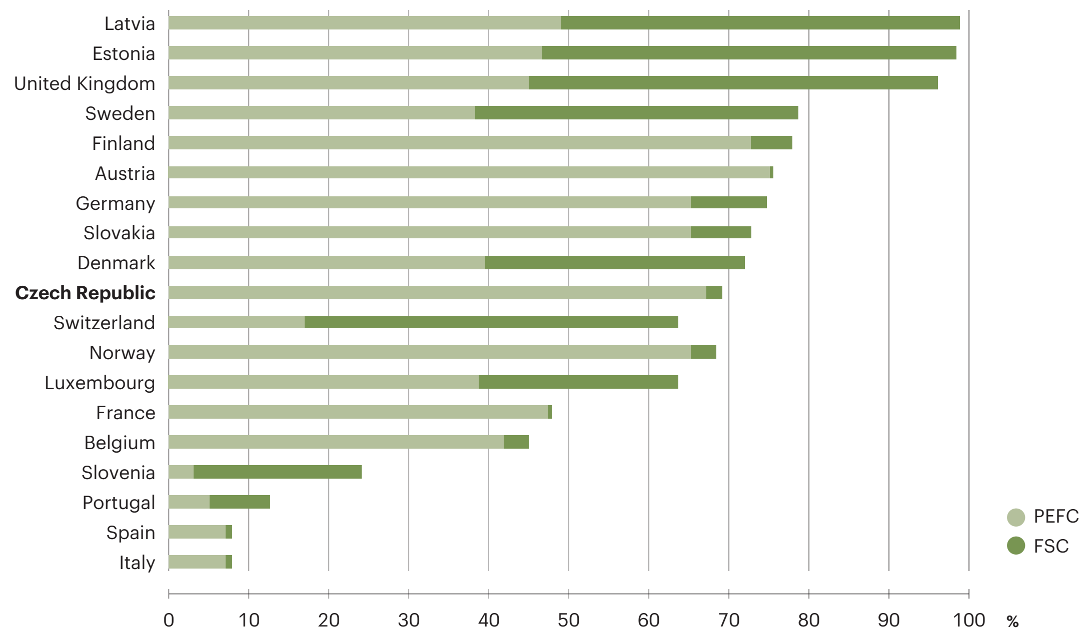
Proportion of the single forest regeneration types [% of afforested area], 2010



Source: State of Europe's Forests 2011

Chart 4

The proportion of PEFC and FSC certified forests in the total forest area in selected EU countries [%], 2015



Source: FSC Czech Republic, PEFC 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, 76.7% 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 Slovakia, or Croatia (Figure 1). There are many reasons as the defoliation is the result of a complex set of factors and is influenced by short-term factors (pest outbreaks or influence disease, 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[7], concerning biodiversity, conservation and non-production functions, the proportion of trees older than 80 years and all-aged stands, the situation in the Czech Republic is significantly better than in the other countries (Chart 1).

In the Czech Republic, the situation concerning the **species composition of forest stands**, in comparison with the European average, is more favourable (Chart 2), concerning the quantity of monocultural stands (18.5% in the Czech Republic, 30.3% in European average). When comparing the area of stands with more than 6 tree species, the situation in the Czech Republic is

[7] *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.*

also favourable. The area of these stands is much higher than the European average (10.3% in the Czech Republic and 4.2% average 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 in the European forests in comparison with the year 1990 is positive, moving towards a mixed species composition. Similar to the age structure, a significant change in species composition may be realised only in the long-term.

An essential tool for the conservation of forest landscapes and for the changes in the age and species composition of forests is the restoration of **forest ecosystems**. In terms of maintaining the genetic diversity, natural species composition and dynamics of the forest ecosystems, natural regeneration is the most suitable process. This, however, is not appropriate in many cases, especially if it involves a process of conversion of monocultures, changes in species composition of introduced species to naturally occurring, or restoration of forests after salvage felling.

In Europe, natural regeneration prevails over the artificial one (Chart 3). In this respect, the Czech Republic is far from attaining the level of European or Central European average (13.6% in the Czech Republic, Central European average is 54.2%). In the Czech Republic, due to the unsuitable species composition and age structure of forests, their natural regeneration is limited. The overall trend, however, in the Czech Republic shows a rising share of natural regeneration in the medium-term.

The proportion of the areas of **forests certified according to PEFC and FSC** on the total area of forest in selected EU Member States is the highest in Latvia (97.6%), Estonia (97.5%) and the United Kingdom (95.0%). In contrast, the smallest proportion is in Spain (7.9%) and Italy (7.8%). The Czech Republic belongs to the European average with 68.5%, 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 Spain (0.8%), Italy (0.5%), France (0.2%) and Austria (0.01%).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

5

Soil and landscape

19 | Land use

Key question

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

Key messages

Within agricultural land resources, the acreage of permanent grassland has gradually been growing and the area of arable land declines. This development is positive from the perspective of protection against erosion, protection of water quality and biodiversity conservation. The area of forests, which have an important function for water retention in the landscape is slightly rising. The growth rate in anthropogenic areas in the years 2014–2015 has slowed down.

The total acreage of agricultural land resources of the Czech Republic is decreasing. In the period 2000–2015 this was a decrease of 67.9 thous. ha, which is almost 1% of the territory of the Czech Republic. The agricultural land is shrinking particularly in favour of urban and other areas, as well as bodies of water and forests.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

State Environmental Policy of the Czech Republic 2012–2020
- restriction on permanent take-up of agricultural land and bedrocks

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, Updated Version 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 of 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

State Nature Conservation and Landscape Protection Programme of the Czech Republic
- 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

Thematic Strategy for Soil Protection
- to provide for sustainable land use

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

Territorial agenda of the European Union 2020
- promotion of polycentric and balanced territorial development
- management and interconnection of ecological, cultural, landscape-related values of regions

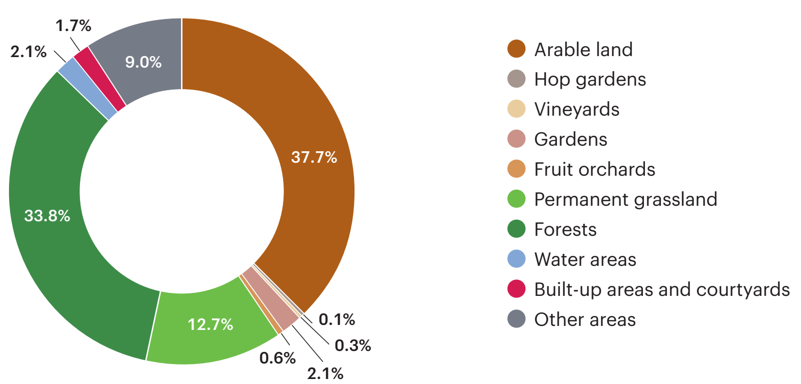
Impacts on human health and ecosystems

Land use and its changes caused by human activities affect the landscape character and its functions and therefore have an effect also on individual ecosystems and on biological diversity. Environmentally more valuable categories of land use, which include forests and permanent grassland, have a water management and erosion control function and are important for the protection of biodiversity. By contrast, arable land represents a potential environmental burden from agricultural activities, in particular for water quality. The development of construction and of other man-made surfaces reduces the retention ability of the landscape, and thus increases the flood threat of the territory; especially in the summer the artificial surfaces affect the temperature and humidity conditions with possible impacts on the public health.

Indicator assessment

Chart 1

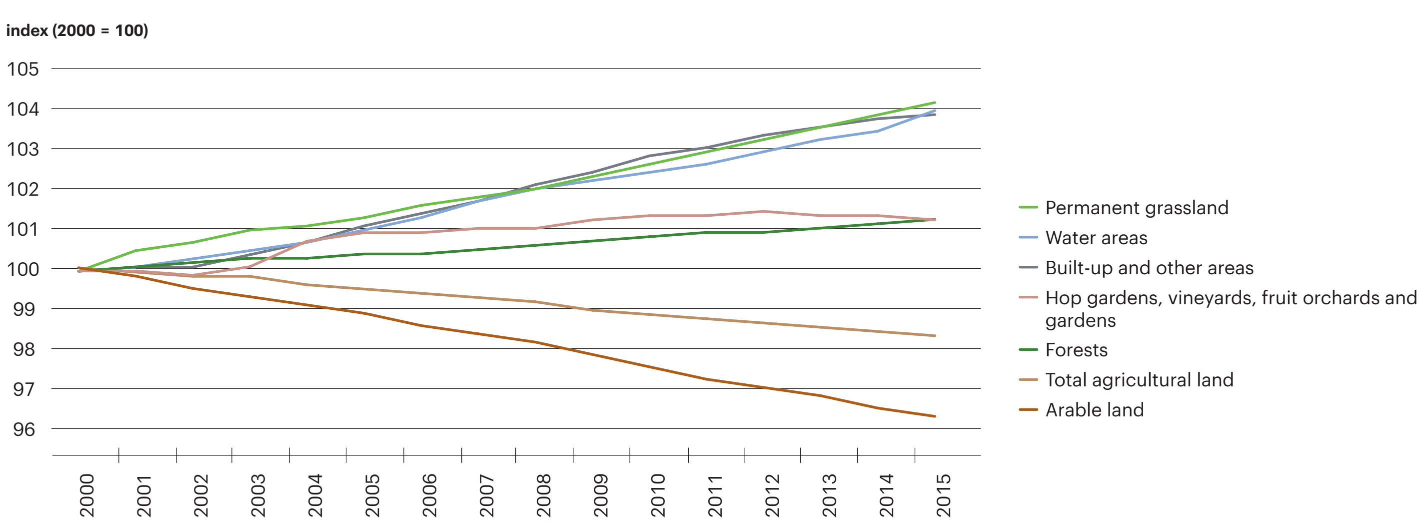
Land use in the Czech Republic [%], 2015



Source: Czech Office for Surveying, Mapping and Cadastre

Chart 2

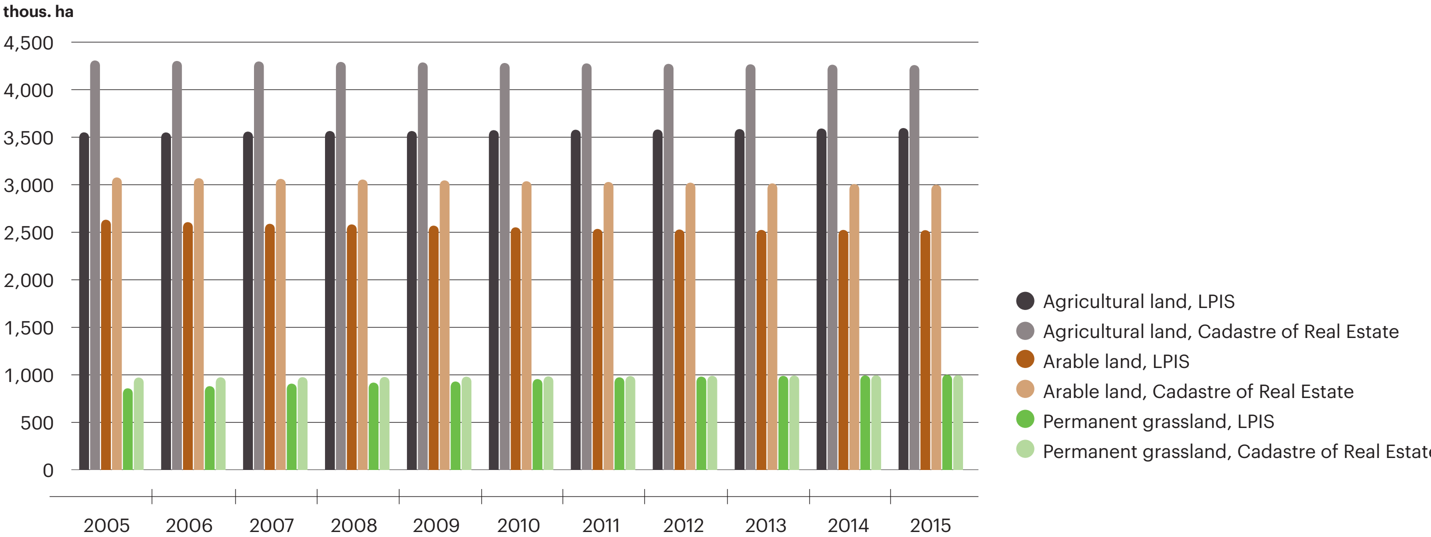
Land use development in the Czech Republic [index, 2000 = 100], 2000–2015



Source: Czech Office for Surveying, Mapping and Cadastre

Chart 3

Development of agricultural land area and its main categories recorded in LPIS and in the Cadastre of Real Estate [thous. ha], 2005–2015

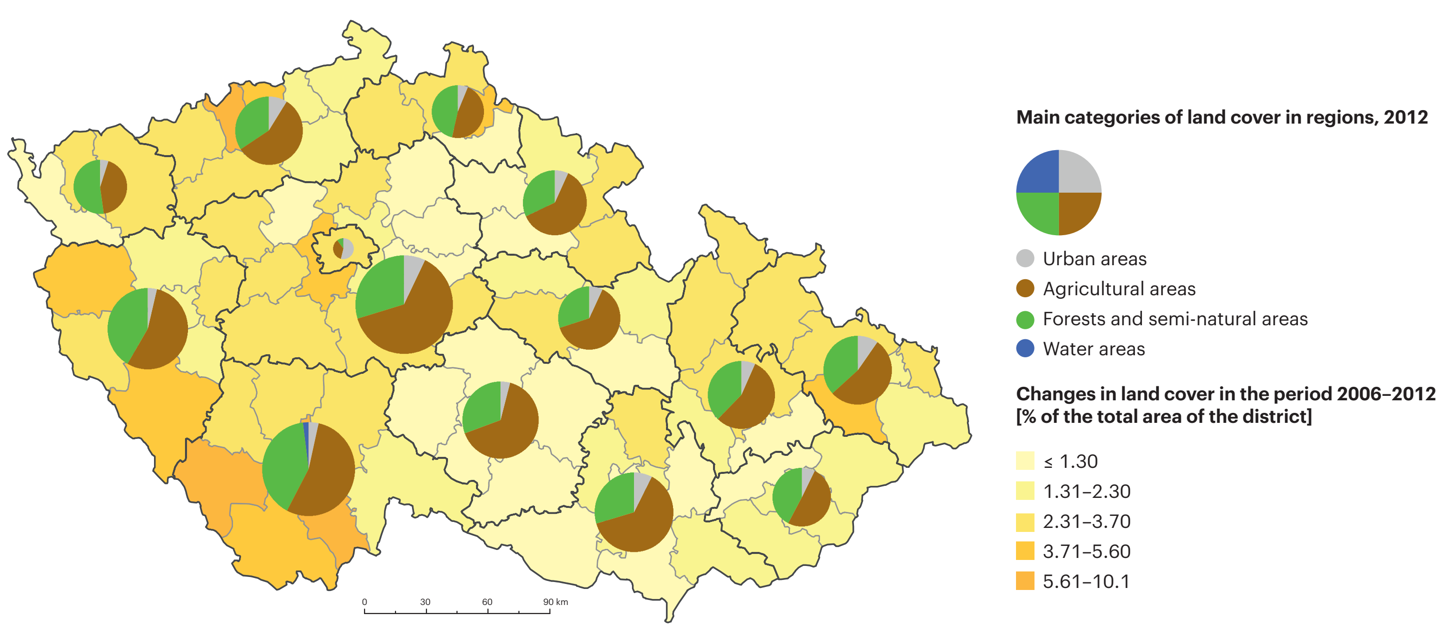


In 2015, the categorisation has changed for the recording of the land parcel in LPIS. To maintain the homogeneity of the time series data are referred to as arable land in 2015 as the sum of acreage of standard arable land and fallow land, the data for permanent grassland are the sum of acreage area of permanent grassland and grassland.

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

Figure 1

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



Source: CENIA, European Environment Agency

The **structure of land use in the Czech Republic** is characterised by a higher percentage of forests (33.8% in 2015, Chart 1), and a high share of arable land in the total agricultural land, which in the year 2015 reached 70.6%. The proportion of agricultural land resources in the total Czech Republic's area in 2015 accounted for 53.4%.

A significant long-term trends in the land use of the Czech Republic are the decrease in the acreage of arable land (Chart 2), in the period 2000–2015 by 110.4 thous. ha (3.6%), and an increase in the area of permanent grassland (in the period 2000–2015 by 39.6 thous. ha, i.e. 4.1%) largely at the expense of arable land. This development, supported by the state subsidy policy and the application of the principles of the Common Agricultural Policy of the EU, is positive from the perspective of the protection of the environment and biodiversity conservation, since the potential burden from farming on arable land is thus declining. The total area of **agricultural land** has been slightly decreasing, according to the Cadastre of Real Estate; in the period 2000–2015 it decreased by 67.9 thous. ha (1.6%) in total, in the year-to-year comparison of 2014–2015 by 3.7 thous. ha (0.1%). The loss of agricultural land resources is caused firstly by its land take as a result of the expansion of urban and other areas, in the period 2000–2015 by 31.2 thous. ha (3.9%), and also the gradual growth of the area of **forests and water areas**. The growth rate of water areas after 2010 has increased in the period 2000–2015 when water areas expanded by 6.1 thous. ha (3.9%), and took 2.1% in the Czech Republic. The growth of water areas was caused by flooding, among others, of former mining areas in the regions of Karlovy Vary and Ústí nad Labem.

Between 2014 and 2015, the area of **arable land** decreased by 7.0 thous. ha, i.e. by 0.2%. The largest losses of arable land (total of 8.2 thous. ha) in 2015 were caused by the transformation of arable land into permanent grassland (about 4.2 thous. ha in total, of which a loss of about 1.3 thous. ha, i.e. 30.2% of the total increment in the South Bohemian region), and into built-up and other areas, which even meant a take up of agricultural land. In total, this concerned 2.3 thous. ha mainly in the regions of Central Bohemia and South Moravia (approx. 620 ha in total). A significant area of arable land was reforested in 2015 (680 ha) or transformed into water areas (405 ha). Increases of arable land in 2015 amounted to a total of 1.1 thous. ha; new arable land was created mainly on permanent grassland areas (469 ha), other areas (339 ha) and fruit orchards (155 ha). As a result of these changes the total acreage of permanent grassland has grown in the year 2015 in the year-to-year comparison by 3.4 thous. ha, i.e. by 0.3%.

The area of **built-up and other areas** increased year-to-year (2014–2015) by 1.2 thous. ha (0.1%) to 841.2 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. The acreage of built-up areas and courtyard does not rise any more, however the extent of other areas continues to slowly increase, in 2015 it was about 1.3 thous. ha (0.2%). In the context of other areas the acreage of roads is increasing (overall in 2015 by 1.1 thous. ha, i.e. 0.5%) and the public green areas (980 ha, i.e. 2.5%). On the contrary, the scope of mining areas is decreasing (year-to-year by 980 ha, i.e. 2.8%), while the rate of decline has increased compared to the year 2014. The total area of the land used as a handling area and barren land is also decreasing. The land take of the agricultural 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 register LPIS** 45.1% of the territory of the Czech Republic was used for agricultural purposes in 2015, which is by approximately 652.7 thous. ha less than the area of 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 (69.9% in 2015) and permanent grassland (27.5%) and thus for other categories fall only 2.6% of the total acreage of agricultural land in LPIS. In the period 2005–2015, the total area of land registered in the LPIS (unlike the Cadastre of Real Estate) was slowly increasing (by 65.0 thous. ha, i.e. by 1.9%), mainly as a result of the growth of registered areas of permanent grassland by 141.3 thous. ha (16.4%), at a decrease in the recorded acreage of arable land by 108.0 thous. ha, i.e. by 4.1%.

Based on the data from the **CORINE Land Cover** 2012, the highest share of agricultural land in the total territory has the Vysočina region (65.1%) and in the region of Central Bohemia (62.9%, Figure 1), the most forested regions, according to the CORINE Land Cover data, are the regions of Karlovy Vary (51.8%) and the Liberec region (46.4%). The highest proportion of urban areas 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 largest changes in land cover in Prachatice district (land cover changed to 10.0% of the territory) in the context of deforestation in the Šumava national park, and in the district of Most (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

20 | Landscape fragmentation

Key question

Is the process of landscape fragmentation being slowed down?

Key messages

Although the pace of decline of unfragmented areas is decreasing, 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 2015 there were a total of 838 weirs, which may adversely affect aquatic ecosystems.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora
- ensuring the continuity of natural habitats and wildlife migration

Regulation No. 1315/2013 of the European Parliament and of the Council of the EU of 11 December 2013 on Union guidelines for the development of the trans-European transport network
- requirement to take into consideration the physical restrictions and topographical features of the regions as well as environmental impacts, including the fragmentation of the landscape, during the planning and development of the transport network; if this is not possible, mitigation of these impacts or their compensation and effective protection of biological diversity is required

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
- 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

Council Regulation (EC) No. 1100/2007 of 18 September 2007 establishing measures for the recovery of the stock of European eel
- enabling the passability of rivers and improvement of the state of river habitats, leading to the reduction in mortality of eels resulting from human activity

Spatial Development Policy of the Czech Republic, Updated Version 1
- ensuring the protection of undeveloped areas (in particular agricultural and forest land) and preservation of public greenery, including minimisation of its fragmentation
- ensuring the migration landscape permeability for wildlife animal species

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

- preservation of the permeability of landscape and minimisation of the extent of its fragmentation while choosing the locations of transport and technical infrastructure

State Environmental Policy of the Czech Republic 2012–2020
- reduction and mitigation of impacts of landscape fragmentation and increase of ecological stability of landscape

The Concept of Making the Czech River Network Passable, 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

Impacts on human health and ecosystems

Landscape fragmentation belongs to important problems which have negative impacts on the landscape character and plant and animal populations. The impacts of fragmentation are not immediate, however, they are long-term and irreversible. The breaking of landscape arises from natural processes (gales, fires, floods, slides), but is also caused by human activities, namely by agriculture, urbanization and most seriously by construction and the use of transport infrastructure. Fragmentation barriers in nature reduce the landscape's potential for recreation and its passability enabling free movement. There is also an increase of noise pollution in the environment concerned.

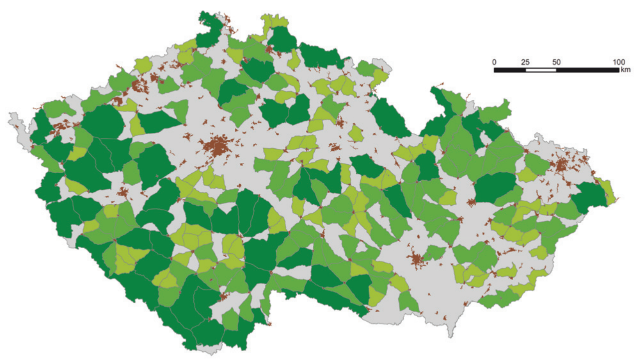
Landscape fragmentation significantly affects natural aquatic and terrestrial ecosystems and the plants and animals living there. The natural habitat of individual species of organisms are occupied and their size is decreasing, the populations are fragmenting, migration distances are increasing, migration barriers are formed, and thus a limitation of food sources and breeding opportunities occurs. All this leads to a loss of genetic diversity and reduced viability of populations and ecosystems.

Indicator assessment

Figure 1

Landscape fragmentation due to transport in the Czech Republic, 2010

UAT 2010



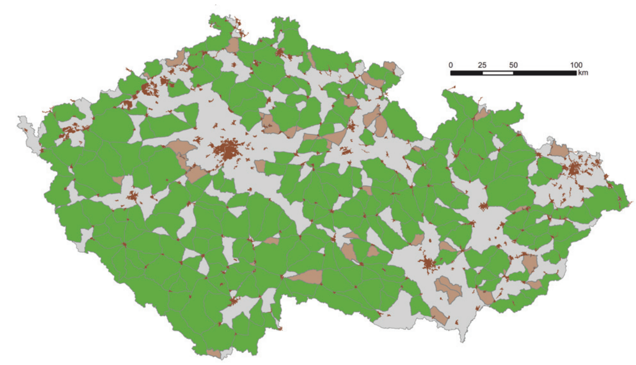
Area of UAT

- Over 300 km²
- 150–299 km²
- 100–140 km²
- Urbanised area (over 2 km²)
- Fragmented area

Figure 2

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

UAT 2010 and 2005 – differentiation map



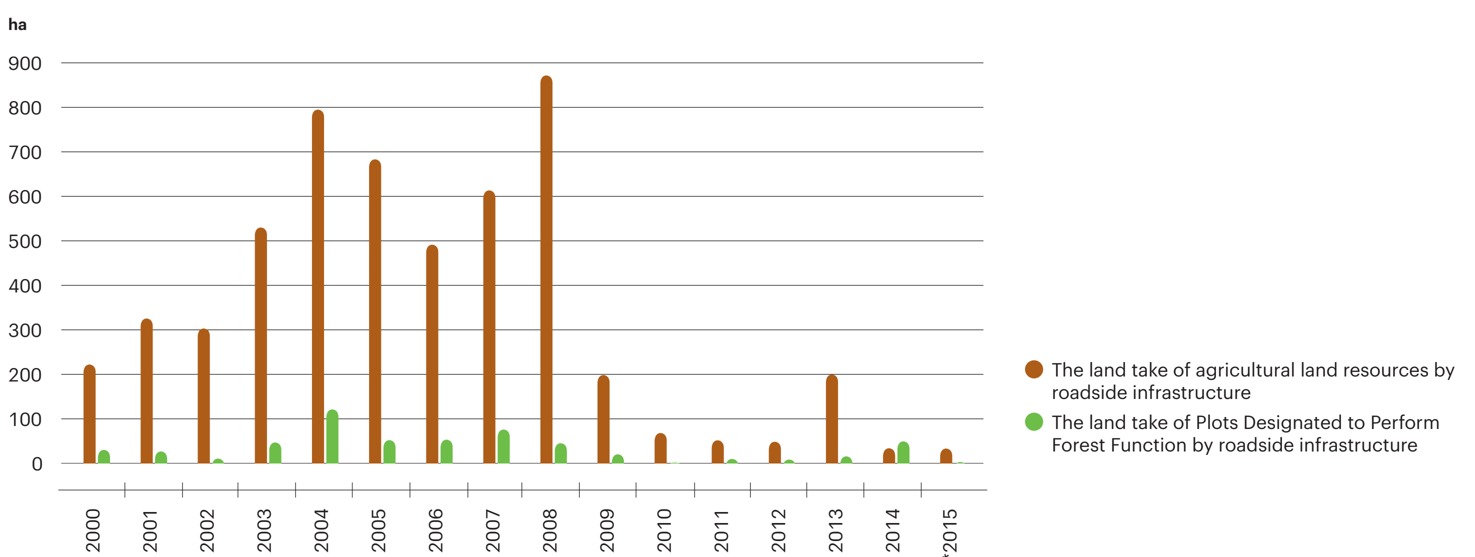
- UAT 2010
- UAT, which disappeared from 2005
- Urbanised area (over 2 km²)
- Fragmented area

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, and whose area is larger than 100 km².
Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: Evernia

Chart 1

Development of land take of agricultural land resources and of Land Designated for Fulfillment of Forest Functions due to road infrastructure in the Czech Republic [ha], 2000–2015



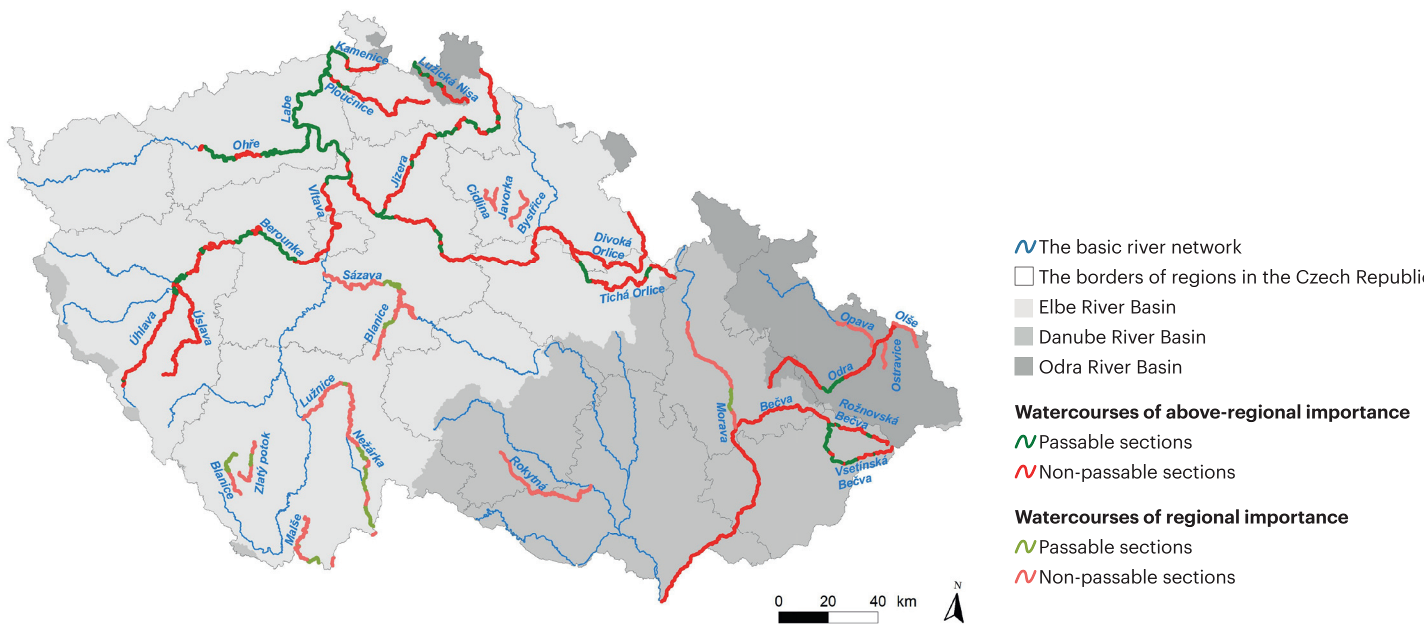
** Preliminary data.*
The methodology of reporting the take-overs of agricultural land and of plots intended for fulfillment of forest functions is annually affected by temporary take-ups of such land which are associated with the construction of transport infrastructure.

Source: Transport Research Centre

Figure 3

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

Current status of the migration permeability in Czech Republic



Data for the year 2015 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 thous. km² (68.6% of the total area of the Czech Republic) to 50 thous. km² in 2010 and therefore covered 63.4% of the total area of the Czech Republic (Figure 1, Figure 2). Compared to the previous five-year period (2000–2005), the rate of decline decreased by 2.4% in the last 5 assessed years, but even despite that 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 be only 53%.

The highest **fragmentation of the landscape** in the Czech Republic is recorded in Central Bohemian region, South-Moravian and Moravian-Silesian region (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 of fragmentation is caused by the territorially incompact expansion of built-up areas as a result of the continuing urbanisation taking place mainly in urban agglomerations and also the development of transport infrastructure, especially the construction of urban ring roads, express roads and motorways. On the contrary, the Pilsen region and the South Bohemian region belong among the regions with the highest number of unfragmented areas, where 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 2000–2015, approximately 5,386 ha of agricultural land and approximately 517 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 2000–2015 occurred in the Central Bohemian and South Bohemia region, in particular, due to the continuing preparation and construction of motorway D1 and D3, in the Central Bohemian region, the land take is also closely related with the construction of the Prague ring road connecting the motorways D1 and D5. Between the years 2014–2015, then there was an increase in land take only in the region of Karlovy Vary as a result of revitalisation, modernisation and static securing of road and technical infrastructure in the region. The most significant loss of forest land was recorded in Central Bohemian and South Bohemian regions between the years 2000–2015. Between the years 2014–2015 forest land take by transport infrastructure was only in the Karlovy Vary region.

Transport infrastructure represents a serious and often insurmountable obstacle to many important species of animals. The solution consists in a suitable construction of migration objects, such as underpasses, bridges and overpasses. Given the lack of a unified database, however, it is not possible to evaluate the importance and effectiveness of these measures.

Watercourses and their flood plains represent a specific migration route, to which various animal and plant populations are bound. 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 the watercourses of different order in the territory of the Czech Republic there are more than 6,600 transverse objects built higher than 1 m and a water tank of more than 50 ha, while the number of lower **migration barriers** is not exactly known and will be higher by order. 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 enterprise Povodí, a total of 838 **weirs** were recorded in 2015, of which 195 are managed by state enterprise Povodí Labe, 343 by state enterprise Povodí Vltavy, 43 by state enterprise Povodí Ohře, 175 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 international agreements, implemented in the Concept of Making the Czech River Network Passable, there are priorities set to make passable the river networks with regard to regional and national priority sections of water courses. According to the National Danube River basin Management Plan in the watercourses in the Danube basin in the period 2009–2015 none of the 5 proposed measures for above-regional priority bio-corridors were succeeded in implementing, and at the same time none of the transverse barriers within the national priority sections of watercourses was succeeded in making passable. According to the National Oder River basin Management Plan, in watercourses in the Oder river basin it was not succeeded in implementing any of the 6 measures proposed in the framework of trans-regional priority bio-corridors, but nevertheless, two measures were initiated (this is a realisation of fish passes). Regarding the implementation of making passable 3 transverse barriers within the national priority sections of the waterways in the Oder river basin, none of the measures was realised. According to the National Elbe River Basin Management Plan for the water streams in the Elbe river basin there were a total of 38 measures proposed in the framework of trans-regional priority bio-corridors, wheres it was succeeded in implementing 8 measures and few others were initiated. In the framework of national priorities in the Elbe river basin it was succeeded in making passable 3 out of 6 proposed profiles. Significant delays in implementation occur mainly due to property-related, economic and legislative reasons.

In order to maintain and strengthen the populations relying on migration and to fulfil the Concept of Making the Czech River Network Passable, an increase in the number of upcoming proposed constructions of fish passes has been endorsed since 2010. In 2015, a total of 35[2] of these projects were prepared and 15 of them 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.

21 | Risk of soil erosion and slope instabilities

Key question

How big is the proportion of agricultural land that is threatened by erosion and landslides?

Key messages

On the Czech Republic's territory, 47.3% of agricultural land is potentially threatened[3] with watererosion and 18.0% with wind erosion. Out of this, 11.4% of agricultural land is extremely threatened by water erosion and 3.2% of most vulnerable agricultural soils by wind erosion. In the case of water erosion there is a significant improvement compared to the year 2014, in the case of wind erosion there was no year-to-year improvement. The framework farming management to prevent further erosion is recommended for a total of 46.1% of the assessed acreage of the agricultural land in the Czech Republic. Other areas of agricultural land (53.9%) do not have a limit.
In the context of slope instabilities the most serious sources of risks are active landslides, which were 3.7 thous. ha of the total area of the 66.3 thous. ha of landslides registered in the year 2015 in the Czech Republic.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

State Environmental Policy of the Czech Republic 2012–2020
- 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
- restoration of the landscape water regime by implementing erosion control measures in the landscape

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 ha for observing agricultural practices which have a beneficial effect on the climate and the environment
- comply with the standards for agricultural and environmental status established by the Member State and pursuing objectives to prevent soil erosion, maintain soil structure and keep organic matter in soil and to ensure minimum level of care

Action Plan of the Czech Republic for the Development of Organic Farming in the years 2011–2015
- ensuring non-productive functions of organic agriculture, which contribute to the restoration of stability and natural processes in the soil

Standards of good agricultural and environmental condition (GAEC)
- management standards to ensure the protection of soil from erosion

[3] *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}.*

The United Nations Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, particularly in Africa

- combating desertification and mitigating the effects of drought in affected or threatened areas (in Central Europe in areas prone to soil erosion)
- focus on improved productivity of land, and the rehabilitation, protection and sustainable management of land and water resources in affected areas

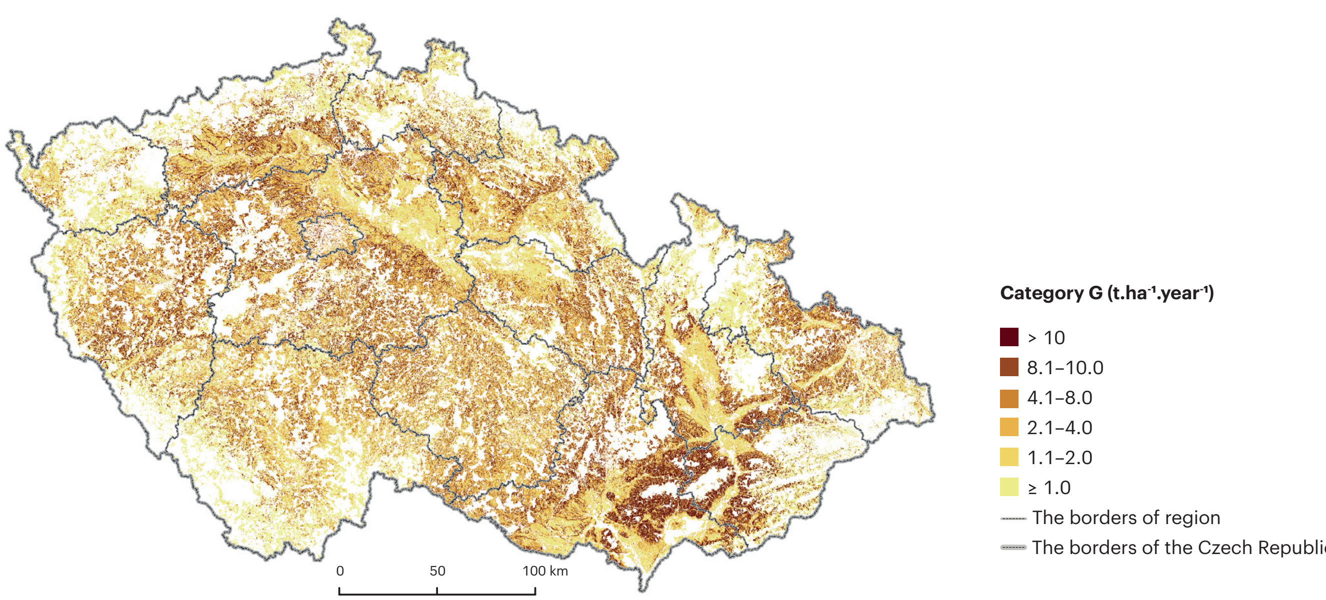
Impacts on human health and ecosystems

Soil erosion, landslides and soil densification are amongst the most significant degradation impacts negatively affecting the soil. Degradation generally results in a restriction or complete loss of production and non-production functions of soil. The very process of erosion as well as of landslides are normal natural phenomena, but an increase in their intensity as a result of anthropogenic activities is a serious problem. Accelerated erosion causes a reduction in the quality of soil through loss of its most fertile parts, thus reducing soil fertility, loss of ecological functions of soil and reduction of water retention and recharge functions. The damage caused by erosion, however, also influences the level of water pollution, causes silting of water reservoirs and thus also indirectly affects human health. Erosion can also cause damage to property (topsoil washing, fertilisers and plant protection products runoff, clogging of drainage systems and sewerage networks, the loss of seeds and seedlings, damage to roads, buildings and utilities). Landslides also cause serious direct or indirect damage, e.g. by surface bulging or subsidence, accumulation of soil and rocks, bulging of slope face, soil accumulation or uprooting of trees, as well as damage to property and human health (e.g. by soil or rock slides or damage to roads or railways, movement retaining walls or cracking buildings, cable ducts, pipelines, etc.). The soil density causes losses of revenue, causing a decreased ability to retain water, which limits the plants nutrition and the biological activity, but also the growing surface run-off, which increases the vulnerability of the soil against water erosion and can also result in the formation of flood events.

Indicator assessment

Figure 1

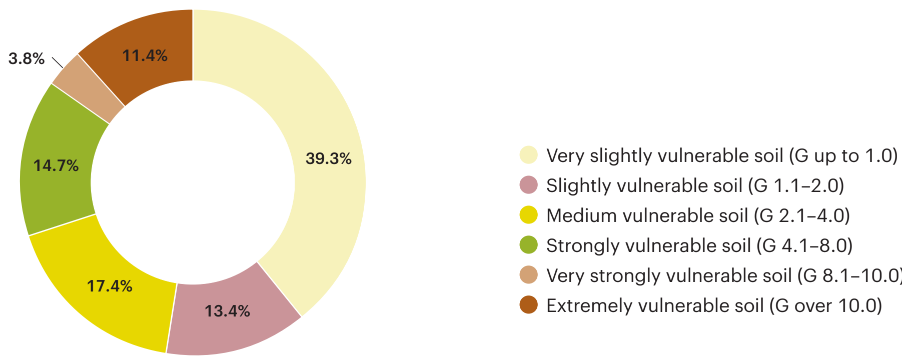
Potential vulnerability of agricultural land to water erosion expressed as a long-term average soil loss (G) in the Czech Republic [t.ha^{-1}.year^{-1}], 2015



Source: Research institute for Soil and Water Conservation

Chart 1

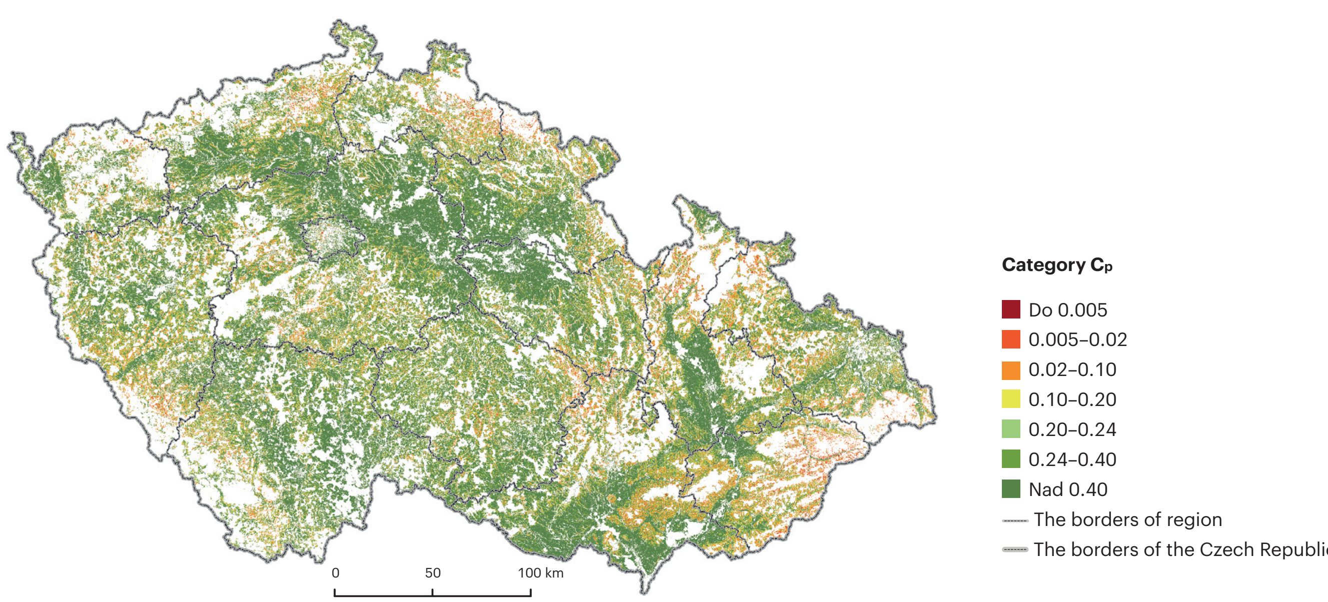
Potential vulnerability of agricultural land to water erosion expressed as a long-term average soil loss (G) in the Czech Republic) [% of agricultural land resources], 2015



Source: Research institute for Soil and Water Conservation

Figure 2

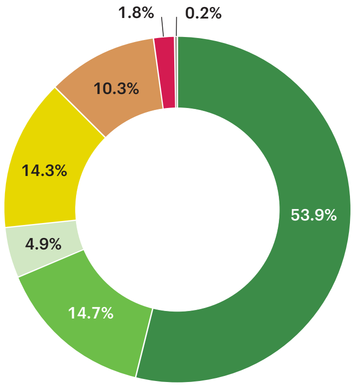
Vulnerability of agricultural land to water erosion expressed as the maximum admissible values of the cover and management factor (Cp) in the Czech Republic, 2015



Source: Research institute for Soil and Water Conservation

Chart 2

Vulnerability of agricultural land to water erosion expressed as the maximum admissible values of the cover and management factor (Cp) in the Czech Republic [% of agricultural land resources], 2015

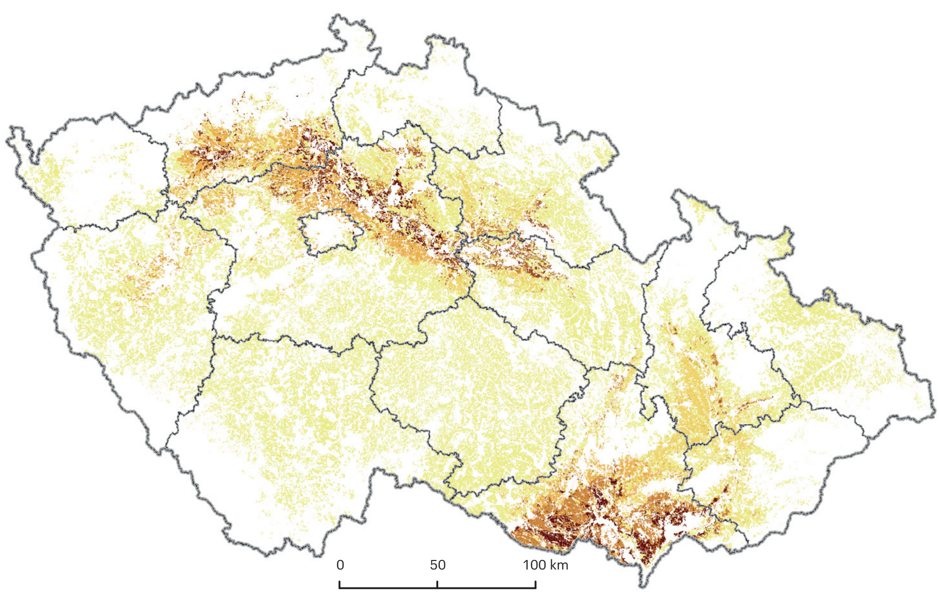


- No limit (Cp over 0.4)
- Erosion-dangerous crops grown with soil protective technologies (Cp 0.24–0.40)
- Belt rotation of crops or exclusion of erosion dangerous crops (Cp 0.20–0.24)
- Exclusion of erosion dangerous crops and the use of soil protective technology (Cp 0.10–0.20)
- Exclusion of erosion dangerous crops and a higher representation of perennial forages (Cp 0.02–0.10)
- Perennial forage crops or protective grassing (Cp 0.005–0.02)
- Protective grassing (Cp up to 0.005)

Source: Research institute for Soil and Water Conservation

Figure 3

Potential vulnerability of agricultural land to wind erosion in the Czech Republic, 2015



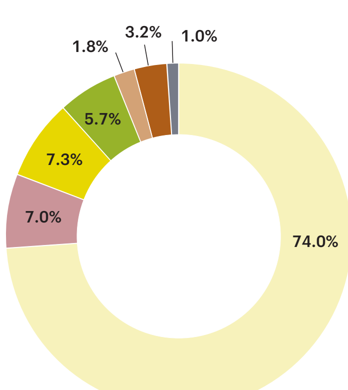
Categories of vulnerability to wind erosion

- The most vulnerable soil
- Strongly vulnerable soil
- Vulnerable soil
- Slightly vulnerable soil
- Fractionally vulnerable soil
- Fractionally vulnerable soil
- Non-agricultural soil or not evaluated
- The borders of region
- The borders of the Czech Republic

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], 2015

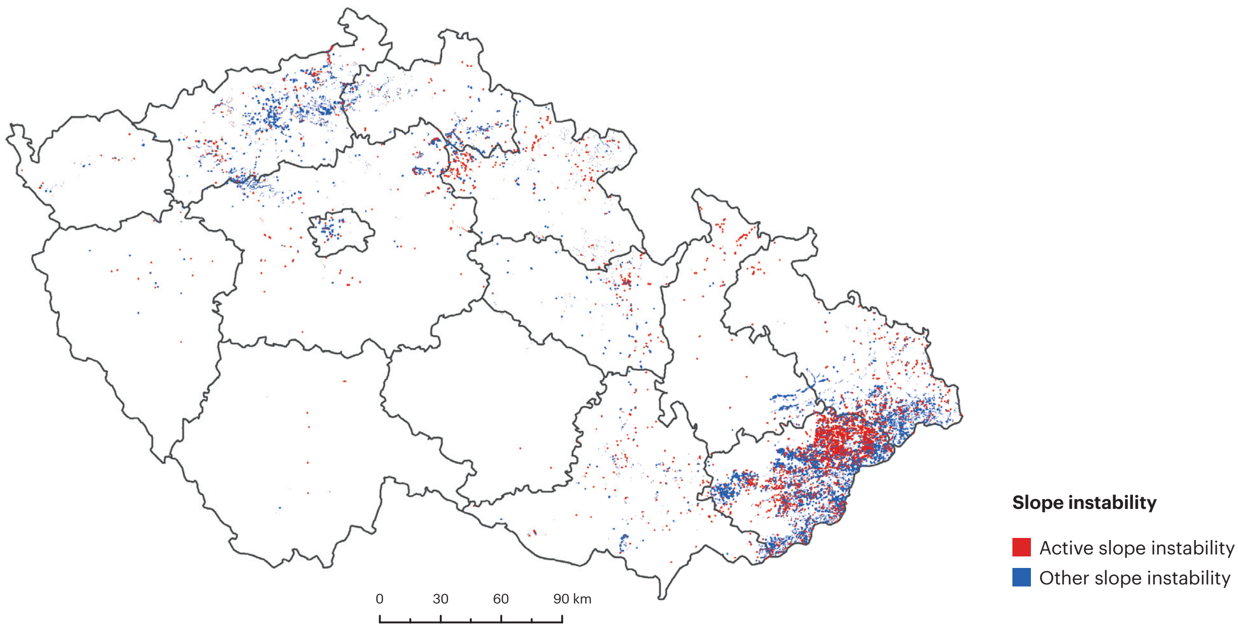


- Soil without vulnerability
- Vulnerable soil
- Slightly vulnerable soil
- Vulnerable soil
- Strongly vulnerable soil
- The most vulnerable soil
- Non-agricultural soil or not evaluated

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 is one of the degradation influences negatively impacting the soil. Under normal conditions, erosion is a natural and gradual process. The intensity of anthropogenically conditioned accelerated erosion of agricultural land, mainly due to inappropriate farming methods (e.g. large scale unification of land plots, growing monocultures, removal of landscape elements, lack of grass-covered belts or terraces, land management irrespective of the slope of the land or growing crops potentially vulnerable to erosion, e.g. maize) may be 10 to 1,000 times higher than the normal (geological) erosion and leads to sediment delivery of soil particles to the extent that the soil-forming process fails to compensate adequately by formation of new soil.

The assessment of agricultural land vulnerable to water and wind erosion and determination of the wind and erosion threat, the so-called potential erosion vulnerability of agricultural land is used, where the calculations are based on natural conditions and inherent characteristics of the soil and relief.

Water erosion is among the most significant manifestations of soil degradation. **Potentially threatened by long-term average soil loss (G)**[4] of more than 2.1 t.ha^{-1}.year^{-1} (i.e. above the lower limit of the slightly vulnerable soil) in 2015 was the total of 47.3% of the assessed area of agricultural land in the Czech Republic according to the BPEJ soil quality database (Chart 1), which represents a substantial improvement by 16.3 p.p. compared to 2014. Of which 11.4% of agricultural land was exposed to extreme water erosion (G with a value higher than 10.1 t.ha^{-1}.year^{-1}), (in 2014 it was 23.9%). On heavily eroded soils, the average reduction of the yields attains up to 75% and land prices are reduced by up to 50%. In addition to the economic damage, the loss of soil represents environmental damage, as the soil-forming process rate, compared to the loss of soil by water erosion, is very slow. The biggest problem in the long run is the loss of soil in areas of the highest quality soil (the area around Elbe and the Moravian valleys, Figure 1), where the largest proportion of land with most vulnerable soil can be found.

The **maximum admissible value of the cover and management factor (Cp)**[5] is a direct tool to assess water erosion in the Czech Republic which serves as a basis for such a framework management of land units which brings about no signs of above-limit

[4] The calculation of the long-term average soil loss (G) is based on the universal soil loss equation (USLE): G = R × K × L × S × C × 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 × K × L × S × 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.

loss of soil due to water erosion. A framework farming method preventing soil erosion on the basis of Cp calculated in 2015 (Chart 2) is recommended by the standards of **Good agricultural and environmental condition**, which ensure the management in accordance with the protection of the environment, for 46.1% of agricultural land in the Czech Republic. Protective grassing was recommended only for 0.2% of agricultural land. At 1.8% of agricultural land it is recommended to grow perennial forage crops, or protective grassing, at 4.9% belt rotation of crops or exclusion of erosion dangerous crops is recommended, at 10.3% exclusion of erosion dangerous crops and a higher representation of perennial forage crops is recommended, at 14.3% the exclusion of erosion dangerous crops and the use of soil protective technology is recommended, and at 14.7% cultivation of erosion dangerous crops is possible when using soil protective technology. Other areas of agricultural land (53.9%) do not have a limit. Cp values were used for the definition of strongly and slightly erosion vulnerable **arable land** for the needs of Good agricultural and enviromental condition standards. Erosion threat that is assessed in this way is registered in the public land registry. Soil not vulnerable to erosion accounts for 89.4% of the land in the register (Cp above 0.1), slightly vulnerable soil 10.2% (Cp 0.02–0.1) and heavily vulnerable soil 0.4% (Cp below 0.02).

In the Czech Republic in the year 2015, **wind erosion**[6] potentially threatened (soil slightly vulnerable to most vulnerable) 18.0% of the evaluated area of agricultural land (18.1% in 2014) based on BPEJ soil quality database (Figure 3, Chart 3). Of which the most vulnerable agricultural land to wind erosion was 3.2%, just like in 2014. If the current trends in land management will continue it may be assumed that in the future the danger of wind erosion will increase.

One of the most serious forms of threats to soil is soil compaction. In the Czech Republic in 2015 the degradation through compacting soil threatened to over 33% of agricultural land (land in the high risk category – 16.3%, or higher medium – 16.8%), while less than 30% of these soils is vulnerable to the so called genetic compaction (by the natural properties of the soils), and over 70% to the technology compaction (the causes of anthropogenic nature, e.g. the travels of heavy agricultural and forestry techniques). Compared to the year 2014, the situation practically did not change.

The widespread geodynamic phenomena that cause in the Czech Republic serious direct or indirect damage are **slope instabilities**, which may be of natural or anthropogenic origin. According to the mechanism and the speed of movement 4 basic groups of slope movements can be distinguished: creeping, sliding, flowing and falling. In the Czech Republic the behavior of the slopes is affected mainly by extreme rainfall situations, the type of rock, the improper structures set up and also management in the landscape. In the Czech Republic, landslides most commonly affect large areas of the Outer Western Carpathians, Bohemian Central Uplands and the area around the River Ohře (Figure 4). In 2015, the Registry of slope instabilities of the Czech Republic contained 17,787 items of slope instabilities with a total area of 66,282.9 ha. Out of which, 3.7 thous. ha consisted of active landslides, which are considered as the most significant sources of risks. Year-to-year (2014–2015) there was an increase in the number of landslides by 297, the total area by 1.9 thous. ha and the area of active landslides by 0.2 thous. ha. Temporarily calmed landslides occupy an area of 41.9 thous. ha and calmed 20.4 thous. ha. The increase in slope instabilities is related to the growing intensity of extreme weather events due to climate change.

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.

22 | Contaminated sites

Key question

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

Key messages

At present, the need for remedial actions (e.g. remediation) in the contaminated sites is evaluated on the basis of an elaborated risk analysis, according to the respective methodical guideline of the Ministry of the Environment No. 1/2011[7]. Remedial actions recorded in Evidence System of Contaminated Sites[8] over the period 2010–2015 include finalized remediation of 272 contaminated sites, 51 other remedial actions were completed in an unsatisfactory condition. From Operational Programme Environment, which is in this field a major source of support, financing was approved for 23 projects in the year 2015 for the implementation of the investigation work and risk analysis, whereas the total costs represented CZK 717.6 mil.

The Evidence System of Contaminated Sites database of contaminated sites or, more precisely of old environmental burdens has not been maintained by systematic inventory of data, but is updated by incrementally adding sites, because the subject of contaminated sites remediation is not regulated by any law and there is no unified approach in this area. For this reason, 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. The Evidence System of Contaminated Sites database currently contains 4,746 sites, of which 2,295 sites are up-to-date. In the land use planning analytical materials used for regional planning 9,242 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	Change since 2000	Last year-to-year change
N/A	positive	positive

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

[8] *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, Ministry of the Environment, Operational Programme Environment, and also information on the removal of the contaminated sites resulting from Soviet army residence on 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.*

References to current conceptual, strategic and legislative documents

State Environmental Policy of the Czech Republic 2012–2020
- limiting and controlling contamination and other degradation of soil and rocks caused by human activities
- remediation of contaminated areas, including old environmental burdens and sites with ordnance exposure

Operational Programme Environment 2014–2020
- finalize the inventory of old environmental burdens (the target value for the year 2023 is 10 thous. of registered contaminated sites)
- on the basis of risk analysis results implement remediation of the most seriously contaminated sites (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)

National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants (POPs)
- removal of old environmental burdens in contaminated POPs

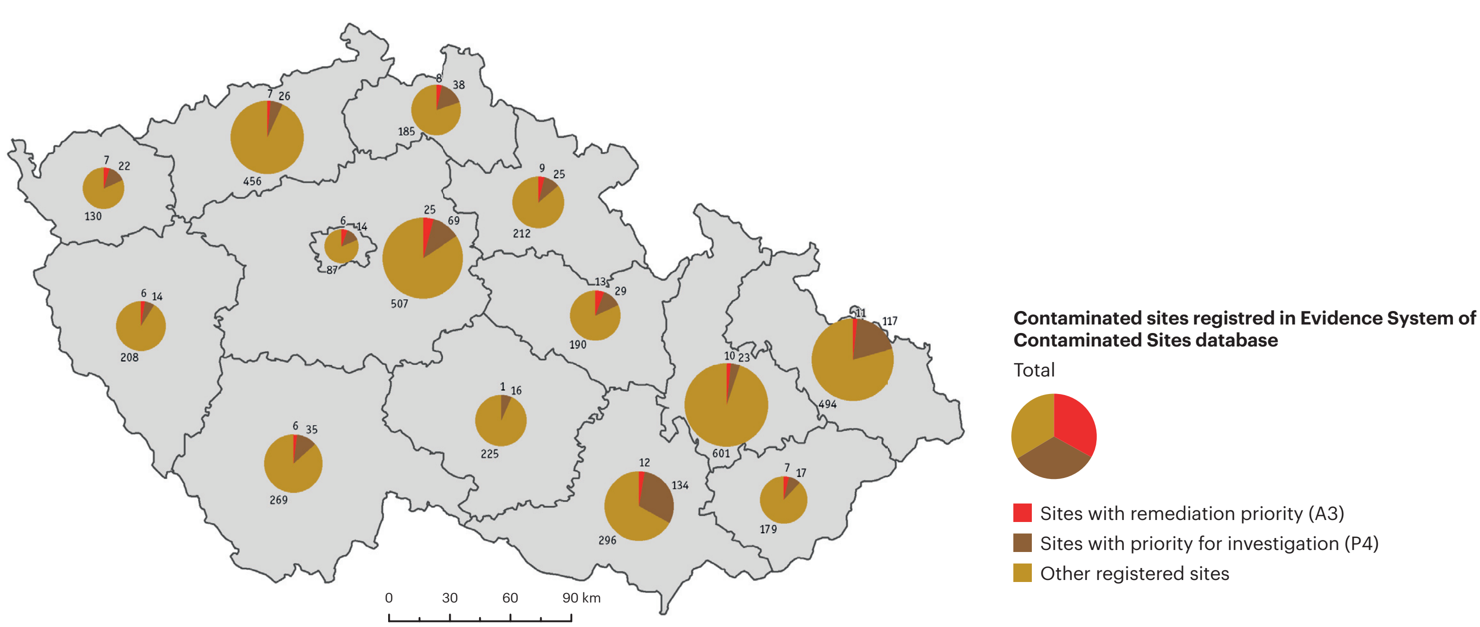
Impacts on human health and ecosystems

Contaminated sites pose environmental risks of pollution to surface water and groundwater sources, soil and rock environment, building structures or air. Groundwater contamination represents a threat especially if the groundwater is used for drinking purposes. As a result of contamination of the rock environment or building structures human health might be threatened by hazardous toxic or carcinogenic substances. Remediation of the contaminated sites thus contributes 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.

Indicator assessment

Figure 1

Number of contaminated sites registered in Evidence System of Contaminated Sites in the Czech Republic, 2015

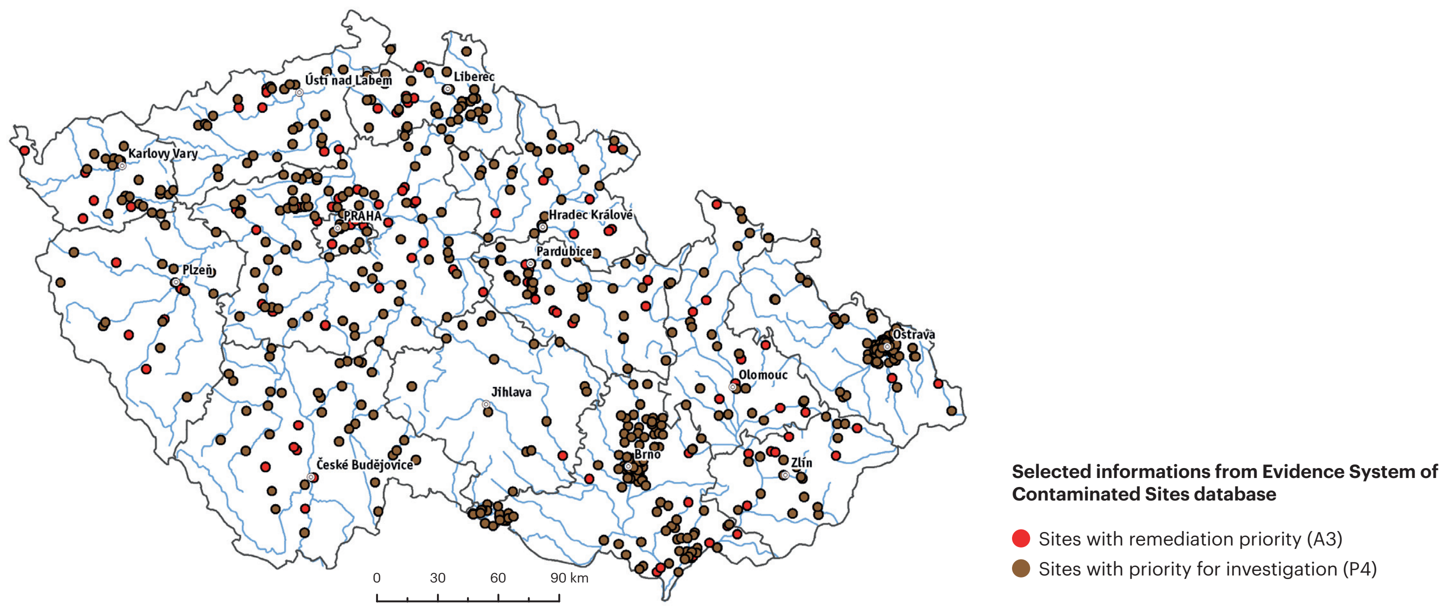


Sites with remediation priority (A3) and priority for investigation (P4) have been determined according to the valid Methodological Guideline of the Ministry of the Environment No. 1/2011.

Source: Ministry of the Environment

Figure 2

Locations of contaminated sites with priority for investigation and for remediation registered in Evidence System of Contaminates Sites in the Czech Republic, 2015

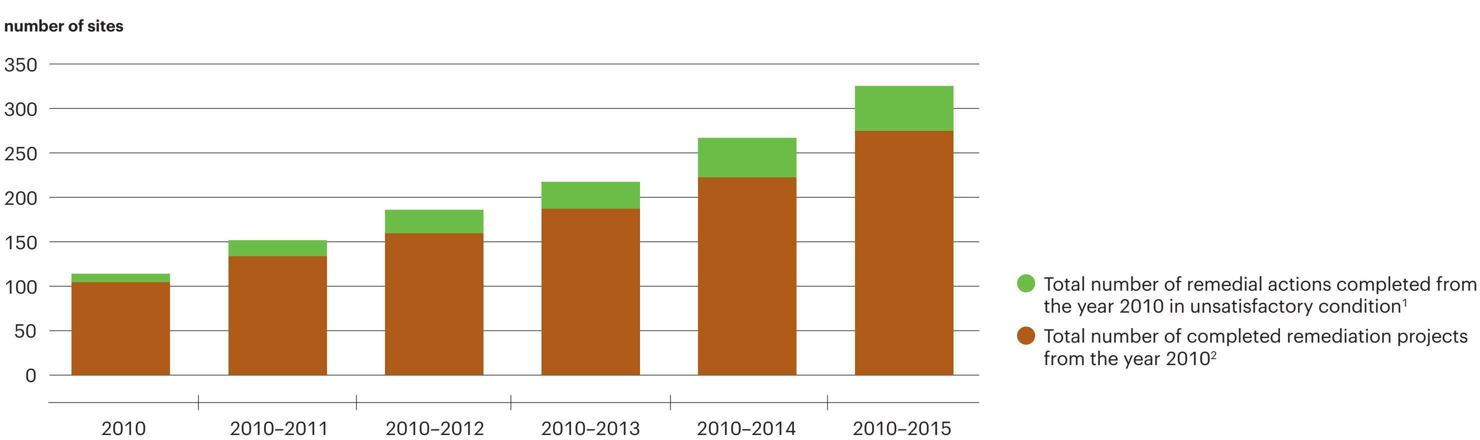


Sites with remediation priority (A3) and priority for investigation (P4) have been determined according to the valid Methodological Guideline of the Ministry of the Environment No. 1/2011.

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 2010–2015



[1] Remediation was terminated for other reasons (e.g. lack of financial resources, unanticipated extent of contamination, newly identified circumstances, etc.).
[2] Remediation may be registered as completed also when post-remediation monitoring continues.

Source: Ministry of the Environment

Contaminated sites (old environmental burdens) represent serious contamination of the rock environment, groundwater and surface water, soil or building structures and threated human health and the environment. The continuing extensive occurrence of contaminated sites in the Czech Republic is one of the remnants of many years of governance of undemocratic regimes, when environmental protection and the use of harmful substances in industrial and other production were at low level.

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.

Since 2005 there has been in the Czech Republic an incremental **database of the existing contaminated sites Evidence System of Contaminated Sites** (formerly Evidence System of Old Environmental Burdens established in 1996), which is publicly accessible. The Evidence System of Contaminated Sites database has not been maintained by systematic inventory of data, but is updated by incrementally adding sites, because the subject of contaminated sites remediation is not regulated by any law and there is no unified approach in this subject. For this reason, 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. The pilot survey on 10% of the territory of the Czech Republic has registered nearly 1,000 sites, using new methodologies, of which one 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[9], used for regional planning, 9,242 sites are registered, including those, which are registered in the Evidence System of Contaminated Sites. The Evidence System of Contaminated Sites database in the year 2015 contained 4,746 sites, of which 2,295 (48% of sites) are sites with up-to-date records and the remaining 2,451 sites in the Evidence System of Contaminated Sites database have not yet been updated. Most of the contaminated sites registered in the Evidence System of Contaminated Sites are located in the Olomouc region, Moravian-Silesian and Central Bohemian regions. These are mostly former industrial facilities, landfills, fuel stations, etc. (Figure 1 and 2).

At present, the need for remedial actions (e.g. remediation) is evaluated on the basis of an elaborated risk analysis, according to the methodical guideline of the Ministry of the Environment No. 1/2011 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 fund contaminated sites incurred before privatisation of the former state enterprises, where the state assumed the liabilities in the 2nd privatisation wave associated from their existence. 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 this framework 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. Within the 1st call for support area 3.4, respectively the 7th call of Operational Programme Environment 2014–2020 (September–November 2015), there were 23 projects for the realisation of investigation work and risk analysis approved for financing, with total costs of CZK 717.6 mil. and the financial requirement for the provision of subsidy from the Cohesion Fund was CZK 610.0 mil. To compare, within the 10th call for support area 4.2, respectively the 58th call of Operational Programme Environment 2014–2020 (February–May 2014), there were 12 projects for the realization of investigation work and risk analysis approved for financing, with total costs of CZK 23.1 mil. and the financial requirement for the provision of subsidy from the Cohesion Fund was CZK 17.5 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 2010–2015 remediation of 272 contaminated sites was completed, and another 51 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 2015 remediation was completed on 52 sites and 6 other remedial

[9] *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 No. 1 of the Decree No. 500/2006 Coll., on planning analytical materials, 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.*

[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 cases of contaminated sites, the buyer became the successor of the originator of contamination.*

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 (on 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.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

Soil and landscape in the global context

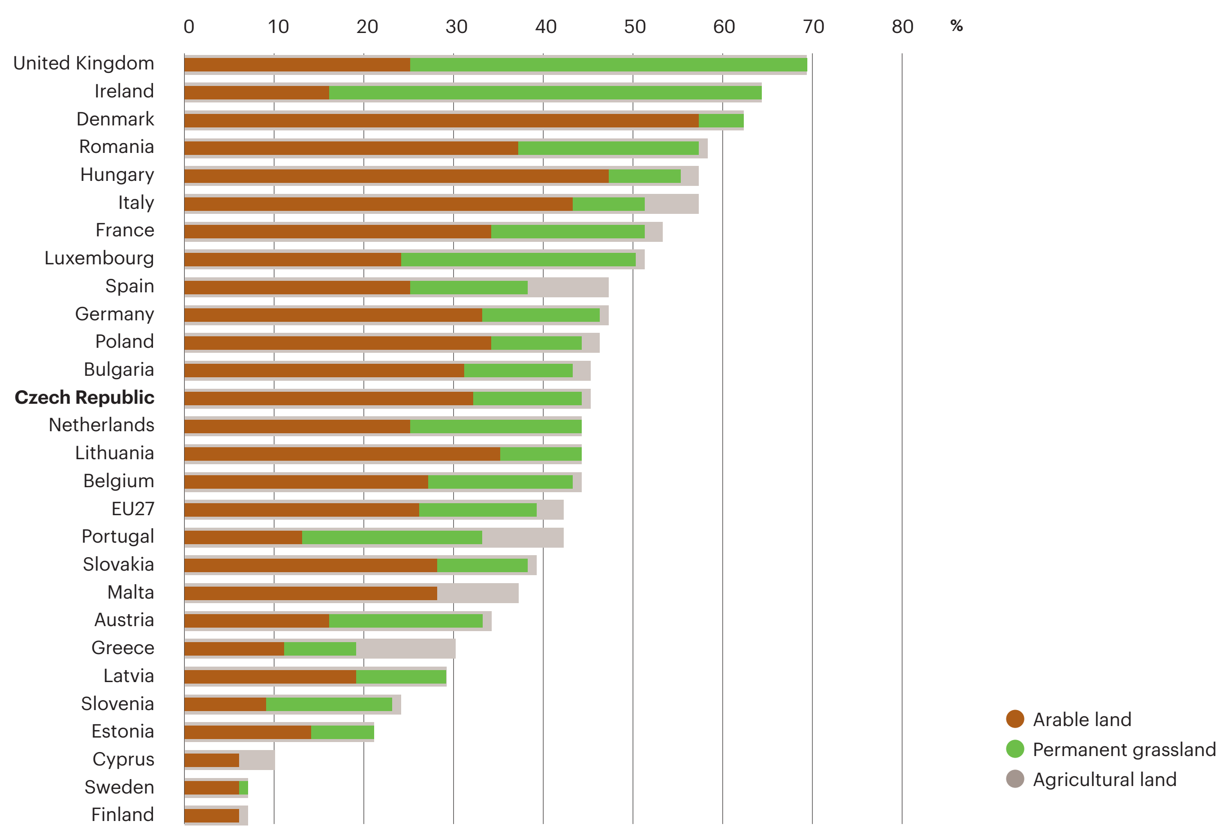
Key messages

- In the context of the EU28 countries, the Czech Republic has a higher than average proportion of arable land in the total area (31.8%), and thus also a high potential for environmental pressures, particularly those concerning water quality, arising from agricultural activities.
- The Czech Republic belongs among the most fragmented European countries.
- According to the latest available model data, approximately 130 mil. ha of the area of EU is threatened by water erosion. Of these, the most vulnerable are the areas exposed to the soil loss exceeding 10 $t.ha^{-1}.year^{-1}$. Wind erosion, which is estimated to threaten approximately 42 mil. ha of land, also represents a serious problem. Although in the European context, the Czech Republic does not rank among the states most threatened by erosion, it also has areas that are heavily threatened by erosion.
- Contaminated sites represent a major problem for the quality of soils and waters in many European countries. In 2011, 2.5 mil. of potentially contaminated sites were estimated to exist in selected European countries, of which 1.1 mil., i.e. 45% of the sites were identified to date. Of these identified sites then there was 30% (342 thous.) with the need for remediation and 15% of them (51 thous.) were already remediated. The average national expenditure for the management of contaminated sites in 2011 amounted to 10.7 EUR per capita.

Indicator assessment

Chart 1

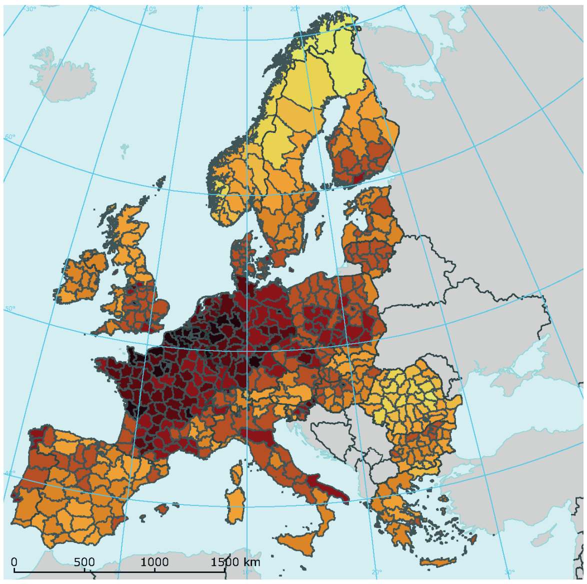
Proportion of agricultural land, arable land and permanent grassland in the total territory [%], 2013



Source: Eurostat

Figure 1

Landscape fragmentation by NUTS regions, 2009



Landscape fragmentation per NUTS region

Number of meshes per 1,000 km²

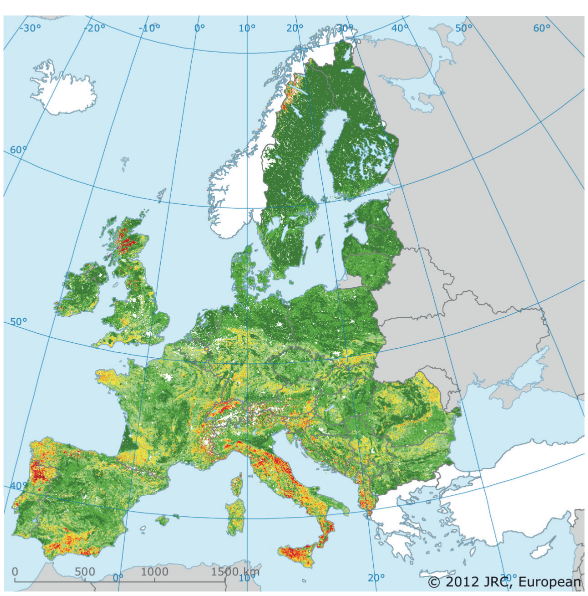
- < 0.10
- 0.11–0.25
- 0.26–0.50
- 0.51–1.00
- 1.01–5.00
- 5.01–10.00
- 10.01–25.00
- 25.01–50.00
- 50.01–100.00
- > 100
- Outside data coverage

The "Effective meshdensity" method is based on the number of meshes per 1,000 km². The smaller the size 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.

Source: European Environment Agency

Figure 2

Soil erosion by water determined according to the RUSLE model [t.ha^{-1}.year^{-1}], 2006



Soil erosion by water

- < 0.5
- 0.5–2
- 2–5
- 5–10
- 10–20
- 20–50
- > 50
- Poor data coverage
- Outside data coverage

Soil erosion by water is determined by a calculation according to the RUSLE model (Revised Universal Soil Loss Equation). The current model includes the slope length (L) and steepness (S) factor, the cover-management factor (C), the stoniness correction factor (St), 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.

Source: Joint Research Centre, European Environment Agency

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 proportion of artificial surfaces (built-up territories, roads, etc.) at the total area of the territory in the EU28 is the highest in the Benelux countries (approx. 12–14%), water areas occupy the largest share of the total territory in the Netherlands (10.6%) and in Finland and Sweden (9.7%, resp. 8.5%).

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.

Approximately 130 mil. ha of land in the EU is threatened by **water erosion** according to the latest available model data (Figure 2). The most vulnerable soils are exposed to loss exceeding 10 $t.ha^{-1}.year^{-1}$ (especially in the southern and southeastern Europe, Switzerland and Scotland). 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, of which 1 mil. ha of land is seriously threatened. 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 threatended 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**[11] were estimated to exist in selected European countries. These sites, where inappropriate manipulation with hazardous substances occurred in the past, pose the risk of soil contamination or groundwater or surface water contamination. Of these, 45% (1.13 mil. sites) were identified to date[12], of which 30% (342 thous.) were identified as in need of remediation and 15% (51 thous.) have already been remediated. Mining, metal-working industry and petrol stations (from the sector of services) represent the most frequent source of contamination in European countries. The main contaminants are mineral oils and heavy metals. The average national expenditure of selected European countries for the management of contaminated sites in 2011 amounted to 10.7 EUR per capita, which represents an average of 0.04% of the 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. The underlying data are not complete for all states and in selected cases set definitions and interpretations for the identification of sites differ. Most European countries have adopted national, or where appropriate, regional legislation governing the exploration and redevelopment activities in contaminated sites, but so far no European framework strategy has been created.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

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

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

6

Agriculture

23 | Consumption of fertilisers and plant protection products

Key question

Is the amount of agrochemicals used in agriculture reducing?

Key messages

In the year 2015, the consumption of plant protection products decreased year-to-year by 3.3%. There is a rising consumption of lime substances that enhance the production capability of the soil, which increased by 7.1% year-to-year, due to the reduction of high acidity of agricultural land.

The period of 2000–2015 has seen a 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 increase in 16.8% of pure nutrients. The consumption of manure fertilisers in the period between the years 2004–2013 stagnated, and from 2014 it began to grow again. Year-to-year, their consumption increased by 4.9%.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

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)

3rd Action program of the Nitrates Directive for the period 2012–2016
- a set of mandatory measures to be met farmers in vulnerable areas

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

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

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

Act No. 254/2001 Coll. on waters and on changes of some Acts
- implementation of the Nitrate Directive into national legislation

Government Regulation No. 262/2012 Coll., on designation of vulnerable zones and action program, and its amendment No. 117/2014 Coll.
- the designation of vulnerable zones and establishing an action program for these areas
- the determination of the resulting Good agricultural practice

National Emission Reduction Programme of the Czech Republic
- the reduction of ammonia emissions from mineral fertilisers

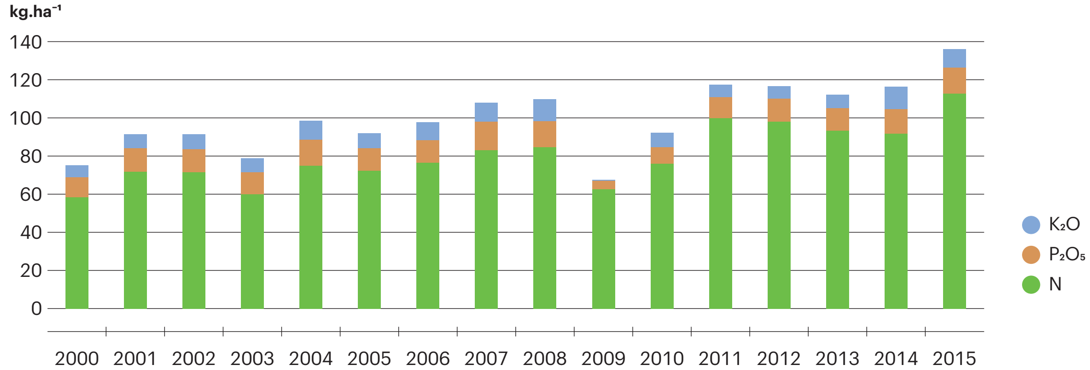
Impacts on human health and ecosystems

Mineral fertilisers and plant protection products increase yields in agricultural production, however, have a negative effect on the quality of the soil and contribute to the pollution of groundwater and surface water. As a result, there is a pollution of surface drinking water sources from agricultural activities (water flows and tank) and anthropogenic eutrophication of water reservoirs. Intensive agricultural activity and the application of fertilisers affect soil micro-organisms on the decline in biodiversity and the decline in abundance of species of birds. Agricultural chemicals get through the food chain are also into food.

Indicator assessment

Chart 1

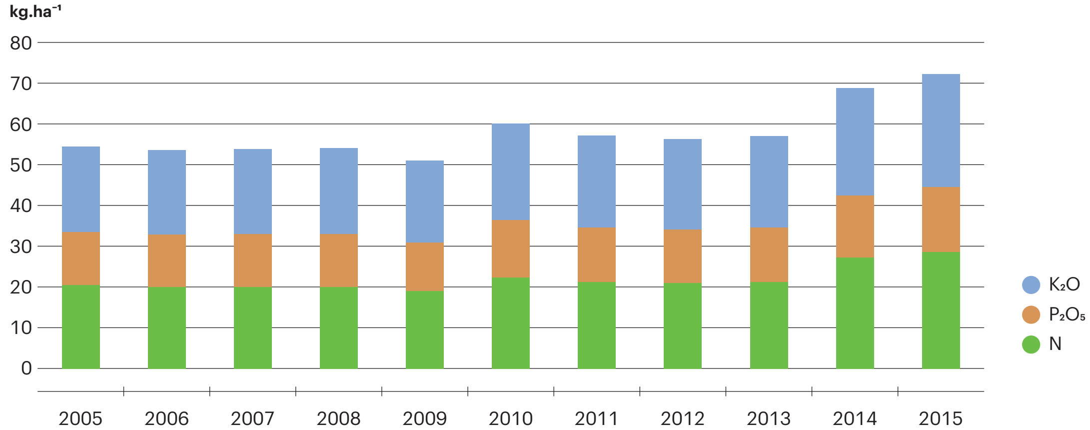
Development of the consumption of mineral fertilisers in the Czech Republic [kg of net nutrients.ha^{-1}], 2000–2015



Source: Ministry of Agriculture

Chart 2

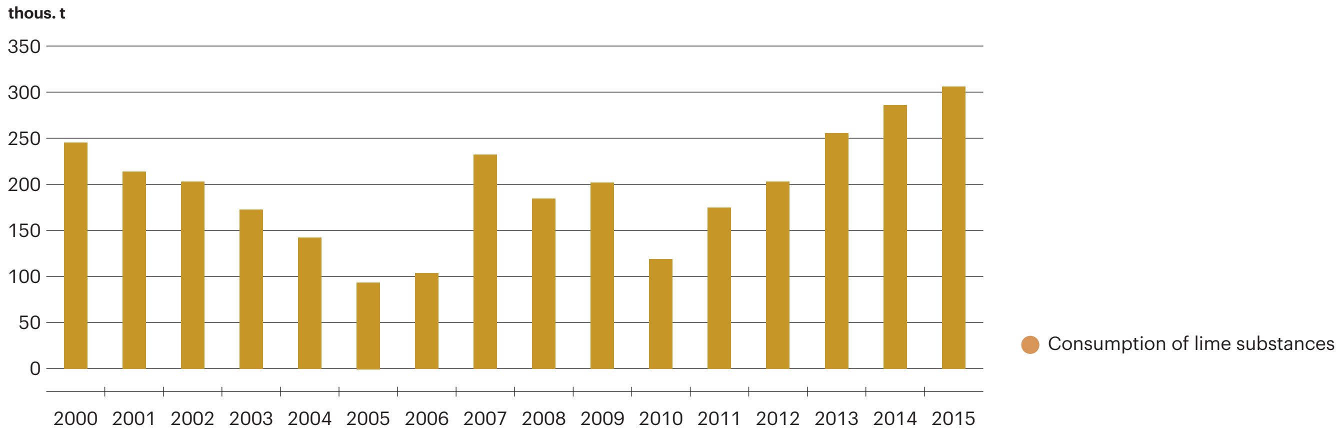
Development of the consumption of manure and organic fertilisers in the Czech Republic [kg of net nutrients.ha^{-1}], 2005–2015



Source: Ministry of Agriculture

Chart 3

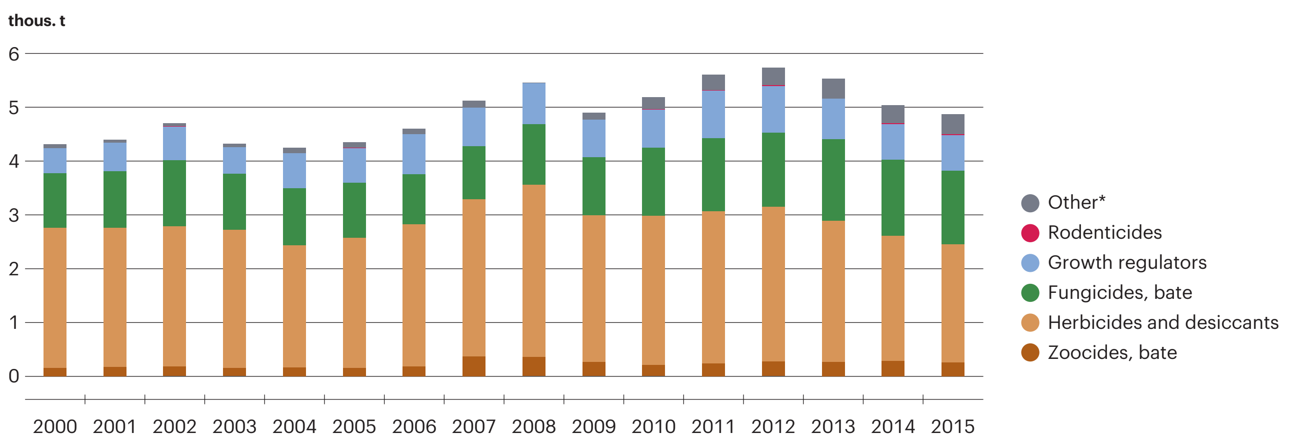
Development of the consumption of lime substances in the Czech Republic [thous. t], 2000–2015



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], 2000–2015



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

Source: Ministry of Agriculture

The period from 2000 has seen a 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. The application of mineral fertilisers in 2015 slightly increased year-to-year by 16.8% to 137.1 $kg.ha^{-1}$ of pure nutrients, reaching the highest values in the reporting period since 2000 (Chart 1). The consumption of nitrogen fertilisers has significantly increased since 2014, by 22.7%. Phosphatic fertilisers consumption increased by 6.4%, conversely consumption of potassium fertilisers decreased (by 8.9%). The increase in consumption was caused by the effort to minimise the damage of extreme drought in 2015. 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. Regarding the composition of mineral fertilisers, nitrogen fertilisers clearly dominate and represent more than 82.9% of total consumption.

The consumption of organic fertilisers after the previous decline caused by the decline of livestock production, stagnated in the period between 2004 to 2013 and since 2014 begun to grow again (Chart 2). In the year 2015, **manure fertilisers** (excluding the harvestable crop residues, e.g. treated straw) and **organic fertilisers** delivered 28.6 kg of N, 15.9 kg of P_2O_5 and 27.6 kg of K_2O per hectare of agricultural land (related to agricultural land 3,493,717 hectares). Total intake of pure nutrients from manure and organic fertilisers was 72.1 $kg.ha^{-1}$. The supply of nutrients in the manure fertilisers of animal origin represents nutrients in the excrements of livestock, excluding the nutrients from litter, after deduction of losses in the stables and storage of livestock manure. In the year 2015 this statistic included, just like in 2014, input of nutrients from digestate, which is produced by agricultural biogas stations in the Czech Republic in the amount exceeding 8 mil. t per year. Part of the manure fertilisers is supplied as the input raw material. Nutrients from manure fertilisers (solid and liquid manure) make up an estimated half of the nutrients in the resulting digestate. 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. Since 2010, there is a growing trend of liming, which was confirmed also in 2015 by the annual growth in consumption of lime substances by 7.1% to 303 thous. t (Chart 3). In the Czech Republic, the average value of soil reaction of agricultural land over the period 2010–2015 was 6.1 pH (i.e. slightly acidic). 31.7% 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 40.4% of agricultural land has a slightly acidic soil reaction, nearly 72.0% of agricultural land would require the application of lime substances. The proportion of alkaline soil (pH above 7.2) amounted to 11.2% of the agricultural land.

The consumption of plant protection products, as another input of anthropogenic substances into the soil, has been declining since 2012. It is influenced by the current incidence of diseases and pests in the given year, which varies according to the weather conditions throughout the year. The consumption of plant protection products in 2015 dropped year-to-year by 3.3% to 4,856.3 thous. kg of active ingredients (Chart 4). The largest proportion of the total consumption were herbicides and desiccants (45.2%), followed by fungicides and wood stains (28.0%) and growth regulators (13.6%).

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

For selected hazardous substances, in the long-term, limits values in soil are exceeded, mainly in for the high risk and potentially carcinogenic polycyclic aromatic hydrocarbons chrysene and fluoranthene. A high degree of persistence in soil is exhibited by a group of persistent chlorinated pesticides – especially DDT and DDE, in 2015 the limit exceedance was detected in the total of 40.0% of the samples tested for DDT.
According to the results of hazardous element content in soil monitoring (after extraction with aqua regia), the most problematic in the period of 1998–2015 were the concentrations of arsenic with 3.9% of over limit samples, followed by cadmium (3.0%), chromium (1.6%) and nickel (1.3%).
In the case of reservoir and river sediments in 2015, there were, overall, 27% of samples exceeding the limit values of PAHs and the limit values were not met even by a high percentage of samples for DDT.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

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

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

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 ha 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

Government Regulation No. 75/2015 Coll., on conditions for the implementation of agri-environment-climate measures and amending Government Decree No. 79/2007 Coll., on conditions for the implementation of agri-environment measures, as amended

- the maximum limit values of the content of monitored heavy metals, which can be detected in a soil sample

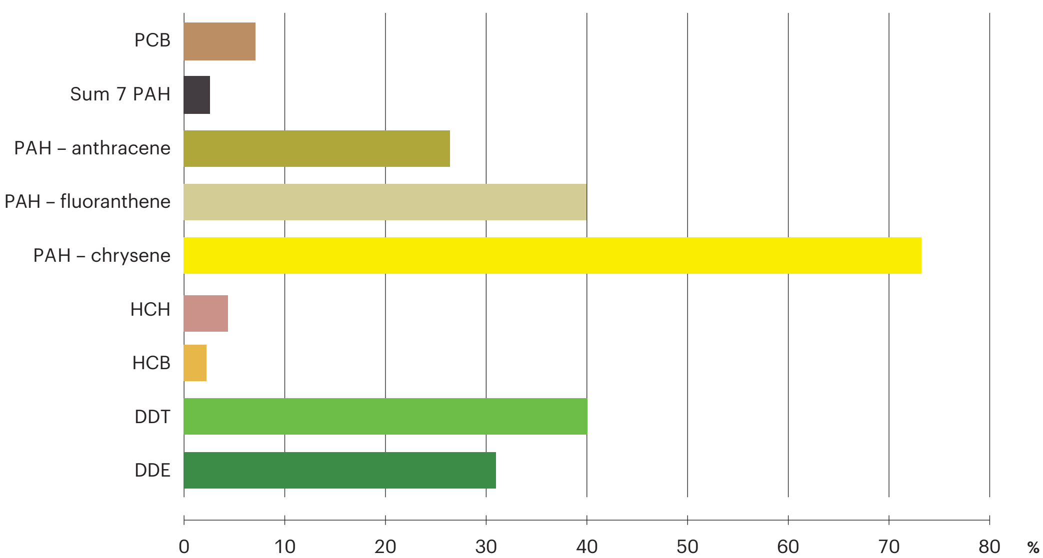
Impacts on human health and ecosystems

The quality of agricultural land depends on natural conditions and on anthropogenic inputs into the soil (mineral fertilisers and plant protection products), that affect the contents of the accessible nutrients, and thus the utilisation of land for agricultural production. Among other important inputs into the agricultural land there are the risk elements (Cd, Pb, Zn, etc.) and risk substances (eg. DDT, PAHs), which may come not only from agricultural activities, but also for example from industrial production. A number of substances bind to soil particles and may thus accumulate in the soil for a very long time. Land degradation may occur also by local contamination from the chemical incident or leakages of contaminated water, by discharge of waste directly into the soil, leaching from contaminated sites, landfills, etc. The risk elements and the risk substances significantly limit the use of sediments from watercourses, ponds and water tanks as well as sludge from waste water treatment plants to be used for the application on agricultural land. Agricultural chemicals get through the food chain to food, and subsequently are deposited in tissues, particularly in fatty tissues. Acute disposition of DDT and PAHs affects primarily the nervous system, interfering with the metabolism, adversely affecting the reproductive system and having a carcinogenic effect.

Indicator assessment

Chart 1

Proportion of samples exceeding limit values of risk substances in soil in the Czech Republic [%], 2015

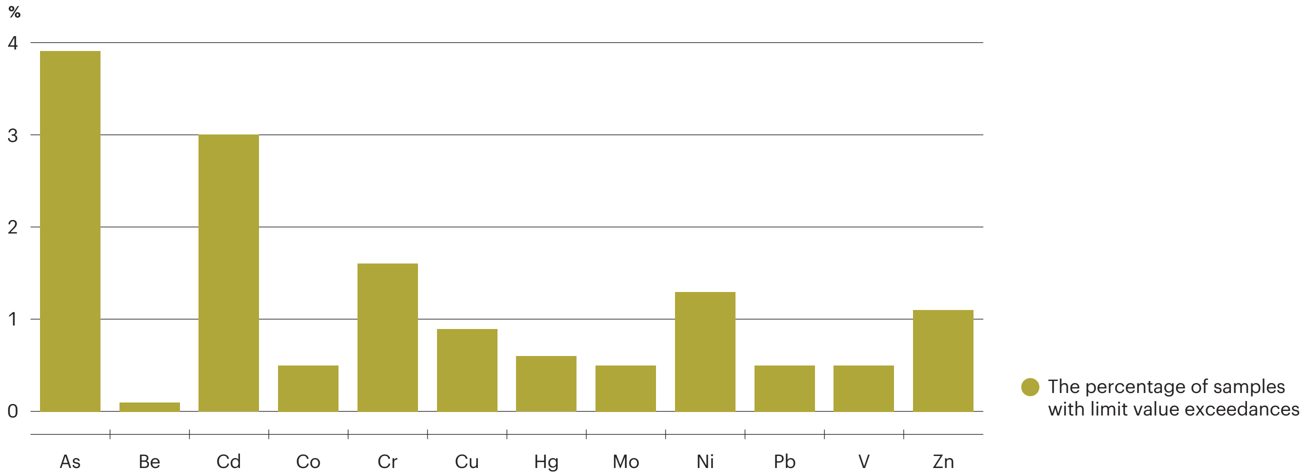


Results of Basal soil monitoring. Evaluated on the basis of samples from selected 40 monitoring plots and 5 areas in protected areas (The Krkonoše Mountains National Park, Kokořínsko, Pálava, Bílé Karpaty, Orlické Mountains). The limit values for the specified risk substances are established by the Decree No. 13/1994 Coll.

Source: Central Institute for Supervising and Testing in Agriculture

Chart 2

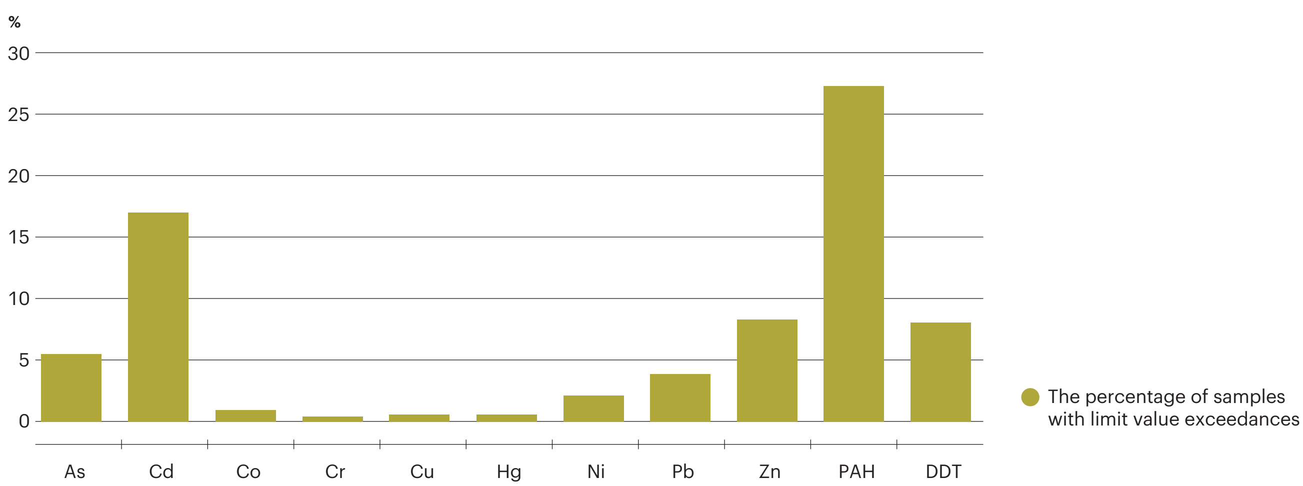
Percentage of soil samples exceeding the limit values for the content of the soil elements after extraction with aqua regia in the Czech Republic [%], 1998–2015



Source: Central Institute for Supervising and Testing in Agriculture

Chart 3

Percentage of reservoir and river sediment samples exceeding the limit values in the Czech Republic [%], 1995–2015



(AOX, PCB: 1995–2015; PAH: 2009–2014; DDT: 2007–2015)

Source: Central Institute for Supervising and Testing in Agriculture

The quality of agricultural land and its production capabilities are adversely affected in the Czech Republic, in particular by the content of the risk elements, which get into soil and sediment particularly by a transfer from economic activity of humans. Input of hazardous substances, particularly heavy metals contained in mineral fertilisers (potentially sludge and sediments) or in plant protection products is in the Czech Republic insignificant, because the use of these potentially hazardous substances in the agricultural sector in the Czech Republic is governed by regulatory limits.

In the context of **monitoring the content of the risk elements and substances in soil** (Basal soil monitoring)[1] both inorganic pollutants, respectively heavy metals are tracked in sediments on agricultural land (e.g. As, Cd, Ni, Pb, Zn, etc.) as well as persistent organic pollutants (in particular the 16 polycyclic aromatic hydrocarbons (16 EPA PAHs), polychlorinated biphenyls (7 PCB congeners) and organochlorine pesticides (HCB, HCH, DDT group)). The presence of hazardous elements

[1] *Basal soil monitoring is performed either annually by sampling of plants in order to determine the levels of hazardous elements and substances in crops and by sampling of soil (40 selected plots and five plots in protected areas) focused on the monitoring of selected persistent organic pollutants (POPs) and/or in six-year cycles on all monitoring plots. The last evaluated six-year cycle took place in 2007; analyses of samples collected in 2013 were completed in 2014 and data are currently undergoing processing.*

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 monitoring of **persistent organic pollutants**, which are toxicologically high risk and potentially carcinogenic, taking place in 2015 (Chart 1), shows in particular the long-term excessive content of polycyclic aromatic hydrocarbons (PAHs), chrysene and fluoranthene, and also in case of anthracene is evident increase in the number of over limit samples compared to 2014. Their source is in particular the incomplete combustion of carbon (fossil) fuels. Overall, generally, the median value for the sum of 16 EPA PAHs in the topsoil of arable land in 2015 is one of the lowest values in the monitoring period 2004–2015. The other problematic organic pollutants are from the persistent chlorinated pesticides (OCP) group, which includes dichlorodiphenyltrichloroethane (DDT) and organochlorides resulting therefrom (DDD and DDE in particular). In the Czech Republic, the use of preparations based on DDT is prohibited since 1974, but these substances are characterized by high persistence in soil and thus cause its long-term contamination, with proven carcinogenic impact on humans. Even though after an increase in DDT contents in arable land in 2013, in 2014 there was a decrease compared to the value of the previous years. This condition persists even in 2015, when the limit has been exceeded for DDT for the total of 40.0% of samples (18 of 45 samples). The limit value for the content of PCB (sum of 7 congeners) in the soil was exceeded in 2015 in three out of 45 soil samples, in the areas of arable land in close proximity to industrial zones, just like in 2014.

According to the results of **hazardous element content in soil** monitoring, after extraction with aqua regia (Chart 2), over long-term (between 1998–2015), the most problematic was the concentration of arsenic with 3.9% over limit samples for all soils (i.e. for light, medium and heavy soils), as well cadmium (3.0%), chromium (1.6%) and nickel (1.3%). Still, the agricultural land in the Czech Republic, in terms of heavy metal content, in most cases, is not dangerous for the food chain. According to the monitoring of **hazardous substances in plants** in 2014[2], risk can be identified as low, because in only five samples of agricultural crops for food use (from a total of 85 plant samples), excessive concentration of cadmium was detected.

The danger of hazardous elements and substances consist also in their easy transport to other environments and bioaccumulation (accumulation in living organisms). This is confirmed by the results of monitoring of reservoir and river sediments and sampling and analysis of plants grown on agricultural land. Regarding **reservoir and river sediments**[3] (Chart 3), in the period 1995–2015, the largest percentage of samples (total 27%) exceeding the limit values, was recorded again for PAHs (50.0% of samples of sediments from village ponds and watercourses). 23.1% of village pond sediments samples tested for DDT did not comply with the limit values. Concerning hazardous substances, the most frequent contaminant is cadmium (total of 16.8% of the samples, village pond sediments 20.7% of samples) and zinc (8.2% of samples).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

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

[3] Sediments from rivers and ponds are formed by deposition of eroded solid particles. The average values of the parameters are monitored by the Central Institute for Supervising and Testing in Agriculture in watercourses and in field, village, and forest ponds.

25 | Organic farming

Key question

Is the proportion of agricultural land under organic farming increasing?

Key messages

In 2015, 11.8% of the total area of agricultural land resources was cultivated in accordance with the principles of organic farming. After a decline in the number of organic farms between 2012 and 2014, there was a growth of organic farming again in 2015. Since 2005 the area of agricultural land farmed organically increased almost twice as much – from 255.0 thous. ha in 2005 to 496.7 thous. ha in 2015. The number of organic farms in the same period increased almost 5 times, from 829 to 4,096 farms. In 2015, there was a slight increase in the acreage of arable land at the expense of acreage of permanent grassland and permanent crops in organic farming.

The organic food market is developing, the number of organic food producers is increasing, as well as the total consumption of organic food. Despite the fact that this market is still underdeveloped, the average annual consumption of organic food per capita remains below CZK 200.

After the growth of the proportion of organically farmed land after the year 2000 and fulfilment of the objectives in the years 2005 and 2010, the development has slowed and the target 15% share in 2015 has not been fulfilled, ecologically farmed land took only 11.8% of agricultural land resources (ALR).

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

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

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

Action Plan of the Czech Republic for the Development of Organic Farming in the years 2011–2015
- achieving 15% proportion of organic farming out of the total area of agricultural land in the Czech Republic by the year 2015
- achieving at least 20% proportion of arable land organically farmed out of the total land area by the year 2015
- achieving 3% proportion of organic food in total food consumption by the year 2015
- increasing the proportion of Czech organic food in the domestic market for organic food to 60% by the year 2015
- increasing the consumption of organic food annually by at least 20% by 2015

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

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

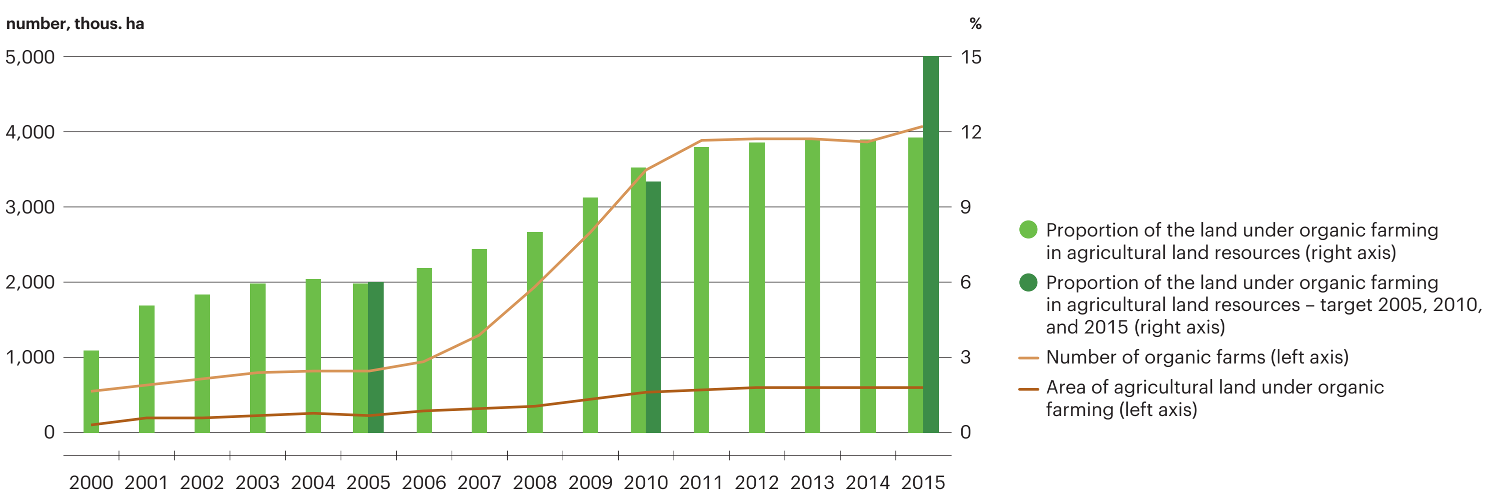
Impacts on human health and ecosystems

The organic farming is characterised particularly by not burdening the soil by mineral fertilisers 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 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.

Indicator assessment

Chart 1

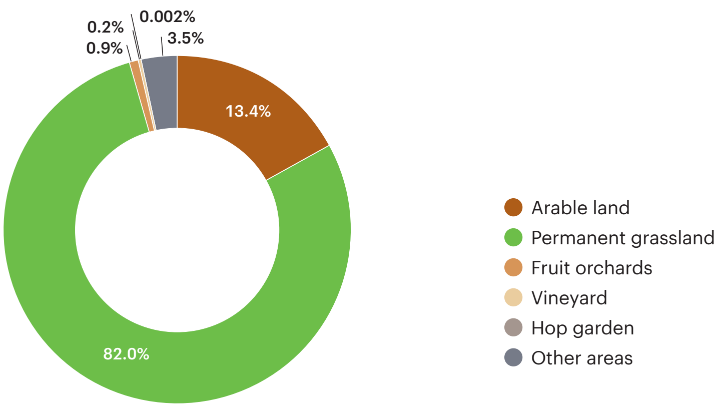
Development of organic farming in the Czech Republic [number, thous. ha, %], 2000–2015



Source: Ministry of Agriculture

Chart 2

Structure of agricultural land resources in organic farming in the Czech Republic [%], 2015

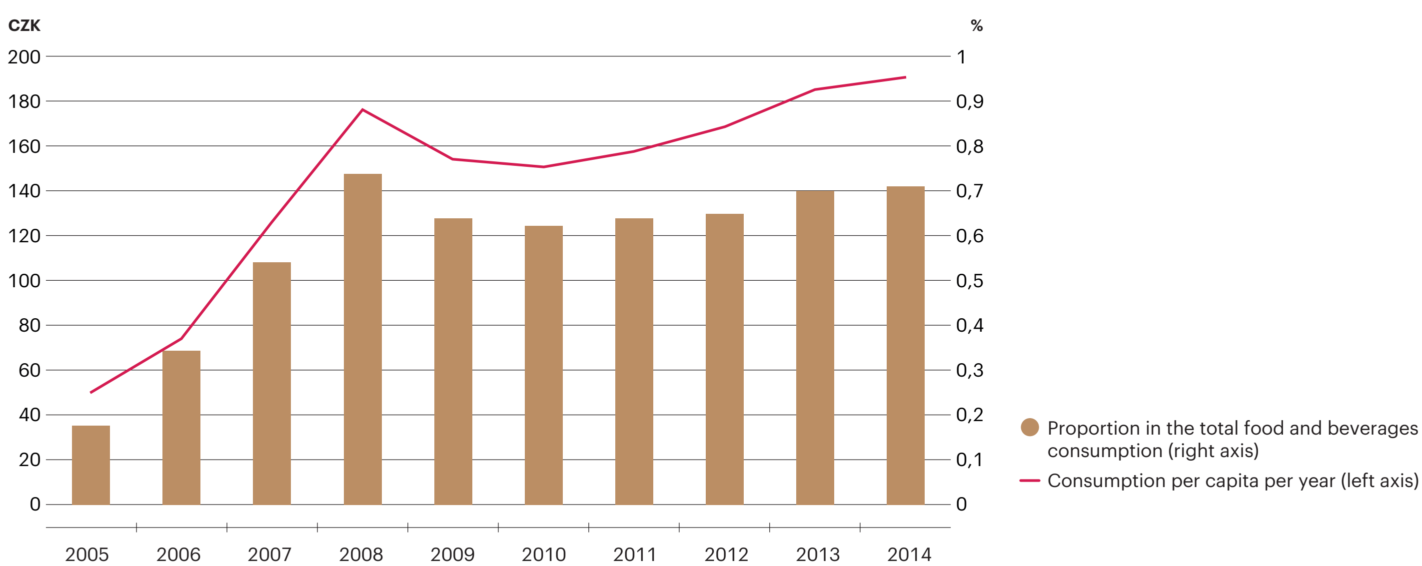


The category of Other areas include the area of fast-growing tree species, nursery, forested land, other culture and other permanent culture (landscape formation kits).

Source: Ministry of Agriculture

Chart 3

Consumption of organic food in the Czech Republic [CZK, % of the total food and beverages consumption], 2005–2014

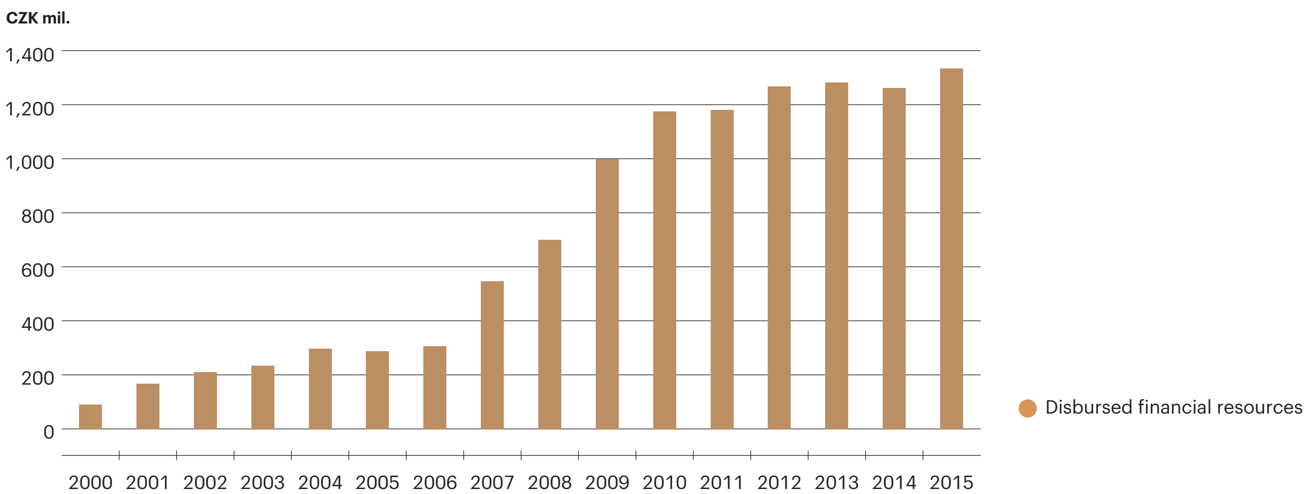


Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

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

Chart 4

Financial resources disbursed within the "Organic Farming" agro-environmental measure [CZK mil.], 2000–2015



Source: Ministry of Agriculture

The importance of organic farming in the Czech Republic has been growing steadily since the late 1990s, mainly thanks to the European and national support and growing public interest in organic food. Since the year 2000, the Czech Republic increased the **area of agricultural land under organic farming** by approximately three times – from 165.7 thous. ha to 496.7 thous. ha and during the past 10 years, by almost two times. Thus in the year 2015, approximately 11.8% of the total area of agricultural land resources was under organic farming, that is by 0.1% more than in 2014 (Chart 1). Since the year 2000, **the number of organic farms**, working in accordance with the established principles of organic farming, increased by nearly 7 times from 563 to 4,096 organic farms in 2015. During the past 10 years, the number of organic farms increased almost 5 times (Chart 1). The former remarkable growth rates of both area of agricultural land under organic farming and the number of organic farms between 2011 and 2015 were replaced by stagnation with only minimum year-to-year fluctuations. While in the years 2005 and 2010 it was succeeded in the fulfilment of the targets the share of land under organic farming on the total agricultural land resources, targets for 2015 (proportion of 15%) were far from being achieved, as this share only amounted to 11.8%.

Regarding the **utilization structure of land resources in organic farming** in the Czech Republic (Chart 2), the largest proportion on the land under organic farming is permanent grassland, which in the year 2015 accounted for 82.0% (407.4 thous. ha). The proportion of permanent grassland reached the maximum in 2003 (90.1%), then did not change significantly, although the hectare area of permanent grassland grew from 231.7 thous. ha in 2003 to 407.4 thous. ha in 2015. The second largest proportion of organically farmed land area is represented by arable land accounting for 13.4% (66.5 thous. ha), while in the year 2003 this proportion was 7.7%. The rest of organically farmed land area, i.e. 4.6% then consists of permanent crops (vineyards, orchards, hop gardens) and other areas. The proportion of permanent agricultural cultures in the period of 2003–2015 significantly increased from 0.4% to 1.4% (6.8 thous. ha). The main reason is the increase in payments for organic production of fruit and wine, as well as raised awareness about the proper organic quality production.

The reason for the high proportion of permanent grassland is the setting of the agri-environmental programmes, which has greatly motivated the farming entities to perform environmental functions primarily on grassland at the expense of arable land. The increased support of organic farming on permanent grassland is given also by the fact that even though permanent grassland is not directly used for the production of organic plant products, but indirectly for the organic livestock production, the permanent grassland has an irreplaceable function in the landscape.

If the main ecological land use mode are related to the total area of the respective agricultural land resources (according to Public Land Parcel Indentification System records), the permanent grassland under organic farming covered 41.6% of the total permanent grassland in 2015, permanent cultures 18.0%, orchards 26.0%, vineyards 6.5%, hop gardens 0.2%, arable land under organic farming only 2.7%.

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 2015 it was already 542 producers. Maximum was reached in the year 2011, when 646 organic food producers served the market. Following a significant decrease in the number of manufacturing sites, primarily related to the commercial activity changes of the Billa company, which over the years 2012–2013 gradually ended baking organic pastry from frozen semi-finished products in their supermarkets. Despite the growing trend (Chart 3), the Czech organic food market is still underdeveloped – the average annual consumption of organic food in 2014[4] reached CZK 191 per capita and the proportion of organic food in the total consumption of food and beverages fluctuates slightly above 0.7%. The main reason is the higher price of organic food, which makes this market highly sensitive to fluctuations in the economic cycle or, more precisely to the economic standing of the households. The main categories of organic food with the largest sales volume in the long-term are "Other processed foods" (especially ready-to-use meals e.g. baby food), followed by "Milk and milk products" and "Fruits and vegetables".

The significant development of organic farming is mainly due to the **European and national subsidies**. Traditional support for organic farmers is (after the completion of the Rural Development Programme 2007–2013) from 2014 paid in the framework of the Rural Development Programme 2014–2020. Since the year 2007, organic farming is supported by a significant point advantage in evaluating investment projects within the investment measures of the Rural Development Programme, which is part of Axis I and III. After a slight decrease in 2014, in 2015 the volume of funds paid out under agri-environment title of "Organic farming" increased to CZK 1.3 bil. (Chart 4). The Ministry of Agriculture also financially supports every year the training of organic farmers and organic food producers, 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

[4] *Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.*

Agriculture in the global context

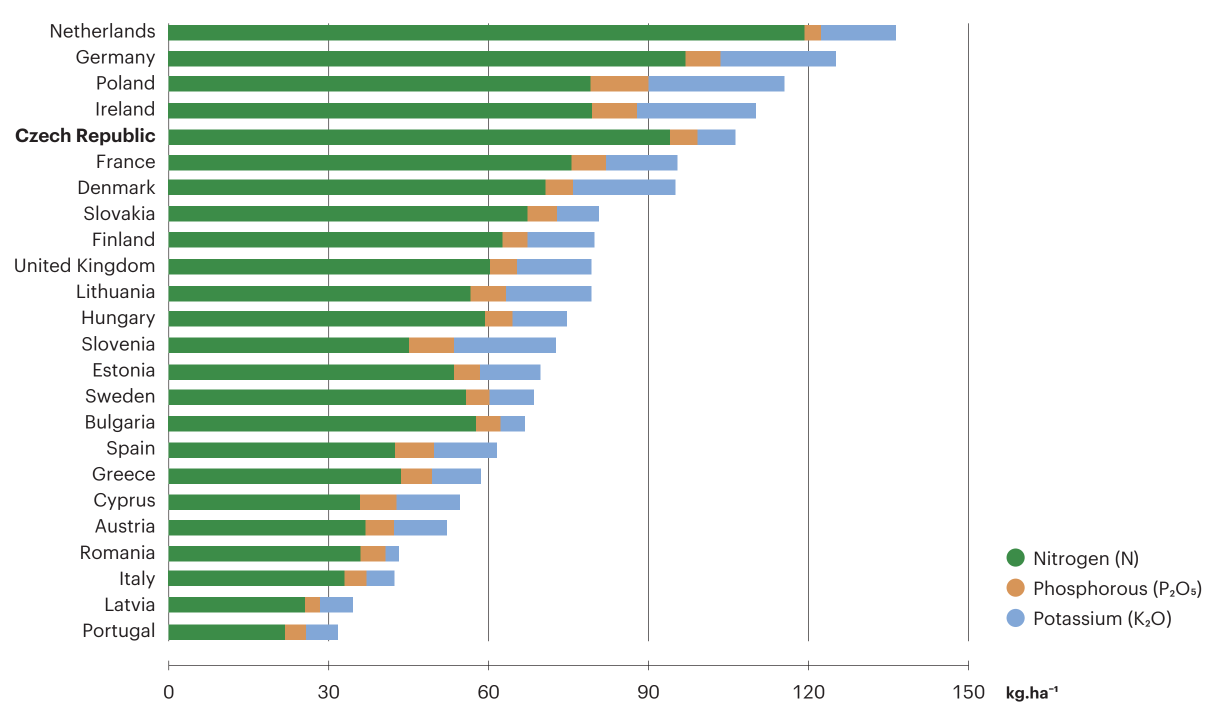
Key messages

- Agriculture represents a significant burden on the quality of surface water and groundwater, due to the excessive application of mineral fertilisers and plant protection products on agricultural land. The consumption of mineral fertilisers in the Czech Republic is above the European average. The consumption of mineral fertilisers in the Czech Republic has not been influenced by the development of organic farming in any major way, unlike some other countries, where there is also a high proportion of agricultural land under organic farming. 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.
- Organic farming in the EU27 and the Czech Republic, in the long-term, is experiencing a relatively rapid development. The area of agricultural land under organic farming in the years 2003–2014 in the EU27 increased by 75%, in the Czech Republic by 87.5%. The Czech Republic ranks among countries with the highest proportion of organically farmed land (13.5%), more than 19.3% proportion is achieved by Austria.
- The organic food market in the Czech Republic, compared to other countries in central and eastern Europe is one of the most developed markets with further growth potential. Yet in comparison with economically developed countries of Europe, the annual consumption of organic food (7 EUR per capita in 2012) is still at a low level. This is due, among other things, to the high cost of organic food in the Czech market. Approximately one third of the total turnover in organic foods in the EU27 is realised in Germany.

Indicator assessment

Chart 1

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

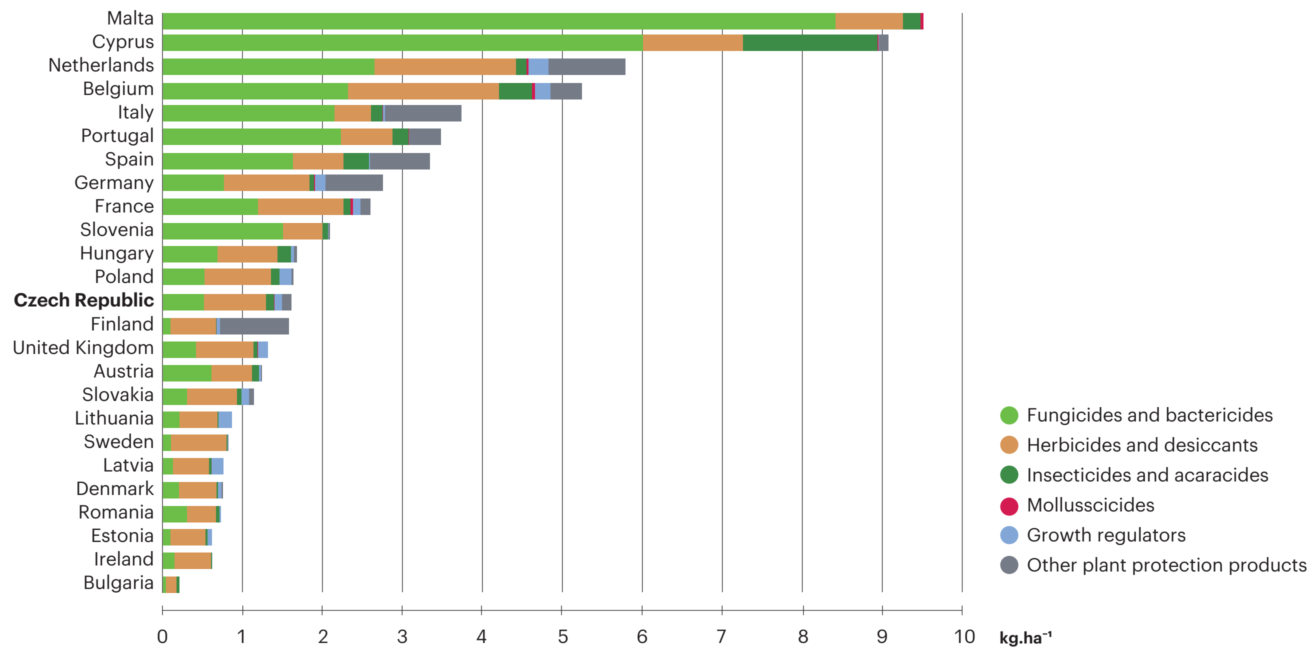


Preliminary data.

Source: Eurostat

Chart 2

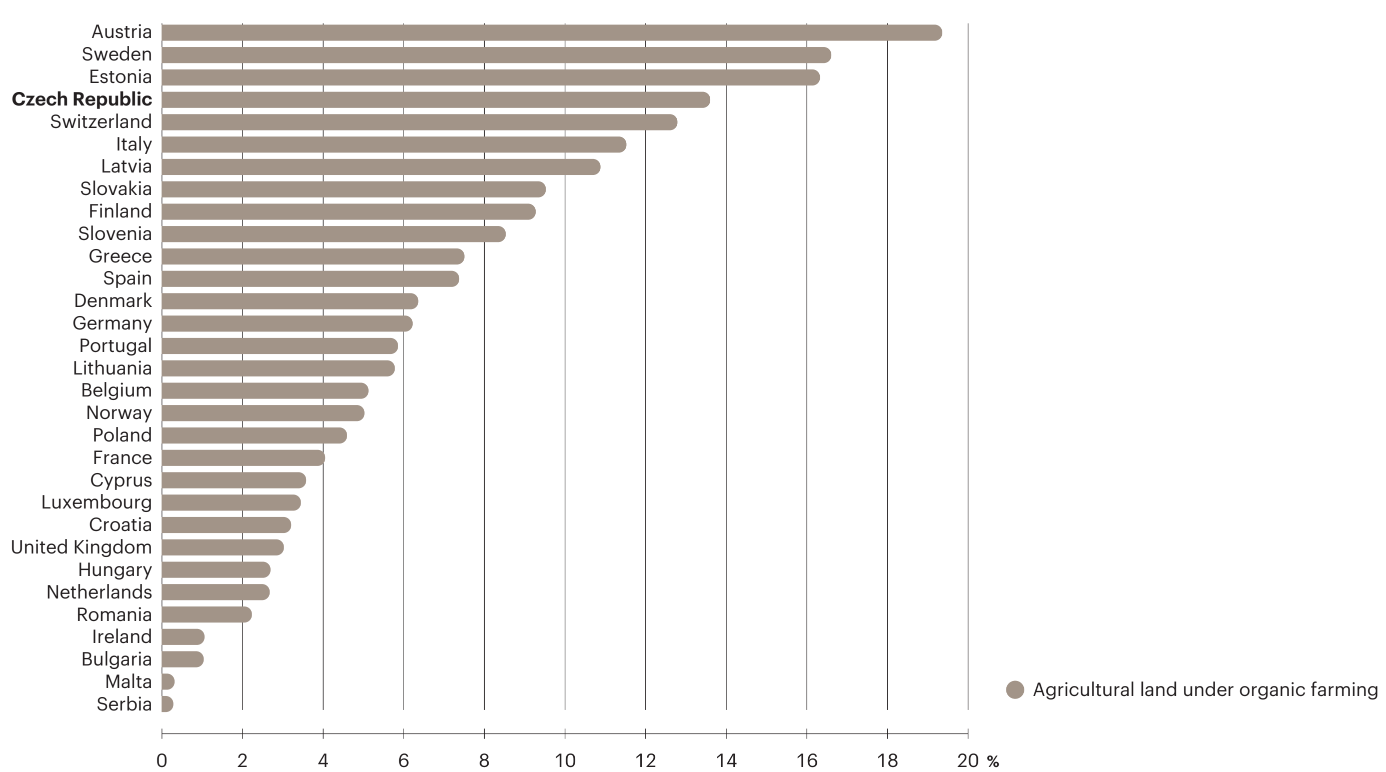
Quantity of plant protection products sold [kg.ha^{-1} of utilised agricultural area], 2014



Source: Eurostat

Chart 3

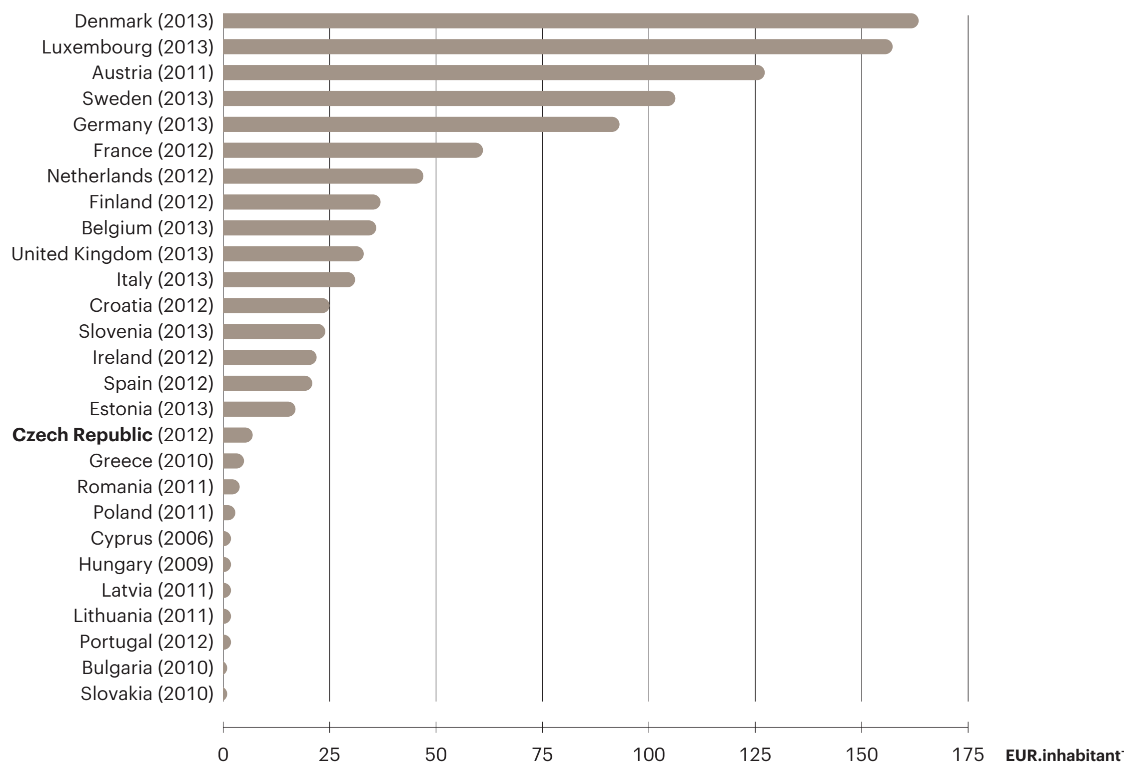
Proportion of land under organic farming out of the total area of utilised agricultural land [%], 2014



Source: Eurostat

Chart 4

Annual organic food consumption per capita [$EUR.inhabitant^{-1}$]



Data relate to the latest year (in parentheses in the Chart) in the Eurostat database for the given state.

Source: OrganicDataNetwork – FiBL-AMI survey 2015

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 agricultural 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 and the Czech Republic, in the long-term, is experiencing a relatively rapid development. In the year 2014, agricultural land under organic farming occupied a total of 10.3 mil. ha, compared to the year 2003 (5.9 mil. ha) representing an increase of almost 75%. In spite of this, land under organic farming occupies in 2014 only 5.9% of the total utilised agricultural area in the EU27. In the Czech Republic the proportion is 13.5% (Chart 3), ranking it as the leading countries in the EU27 (the highest proportion of more than 19% is achieved by Austria). The largest area of organically farmed land was in 2014 in Spain (1.7 mil. ha), in Italy (1.4 mil. ha) and in France (1.1 mil. ha) representing nearly 40.9% of agricultural land under organic farming in the EU27. The dynamics of organic farming development of in the Czech Republic is above average, despite a slowdown in 2012.

The **organic food market** of the EU27 is represented by the total annual turnover (according to the latest available data from 2009–2013) of approximately EUR 22.2 bil. The largest organic food market is Germany with about a third of total turnover of the EU27 for organic food (EUR 7.6 bil. in 2013), that is 100 times greater turnover than in the case of the Czech Republic (EUR 70 mil. in 2012). More illustrative is the comparison of the per capita annual consumption of organic food. It was highest in Switzerland (210 $EUR.inhabitant^{-1}$ in the year 2013) and in EU27 in Denmark (163 $EUR.inhabitant^{-1}$ in 2013). The lowest consumer spending on organic food is in central, eastern and southern Europe (Chart 4). The average annual per capita consumption in the Czech Republic in 2012 was only about 7 EUR (less than CZK 200). The main reason is the higher price of organic food in the Czech Republic, which makes this market highly sensitive to the economic situation of households, and also the lack of promotion. In the countries of central and eastern Europe, however, the Czech organic food market is considered to be one of the most developed, with a potential for further growth.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

7

Industry and energy

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 every year, and on the other hand, the amount of reclaimed areas is increasing.

Overall trend assessment

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

State Environmental Policy of the Czech Republic 2012–2020
- conservation and sustainable use of resources
- covering and preventing the effects after mining activities and raw materials extraction
- limiting and controlling contamination and other degradation of soil and rocks caused by human activities

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

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

Air Quality Improvement Program of the Northwest zone – CZ04
- determining the emission ceiling for a group of stationary sources of category 5 based on annex No. 2 to the Act on the Air Protection

Impacts on human health and ecosystems

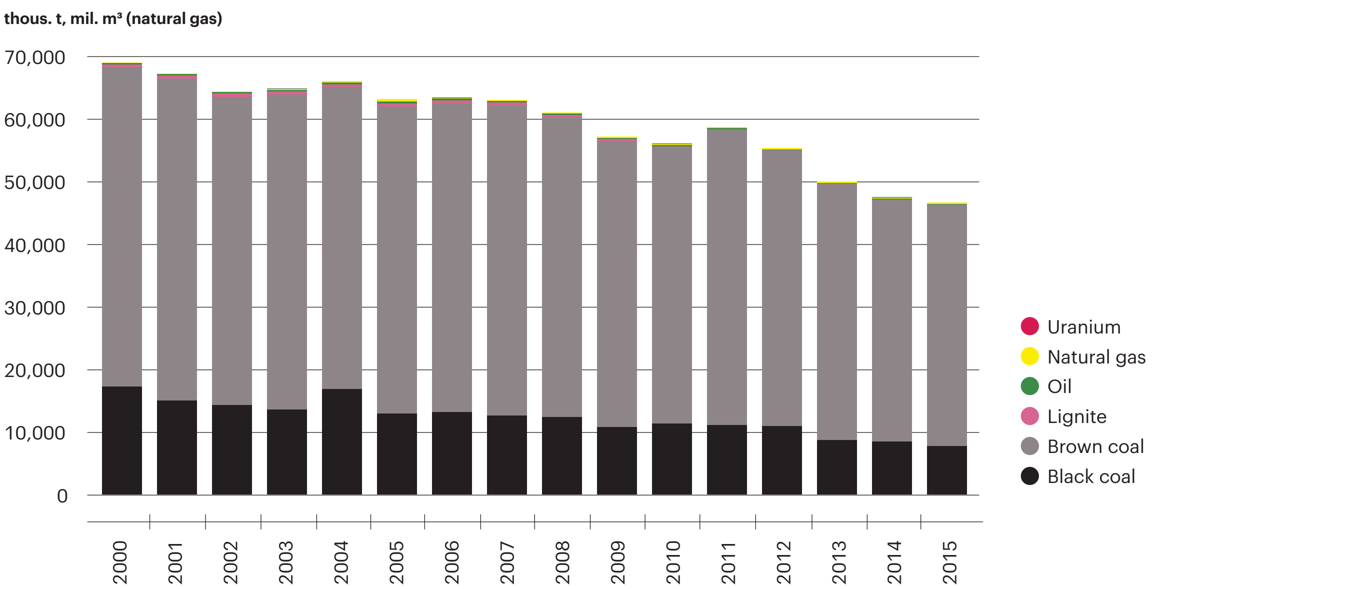
Mining and processing of mineral raw materials affects the surrounding environment. This is done during the actual mining and often even after its completion. The most common negative impacts of mining on the environment is the irreversible disruption of the rock mass and hydrogeological conditions, destruction or deformation of the original landscape, loss of agriculturally usable land and biodiversity. Dust from mining released into the air contributes to the increased incidence of respiratory diseases. Noise pollution affects the nervous system of humans and animals.

However, many mining facilities are not exclusively negative actors in the territory, but on the other hand, bring also biodiversity, which is so welcome in the landscape, and in many cases even during the extraction period. Where there has been a reclamation by way of natural succession, ecosystems are developed, which are subsequently declared as specially protected areas of nature and also the territory of Natura 2000. 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.

Indicator assessment

Chart 1

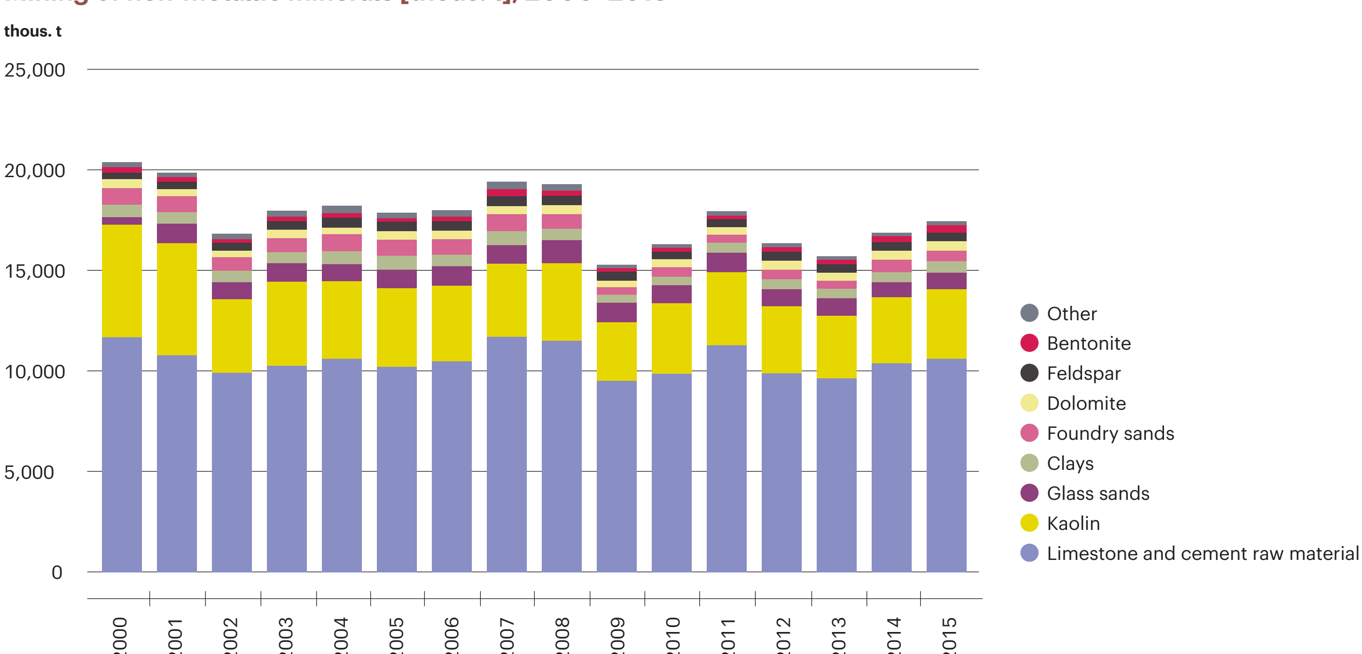
Extraction of energy raw materials [thous. t, mil. m³ (natural gas)], 2000–2015



Source: Czech Geological Survey

Chart 2

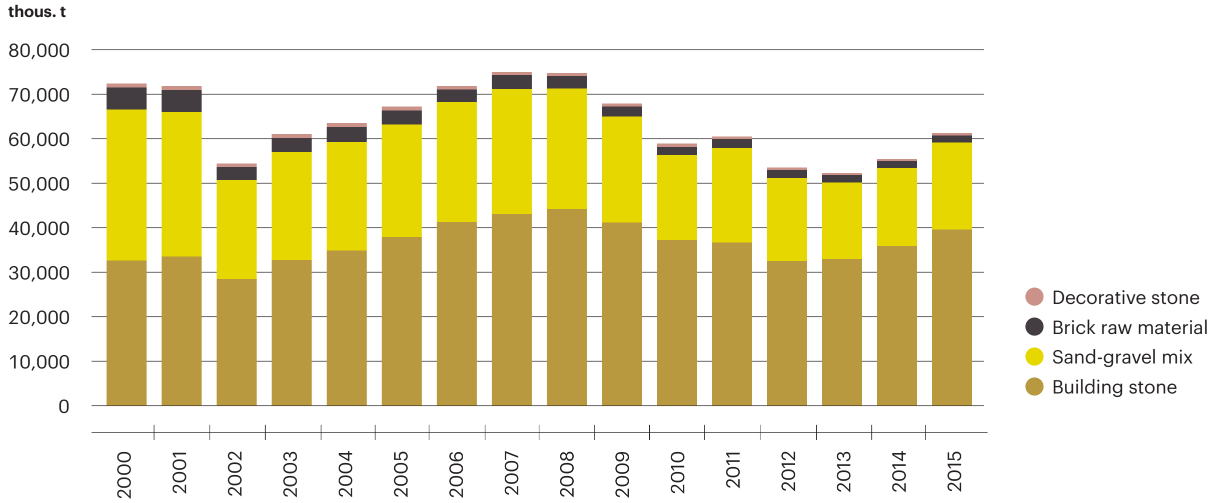
Mining of non-metallic minerals [thous. t], 2000–2015



Source: Czech Geological Survey

Chart 3

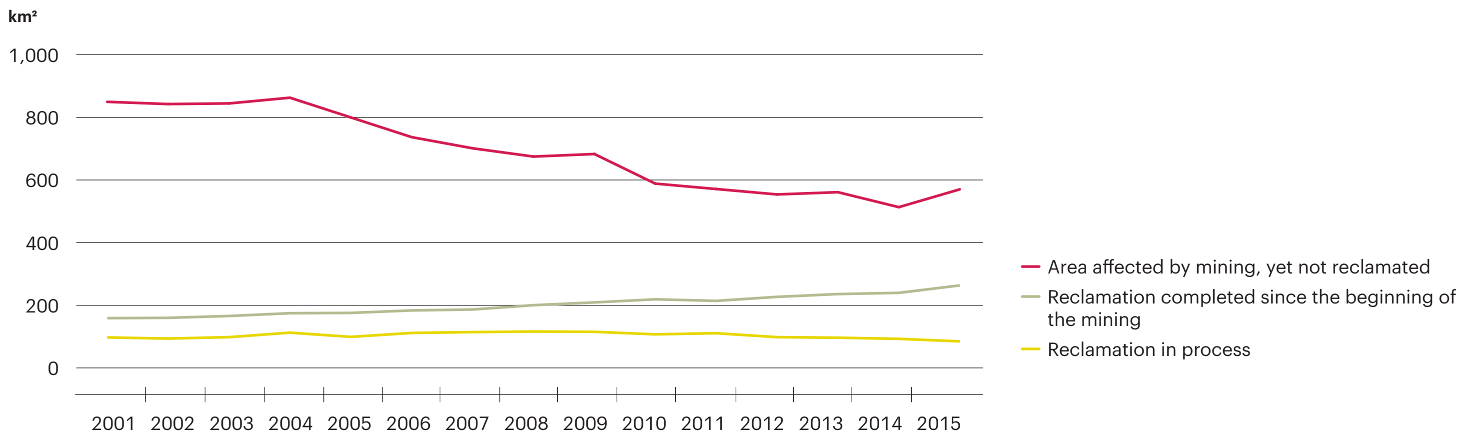
Mining of construction raw materials minerals [thous. t], 2000–2015



Source: Czech Geological Survey

Chart 4

Development of reclamation after mining and quarrying [km²], 2001–2015



Source: Czech Geological Survey

Mining and quarrying total in the Czech Republic after 1989 has an overall downward trend. In 1990, 232 mil. t of minerals were extracted in the Czech Republic. In the year 2000 it was 142 mil. t, in 2010 the extraction reached 133 mil. t and in 2015 only 128 mil. t of mineral materials in total.

From **energy raw materials** (Chart 1) 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 Sokolovská basin. The relatively large reserves of brown coal were, based on the publication of the so-called territorial limits of mining, from 1991 blocked because of the protection of the environment and landscape in the area of Northern Bohemia. In October 2015 the Government decided to abolish the limits in the Bílina mine. The reason for this were primarily the needs of heating sector, and the associated energy security of the country and also maintaining of many working positions. As a result of breaking the limits it will be 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. For the black and brown coal consumption the Czech Republic is self-sufficient due to domestic extraction, black coal is also exported to foreign countries.

In the period 2000–2015, brown coal mining declined by 24.4%, in the year-to-year comparison of 2014–2015 by 0.3% to 38,251 thous. t, black coal mining declined by 55.1% since 2000, and year-to-year by 8.4% to 7,640 thous. 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 is extracted in the Czech Republic in the site of Dolní Rožínka. 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 2000–2015 decreased from 498 t to 134 t (decrease by 73.1%), the year-to-year decrease in 2015 amounted to 18.8%.

Natural gas is mined in the areas Southern and Northern Moravia. Its mining covers approximately 3.5% of domestic consumption. In 2015, 200 mil. m^3 of natural gas were extracted in the Czech Republic, which is more than 69.5% more than in 2000 and by 1.0% more than in 2014.

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 approximately 2% of domestic consumption. In the period 2000–2015 the oil production dropped by 25.0%, in the year-to-year comparison of 2014–2015 by 14.3% to 126 thous. t.

From **non-metallic minerals** (Chart 2), 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. Another important raw material extracted in the Czech Republic is **kaolin**. In the global kaolin extraction the Czech Republic takes the 4th place, while its share of world production is 8.5%. In 2015, 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. 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 2013 there is a noticeable growth in extraction of these raw materials. The annual growth in the extraction of non-metallic minerals for 2014–2015 is 3.3%.

The extraction of **mineral materials for construction** copies the development of the construction industry, which has been linked by a momentum with development of the economy. Therefore it reflects the growth in the extraction after 2002 and the decline after 2008. Even in this sector the economic recovery and development of the construction industry is manifested from 2013. In 2015, there was a year-to-year increase in extraction of selected construction materials (Chart 3) of 10.5%.

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 our conditions 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 in the has been decreasing since 2001, and on the other hand, the amount of reclaimed areas is increasing (Chart 4).

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. However, the new arrangement may even on a certain level out or even surpass the original one. It is proven for instance by the artificial lakes formed for example in southern Bohemia by the extraction of gravel sand, structures and sport facilities in the former quarries or specially protected areas of nature, paradoxically declared in the former quarries, but also by 35 ha of new vineyards planted as an agricultural reclamation of the discharge of a brown coal quarry in Northern Bohemia in the wine-growing region of Most. Its area represents nearly 6.5% of the acreage from a total of about 550 ha of vineyards newly rising in the Czech wine region.

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

Year-to-year the industrial production in 2015 increased by 4.6%.

In 2014[1], there was a slight increase of pollutants from industry, which is a consequence of the increase in industrial production, which in 2014 accounted for 5.0%. In the longer term, however, there is a noticeable downward trend in emissions of all pollutants, both from the industrial energy and manufacturing processes without combustion.

The energy performance of the industry in the long term decreases significantly, in 2014, there was a decrease of 5.7%.

Overall trend assessment

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

European REACH legislation
- exclusion of substances with the worst impact on human health and the environment from circulation and replacing them with less harmful substances

Directive of the European Parliament and of the Council 2010/75/EU of 24 November 2010 on industrial emissions (integrated pollution prevention and control)
- the obligation to have a permit for industrial equipment, the conditions of the authorisation and obligations of operators
- monitoring and control of emissions from installations

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

Raw Material Policy of the Czech Republic
- 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
- ensuring the continuation of domestic uranium production as a super-strategic resources

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

- continuing the modernisation of mining and processing technology
- improving the social perception of the mining industry

Secondary Raw Material Policy of the Czech Republic
- 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
- supporting education to ensure qualified workers in the field of secondary raw materials

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

National Emission Reduction Programme of the Czech Republic
- emission ceilings for SO_2 and NO_x for defined groups of stationary sources in the sector of combustion processes in industry and construction

Operational Programme Environment 2014–2020
- reducing emissions from stationary sources contributing to the population's exposure to excessive concentrations of pollutants

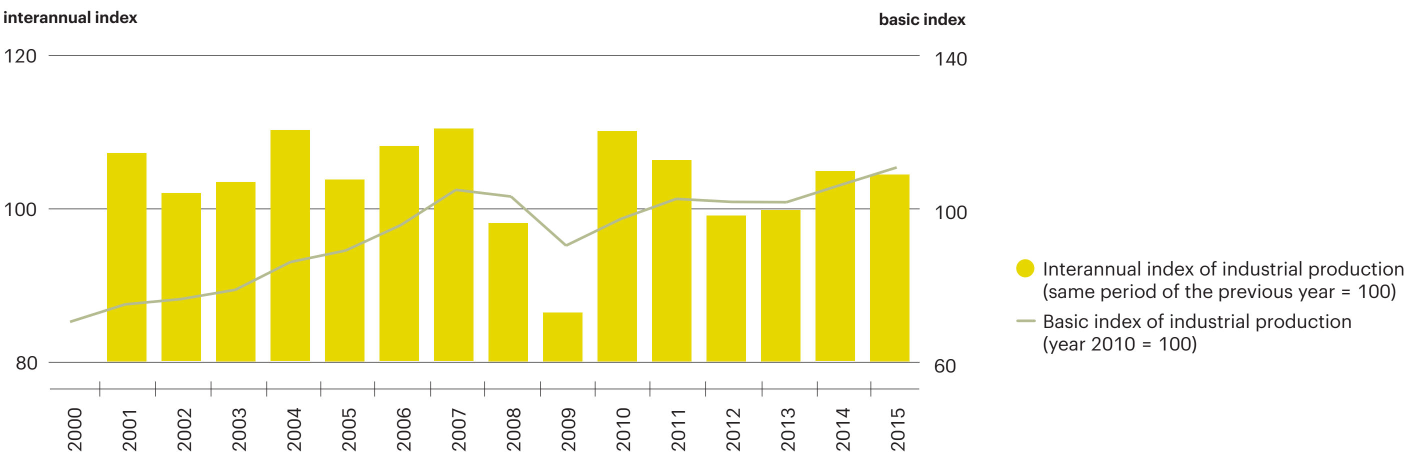
Impacts on human health and ecosystems

The industrial sector is a consumer of significant quantities of natural resources, including both raw materials used in production and energy resources. The extraction of raw materials disrupts the landscape and affects the quality, quantity and level of groundwater in mining areas. In the vicinity of the mined deposits dust and noise emissions may 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. They lead to the death or force migration of animals and plants that do not adapt to these changes. Some mining projects, however, may actually benefit biodiversity because they give rise to valuable ecological niches. 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. Noise pollution affects the nervous system of humans and animals. The industry also produces, imports and processes chemicals, mixtures and products whose content does not always possess known properties with respect to toxicity for the environment and for humans.

Indicator assessment

Chart 1

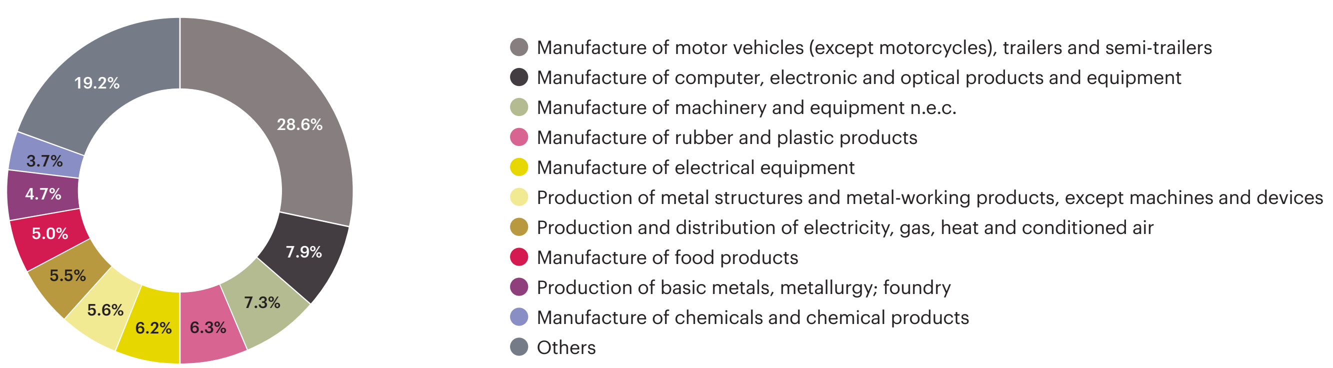
Index of industrial production in the Czech Republic, 2000–2015



Source: Czech Statistical Office

Chart 2

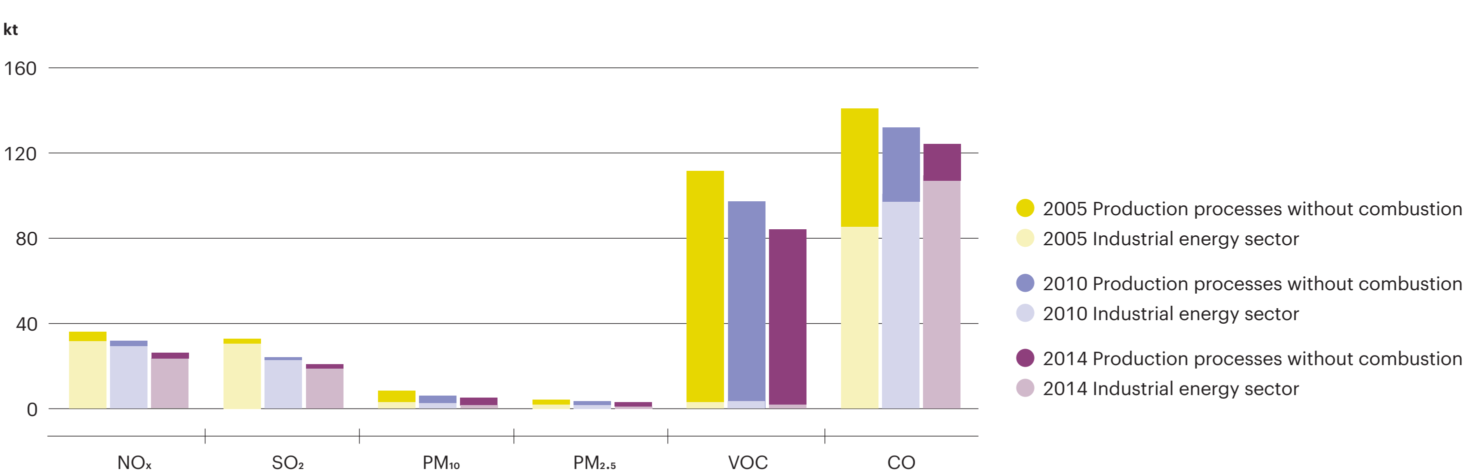
Structure of industrial production in the Czech Republic [%], 2015



Source: Czech Statistical Office

Chart 3

Pollutant emissions from industry in the Czech Republic [kt], 2005, 2010, 2014



Data for the year 2015 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**, making it one of the critical elements of the Czech economy. This sector has environmental impact especially in regions where the large industrial enterprises are concentrated (Moravian-Silesian region, Ústí nad Labem region, Central Bohemian region).

Industrial production in the Czech Republic grew in 2015, the increase amounted to 4.6% (Chart 1). A decisive role in this trend played the domestic market, where the production as well as investment grew and households were not afraid to spend, as the revival of economic activity is reflected in a greater supply of opportunities as well as in the increase of household income.

Among the main drivers of the industry of the Czech Republic (Chart 2) there are – according to the revenues from own products and services – manufacture of motor vehicles sector (28.6%), manufacture of computer, electronic and optical products and equipment (7.9%), manufacture of machinery and equipment (7.3%), manufacture of rubber and plastic products (6.3%) and manufacture of electrical equipment (6.2%). The year-to-year industrial production growth in 2014–2015 mostly contributed to the sector of manufacture of motor vehicles, manufacture of rubber and plastic products and manufacture of structural metal and fabricated metal products. In contrast, a slight decrease was recorded in the sectors of electricity, gas, steam and air conditioning supply, manufacture of chemicals and chemical products as well as mining and quarrying.

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. This group includes the category of solvents, which are a significant source of VOC emissions.

In the year 2014[2] (Chart 3), the industrial energy category exhibited a year-to-year growth in emissions of all monitored substances. On the other hand, the category of production processes without fuel combustion exhibited a decrease in emissions of monitored substances, except NO_x. Overall, the decline of the emissions of CO (by 6.6%) and VOC (by 1.1%) was recorded. PM_{10} emissions have remained at the same level as in the previous year. A year-to-year increase in emissions occurred for NO_x (by 2.8%), SO_2 (by 3.7%), and $PM_{2.5}$ (by 1.1%). Due to the fact that emissions from industry are closely linked to industrial production, there is a noticeable year-to-year increase of industrial production, which in 2014 accounted for 5.0%.

In the longer term, however, there is a noticeable downward trend in emissions of all pollutants, 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, whose vast majority comes from iron and steel in industrial sources 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 2000–2014[3] significantly decreased, with slight fluctuations, which has led to a decline in specific environmental load per unit of industrial production. While in 2000 the energy intensity[4] of the industrial sector was 622.3 MJ.thous. CZK^{-1}, in the year 2014 it amounted to only 280.2 MJ.thous. CZK^{-1}, which means a decline by 55%. Year-to-year, the energy intensity of the industry in 2014 dropped by 5.7%. 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

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

[3] Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

[4] 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[5] in the Czech Republic dropping, and thus the burden on the environment from the production of energy?

Key messages

The final energy consumption in recent years varies, it is affected by the changes in the industry due to the economic recession and its aftermath.

Most of the energy is consumed in industry, households and transportation.

In 2015, year-to-year, the final energy consumption in the Czech Republic increased by 7.5%.

Overall trend assessment

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

Climate-Energy Package (2008)
- reducing greenhouse gas emissions
- increasing the share of renewable energy sources in the final energy consumption

Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources
- achievement of the goals for the Czech Republic, i.e. a 13% share of renewable energy sources (RES) in gross final energy consumption in 2020

Directive 2010/30/EU on information concerning the energy consumption
- determine ways to inform end-users about the energy consumption during use
- provide additional information relating to products associated with energy consumption so that end-users are able to select more efficient products

Directive 2010/31/EU on the energy performance of buildings
- decreasing the energy demand of buildings

Directive 2012/27/EU on energy efficiency
- fulfilling the main objective of 20% energy efficiency by the year 2020 and further energy efficiency improvements beyond this date in the amount of 50.67 PJ (14.08 TWh) of new savings in the final energy consumption up to 2020
- fulfilling of 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

[5] *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).*

Action Plan for Energy Efficiency KOM/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

State Energy Policy of the Czech Republic
- implementation of energy-saving measures so that the net final energy consumption in 2020 matches the level of 1,020 PJ (according to the methodology of the IEA), respectively 1,060 PJ (according to Eurostat methodology)

The Second Energy Efficiency Action Plan is a national document elaborated in accordance with the requirements of the Directive of the European Parliament and of the Council No. 2012/27/EC
- reduction of the final energy consumption

National Action Plan for Energy from Renewable of the Czech Republic
- 14% share of energy from renewable sources in gross final consumption of energy in 2020
- 10.8% share of energy from renewable sources in gross final consumption in transportation in 2020

Impacts on human health and ecosystems

The actual energy consumption does not have direct impacts on human health and ecosystems, but its production is very significant for the quality of the environment because of the energy mix in the Czech Republic. Given the high proportion of fossil fuels, it is a significant source of emissions of pollutants and 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. The production of electricity and heat is also accompanied by air pollution that affects the health of population and pollution stress on ecosystems.

Indicator assessment

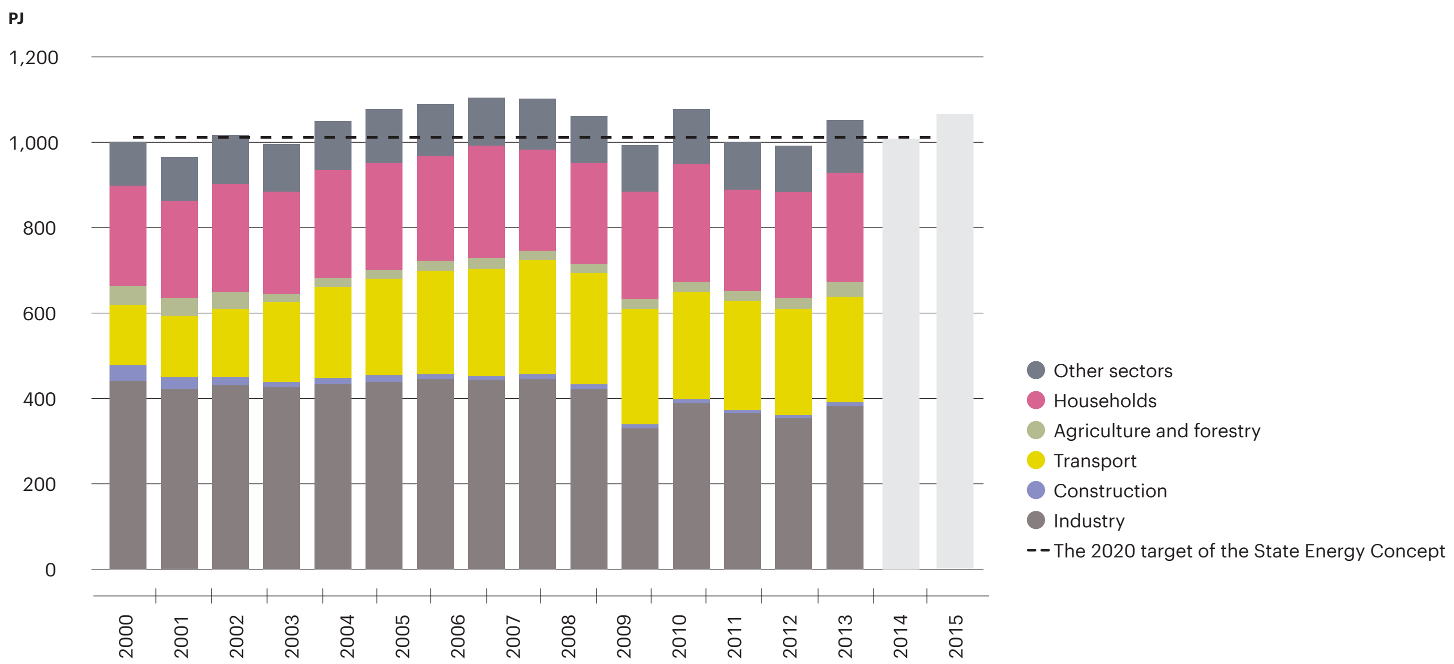
Chart 1

Development of final energy consumption by source in the Czech Republic [PJ], 2000–2015

Source: Czech Statistical Office

Chart 2

Development of final energy consumption by sector in the Czech Republic [PJ], 2000–2015



With respect to the data reporting methodology, the 2014 and 2015 data concerning energy consumption by sectors were not available as of the closing date of this publication.

Source: Czech Statistical Office

The amount of energy consumed is dependent on various factors. In the **agricultural** sector the main driver of the decrease in energy consumption is the effort to increase energy efficiency as well as improve productivity. Changes in energy intensity in the **service** sector are the result of balancing conflicting driving forces: on the one hand increases the efficiency of energy use, on the other the growing demand for the convenience of people hampers energy consumption reduction in the service 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. Also in **transportation**, several conflicting factors play against each other. The proportion of individual automobile transportation in transportation energy consumption is consistently high, but energy consumption per unit of transportation performance declines. A similar situation is in road transportation where the transport performance increases. In the **household** sector, energy consumption increases on the one hand because of the increasing living area of households, increased comfort level, greater number of electrical appliances, but on the other hand are the improvements in the efficiency of heating, heat insulation of existing buildings and new construction already built in low energy standard.

The final energy consumption (Chart 1) fluctuates in the monitored period since the year 2000. In the years 2002 to 2006 it had an increasing trend, but since the year 2007 the situation reversed and the consumption started to decline or fluctuate. Due to the fact that energy consumption is by the largest proportion affected by the industry, it is clear that also here the economic crisis in 2008–2009 was reflected. In the year 2010 a temporary increase in total energy consumption was recorded, together with the growth of the industrial production and the national economy as a whole, with subsequent fluctuations corresponding to the fluctuations in the economy. In the year 2015, the Czech Republic exhibits an annual reduction in final energy consumption by 7.5% to the value of 1,100.8 PJ. The objective of the updated State energy concept is not to exceed the level of 1,020 PJ by 2020.

The highest final energy consumption (Chart 2) is exhibited by the **industrial sector** (36.3% in 2013[6]). The high consumption in this sector is determined by the energy intensity of industrial production and the high share of industry in GDP. The

[6] *With respect to the division of the individual sectors, the 2014 and 2015 data concerning energy consumption by sectors were not available as of the closing date of this publication.*

industrial sector accounts for approximately 30% of the country's GDP. Energy consumption in this area fluctuated year-to-year, however, since 2006, due to the restructuring of industries and through the efforts to implement more energy efficient technologies it decreased every year. Significant year-to-year decline in consumption occurred in 2009 as a result of the economic crisis that severely affected the sector. In 2010, however, the energy consumption reflected the economic growth and year-to-year (2009–2010) the consumption increased by 18.0%. Between the years 2011 and 2012 slight downward trend continues, but the last observed year-to-year consumption (2012–2013) in this sector increased by 7.9%. 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.

Another important sector in energy consumption are the Czech **households**, which in 2013[7] consumed 24.4% of energy. The development of energy consumption in households is significantly affected by the character of the heating seasons. Year-to-year (2012–2013) an increase in household consumption by 3.7% was recorded, which is largely due to the colder heating season in the year 2013 compared to the more moderate one in 2012. The transportation sector contributed 23.6% to the total consumption in the year 2013. Only in this industry the long-term energy consumption increased, but since 2010 the trend is rather volatile. In the year-to-year comparison 2012–2013 the energy consumption in transportation retained the same values.

Other possibilities for energy savings is in the industry, services and households: increasing efficiency of steam power plants for fossil fuels and heating plants, application of best available techniques, using energy efficient appliances and preventing unnecessary wasting, construction of energy efficient buildings, using high-quality insulation materials, elaboration of energy audits, labelling for electrical.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[7] With respect to the division of the individual sectors, the 2014 and 2015 data concerning energy consumption by sectors were not available as of the closing date of this publication.

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

Since the year 2001, the ways of heating homes in the Czech Republic have not changed much. District heat supply (35.8%) and heating using natural gas (34.7%) prevail. Solid fuel heating is not falling (15.0%).

The selection of fuel type for home greatly influence emissions into the air. In 2014, the total emissions of PM_{10} were caused by home heating in 33.9%.

Overall trend assessment

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

State Energy Policy of the Czech Republic
- increasing energy savings and continuing improvements in energy efficiency
- supporting the replacement of direct heating systems for heat pumps and their further expansion, including involvement in management in intelligent networks
- the transition from 2020 to the low-energy standard of new buildings, or the construction of buildings with nearly zero-energy consumption

State Environmental Policy of the Czech Republic 2012–2020
- improvement in air quality in places where pollution limits are exceeded; maintaining air quality in the territories where air pollution limit values are not being exceeded
- maintaining emissions of heavy metals and persistent organic substances below the level of 1990 and their further reduction

National Emission Reduction Programme of the Czech Republic
- determination of emission ceilings for SO_2, NM-VOC and $PM_{2.5}$ for the group stationary sources in the sector of local household heating
- reduction in the proportion of solid fossil fuels in internal combustion stationary sources outside the EU ETS
- supporting the speeding up of the replacement of heat sources in the sector of local household heating
- 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 the directive on eco-design
- restrictions on the availability of internal combustion stationary sources on the rated thermal input up to 300 kW designated for coal combustion

Operational Programme Environment 2014–2020
- reducing emissions from domestic heating contributing to the population's exposure to excessive concentrations of pollutants

Act No. 261/2007 Coll., on the stabilisation of public budgets
- impose a consumer tax on fuels producing more pollutants into the air (coal approximately 10%, electricity for heating 1%)

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. 406/2000 Coll. on energy management
- reducing energy consumption of buildings, energy performance of buildings, eco-design and labelling requirements for products labels
- the obligation to provide labels to buildings and energy-using products

Decree No. 194/2007 Coll., laying down rules for the heating and hot water supply
- establishment of rules for heating and hot water supply
- the requirements for the equipment of buildings for the measuring and regulating of the supply of heat energy to end consumers

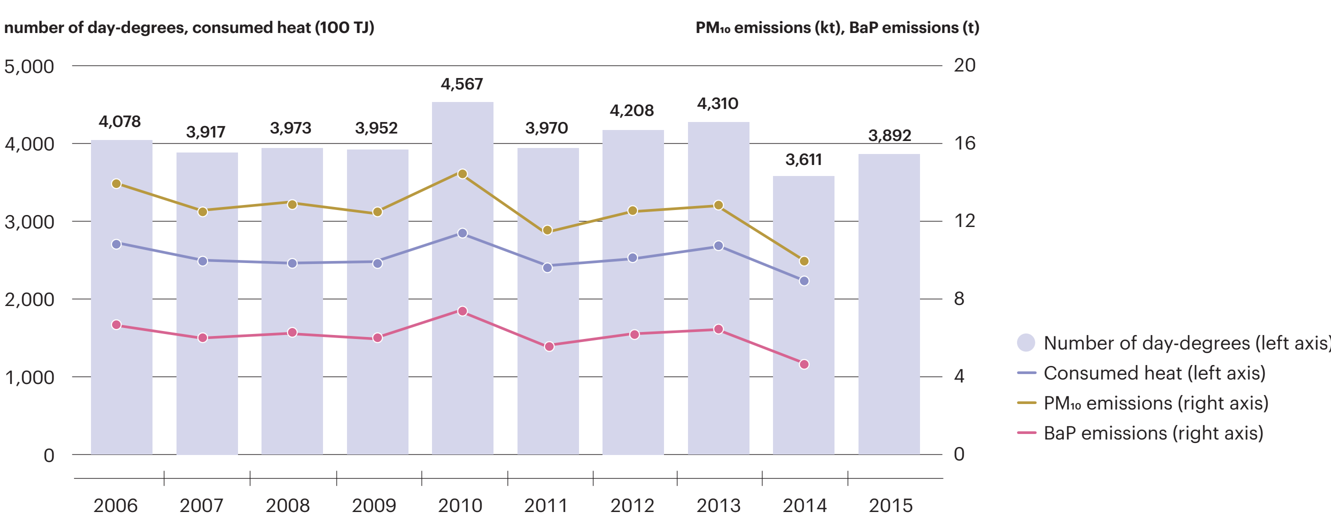
Impacts on human health and ecosystems

The way of heating homes and the given type of fuel affects the air quality in the immediate environment where people reside. The emissions from local sources, compared with emissions from large combustion facilities, are very dangerous because they are discharged directly into the environment, where the population resides. From the chimneys of low buildings, mostly family houses, the pollutants are not dispersed enough in the air and people breathe these substances directly. Due to the incomplete combustion of solid fuels polyaromatic 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. The production of pollutants originating from home heating leads to pollution and other environmental elements, which contributes to air pollution burden on ecosystems. Problematic in this context are especially dust particles, polycyclic aromatic hydrocarbons, or heavy metals.

Indicator assessment

Chart 1

Comparison of heating season with consumed heat and PM_{10} and BaP emissions from household heating in the Czech Republic [number of day-degrees, 100 TJ, kt, t], 2006–2015 (2014)

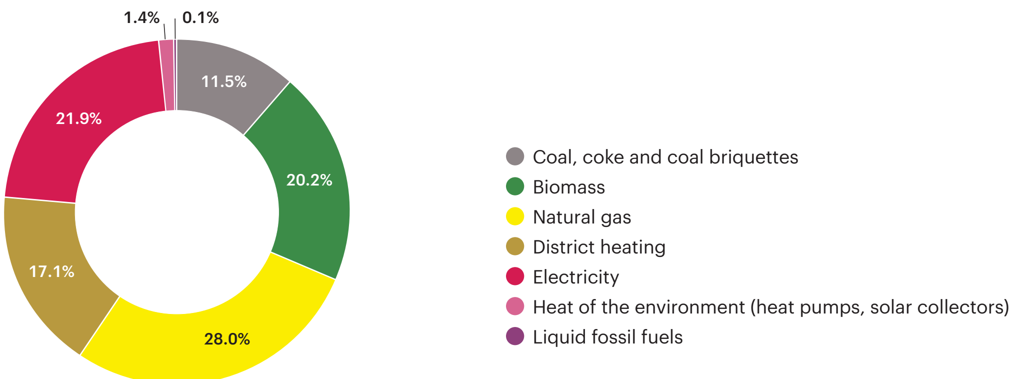


Data for the consumed heat, and the PM_{10} and BaP emissions for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute, MPO

Chart 2

Fuel and energy consumption by households (the proportion of energy contained in individual sources) in the Czech Republic [%], 2014

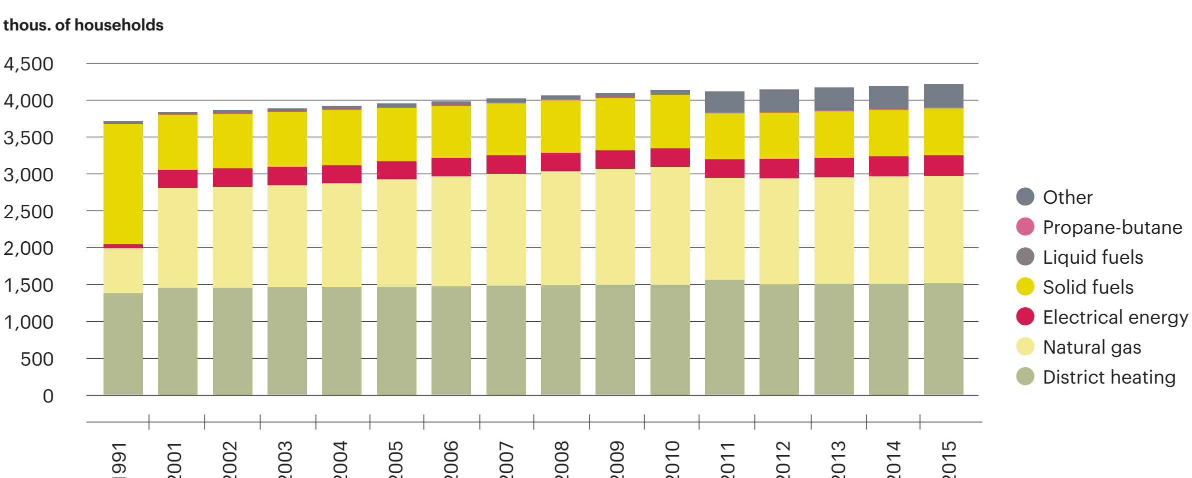


Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: Ministry of Industry and Trade

Chart 3

Prevailing heating methods used in permanently inhabited households in the Czech Republic [thous. of households], 1991, 2001–2015

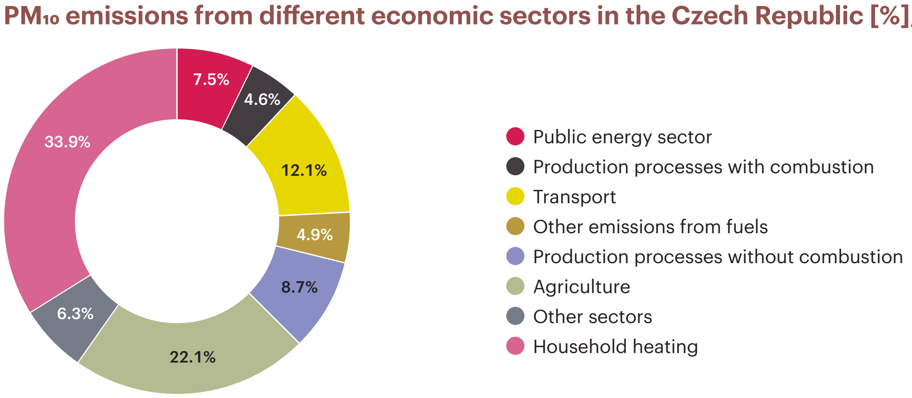


Data from the population and housing censuses in 1991, 2001 and 2011 have been included in the calculation.

Source: Czech Hydrometeorological Institute

Chart 4

PM_{10} emissions from different economic sectors in the Czech Republic [%], 2014

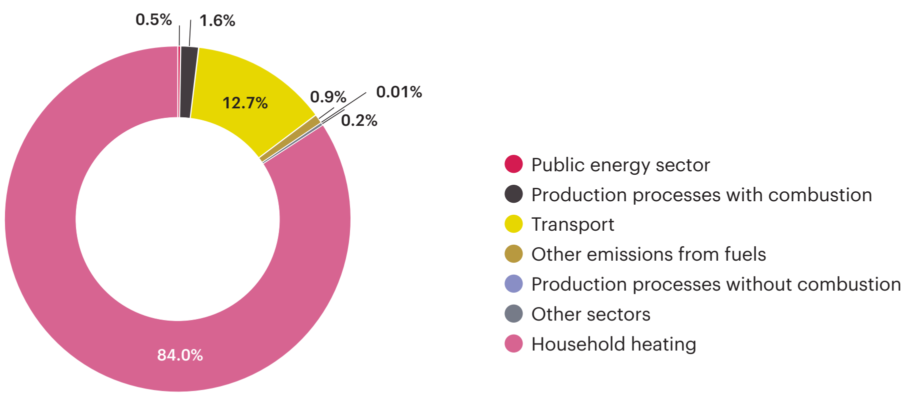


Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Hydrometeorological Institute

Chart 5

BaP emissions from different economic sectors in the Czech Republic [%], 2014



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

Source: Czech Hydrometeorological Institute

Evaluation for the year 2014[8]

Fuel consumption in households is affected by many factors. The intensity of heating in buildings is largely dependent on the outside temperature in the area. Another also important factor is the individual needs of the population, e.g. thermal comfort level and ventilation demands are highly subjective and significantly impact the heat consumption for heating. Due to the rising energy prices and the fact that the vast majority of energy is consumed in homes for heating and hot water, the households gradually replace their appliances by more efficient ones with higher efficiency, the houses and apartments are continued to be insulated. A significant impact on the environment is also the **method of heating**. The select fuel type, especially in local furnaces, 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.

In 2014, the heating season[9] was warmer, and therefore requires less heating than in the previous year (Chart 1). This was also reflected in the **year-to-year change in fuel consumption in households** where there was a decrease in the consumption of almost all types of fuels (natural gas by 18.3%, coal, coke and coal briquettes by 16.5%, district heating by 15.4%, biomass by 2.0%). The exception are the heat pumps and solar panels. In recent years these systems have seen development and heat production growing every year. Solar panels are often used for hot water heating or for preheating of water. The year-to-year increase for this category was 8.7%. The electricity consumption in households increased slightly by 1.3%. This category, however, includes all electricity consumed in households, including use for purposes other than heating (Chart 2). In the year 2014, the total quantity of energy supplied to households was approximately 246.2 PJ, which is 10.4% less than in 2013.

Since 2001, the **household heating methods**[10] have not changed significantly in the Czech Republic and heating using solid fuels has also been declining only minimally (Chart 3). This category includes mainly coal and wood, however their exact proportion is not clearly 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. In the past decade, the sector of local home heating shows an increase in the share of burning firewood, while the consumption of other fossil fuels is declining. This trend has resulted in an increase in emissions of PM_{10}, $PM_{2.5}$ and BaP.

In the year 2014 the population of the Czech Republic used for home heating most frequently **the central (district) heat supply** (35.9% of households) and natural gas (34.6% of households). Solid fuels heated 15.1% of households (see Chart 3). In

[8] *Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.*

[9] *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.*

[10] *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.*

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.

In the year 2014 the local heating units generated 11.9 kt of **PM_{10} emissions**, representing 33.9% of the total emissions of these pollutants (Chart 4). **BaP emissions** from home heating (Chart 5) in 2014, amounted to 7.3 t, which represents 84.0% of the total emissions of the substance. The emissions of pollutants from home heating and concurrently the quantity of heat used in heating systems are fundamentally impacted by the meteorological conditions. In the year 2014 the total PM_{10} emissions the Czech Republic amounted to 35.2 kt. Compared to 2013, the quantity of PM_{10} emissions from household heating increased by 17.1%. Total BaP emissions decreased year-to-year by 14.3%, households emissions recorded a decline by 17.3%. These positive changes are related, in particular, to the mild heating season, when there was no need to heat so intensively as in the previous year. In the long run, however, emissions from household heating are declining slightly (Chart 1). While in 2006 the amount of emissions of PM_{10} was 15.4 kt, in 2014, it was only 11.9 kt. We record the same development as well as for the emission of BaP, which in 2006 amounted to 9.0 t, in 2014 dropped to 7.2 t.

Evaluation for the year 2015

In 2015, there were 24,959 more households in the Czech Republic, while the majority of them was heated by natural gas (11,120). The number of new units heated by electricity, including heat pumps was 5,187 and by central heating 3,277. The number of new households heated by solid fuels was 2,900, by propane-butane it was 96, by liquid fuels it was 40 and heated by other ways it was 7,500 (Chart 3).

In 2015, the heating season was cooler, and therefore requires more heating than in the year 2014 (Chart 1). This development will also affect the heating of households in 2015.

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

The energy intensity of the economy of the Czech Republic is falling in the long term, since 2000 there was an overall decrease of energy intensity by 29.6%. In 2015, its value decreased by 5.1%.

In the year 2015, the PES consumption dropped in the category Primary heat and electricity decreased by 9.0%, which has been substituted by the increased in the production in steam plants for solid fuels. PES consumption in the category of solid fuels in 2015 increased year-to-year by 1.7%.

The transportation, agriculture and industry sectors represent the most significant proportion in the economy energy intensity by sectors.

Overall trend assessment

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

Climate-Energy Package (2008)
- reducing greenhouse gas emissions by at least 20% by 2020, compared to 1990
- increasing energy efficiency, the target is to reduce energy consumption by 20% by 2020

State Energy Policy of the Czech Republic
- continuing the increase in the energy efficiency by 2040, in accordance with the EU strategy with the objective to achieve the energy performance and the average energy consumption per capita, below the average of the EU28

State Environmental Policy of the Czech Republic 2012–2020
- protection and sensible use of resources
- support for energy savings
- ensuring commitment to energy efficiency by 2020 (for the EU as a whole it is 20%)

Fourth Action Plan for Energy Efficiency for the Czech Republic
- fulfilling of the national indicative target at 50.67 PJ (14.08 TWh) of new savings in final energy consumption by the year 2020

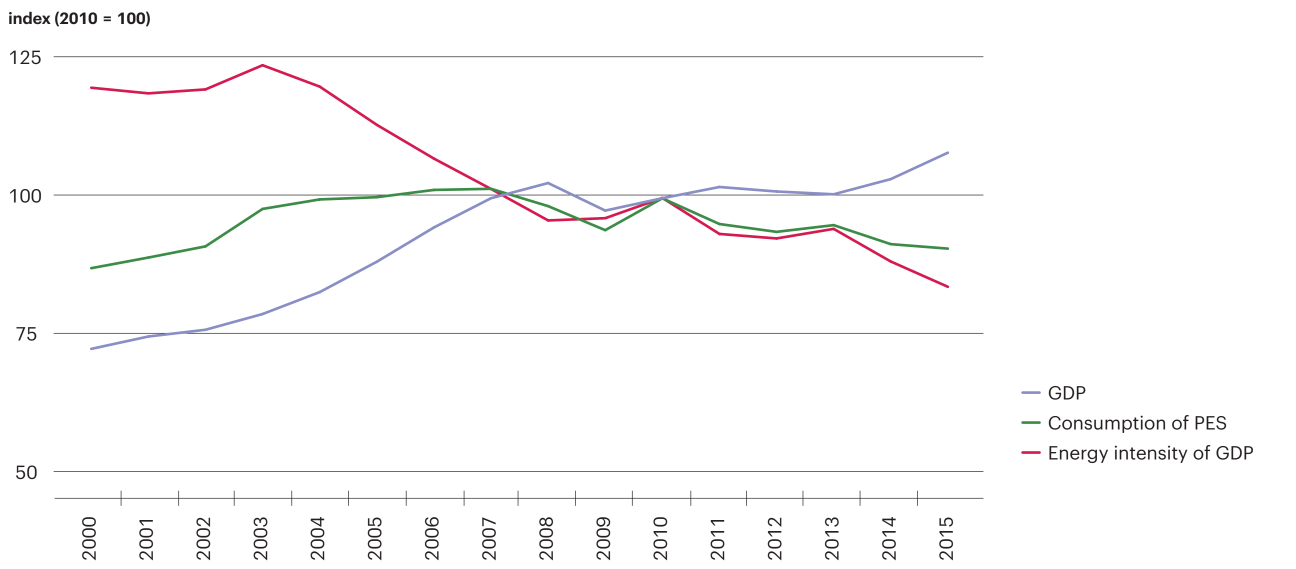
Impacts on human health and ecosystems

The impacts of high energy demands on human health and ecosystems are considerable. Production of large amounts of energy causes higher emissions of pollutants and greenhouse gases. Due to the greenhouse gas emissions the energy sector contributes to climate change, the emissions of pollutants contribute to air pollution load on ecosystems, e.g. defoliating of forests and overall disruption of the landscape. Air pollution also affects the higher incidence of respiratory and cardiovascular problems, allergies, asthma and decreased immunity and increased mortality in general.

Indicator assessment

Chart 1

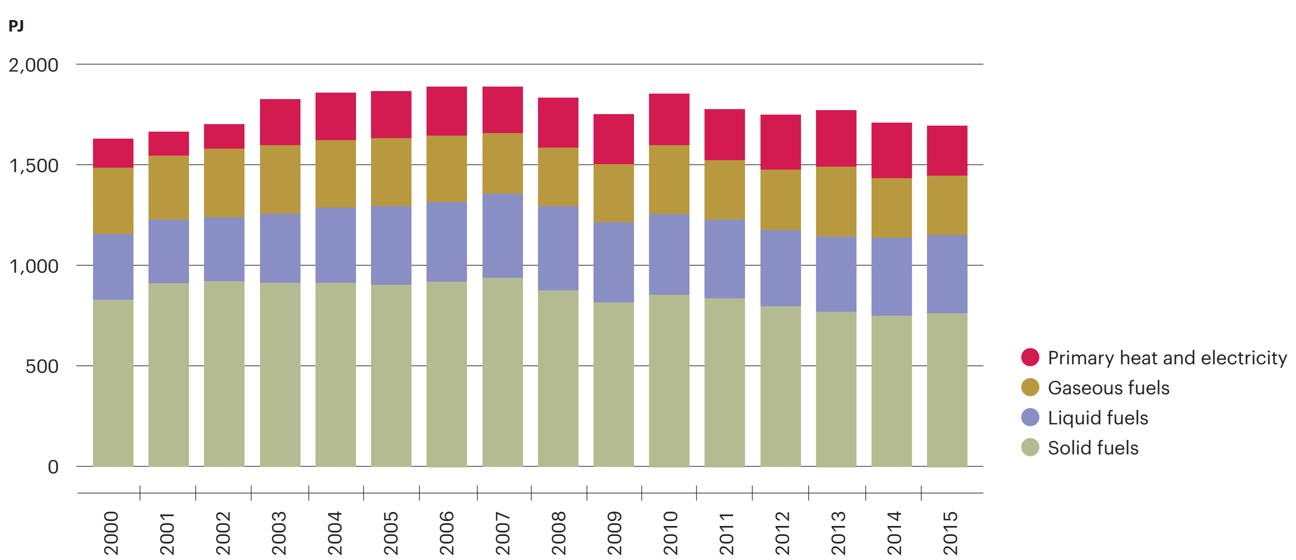
Energy intensity of Czech Republic GDP [index, 2010 = 100], 2000–2015



Source: Czech Statistical Office

Chart 2

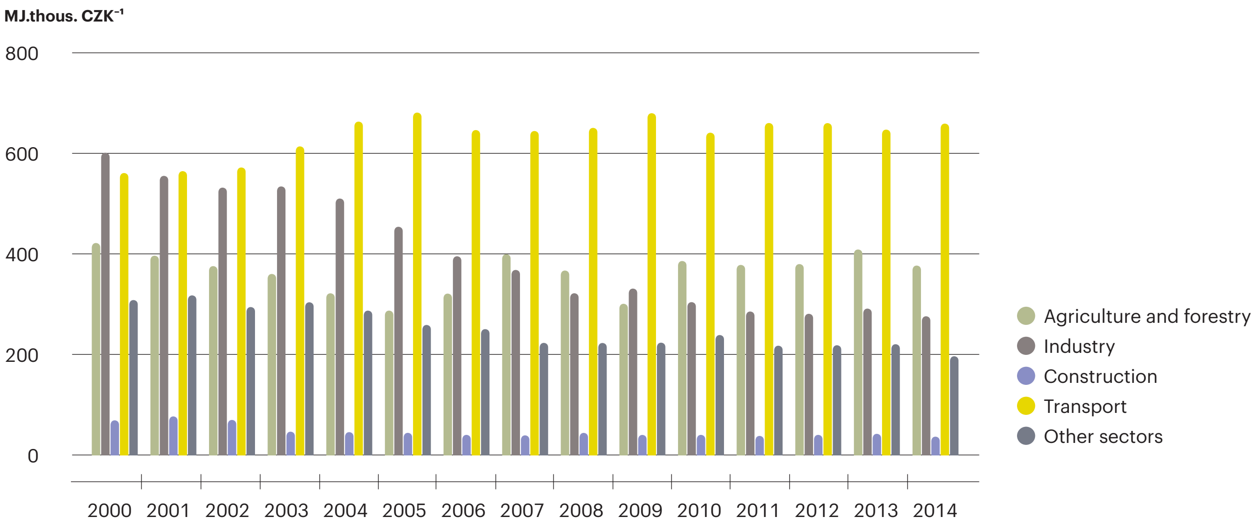
Development of primary energy sources consumption in the Czech Republic [PJ], 2000–2015



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], 2000–2014



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

Source: Czech Statistical Office, Eurostat

The **energy intensity of the economy** is the amount of energy needed to ensure the given volume of production, transportation or services. Therefore, it measures the energy consumption of the economy and its overall energy efficiency. The emphasis on the reduction of energy intensity is based on needs related to the decreasing availability of own available primary sources and the persistence of the industrial economy, but also with energy security, competitiveness and sustainability.

The energy intensity of the Czech Republic economy is decreasing in the long-term (Chart 1). Generally, this is due to the economic growth (GDP), but also due to the reduction in energy consumption, thus the increasing proportion of production with less energy demand, owing to the use of best available techniques, building insulation, or savings in the households. This relative indicator 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 monitored period of 2000–2015 the energy intensity of the economy of the Czech Republic is falling. The exceptions were the years 2009–2010, when this parameter was affected by the financial and economic crisis. There was a decline in GDP and in consumption of primary energy sources, but in such proportions that the energy intensity of the economy increased. Since the year 2011, however, the energy intensity of the economy continues the ongoing slight decline or stagnation. In the year 2015, the consumption of PES slightly decreased (by 0.8%), but at the same time there was an increase in gross domestic product (by 4.5%). The economy's energy intensity has reached 394.5 GJ.thous. CZK-1 (at constant 2010 prices) and therefore it decreased by 5.1% year-to-year. In longer term, i.e. since 2000 (when this value was 560.5 GJ.thous. CZK-1), there was a total decline in energy intensity by 29.6%.

The **PES consumption in the Czech Republic** (Chart 2) steadily grew since the year 2000 (year-to-year by 0.7 to 5.6%). In 2007, PES consumption reached the highest value for the entire monitored period since the year 2007, namely 1,883.3 PJ. Then the trend reversed and the PES consumption began to decline with slight fluctuations. In 2015, there was an interannual decrease in PES consumption by 0.8%; its value reached 1,686.3 PJ.

In the **structure of PES** (Chart 2), you can record from 2007 the decline in consumption of solid and liquid fuels, and by contrast, the consumption of gaseous fuels and the production of energy in nuclear power plants (category primary heat and electricity) slightly grows or fluctuates. The quantity of energy derived from renewable sources also increases. The proportion of fossil fuels in consumption still predominates, in the year 2015 it represented 45.0% of total primary energy sources. Liquid fuels had a share of 22.8%, gaseous fuels 17.5%, and primary heat and electricity (representing the electricity produced by nuclear and hydro power plants, excluding pumped storage power plants, wind and photovoltaic power plants plus the balance of imports and exports of electricity) had 14.8%.

In the year 2015, the PES consumption in the category Primary heat and electricity decreased by 9.0%, which was influenced by the low production of electricity from hydroelectric power plants due to the drought and also performing unplanned temporary shutdowns of nuclear power plants. The fall in production from these sources has been replaced by an increased production in solid fuel steam plants, which burn mainly brown coal. The annual consumption of PES in the category of solid fuels in 2015 increased by 1.7%.

The transportation, agriculture and industry sectors represent the most significant proportion in the **economy energy intensity by sectors** (Chart 3). While the energy intensity of **industry** in the period from 2000 continuously decreases, for **transportation** a rather growing trend was recorded which, however, fluctuates since 2006. The energy intensity of traffic, compared to other sectors, is high because it includes also private automobile transportation. In 2014[11], there was an interannual increase in energy intensity of transport by 1.9%; in industry there was a decrease by 5.4% and in agriculture there was a decrease by 7.9%.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[11] *Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.*

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

In 2015, the electricity production decreased year-to-year by 2.5%.

Foreign trade with electricity in 2015 had an export character. The balance of exports and imports for the whole year amounted to 12.5 TWh, which corresponds to 14.9% of the overall amount of electrical energy produced in the Czech Republic. This value is lower by 23.2% compared to the year 2014.

The public and industrial energy sector is a major producer of emissions of pollutants and greenhouse gases into the atmosphere. In 2014[12], however, the values of the emissions from this sector decreased year-to-year for all major monitored substances.

Overall trend assessment

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

Climate-Energy Package (2008)
- reducing greenhouse gas emissions by at least 20% by 2020, compared to 1990
- increasing energy efficiency by 20% by the year 2020 compared to the year 1990
- increasing the share of renewable energy sources in the final energy consumption

European Directive 28/2009/EC on the promotion of RES (included in package)
- 13% proportion of RES in final energy consumption by the year 2020

State Environmental Policy of the Czech Republic 2012–2020
- reducing greenhouse gas emissions
- securing 13% proportion of energy from renewable sources in gross final energy consumption by the year 2020
- ensuring commitment to increase energy efficiency by the year 2020
- implementing the national emission ceilings and reducing total emissions of SO_2, NO_x, VOC, NH_3, and $PM_{2.5}$ by the year 2020 in line with the commitments of the Czech Republic
- maintaining emissions of heavy metals and persistent organic substances below the level of 1990 and their further reduction

[12] *Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.*

State Energy Policy of the Czech Republic
- 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%
- ensuring self-sufficiency in the production of electricity, with an increasing share of RES sources and secondary sources, the gradual replacement of coal-fired energy as a pillar of electricity production by the nuclear energy production
- gradual decline of exports of electricity and maintaining the balance in the range of +/–10% of domestic consumption
- enhancing energy security and the resilience of the Czech Republic

National Emission Reduction Programme of the Czech Republic
- determination of emission ceilings for SO_2 and NO_x for stationary source group in the public sector, energy and heat production

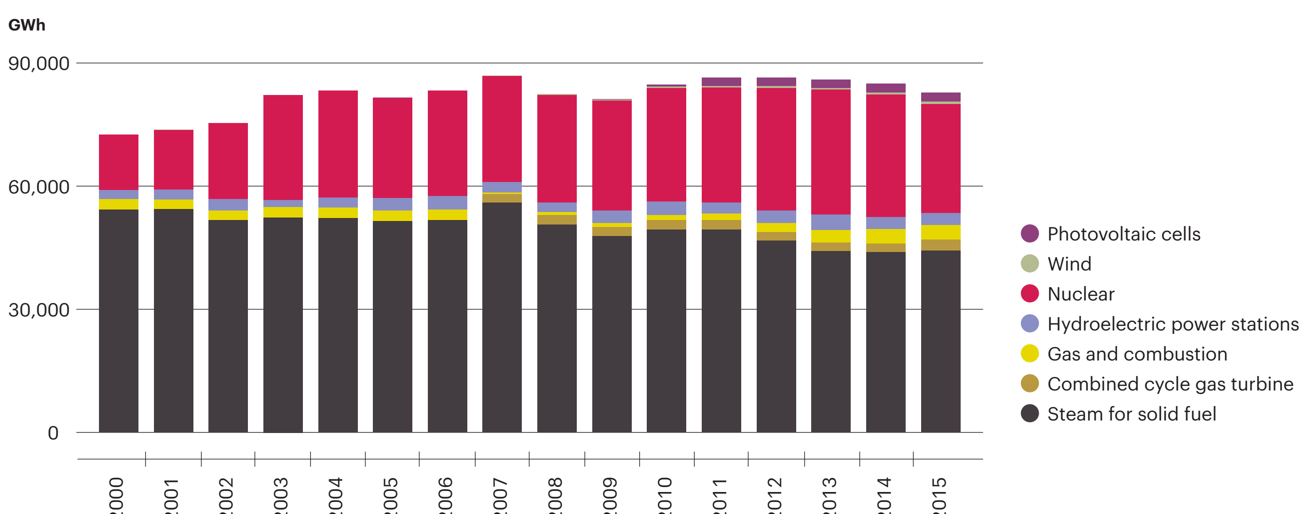
Impacts on human health and ecosystems

The composition and the proportion of individual energy sources is closely related to the production of pollutant emissions and greenhouse gases that are discharged into the atmosphere. The energy sector contributes to climate change by the production of greenhouse gas emissions, the emissions of pollutants contribute to air pollution load on ecosystems and among other things, to the defoliation of forests. Air pollution causes a higher incidence of respiratory problems, allergies, asthma and increased morbidity and mortality in general. The predominance of the use of local fossil fuels guarantees a certain degree of energy security and independence. However, strip mining of brown coal causes disruption of the landscape and the related reduction in the attractiveness of the territory. Many facilities for the production of energy also occupy large areas of land, affecting the microclimate in the given area or interfering with the aesthetic and recreational function of the landscape.

Indicator assessment

Chart 1

Electricity generation by the type of power stations in the Czech Republic [GWh], 2000–2015



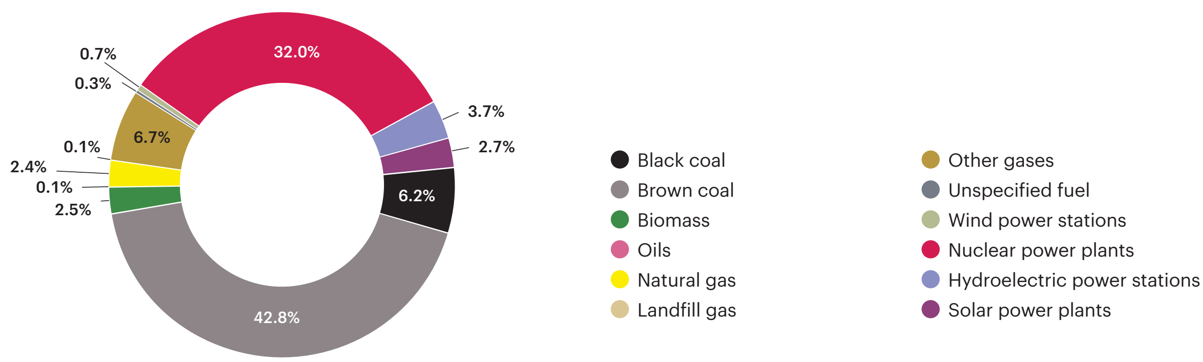
Photovoltaic power plants: Gaining energy from the solar radiation transformation on the principle of the photoelectric effect.
Wind power stations: The wind drives the propeller through an electric generator that produces electricity.
Nuclear power plants: This is in principle of a steam power plant, 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).
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 plants: The gas is first burned in a gas or 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.
Steam power plants for solid fuels: 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

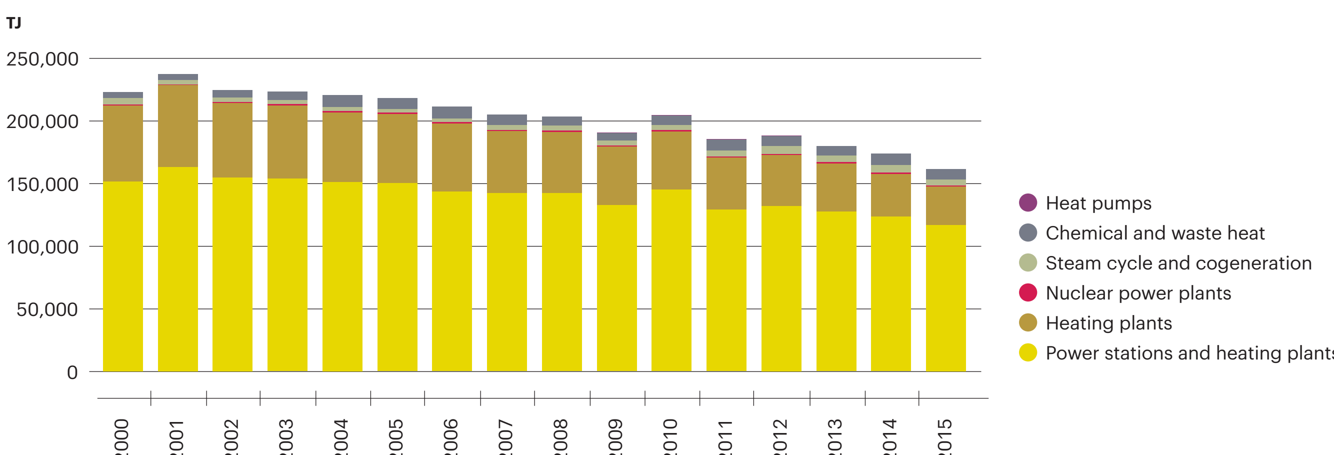
Electricity generation by fuel type in the Czech Republic [%] 2015



Source: Energy Regulatory Office

Chart 3

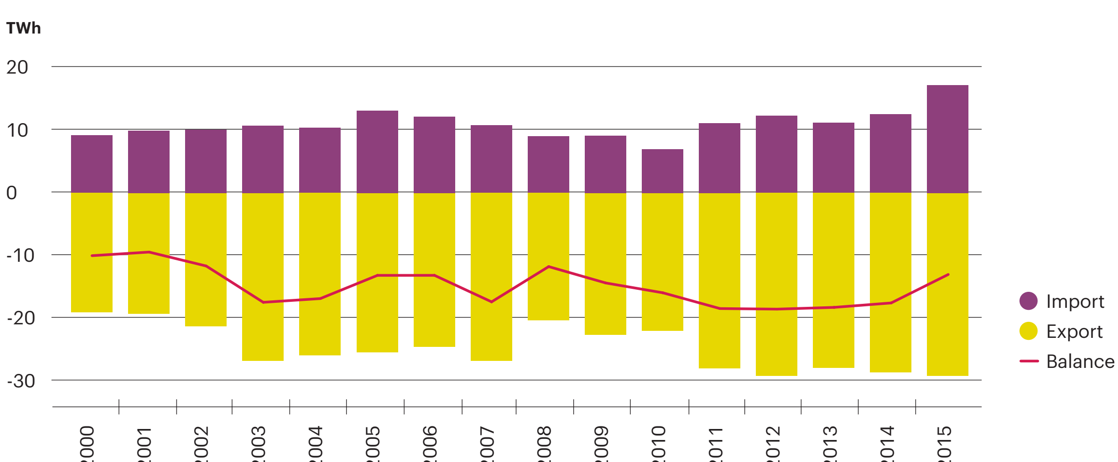
Net heat production by sources in the Czech Republic [TJ], 2000–2015



Source: Czech Statistical Office

Chart 4

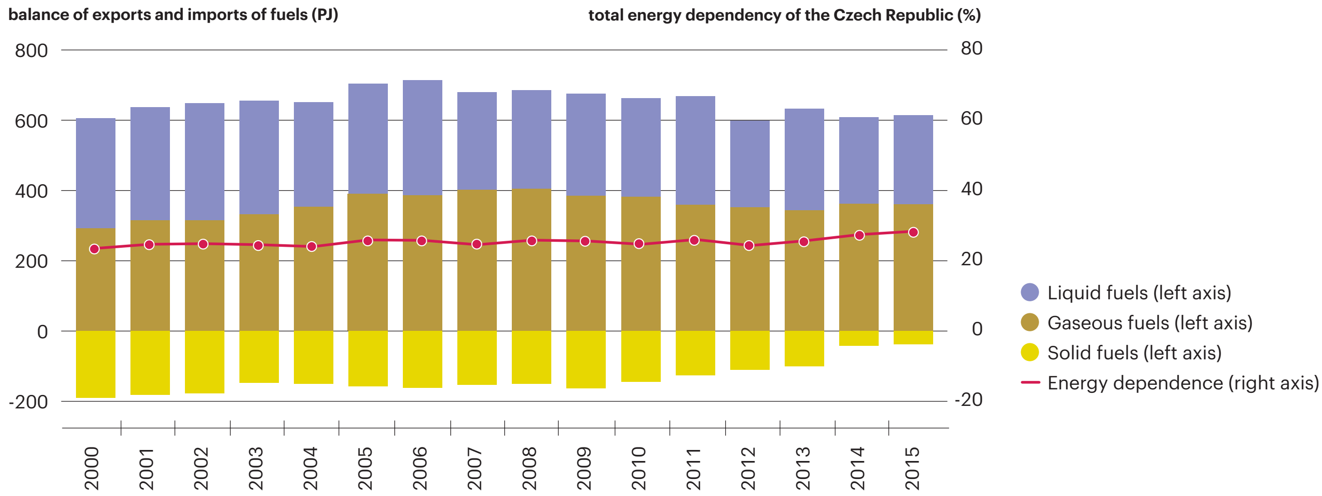
Electricity imports and exports in/from the Czech Republic [TWh], 2000–2015



Source: Energy Regulatory Office

Chart 5

Export/import balance of single fuels, overall energy dependence of the Czech Republic [PJ, %], 2000–2015



Source: Czech Statistical Office

Production of electricity and heat is determined by the demand, therefore, closely related to power consumption. The most significant share of electricity consumption lies in the industrial sector (31.1% share of electricity consumption in 2015), households (25.5% of annual consumption in 2015) and in services (22.0% of consumption in 2015). Foreign trade enters into demand as well, because a part of electricity produced in the Czech Republic is exported abroad. 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 sources of energy raw materials and their availability and the energy policy is also an important factor, which sets the conditions for their use.

The electricity generation in the Czech Republic fluctuates since 2000 in two to three-year waves, however, the year-to-year changes are in units of percent. In the long run the production until 2007 had an increasing tendency, but after that, since 2008, with slight fluctuations it has been rather declining (Chart 1). Compared to the year 2000, in 2015 it was generated by 14.2% more electricity, in the year-to-year comparison of 2014–2015 electricity generation decreased by 2.5%. In 2015 in the Czech Republic there were 83,888.4 GWh of electricity generated (in 2013 it was 86,003.4 GWh).

The **energy mix of the Czech Republic** (Chart 2) is constantly 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 power plant for solid fuel[13] combusting particularly brown coal were partially shut down, partially reconstructed. In this situation, enters the development of renewable energy sources, which by each year attain a larger share in the overall energy mix. In the year 2015 the territorial limits of the extraction of brown coal in the mine Bílina were broken, which allows using another up to 120 mil. t of coal.

Steam power plants for solid fuel in 2015, generated 44,816.5 GWh of electricity, which represents 53.4% of the total production. Year-to-year, the production grew by 0.9%. Combined cycle gas turbine power plants with the generation of 2,749.0 GWh, increased their production by 24.7%, which partly compensated for the annual decline in the production of electricity in **nuclear power plants** (by 11.5%), caused by unplanned temporary shutdown. For **hydroelectric power plants** (excluding pumped storage plants) the production decreased year-to-year, again by 6.0%. Whereas even the production in 2014 was assessed as the lowest during the reporting period as a result of extremely low levels at watercourses due to drought that persisted even in 2015. On the contrary, for the pump and storage plants the electricity generation has increased by 21.3%. Similarly, the electricity generation from **wind power plants** grew year-to-year by 20.2%. The production of electricity from solar sources, biomass, biogas and biodegradable municipal waste slightly increased.

[13] *Steam power stations are generally those that use steam to drive the generator of electricity, whereas water vapor 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 Regulatory Office and includes thermal power plants that burn, in the conditions of the Czech Republic, particularly brown coal. Nuclear power plants are then listed in a separate category.*

Heat generation (Chart 3) was in the Czech Republic in 2015 provided mainly by power plants and heating plants (72.3%) and by heating stations[14] (18.9%). Other sources producing heat have a share only on the order of several units of percent. The heat from these facilities (Chart 3) is intended for sale and for use in own business in public and facility energy systems, however, it is not intended to produce electricity. Due to the fact that this heat is also intended for industrial use, a noticeable decline in the year 2009 is visible in the total quantity of heat energy produced, caused by the economic crisis and declining industrial production.

The total amount of produced heat has been decreasing in the long term, 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 2015, the net heat production amounted to 159,334 TJ, which is a slight interannual decline by 7.2%.

The public and industrial energy sector is a major producer of **emissions of pollutants and greenhouse gases** into the atmosphere. In the year 2014[15], SO_2 contributed to total emissions by 82.8% (105.2 thous. t), to NO_x emissions by 48.1% (82.0 thous. t), to CO_2 emissions by 50.8% (62,846.5 thous. t) and to PM_{10} emissions by 12.1% (4.3 thous. t). Compared to last year 2013, there was a decrease of the main monitored emissions: CO_2 by 5.6%, NO_x by 5.3%, SO_2 by 3.6% and PM_{10} by 1.4%, whereas emissions from the energy sector decreased for all monitored substances, while emissions from industrial energy sector, with the exception of CO_2, increased slightly for all substances.

Foreign trade with electricity in 2015 had an export character (Chart 4). 28.6 TWh of electricity was exported, but imports amounted to 16.1 TWh. The balance of exports and imports for the whole year thus amounted to 12.5 TWh, which corresponds to 14.9% of the overall amount of electrical energy produced in the Czech Republic (83,888.7 GWh). This value is lower by 23.2% compared to the year 2014.

The energy dependence is an important indicator as to the extent to which an economy relies on imports 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 the raw materials are mined on its territory. Electricity and coal are also exported (Chart 4 and Chart 5). Regarding coal, this relates solely to 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**. Although the Czech Republic is the only EU country producing uranium, it imports nuclear fuel for nuclear power plants, because the Czech Republic does not own the technology to produce nuclear fuel. 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 amounted to 31.8%, 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

[14] Heating station – a separately standing heat source for a residential area or an industrial plant, supplying heat to the heating network or possibly to heat transfer substations. Power station with heat supply a source intended primarily for electricity generation but it is also a source of heat in the partial heat production operational mode. Heating plant – a source in which both heat and electricity produced in a common circuit. Heating station a separately standing heat source for a residential area or an industrial plant, supplying heat to the heating network or possibly to heat transfer substations.

[15] Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

32 | Renewable energy sources[16]

Key question

What is the structure and the share of renewable energy in the total energy sources?

Key messages

Electricity generation from the supported sources, i.e. biomass and biogas has increased by 19.2%, respectively 11.9%.

The shift towards greater diversity of energy sources is beneficial in terms of greater energy independence and security.
Heat production from renewable energy sources is mostly influenced by the use of wood for heating households.

A slight decrease in electricity production from RES, that was due to the decrease in production in aquatic plants as a result of low levels of water flows.

Overall trend assessment

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

Climate-Energy Package (2008)
- reducing greenhouse gas emissions by at least 20% by 2020, compared to 1990
- increasing energy efficiency by 20% by the year 2020 compared to the year 1990
- increasing the share of renewable energy sources in the final energy consumption

Directive 2009/28/EC of the European Parliament and of the Council on the promotion of the use of energy from renewable sources (is part of the package)
- ensuring 13% proportion of RES in final energy consumption by the year 2020

Act No. 165/2012 Coll., on supported energy sources and on amendment of certain laws
- determining support for the generation of electricity, heat and bio methane from renewable energy sources, secondary energy sources, high-performance combined production of electricity and heat, and decentralised electricity generation

State Environmental Policy of the Czech Republic 2012–2020
- reducing greenhouse gas emissions
- 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

State Energy Concept of the Czech Republic
- supporting the development and use of RES, in accordance with the economic possibilities and natural geographic-geological-climatic conditions of the Czech Republic
- the potential of biomass, wind energy and solar power on roofs and building structures

[16] *Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.*

- ensuring the annual share of electricity generation from indigenous PES on the total gross electricity generation in the Czech Republic of at least 80% with the target structure of electricity generation in the following corridors: nuclear fuel 46–58%, RES and secondary sources 18–25%, natural gas 5–15%, brown and black coal 11–21%

National Action Plan for Energy from Renewable of the Czech Republic
- achieve a 14% share of energy from renewable sources in gross final consumption of energy 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

Strategy on Adaptation to Climate Change in the Czech Republic
- providing enough biomass as a source of energy for the installations for the production of heat or combined electricity systems
- supporting such kinds of energy sources the production of which will be eco-friendly and economical
- supporting construction and high availability of renewable resources and their effective crisis management in case of emergencies

Act No. 165/2012 Coll., on supported energy sources
- supporting the production of electricity and heat from renewable energy sources

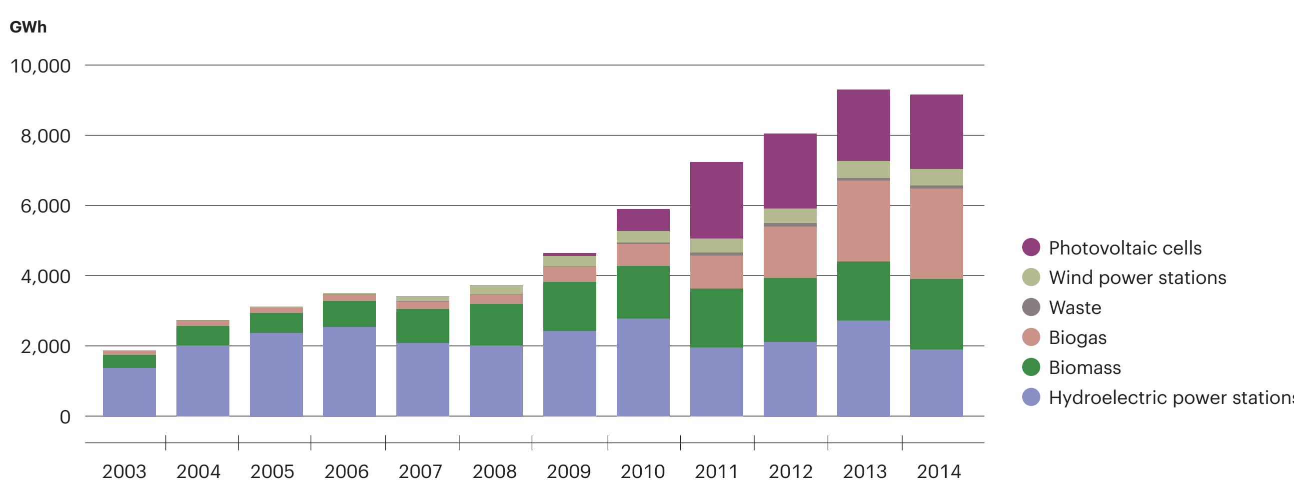
Impacts on human health and ecosystems

The renewable energy sources are generally perceived as a clean and environmentally friendly, because they do not pollute the surroundings as much as the fossil fuel sources during their operation. They are also beneficial in terms of climate change mitigation, mainly they do not contribute to greenhouse gas emissions. Additionally, they are also significant in terms of energy self-sufficiency of the Czech Republic, they do not directly stress the environment and their effects on human health are, compared with other energy sources, minimal. The often discussed issue of renewable resources is the occupation of arable land by photovoltaic plants or the disruption of the aesthetic values of the landscape by wind turbines.

Indicator assessment

Chart 1

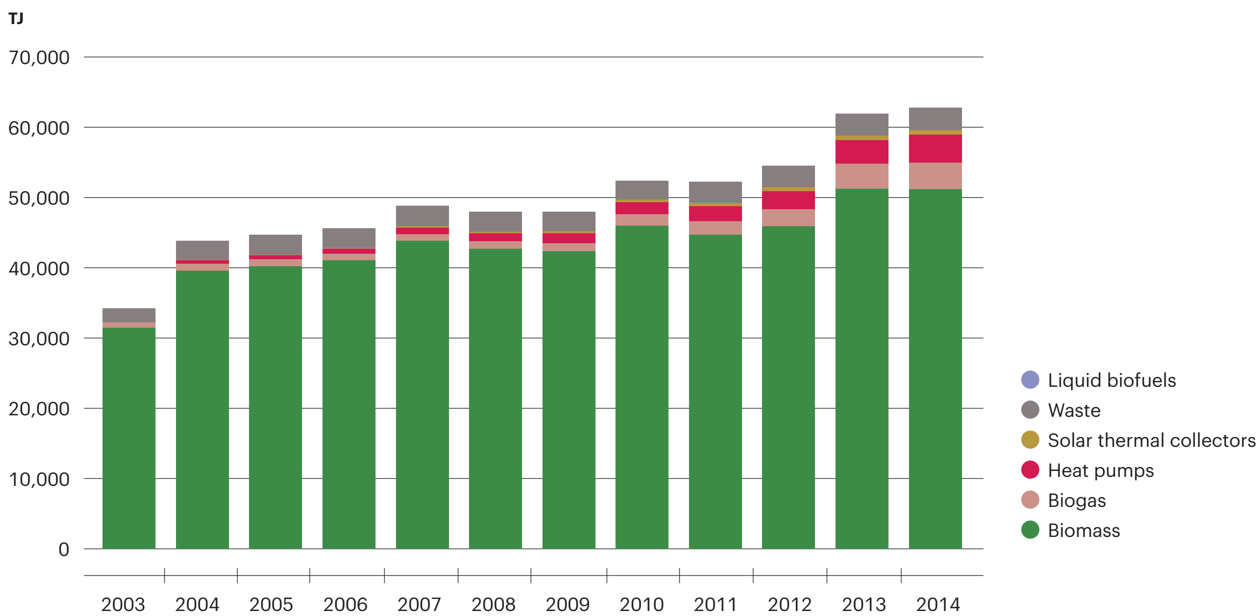
Electricity generation from renewable sources in the Czech Republic [GWh], 2003–2014



Source: Ministry of Industry and Trade

Chart 2

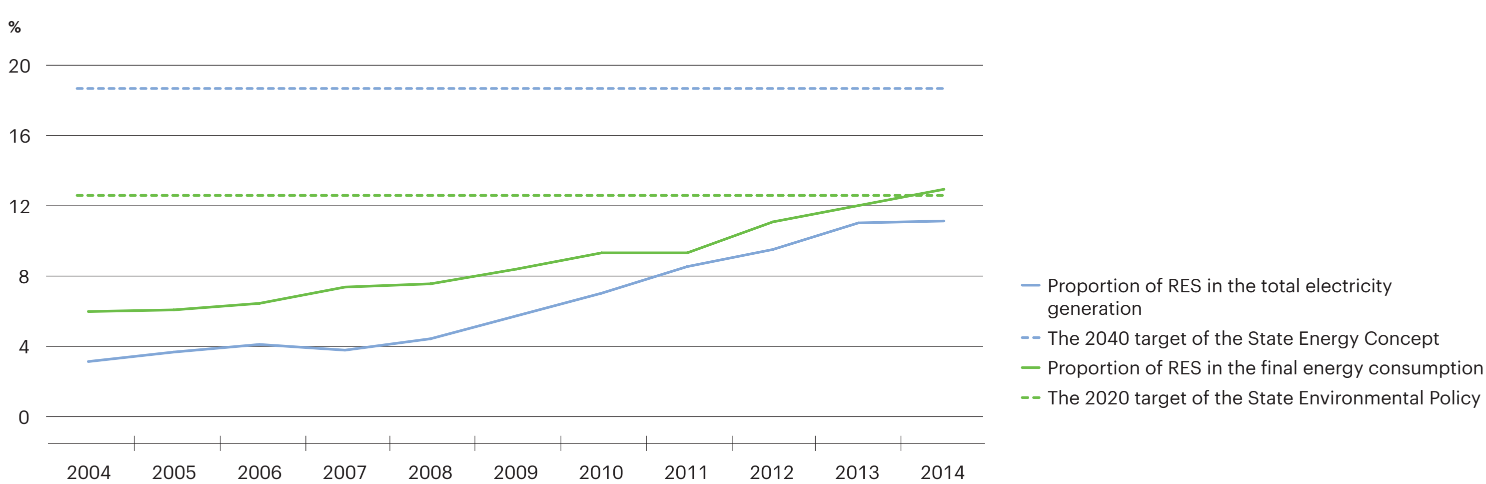
Heat production from RES in the Czech Republic [TJ], 2003–2014



Source: Ministry of Industry and Trade

Chart 3

Targets for RES and the status of their implementation in the Czech Republic [%], 2004–2014



The aim of the State Energy Concept 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%.

Source: Czech Statistical Office, Energy Regulatory Office, Ministry of Industry and Trade

The **renewable sources** 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 the considerable dependence on climatic, meteorological and geographical conditions, therefore they cannot be placed at any location. Also, their energy production may not be regulated according to the actual demand.

The **production of electricity from renewable sources** has experienced in the last decade a significant development (Chart 1) as a result of international and national strategies and targets, that have generated significant support for renewable sources. In the year 2014, total of 9,170 GWh was produced from renewable sources, which represents after 6 years of significant growth for the first time a slight year-to-year decline (by 1.5%). This was caused by the decrease in the production in hydropower plants by 30.2%. The production of electricity in this category was at its lowest level since 2004 and was caused by the extremely low level of watercourses. An additional slight decline in production was recorded in wind power (by 0.8%), although the installed capacity increased (by 3.0%). And here the decline in production is caused by the metrological conditions. For other renewable sources the year-to-year changes were positive. The largest year-to-year jump in production occurred for the supported sources: for electricity production from **biomass** with a recorded increase of 19.2% and from **biogas** where the production increased by 11.9%.

In the year 2014, the largest **proportion of electricity produced from renewable energy sources** was from biogas (28.0%), followed by photovoltaics (23.2%), and biomass (21.9%). The following important source are the hydroelectric power plants (20.8%). On a much smaller scale electricity is produced by wind power (5.2%), its potential the Czech Republic is limited by natural conditions. The smallest share is taken up by the biodegradable fraction of municipal solid waste (waste category) at 0.9%.

The **structure of electricity production from renewable energy sources in the Czech Republic** is relatively diverse and the proportion of the single energy sources is balanced. This state came about only in 2011, when RES received support. In the previous period, the only major renewable source of energy were the hydropower stations, while other sources had a minimum share.

The **heat production from renewable energy sources** increases in the long-term, in 2014 a year-to-year increase of 2.8% was recorded (Chart 2). The largest proportion is provided by the biomass (81.5%), where the decisive factor is fuel consumption in households, especially of wood for heating. Year-to-year the production of heat from biomass was stagnant at –0.2%. The other sources of heat generation have a much smaller share (6.4% heat pumps, 6.0% biogas, 5.1% waste, solar thermal collectors 1.0%). More significant year-to-year increase was recorded for the generation of heat by heat pumps, by 18.6%.

The Czech Republic proceeds today, having updated the State Energy Concept and the State Environmental Policy towards **two indicative targets** regarding electricity production from renewable energy sources (Chart 3). 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 the year 2014, the value for the Czech Republic, according to the uniform methodology for the EU, was 13.4%. However according to the data calculations by the Czech Statistical Office this target was achieved already in 2012. The second target, resulting from the updated State Energy Concept, is to achieve the proportion of RES in electricity production in the range of 18%–25%. In 2014, this share amounted to 10.7%.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

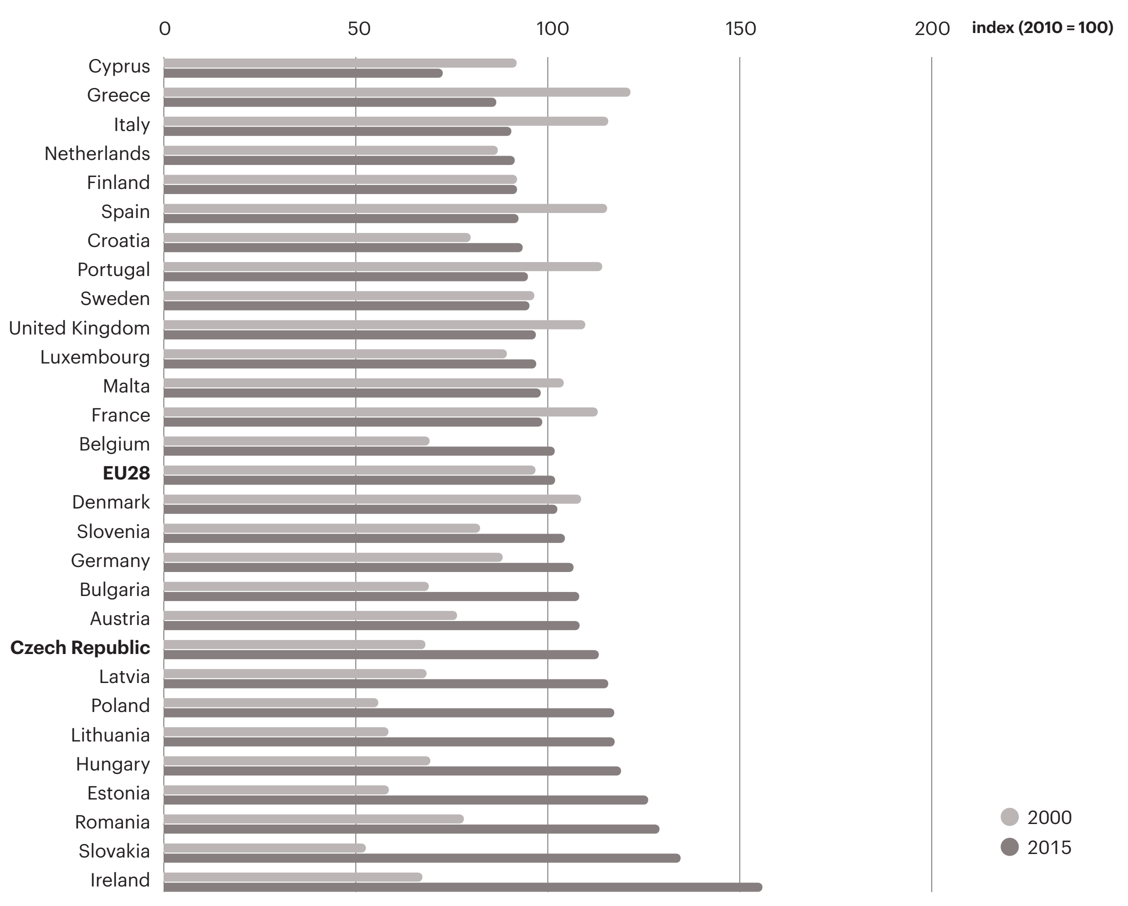
Industry and energy in the global context

Key messages

- In the individual countries of the EU28 industrial production has a different development. Its role plays historic cross-compliance, the sources of material, policy and international trade.
- Energy consumption per capita in European countries in the period 2000–2014 dropped by 9.5%. The trend of reduction of energy consumption is noticeable in most EU28 countries.
- The energy intensity of the economy in EU28 countries and in the Czech Republic is decreasing, which is caused by increasing the energy efficiency and structural changes in the economy.
- The dependence of the EU28 countries on energy import is increasing, in 2014 it reached 53.4%.
- The share of renewable energy sources in final consumption in the EU28 countries is growing, in 2014 the share was 16%, while the target for the EU28 as a whole by the year 2020 is 20%. Their national objectives were already achieved by 8 countries of EU28, including the Czech Republic.

Chart 1

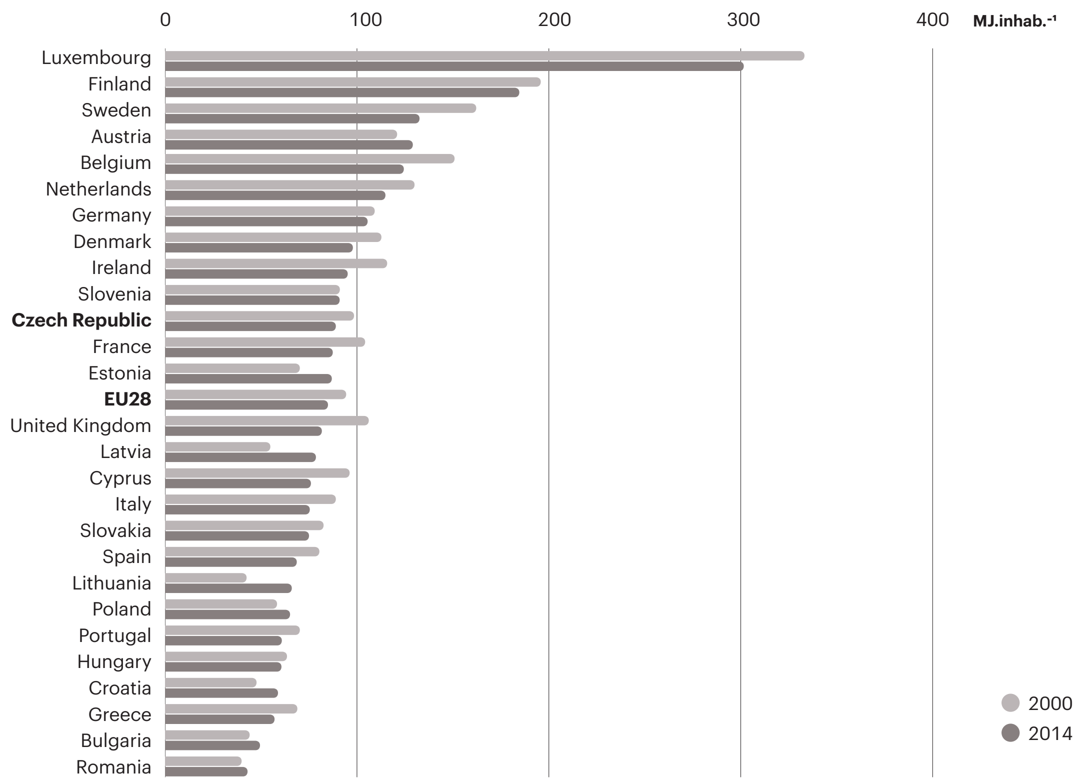
Index of industrial production [index, 2010 = 100], 2000, 2015



Source: Eurostat

Chart 2

Final energy consumption per capita, [MJ.inhab.-1], 2000, 2014



Source: Eurostat

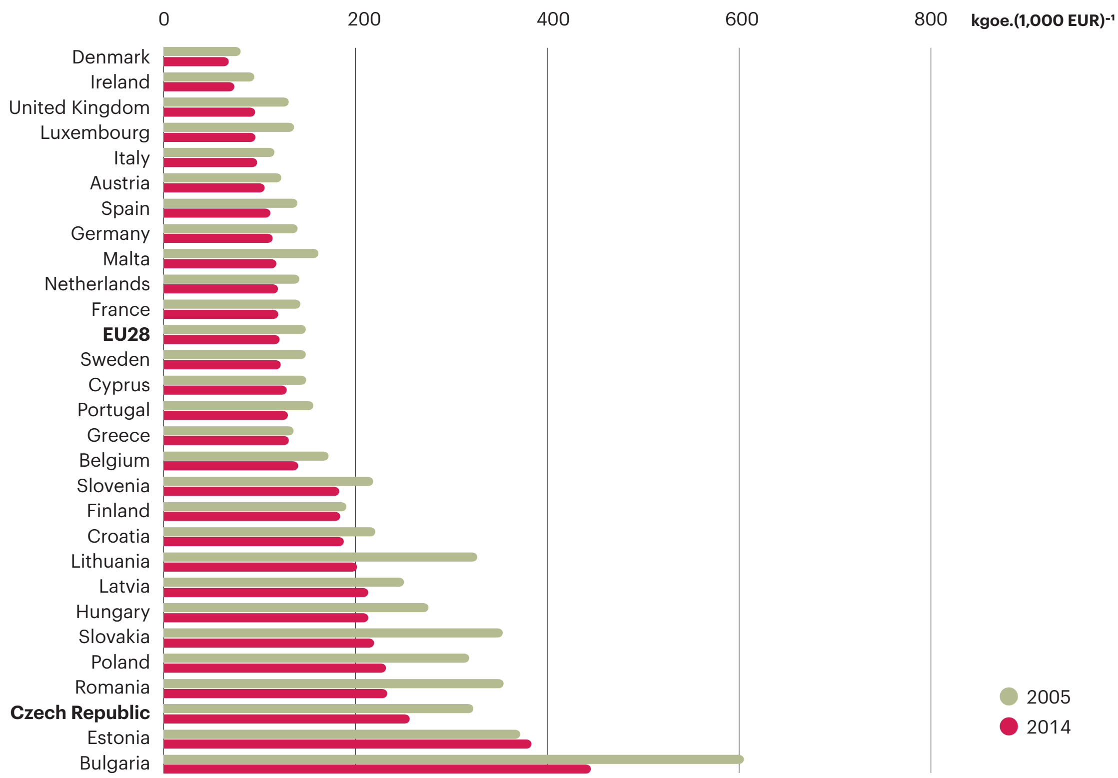
Chart 3

Final energy consumption by sectors [%], 2014

Source: Eurostat

Chart 4

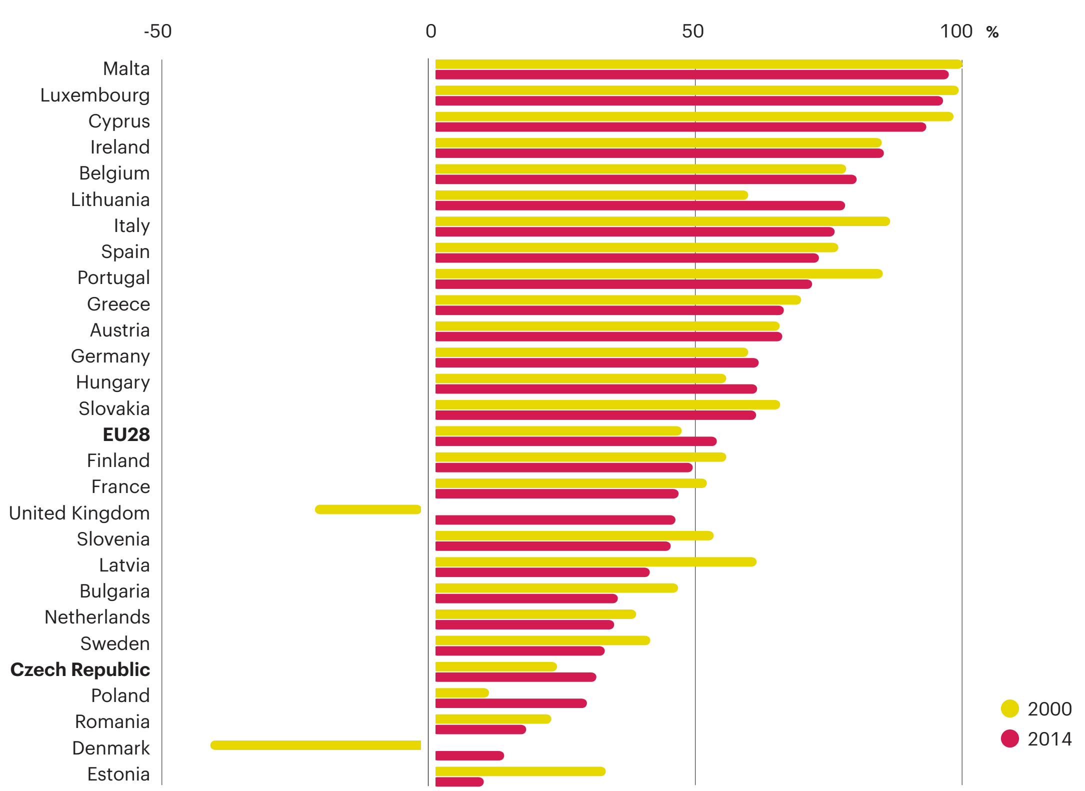
Energy intensity of the economy [kgoe.(1,000 EUR)⁻¹], 2005, 2014



Source: Eurostat

Chart 5

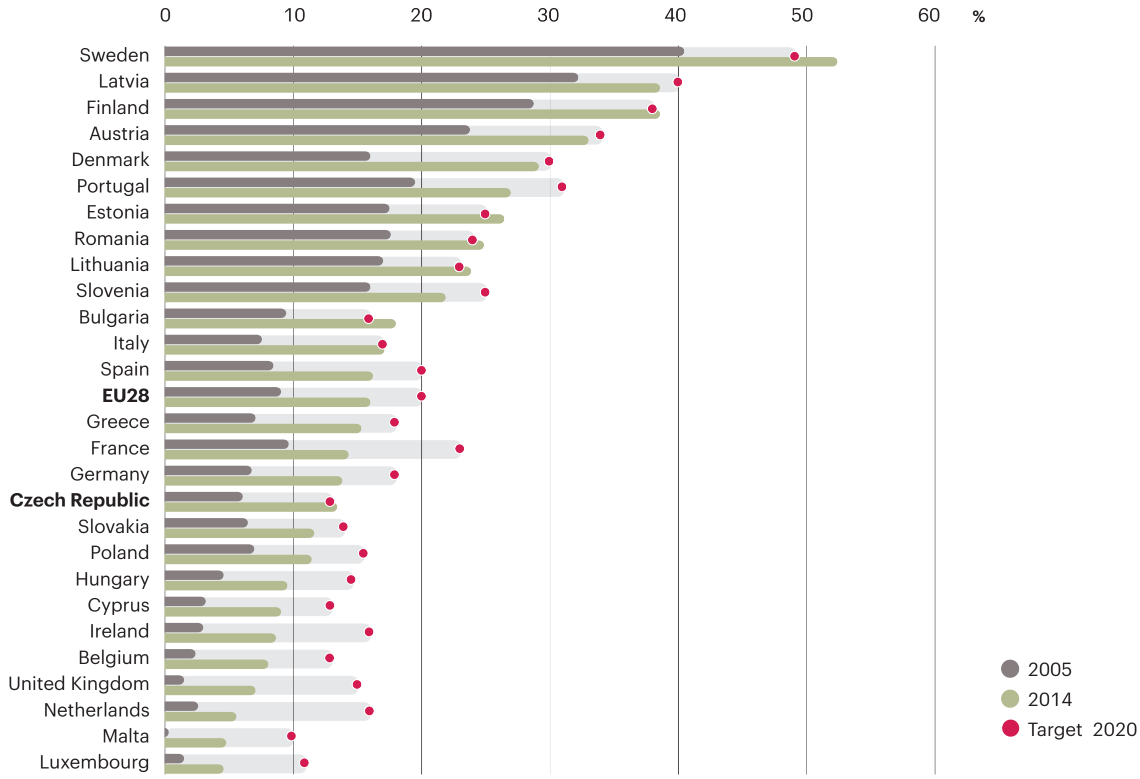
Energy dependence [%], 2000, 2014



Source: Eurostat

Chart 6

Proportion of renewable energy sources in final energy consumption [%], 2005, 2014



Source: Eurostat

In the individual countries of the EU28 **industrial production** has a varied development (Chart 1). While some countries succeed in increasing the production by a considerable pace (e.g. Ireland, Slovakia, Romania), others are trying to cope with the decline (e.g. Greece, Cyprus, Italy). These changes are related to 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 in the entire EU28 increased over the period from 2000 to 2015 from 98.7 to 103.9 (year index 2010 = 100). For comparison, in the Czech Republic this change was much more pronounced, the index in the same period increased from 69.5 to 115.5.

The focus of the individual countries on industrial production is largely given by the presence of mineral and energy resources deposits. During the second half of the 20th century, the European countries have pursued two different directions. While the western part applied market economy based on the principle of balance between supply and demand, the eastern part was 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 has fallen in the countries of the EU28 in the period of 2000–2014 by 9.5%. The trend of reduction in energy consumption is noticeable in most countries (Chart 2), the largest decline in this period was recorded in Luxembourg (−31.7%), Sweden (−29.6%) or Belgium (−26.5%). Some of the countries, however, show an increase in consumption, for example, Latvia (23.7%), Lithuania (23.7%) and Estonia (16.7%). A total decline in energy consumption in EU28 countries 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, the per capita consumption is 91.7 MJ, i.e. 4.6% higher than the average for EU28 (87.6 MJ.inhabitant^{-1}).

The final energy consumption in 2014 in the EU28 reached the value of 1,061.2 mil. t of oil equivalent (toe)[17], which means the year-to-year decline by 3.9%. Of this total consumption the largest share is for transportation (33.2%), industry (25.9%) and households (24.8%). Next follows the service sector (13.3%) 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.

The **energy intensity of the economies** in EU28 countries (Chart 4) is decreasing. Between the years 2005–2014 its value dropped from 149.5 to 122.0 kgoe.(1,000 EUR)$^{-1}$. This trend affects the improvement of energy efficiency in energy production and for 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 2005–2014 is reported in all countries EU28 with the exception of Estonia. The energy intensity of the economy of the Czech Republic during this period dropped from 325.4 to 258.6 kgoe.(1,000 EUR)$^{-1}$, that is by 20.5%, however it is still high compared to the average of the EU28, approximately twice as high. The reason is the significant role of industry in the Czech Republic on the creation of GDP.

EU28 dependence on energy imports is increasing. In the eighties of the last century its value amounted to less than 40%, in 2000 it went up to 46.7% and in 2014 it reached 53.4%. Among the individual member states EU28, however the energetic dependency varies significantly (Chart 5), which is caused by the differences in domestic fossil resources' availability and the potential of renewable energy sources. In the Czech Republic in 2014, the total energy dependency was 30.4%, 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 fuels and fuel to 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** in the EU28 final consumption grew year-to-year from 15.0% to 16.0%, while in 2005 this value amounted to only 9.0% (Chart 6). European countries 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 2014, the national target has been already reached by 8 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 2014 in the Czech Republic reached 13.4%, while the target is 13%.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[17] toe – tonne of oil equivalent. It corresponds to the energy extracted from one tonne of oil, 41.868 GJ or 11.63 MWh. Similarly as the unit kgoe (kilogram of oil equivalent) corresponds to the energy obtained from one kilogram of crude oil, 41,868 kg or 11.63 kWh).

8 Transportation

33 | Transport performance and infrastructure

Key question

What is the development of transport and the related environmental burden?

Key messages

The total performance of public passenger transport is increasing. The transport performance of rail passenger transport in 2015 grew year-to-year by 6.4%, significantly increasing the railways performance within integrated transport systems in cities and international transport.

The total transport performance of passenger and freight transport is growing, which increases the potential burden from transport on the environment. In 2015, the passenger car transport performance significantly increased by 5.2% and the share of public transport in passenger transport was reduced to 33.0%. Within the structure of the performance of fright transport according to transport modes there is a continued growth of road transport, which is the least favourable from an environmental point of view.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

State Environmental Policy of the Czech Republic 2012–2020
- supporting measures to increase the share of low-emission freight transport, support of the development of logistic solutions and traffic organisation on the basis of the of co-modality principle
- priority strengthening of the capacity of the existing transport corridors before building of the concurrent road with similar transport capacity serving the same territory
- in the construction and reconstruction of transport structures ensuring a functional permeability for animals and making passable the existing structures in areas with significant fragmentation influence

National Emission Reduction Programme of the Czech Republic
- measures of supranational importance in the area of transport infrastructure, for which a significant contribution is expected to improve air quality
- priority construction of bypasses of towns and municipalities
- move the freight transport performance from roads to railways

Air Quality Improvement Programmes
- promotion of integrated transport systems
- quality improvement in public transport system
- ensure city public transport preference for transport within cities
- construction and reconstruction of railway lines

- construction and reconstruction of tram tracks and subway lines
- construction of parking lots

Transport Policy of the Czech Republic for the period 2014–2020, with prospects till 2050
- supporting energy efficient public transport
- supporting non-motorised transport in the connectivity system

White Paper – Roadmap to a Single European Transport Area
- 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, tripling the length of the high-speed railway network and maintaining a dense railway network in all Member States

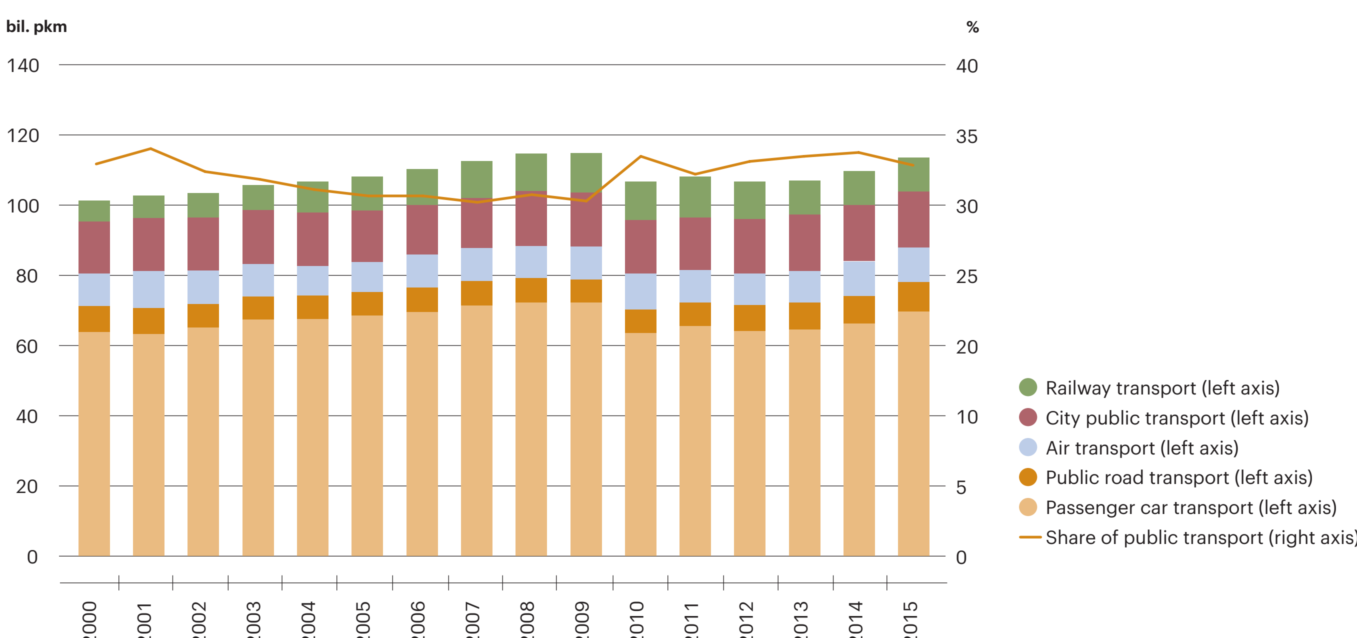
Impacts on human health and ecosystems

The impacts of transport on ecosystems and human health are caused mainly by the actual traffic on roads (emission and noise pollution), however, the effects on landscape and biodiversity that are associated with development and operation of the transport infrastructure are also significant, causing the fragmentation of landscape and take-up of agricultural and forest land resources. The greatest negative impacts on human health and ecosystems are caused by road traffic. In the context of passenger transport, from the perspective of the environment, the best is public transport, particularly the rail transport, causing in comparison with the individual transport lower environmental burden per unit of transport performance.

Indicator assessment

Chart 1

Development of passenger transport performance and the proportion of public transport in total passenger transport performance in the Czech Republic (excluding air transport) [bil. pkm, %], 2000–2015

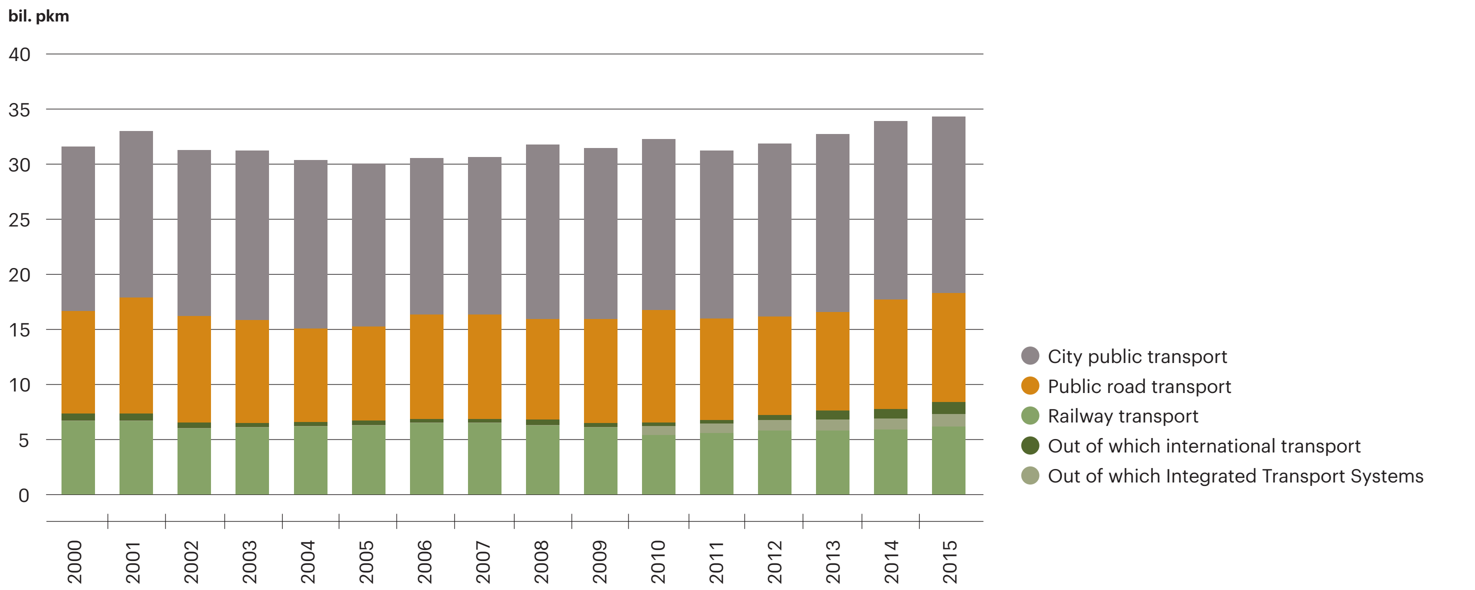


The decline in performance of passenger car transport between 2009 and 2010 is of a methodological nature and is related to a change in calculation of the transport performance in relation to the national transport census. It is therefore impossible to interpret the development of transport performance between the years 2009 and 2010 as an actual drop in passenger car transport or in passenger transport as a whole.

Source: Ministry of Transport

Chart 2

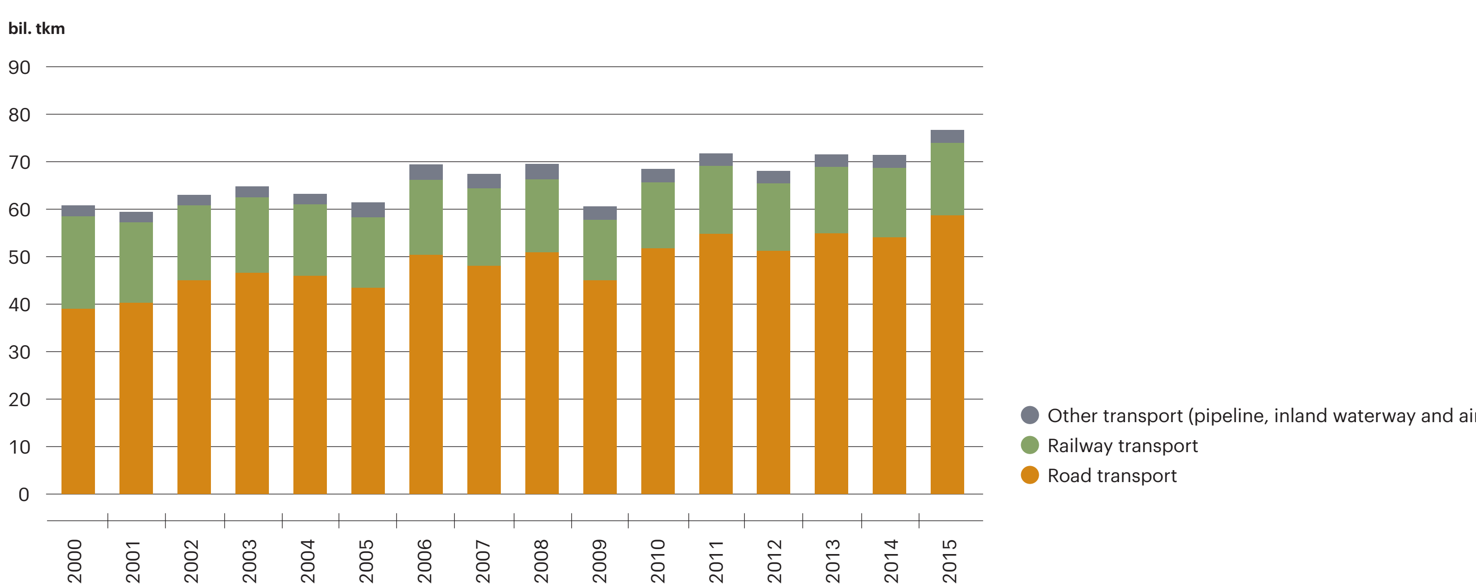
Development of transport performance of passenger public transport in the Czech Republic, [bil. pkm], 2000–2015



Source: Ministry of Transport

Chart 3

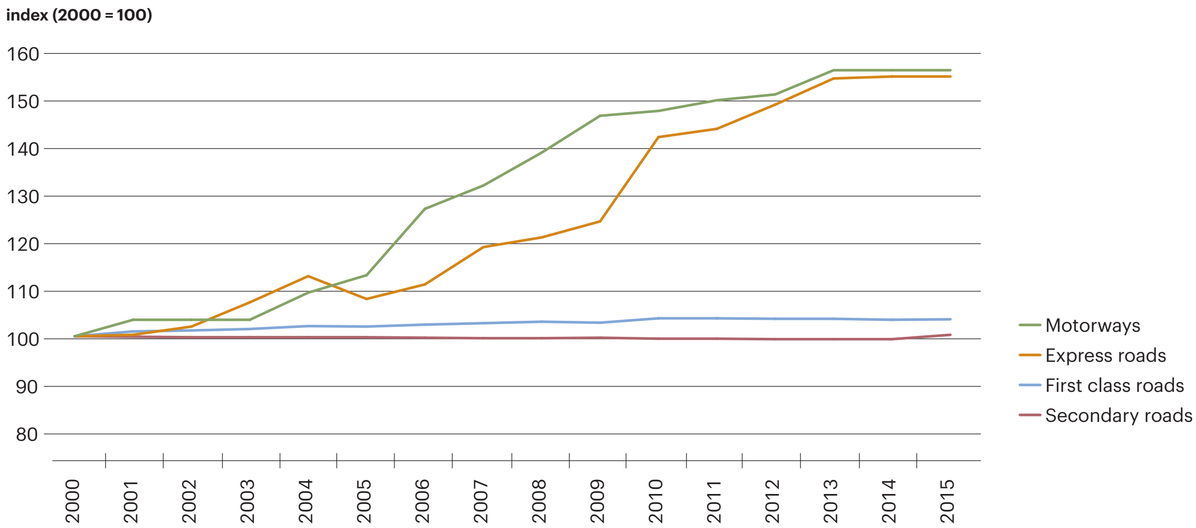
Development of freight transport performance in the Czech Republic [bil. tkm], 2000–2015



Source: Ministry of Transport

Chart 4

Development of the road and motorway networks in the Czech Republic [index, 2000 = 100], 2000–2015



Source: Ministry of Transport

The **total transport performance of passenger transport** in the Czech Republic is rising, reflecting the growth of the economy of the Czech Republic. In the year 2015 in the year-to-year comparison it grew by 3.4% to 113.8 bil. pkm, which means an increase of 12.2% in comparison with the year 2000, respectively by 6.0% compared to 2010 (Chart 1). The share of road transport on the total performance of land modes of passenger transport accounted for by approximately three quarters, while this proportion is relatively stable in the long term. After the temporary stagnation in the period of 2010–2013 the performance of **passenger car transport** is growing. It was influenced by the growing purchasing power of households, significantly increasing sales of new passenger cars as well as a relatively lower price of fuel, supported by the situation on the global oil market. In 2015, the performance of passenger car transport in year-to-year comparison grew by 5.2%, and during the period of 2010–2015 increased by 9.7%. The performance of the **public passenger transport** (without air transport) as a whole is increasing as well, in particular thanks to the railways (in 2015 by 0.9%, since the year 2010 by 5.7%, Chart 2). Nevertheless, the share of public transport on passenger transport in 2015 as a result of the growth of the passenger car transport dropped to 33.0%, reaching the same values as at the beginning of the 21st century. In the longer-term development the transport is thus not yet being individualised, even though the development in 2015 suggests a reversal of the earlier trend, which was favourable from the environmental perspective.

Railway passenger transport performance has been growing since 2010. In 2015, the performance grew interannualy by 6.4% to 8.3 bil. pkm. In comparison with the year 2000 the railway passenger transport performance increased by 13.7%, while from 2010 grew by 26.0%, i.e. roughly by a quarter. In 2015, railways transported 176.6 mil. people, which is 0.5 mil. people more than in 2014. Since 2000, railway performance within integrated transport systems has been growing: in 2015 it amounted to 12.8% of total railway transport performance while in 2000 it was only 2.9%. After 2010, international railway transport performance has also grown, in 2015 its proportion in total transport performance was 13.1%. The competitive environment on international railway corridors has contributed to the growth of railways in the national and international transport.

Road public transport, i.e. regular and irregular buses, in the period 2000–2015 fluctuated and in 2015 stagnated at the level of 10.0 bil. pkm, which is by 6.9% more than in 2000. The number of passengers travelling by bus increased year-to-year by 1.4 mil. (0.4%) to 350.9 mil. passengers and in comparison with railway it was roughly twofold. This percentage does not correspond to the comparison of railway transport performance and bus transport performance. This is due to the fact that the average transport distance of buses (28.5 km in 2015) is much shorter compared to that of trains (47.0 km). The performance of the city public transport in 2015 year-to-year dropped by 1.0%, for the entire period 2000–2015, however, recorded an increase by 7.6%. The growth in the performance of the **city public transport** in the monitored period ensured mainly the development of performance of the Prague metro, which increased during the monitored period by 67.6%, respectively by 7.8% in 2015.

The **air transport performance** in the Czech Republic[1] grew by 86.4% in the period of 2000–2010. In subsequent years it fell slightly by 9.7 bil. pkm in 2015, which is by 11,0% less than in 2010. A total of 12.8 mil. passengers passed through airports in the Czech Republic in 2015, which represents a growth by 5.5% compared to the previous year 2014. Inland passenger transport in 2015 reached only 0.8% of the number of passengers transported.

Transport performances of freight transport in the Czech Republic in the context of economic development also clearly increase, in 2015 they increased by 7.3% to 76.6 bil. tkm and were by 26.1% higher than in 2000. During the period 2000–2015 the structure of freight transport has significantly changed, when railway transport performance decreased by 21.8% while road freight transport performance increased by 50.5%. This development, influenced by higher flexibility of road freight transport and attenuation of the high-volume shipments for which the railway is more appropriate, caused an increase in the share of road transport in total freight transport performance to 76.6% in 2015, which is an unfavorable finding from the environmental perspective. In the year 2015 in the year-to-year comparison the railway transport performance grew (by 4.7%),however the growth of road freight transport was more pronounced (8.5%). The performance of the other types of freight transport (inland waterway, air and pipeline transport), whose share in total freight transport performance was in 2015 only 3.5%, have stagnated or even fall, as in the case of inland waterway freight transport. In the period of 2010–2015 inland waterway freight transport performance decreased by 13.9%, decline in 2015 by 10.9% was influenced by low water conditions as a result of drought.

After 2000, a **network of motorways, express roads and first class roads** was developing in the Czech Republic, which was associated with land take of agricultural and forest land, the largest ones taking place in 2003–2008. In 2000–2015, the motorways network expanded by more than a half of the original size to 776 km, the express roads network to 459 km (Chart 4). In the years 2014 and 2015 no new sections of motorways were put into operation and only 1.1 km of express roads were added, although the reconstruction and modernisation of express roads was continuing, in particular, the D1 motorway. The length of the first class roads increased in the period 2000–2015 by 203 km, from 2010, however, the total length of first class roads was slowly dropping, which is given by the realisation of the bypasses of municipalities and the transfer of original sections of first class roads to the road of the lower classes.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[1] *Airline carriers registered in the Czech Republic.*

34 | Emission intensity of transport

Key question

Is the emission intensity of transport, together with its impact on the environment and public health, declining?

Key messages

Emissions of VOC, CO and suspended particles from transport continue to fall, the decline rate is, however, decreasing. There is a significant modernisation of the dynamic composition of a car fleet of road vehicles, the road transport emission intensity decreases. On the roads in 2015 the biggest proportion of passenger cars were meeting EURO 5 emission standard. Renewal of the car fleet of the registered passenger cars in 2015 accelerated due to a record number of registrations of new vehicles, however, despite that, the average age of the car fleet increased and in the case of passenger cars in 2015, it exceeded 14.5 years. The use of alternative fuels and propulsions in road transport is clearly growing, however, overall it is still marginal.

Due to the growth of the transport performance of both passenger and freight transport the consumption of energy in transport is increasing, and thus also the production of greenhouse gas emissions from transport. Emissions of polyaromatic hydrocarbons from transport are increasing, in the period of 2000–2015 increased by 163.1%. The use of biofuels due to low prices of petroleum products in 2015 declined and the share of RES in the total energy consumption in transport in the Czech Republic in 2015 reached 6.5%. The target of a 10% share of energy from RES in transport by the year 2020 has not yet been fulfilled.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

State Environmental Policy of the Czech Republic 2012–2020
- securing a 10% share of energy from renewable sources in transport by the year 2020, while reducing emissions of NO_x, VOC and $PM_{2.5}$ from transportation
- increasing the proportion of vehicles with alternative propulsion in the sector of public and individual transport
- taking into account the traffic problems in transport development plans of regions, cities and municipalities to achieve air pollution limit values, for example by construction of bypasses and establishing low emission zones

National Emission Reduction Programme of the Czech Republic
- determining emission ceilings for NO_x and VOC for the designated resource groups in the road transport sector
- supporting speeding up of the renewal of the fleet of passenger cars
- stimulating the use of alternative propulsions in road freight transport through reduced rates of road tax
- supporting the purchase of vehicles with alternative propulsion for public passenger transport
- supporting the construction of infrastructure for petrol and rechargeable stations for alternative propulsions
- supporting the implementation of low emission zones
- replacement of the car fleet of the public administration for alternatively powered vehicles
- improving the functioning of the system of periodic technical inspections of vehicles

Air Quality Improvement Programmes
- determining emission ceilings for road transport for the built-up areas of municipalities with a population of over 5,000
- introducing low emission zones
- developing alternative propulsions in public transport
- promoting the use of low-emission and zero-emission propulsions in automotive transport

National Action Plan for Energy from Renewable Sources
- achieving a 13% share of energy from RES in gross final energy consumption and a 10% share in final energy consumption in the transport sector by the year 2020

National Action Plan for Clean Mobility
- creating favourable conditions for a wider application of alternative fuels and propulsions in the transport sector in the Czech Republic

Transport Policy of the Czech Republic for the period 2014–2020, with prospects till 2050
- 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

White Paper – Roadmap to a Single European Transport Area
- reducing greenhouse gas emissions from transport by 60% compared to 1990 levels by 2050
- improving the energy efficiency of vehicles for all kinds of transport

Directive of the European Parliament and of the Council 2014/94/EU on implementation of infrastructure for alternative fuels
- implementing infrastructure for alternative fuels in the EU in order to minimise dependence of transport on oil and reducing its impact on the environment

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 consumption of energy by the year 2020

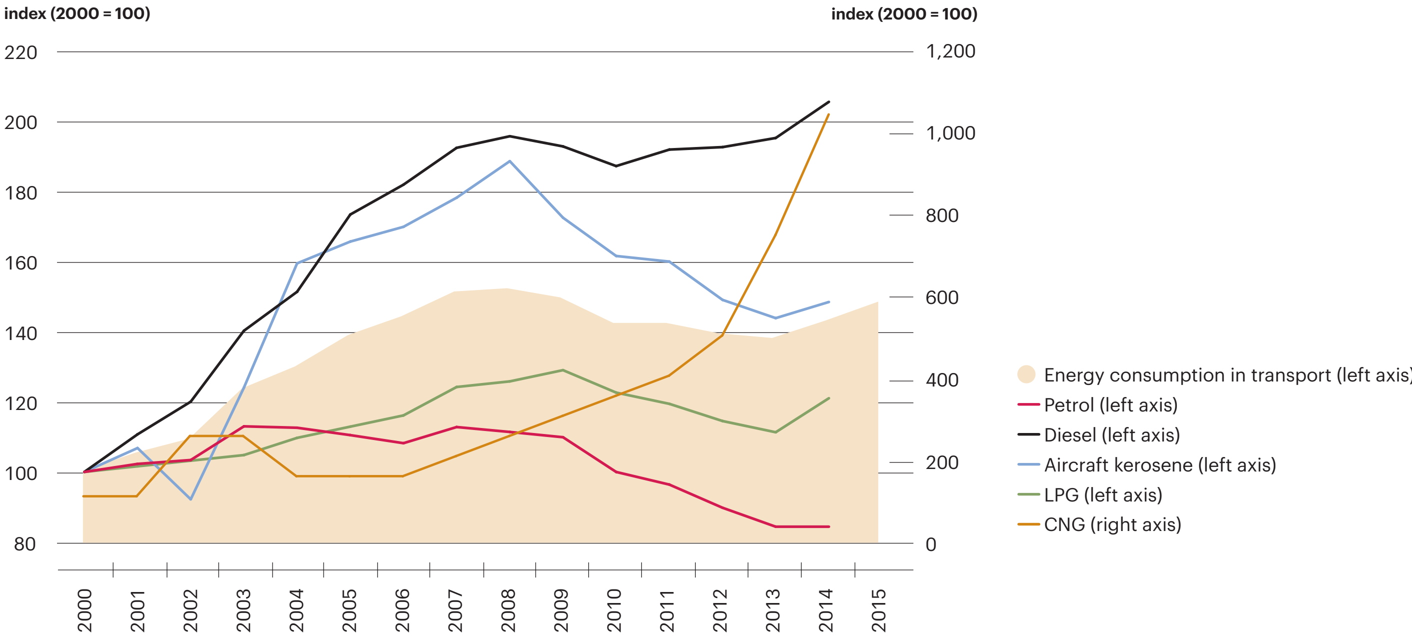
Impacts on human health and ecosystems

Transport is an important source of air pollution. Health impacts from transport-related air pollution are also amplified by the fact that transport emits pollutants most in densely populated areas and in close proximity to the Earth's surface, which reduces the possibility of their dispersion. In cities and agglomerations without significant industry, transport is the main factor affecting air quality and thereby the public health. The negative effects include reduced immunity, deterioration of the health of asthmatics and allergy sufferers and the more frequent occurrence of respiratory and cardiovascular diseases. Trough air pollution, transport also burdens ecosystems, namely by producing precursors of ground-level ozone which damages vegetation and reduces agricultural yields.

Indicator assessment

Chart 1

Energy and fuel consumption in transport [index, 2000 = 100], 2000–2015

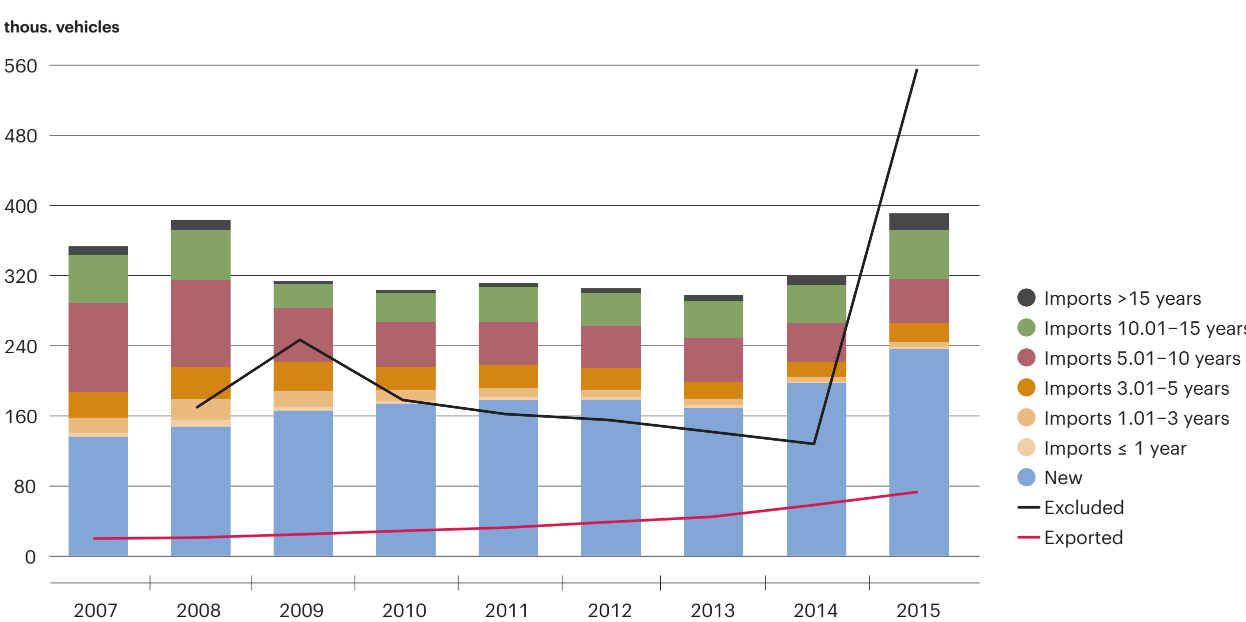


Fuel consumption data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: Czech Statistical Office, Transport Research Centre

Chart 2

Number of registrations of new passenger cars, imported second-hand cars, exported and excluded vehicles [thous. vehicles], 2007–2015

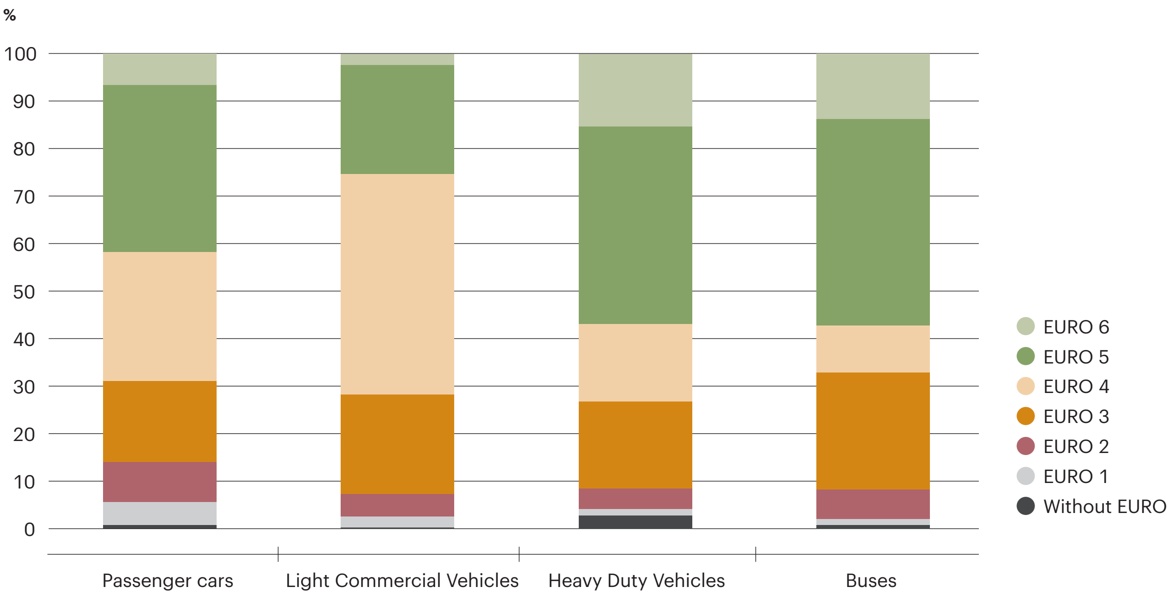


The significant increase in deregistered vehicles in 2015 includes most of the administrative deregistration of non-existent vehicles and vehicles in the half-transfer from the Central Vehicle Register. According to the information of the Car Importers Association only 111,222 vehicles were physically discarded.

Source: Car Importers Association

Chart 3

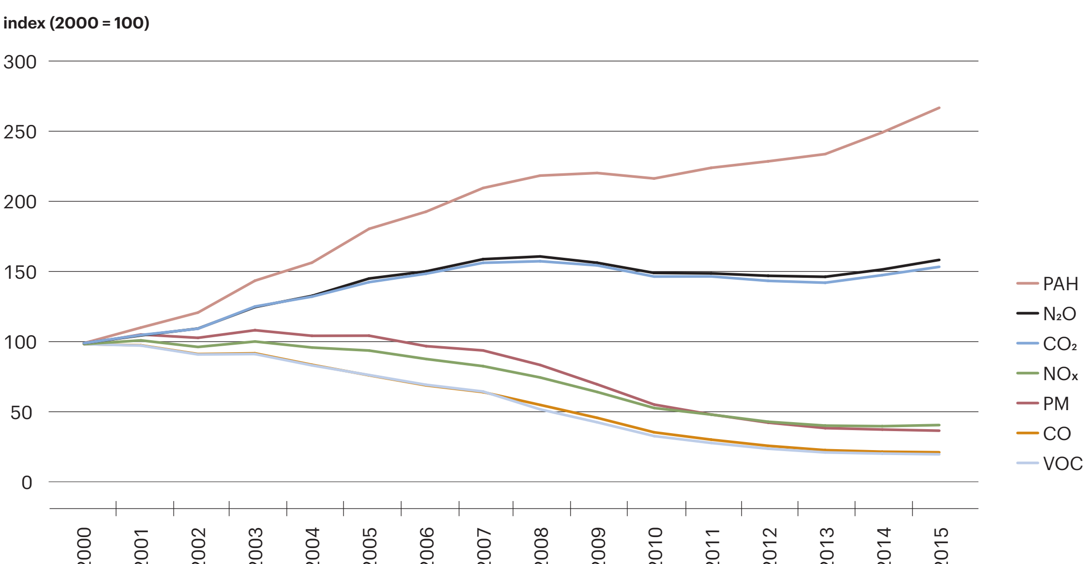
Structure of the car fleet operated at roads per the individual categories of vehicles, the average of all monitored profiles [%], 2015



Source: Road and Motorway Directorate of the Czech Republic

Chart 4

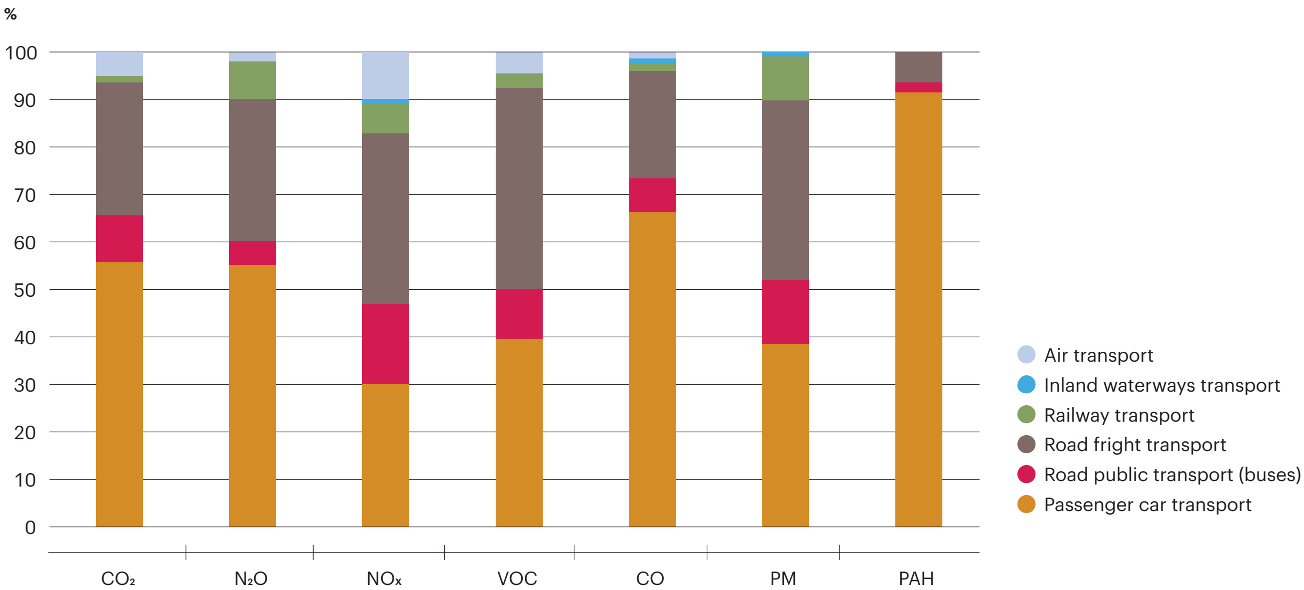
Emissions of air pollutants and greenhouse gases from transport in the Czech Republic [index, 2000 = 100], 2000–2015



Source: Transport Research Centre

Chart 5

Proportion of the various modes of transport in transport-related emissions in the Czech Republic [%], 2015



Source: Transport Research Centre

The **consumption of energy in transport** is increasing as a result of the growth of the transport performance of passenger and freight transport, the interruption of the growth trend in the years 2010–2013 was only transient (Chart 1). In 2015, the total consumption of energy in transport increased by 4.0%, i.e. by 10.2 PJ to 262.2 PJ and was higher by 51.7% than in 2000. The growth of energy consumption in 2015 was mostly contributed to by the passenger car transport (by 6.3 PJ, i.e. 4.4%), which participated by 56.5% on the total energy consumption in transport in that year; the share of freight road transport was 27.2%.

The **development of fuel consumption** in the transport sector is characterised by the continued growth of diesel consumption in 2014[2] by 5.3%, affected by the development of the fright road transport performance and the growth of the diesel engine technologies in the passenger cars fleet, and the stagnation of consumption of petrol. **The use of alternative fuels and propulsions** in road transport is increasing, however, particularly in the individual transport it remains marginal. The CNG consumption increased between 2000 and 2014 more than tenfold, in the year-to-year comparison in 2015 then by 45.7%[3] to 43.6 mil. m³. The proportion of buses on CNG consumption is estimated to be about 40%, i.e. 17.5 mil. m³. In 2015, a total number of approx 10.5 thous. cars was registered, 820 buses for CNG and 713 electric vehicles, in 2015, the number of new registrations of passenger CNG vehicles was 1,279, 268 electric vehicles and 1,024 hybrids.

The consumption of renewable energy in transport in 2015 reached 6.5%[4] of the total final energy consumption in the transport sector, the target of 10% share by the year 2020 based on the European legislation has not yet been fulfilled. The consumption of FAME after a marked increase in the period 2007–2014 fell in 2015 in the year-to-year comparison by 7.7%, the bioethanol consumption stagnated. The main cause of the changes in the increasing trend of biofuels consumption, whose majority is created by the mandatory blending of bio-component to petrol and diesel, is a decline in consumption of high-percentage biofuels due to lower prices of petroleum products.

The volume of vehicle fleet of road vehicles continues to increase, at the end of the year 2015 a total number registered in the Central Vehicle Register was 6.9 mil. road motor vehicles (increase by 5.6%), of which passenger cars are 5.1 mil. (growth by 5.8%). In 2015, the number of registrations of new passenger cars was significantly increased, by 20.0% year-to-year to 230.9 thous. vehicles, which is the highest value since 2000. The growth of registrations is a manifestation of the positive development of the economy. At the same time the registration of second-hand imported cars is increasing, in 2015 by

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

[3] *According to the data of the Czech Gas Association.*

[4] *Based on the National Action Plan for Energy from Renewable Sources.*

25.7% in interannual comparison (Chart 2). The biggest increase in imports of second-hand vehicles was recorded in the age group over 10 years, which is caused by a serious drop of the price of these vehicles, whose entry into the low emission zones in Western European countries is either permitted for a payment or completely prohibited. In the development of the number of cancelled vehicles it is possible to record the abnormal increase in 2015 due to legislative change, the amendment to Act No. 56/2001 Coll., on conditions for the operation of vehicles on the road, when a vehicle temporarily retired from operation and the vehicles in half-transfer officially ceased to exist. Due to the mentioned development of the registrations and deregistrations of vehicles the proportion of the youngest age category of passenger cars up to 2 years increased to 9.6%, but still there are about 3.1 mil. cars older than 10 years in the register.

The renewal of the dynamic structure of the vehicle fleet, i.e. vehicles operating on the roads, is considerably faster, because the use of newer vehicles is higher than the older vehicles. The proportion of passenger cars which do not fulfil the EURO 1[5] emission standard, which in 2001 reached on motorways and in Prague 22–25%, on other profiles 40–60%, decreased to around 5% in 2005 and to around 1% in 2015. In 2015, for all categories of vehicles on the roads in operation, the most represented is the EURO 5 emission standard (Chart 3), with the exception of light commercial vehicles, where were it was the EURO 4 standard.

The emissions of NO_x, VOC, CO and suspended particles from transport in the period 2000–2015 have declined significantly, in the case of NO_x and PM to less than half and VOCs and CO to about a quarter of the state of year 2000 (Chart 4). At the end of the monitored period, the dynamics of decline of emissions reduced, in the year-to-year comparison of 2015, VOC emissions decreased by 1.8%, CO by 1.6% and PM emissions by 2.1%. NO_x emissions have recorded a slight year-to-year increase of 1.8% due to the significant growth in emissions from air transport. A major impact on the reduction of emissions had the decline of the **emission intensity of road transport**, i.e. the unit of emissions per the unit of transport performance, and that as a result of the positive development of the vehicle fleet. For example in the passenger car transport, the emission intensity fell for NO_x production from 544.5 t.bil. pkm^{-1} in 2000 to 183.0 t.bil. pkm^{-1} in 2015, the average passenger car in 2015 thus produced per a unit of the transport performance one-third of NO_x emissions in comparison with the year 2000. A significant increase during the period 2000–2015, by contrast, was recorded for **emissions of PAHs**, due to the growth in consumption of fuels they grew by 163.1%, i.e. to more than a double, in the year 2015 in the year-to-year comparison by 6.9%.

The production of greenhouse gas emissions in the transport sector is largely dependent on the development of energy and fuel consumption, in the period 2000–2015 the trend of greenhouse gas emissions in the transport sector was therefore growing, especially at the beginning and at the end of the period. In the year 2015 emissions of CO_2 were by 53.3% and N_2O by 58.1% above the level of the year 2000, in the year-to-year comparison of 2015 they grew by 3.9%, respectively 4.4%.

In the **structure of transport emissions from the transport sector** in 2015 in the case of greenhouse gas emissions, CO and PAHs had the largest share the passenger car transport, and in case of PAHs it reached up to 91.8% of total emissions (Chart 5). Road freight transport with approx. 40% share in the total transport-related emissions is the biggest source of NO_x, VOC and particulate matter emissions. Of the total emissions of each pollutant in the Czech Republic in 2015, transportation had the largest share in the case of NO_x, i.e. 26.0%.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[5] *ATEM – Studio of Ecological Models: Survey on the current dynamic structure of the vehicle fleet in 2015. The forecast of the structure of the vehicle fleet by 2040.*

35 | Noise pollution burden of the population

Key question

What is the state and development of the noise pollution in the Czech Republic?

Key messages

The noise exposure of the inhabitants of the Czech Republic is not present in the entire area, but concentrates into large municipalities and surroundings of main roads.
In the agglomerations of Liberec, Olomouc and Ústí n. Labem/Teplice is the proportion of the population exposed to noise levels exceeding the limit values below the average of all the agglomerations in the Czech Republic.

Noise is an important factor influencing the quality of the environment in the Czech Republic, 2.8% of the inhabitans are exposed to noise levels from road transport exceeding the stipulated limit values during the whole day and 6.2% of the population in agglomerations of over 100 thous. of inhabitants. In Prague, Brno and Pilsen agglomerations around 10% of the population are exposed to noise exceeding the limit values and a lower noise pollution affects the majority of the inhabitants of these agglomerations. In regional centres and smaller settlements along the major roads, the transit road transport is a significant cause of noise pollution.

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.

References to current conceptual, strategic and legislative documents

Directive 2002/49/EC of the European Parliament and of the Council relating to the assessment and management of environmental noise (Environmental Noise Directive – END)
- determining exposure to environmental noise, through noise mapping and by using assessment methods common to the Member States
- ensuring that information on environmental noise and its effects on the public is made available
- adopting action plans by the Member States, based upon noise-mapping results, with a view to preventing and reducing environmental noise
- processing of Strategic Noise Mapping by 30 June 2012 and then once every five years

Act No. 258/2000 Coll., on protection of public health and on amendment to some related acts
- procuring strategic noise maps for all agglomerations with a population exceeding 100 thous. and for main roads and railways by 30 June 2012
- procuring action plans for reducing noise pollution in areas specified by noise mapping

State Environmental Policy of the Czech Republic 2012–2020
- limiting the negative impact of exposure to noise on the human health and ecosystems

Transport Policy of the Czech Republic for the period 2014–2020, with prospects till 2050
- implementing measures for protection against noise and vibrations especially in densely populated areas where hygienic noise limits are exceeded

Impacts on human health and ecosystems

At present, noise is a significant indicator of environmental quality and factor affecting the public health. Excessive noise causes stress, which brings about number of diseases of affluence. Noise nuisance, i.e., the subjective effects of acoustic discomfort, and also sleep disturbance and influence on everyday activities (work, relaxation) are considered the most frequently occurring noise impacts on humans. The most serious health effects of noise are effects on the hearing organs and cardiovascular system. Noise levels causing these effects are not reached in the municipal environment, however. Noise affects animals in the same way as it does humans, possibly leading to disturbance of populations and subsequent loss of biodiversity.

Indicator assessment

Table 1

The limit values for noise indicators in the Czech Republic [dB]

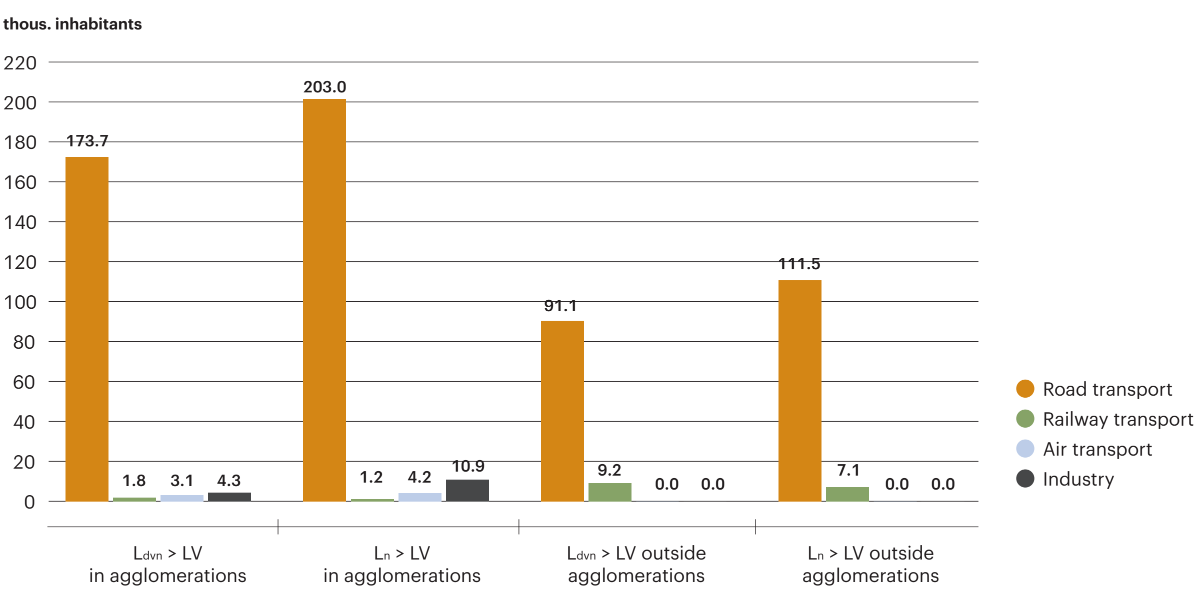
The source of the noise	L_{dvn} [dB]	L_n [dB]
Road transport	70	60
Railway transport	70	65
Air transport	60	50
Integrated devices	50	40

L_{dvn} – 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], 2011

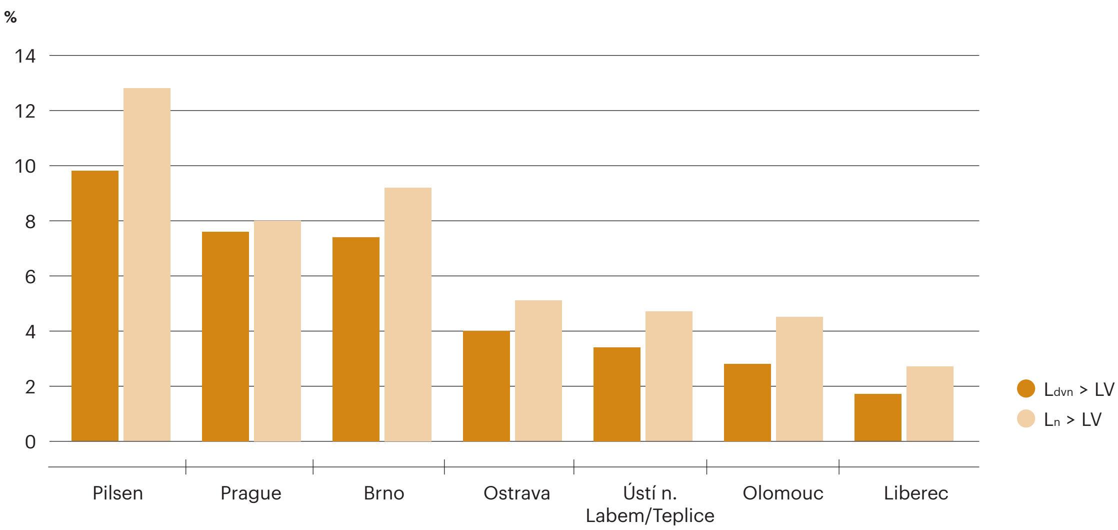


L_V – the limit value of noise indicators is stipulated separately for the various sources of noise – see Table 1.
Noise pollution from industry is not, according to the directive END, evaluated outside agglomerations. The criteria of the END directive for reviews of noise from air transport include Prague and Brno Airport only.
Data for the year 2015 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 living in the areas with exceeded limit values of noise indicators L_{dvn} and L_n in the agglomerations of the Czech Republic [%], 2011

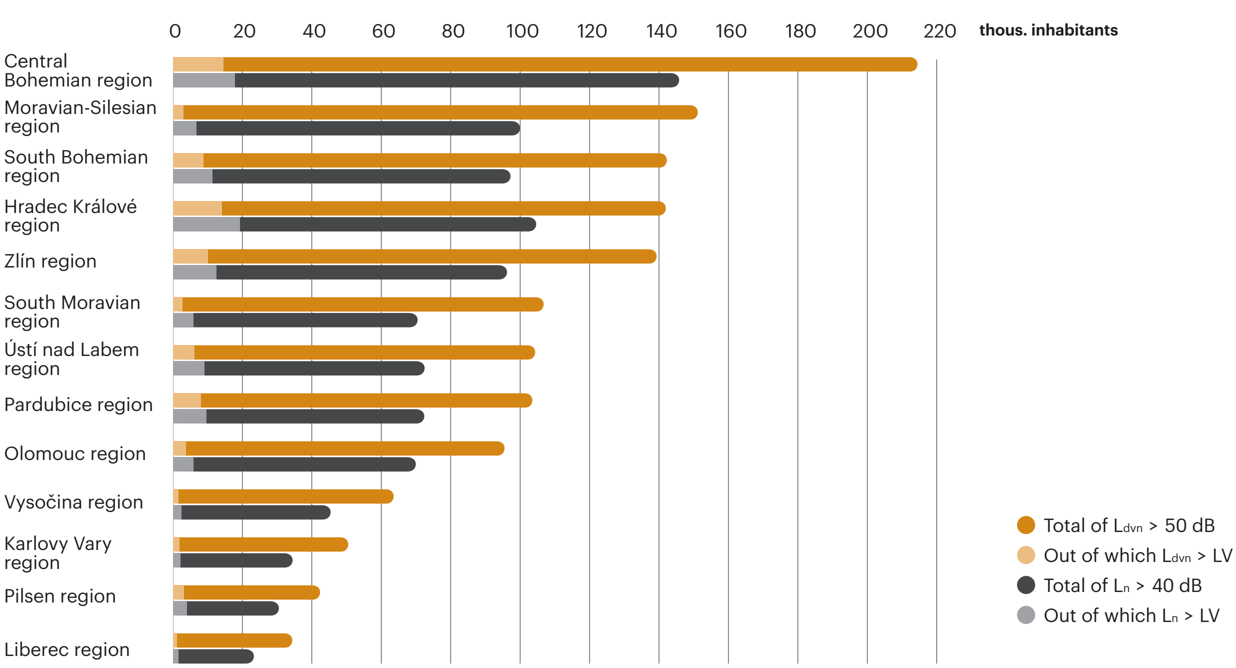


Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

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* and the number of inhabitants in the Czech Republic's regions exposed to above-limit noise [thous. inhabitants], 2011



**Roads with traffic volumes exceeding 3 mil. vehicles per year.*
Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: National Reference Laboratory for Environmental Noise

The exposure to **noise burden from road traffic** in excess of the determined limit values, which indicates the need for the creation of action plans to reduce noise, are detected in the Czech Republic, according to compete results of the 2nd round of the Strategic Noise Mapping[6], for 264.8 thous. inhabitants for 24 hours exposure (2.5% of the population of the Czech Republic) and 314.5 thous. inhabitants at night[7] (3.0% of the population, Chart 1). The majority of people affected by noise from road transport in excess of the limit value live in urban agglomerations[8]. Specifically, 173.7 thous. inhabitants, i.e., 65.6% of the total population of these agglomerations, are exposed to excessive noise the whole day and 203.0 thous. inhabitants, i.e., 64.6% of the whole affected population, at night. The 24-hour exposure to the noise burden exceeding 50 dB caused by road transport generally affects 3.7 mil. inhabitants (35.4% of the population of the Czech Republic), the noise level at night exceeding 40 dB affects a total of 3.4 mil. inhabitants (32.4%).

The traffic on **main railway lines**, used by more than 30 thous. trains per year, causes a noise burden particularly outside of city agglomerations. Overall, the exposure to 24-hour noise burden from railway above 50 dB outside agglomerations is for 306.1 thous. inhabitants, of which exceeding the limit value the total 9.2 thous. inhabitants 24-hours a day and 7.1 thous. inhabitants at night. The biggest noise burden from railways are in the Central-Bohemian region, Ústí region and Pardubice region, the share of which on the total number of people exposed to noise from railways exceeding the limit value for the indicator L_{dvn} is 71.3%. The noise pollution from **air transport** was assessed only for the Václav Havel Airport in Prague and Brno-Tuřany airport that burden by noise affects 12.0 thous. inhabitants all day (12.9 thous. inhabitants at night), out of which 3.1 thous. over the limit value for L_{dvn}, respectively 4.2 thous. inhabitants for L_n living exclusively in Prague and Brno agglomerations. Noise pollution from **industry**, monitored according to the END directive only in agglomerations, burdens 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 value due to the low limit values for industry.

In the **agglomerations** of the Czech Republic, in terms of the noise burden the worst noise situation is in Pilsen, where is the 24-hour noise burden from road transport exceeding limit value affects 9.8% of the population, and at night 12.8% of the population (Chart 2). Unfavourable situation is also in Prague and Brno agglomerations, where the noise levels from road transport exceeding limit values affect around 8% of the population. In Plzen there is also a more pronounced noise pollution from industry, to which 2.4 thous. inhabitants are exposed for the whole day and 8.5 thous. inhabitants at night. A more favourable acoustic environment is in the agglomerations of Liberec, Olomouc and Ústí n. Labem/Teplice, where the proportion of the population living in areas with exceeded limit values of noise indicators for road transport is below the average for all agglomerations of the Czech Republic, which is 6.2% for 24-hour noise burden and 7.3% for the night noise burden. The exposure to 24-hour road traffic noise pollution above 50 dB in agglomerations is for 84.9% of inhabitants, most of them in the agglomerations of Ústí n. Labem/Teplice (96.5%) and Pilsen (96.0%). From this point of view, the best situation is in the agglomeration of Ostrava (51.8% of the population); however, this is influenced by the agglomeration's delimitation which does not include the city's territory exclusively.

In the Czech Republic's agglomerations, there are a total of 16 **hospitals** exposed to 24-hour road traffic noise pollution and 23 hospitals are affected at night. Most medical facilities exposed to noise from road transport exceeding limit values are in Pilsen (6) and in Ostrava (5). **School facilities** exposed to noise from road transport exceeding the limit values are a total of 149, the most in Prague (60), Pilsen (31), in Prague there are also 2 schools exposed to noise from air traffic, in Pilsen there are 14 educational institutions exposed to excessive noise from industry.

A major source of noise **outside agglomerations** is the transport on the main roads with the transport intensity over 3 mil. vehicles per year, which is generally exposed (for indicator L_{dvn} > 50 dB) total of 1.4 mil. inhabitants of the Czech Republic, of which over limit values are exposed 91.1 thous. inhabitants (6.6% exposed). A level of the noise burden from the main roads is dependent on the routing of roads, traffic intensity and noise control measures. 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 (13.1 thous. inhabitants for L_{dvn}) and Hradec Králové (12.8 thous. inhabitants) – Chart 3. By contrast, the lowest level of the noise burden on the main roads are in the Liberec region (1.6 thous. inhabitants are exposed to noise above the limit value for the whole day), low share of population exposed to noise above the limit value are also in the South Moravian and the Moravian-Silesian region (0.4% for L_{dvn}). A higher proportion of inhabitants affected by noise from main roads exceeding the limit values was discovered on municipal level. About 4% of the population of Hradec Králové (3.7 thous. inhabitants), 3.8% of the population of Pardubice (3.3 thous. inhabitants), and

[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.*

[7] *The above values refer to the indicators L_{dvn} a L_n. The indicator L_{dvn} describes all-day noise disturbance (0–24 hours); the indicator L_n is the noise indicator of sleep disturbance (23–7 hours). The limit values of these noise indicators under Decree No. 523/2006 Coll. are set out in the Table 1.*

[8] *Agglomerations are defined by Decree No. 561/2006 Coll., stipulating a list of agglomerations for the purpose of assessing and reducing noise.*

[9] *Apart from the Region of the Capital City of Prague, which is assessed as an agglomeration.*

2.8% of the population of České Budějovice (2.6 thous. inhabitants) live in areas where limit values for 24-hour noise from main roads are exceeded. In the case of smaller municipalities, a substantially greater number of inhabitants are exposed to excessive noise. In extreme cases, the number can exceed 50%. According to results available to date, the worst situation is in municipalities located in the Hradec Králové region (Bílsko u Hořic, Blešno and Ohařice) due to the fact that major long-distance routes pass through them.

The effects and consequences of transport noise can be reduced by **measures on the transport infrastructure**. In the implementation of noise reduction measures on roads and motorways it was invested from the State Transport Infrastructure Fund and the state budget in 2015 the total of CZK 182.5 mil., whereas the length of roads, equipped with noise reduction measures increased by 18.6 km and the total length of noise barriers on the network of motorways and first class roads reached 369.5 km.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

Transportation in the global context

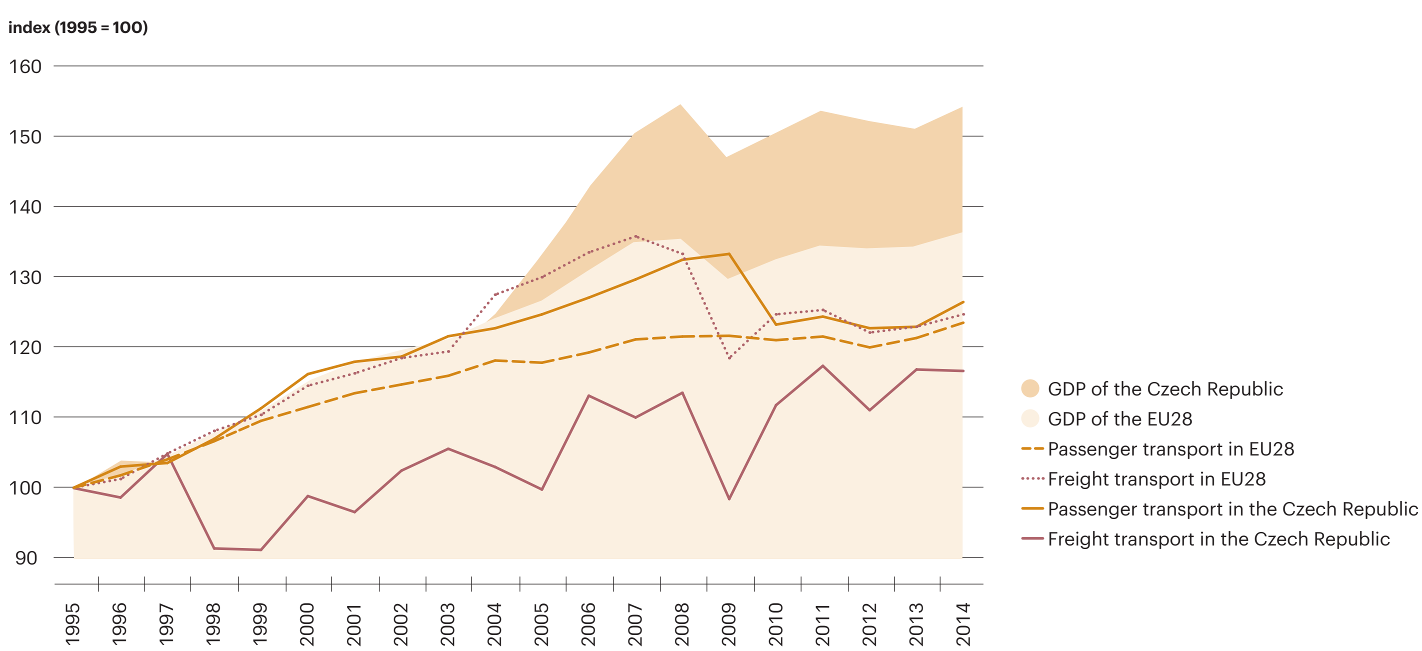
Key messages

- Passenger car transport comprises more than 80% of total inland modes of passenger transport performance in the EU28. The level of individualisation of transport in the Czech Republic is markedly below the average for the EU28, especially due to the greater use of railway and public city transport.
- In the structure of the transport performance of inland freight transport in the EU28 the road transport prevails with the share in 2014 of 71.9%, in the Czech Republic the share of road transport in total freight transport performance was 75.8%.
- The rate of automobilisation in the Czech Republic compared with the EU28 average is below average. The renewal of the vehicle fleet of passenger cars in the Czech Republic is slower than in the EU28, but among the new member countries of the EU13 it belongs to the fastest.
- The proportion of transport-related greenhouse gas emissions in total aggregated greenhouse gas emissions in the Czech Republic is one of the lowest in the EU28 countries for the reason of high emissions from stationary sources.

Indicator assessment

Chart 1

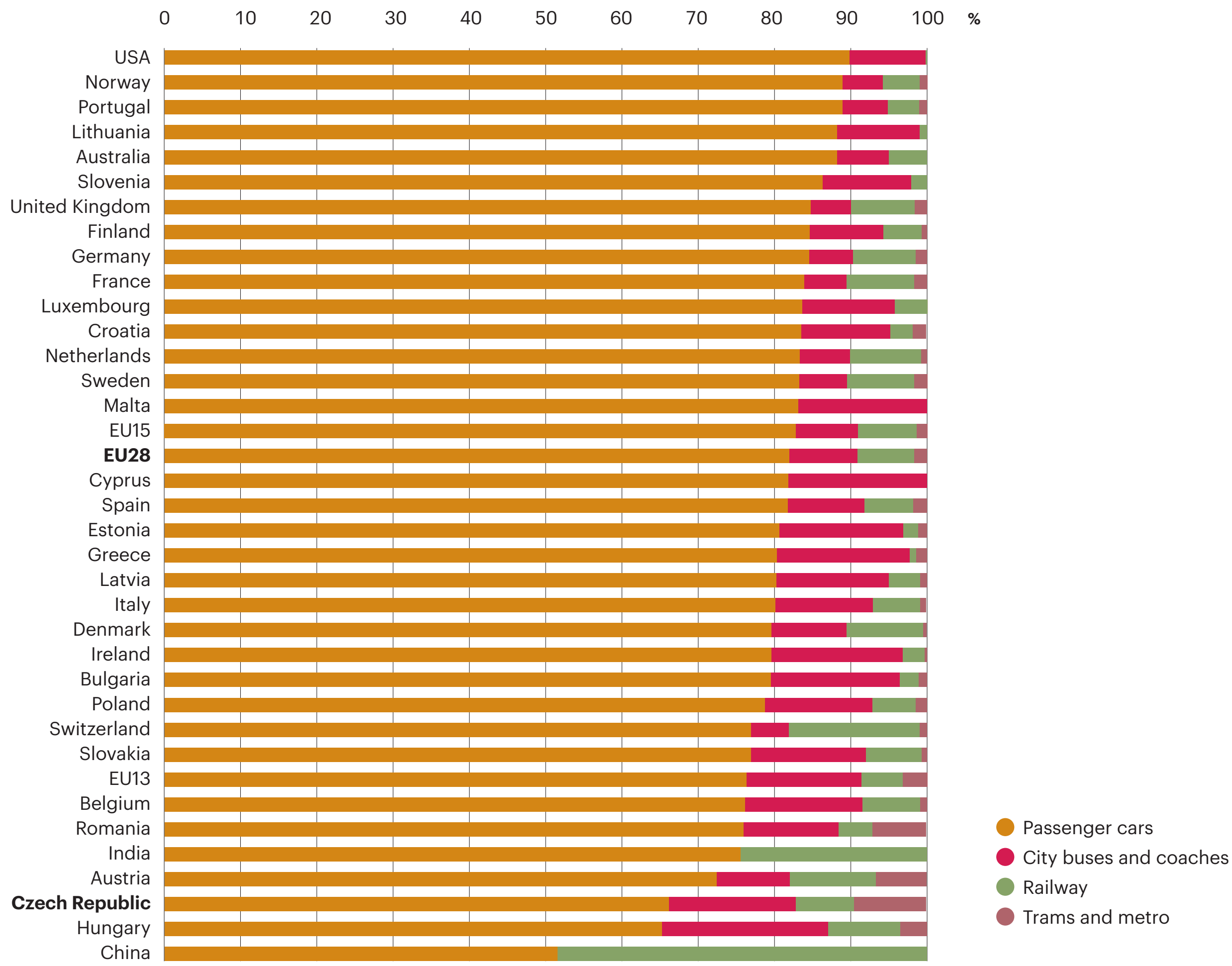
Development of total performance in passenger and freight transport and GDP in the Czech Republic and EU28 [index, 1995 = 100], 1995–2014



Source: European Commission, Eurostat, Ministry of Transport

Chart 2

Structure of passenger transport performance (excluding air transport) [%], 2014

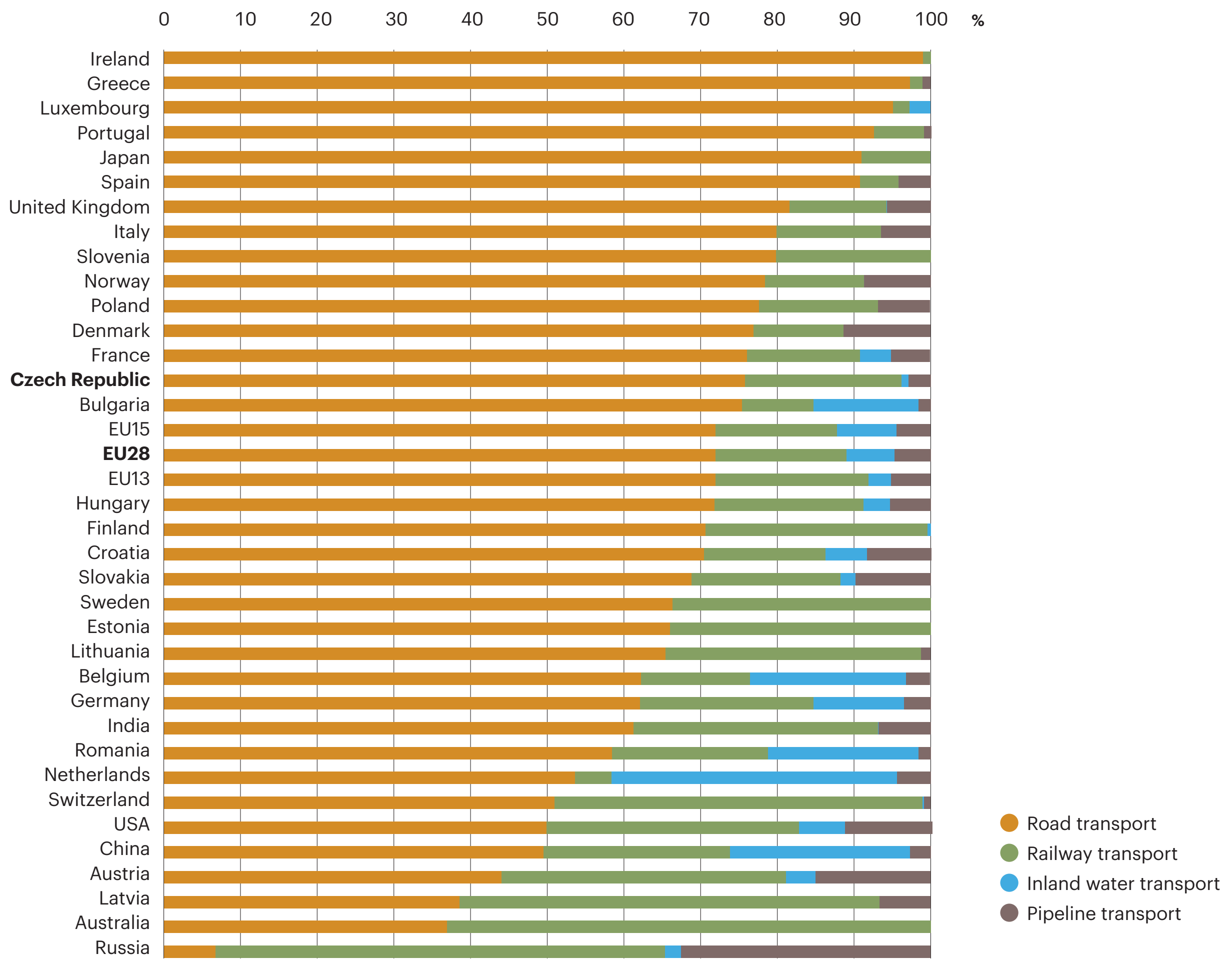


Data for non-European countries from the OECD are as at 2013, the transport performance of city public transport (tram and metro) for the these countries are not available.

Source: European Commission, OECD

Chart 3

Structure of freight transport performance (excluding sea transport) [%], 2014

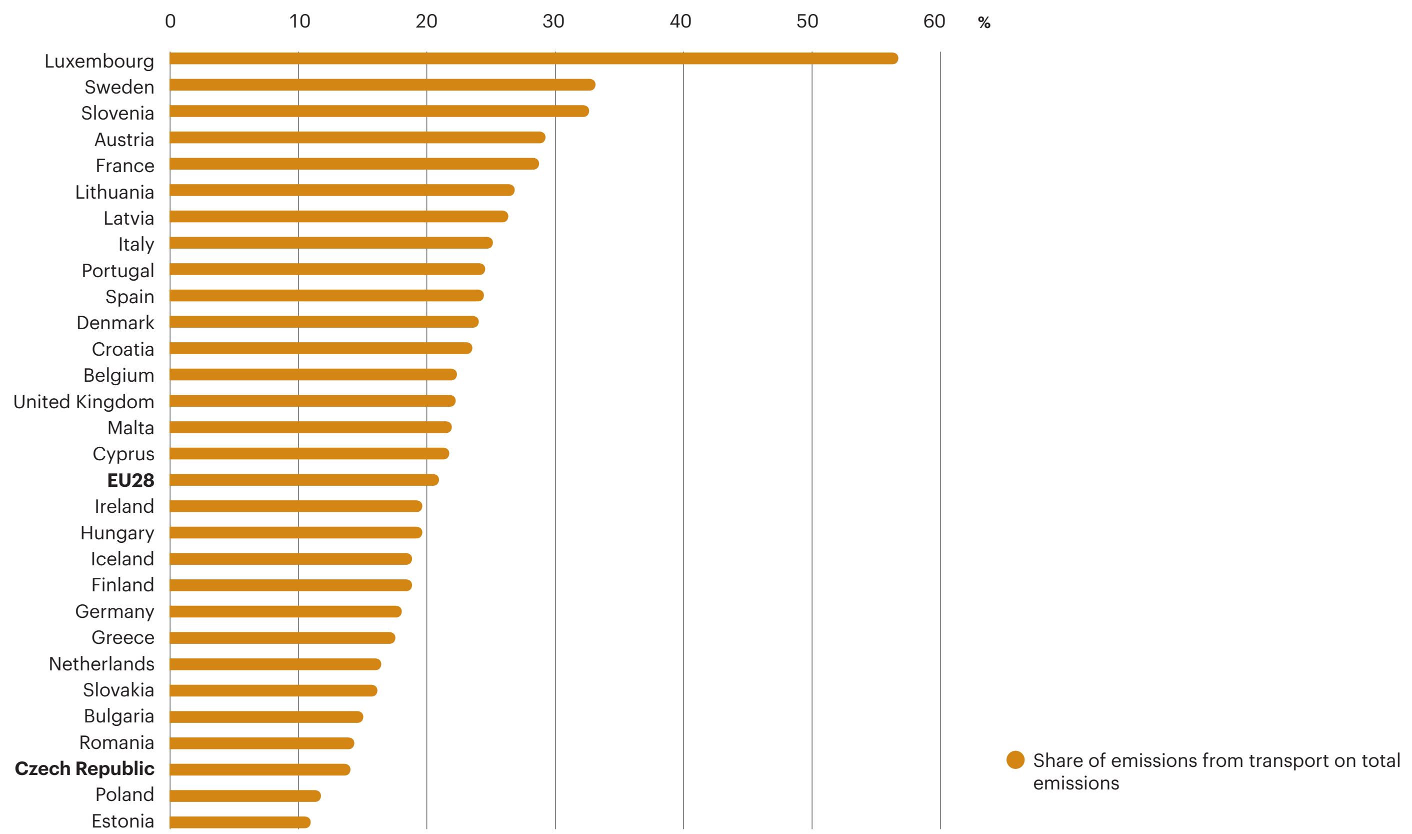


Data for non-European countries from OECD are as at 2013.

Source: European Commission, OECD

Chart 4

Proportion of transport-related greenhouse gas emissions in total aggregated greenhouse gas emissions, excluding LULUCF [%], 2014



Source: EEA

The development of the **transport performance of both passenger and freight transport** in the EU28 and in the Czech Republic is largely dependent on the development of the economy, especially for freight transport. At the beginning of the 21st century there was a significant growth of transport performances, after 2008 the growth trend has slowed down and fluctuations dependent on economic development can be seen with a clear influence of the decline in the economy in the crisis year of 2009 (Chart 1).

In the **structure of the transport performance of passenger transport** in 2014 in the EU28 average passenger car transport was prevailing with a share of 81.9% of the total transport performance (without air transport, Chart 2). In the Czech Republic the level of individualisation of passenger transport is lower than in the EU28 (66.1%). The proportion of city railway transport (metro, tram) in total passenger transport performance in 2014 reached 9.5% in the Czech Republic, the highest in the EU28. Similarly, the proportion of city and line buses in total passenger car transport performance of 16.7% ranks the Czech Republic at the top of the whole of the EU28. In a global comparison, the level of individualisation of transport in the EU28 is lower than for example in the USA (passenger car transport 89.8% share, the rest is provided by buses, railway passenger transport in the USA is negligible) and in Australia (88.2%). In China and Japan it has an important function in the passenger transport railway, which in China in 2013 provided 48.5% of the total transport performance. Railway is significant in passenger transport also in India.

In the composition of **freight transport performance** in EU28 in 2014 road transport significantly prevailed with a share of 71.9% (Chart 3), in the Czech Republic it was 75.8%. The highest share of road transport in total transport performance is in the island states (Malta, Cyprus, Ireland) and also for example in Greece and Luxembourg. In contrast, a lower proportion of road transport is in countries with developed railway freight transportation (Baltic countries, Austria, from countries outside the EU28 it is Switzerland) and inland waterway transport (Netherlands, Romania). In the global context, the importance of road transport in total freight transport is lower than in the EU28 average, for example in China in 2013 the share of road transport reached 49.5% and in Russia only 6.7%. High proportion of road transport are rather rare in the world (e.g. Japan). Railway in freight transport is significantly used also in countries with well-developed road transport, for example in Australia (63.1%) and the USA (32.9%).

The total number of **registered passenger cars** in the EU28 reached 249.8 mil. in 2014, with average motorisation reaching 491 cars per 1,000 inhabitants in that year. The level of motorisation in each country is dependent on economic performance and standard of living. In the Czech Republic, it is slightly below the EU28 average (459 vehicles.1,000 inhab.$^{-1}$ in 2014), but higher than the average for the new EU Member States. The fastest possible renewal of the vehicle fleet is in Luxembourg and other countries of Western and Northern Europe with high economic performance, where the share of new cars in the vehicle fleet ranges from 6–13%. On the contrary, the slowest renewal due to the lower purchasing power of the population is in the countries in the Balkans, in Bulgaria only 0.7% of passenger cars were renewed of the total size of the vehicle fleet in 2014. By the speed of renewal of the vehicle fleet of passenger cars (4.0% in 2014), the Czech Republic belongs to the front places among the countries of the EU13.

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 2014 throughout the EU28 reached 20.8% (Chart 4). The proportion of transport in total emissions is still significantly higher in states with a developed road transport system and whose energy industry uses carbon-free sources and whose manufacturing industry contributes less to GDP creation (Luxembourg, Sweden and France). The Czech Republic, especially with regard to the significant amounts of greenhouse gases produced by stationary sources, belongs in EU28 among countries where transport contributes the least to total emissions (13.9% in 2014). Countries with an economy and energy industry similar in nature to that of the Czech Republic also register similarly lower proportions of transport-related greenhouse gas emissions (Poland), as do countries with lower transport performance of freight and passenger car road transport and thus also lower emissions from transport-related greenhouse gases (Romania and Bulgaria).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

9 Waste and material flows

36 | Domestic material consumption

Key question

Is the environmental burden associated with the extraction and consumption of materials decreasing in the Czech Republic?

Key messages

The long-term trend of domestic material consumption is decreasing in spite of the annual growth; in the period 2000–2014[1] it dropped by 11.3%. Because of warmer winter, in the year 2014 there was a significant drop in the consumption of natural gas; the consumption of fossil fuels as a whole has a decreasing trend. The proportion of biomass at DMC is slowly rising with regard to the increase in consumption of biomass; in 2014 it reached 14.4%.

The growth of industrial production and construction in 2014 has led to an increase in the consumption of metal and non-metallic minerals; the development of the economy supported also the growth of oil consumption. Domestic material consumption in 2014 increased by 3.1% in the interannual comparison. Material dependency of the Czech Republic on abroad is still high, the proportion of imports on the DMC in 2014 reached 45.4%. In addition to oil and natural gas, the Czech Republic is almost completely dependent on imports of metallic minerals.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

Europe 2020 – A European strategy for smart, sustainable and inclusive growth

- efficient use of resources
- creation of a circulatory economy based on the use of secondary raw materials as resources
- creating a knowledge base and analytical apparatus for monitoring the efficiency of resource use

EU Sustainable Development Strategy

- improving the effectiveness of resources in order to reduce the overall use of non renewable natural resources and the reduction of the environmental 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, sustainable transport and sustainable consumer behaviour

7th Environmental Action Programme until 2020

- protection and development of natural capital of the EU
- the transformation of the EU to a low carbon economy, effectively utilising resources

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

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

Secondary Raw Materials Policy of the Czech Republic
- 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

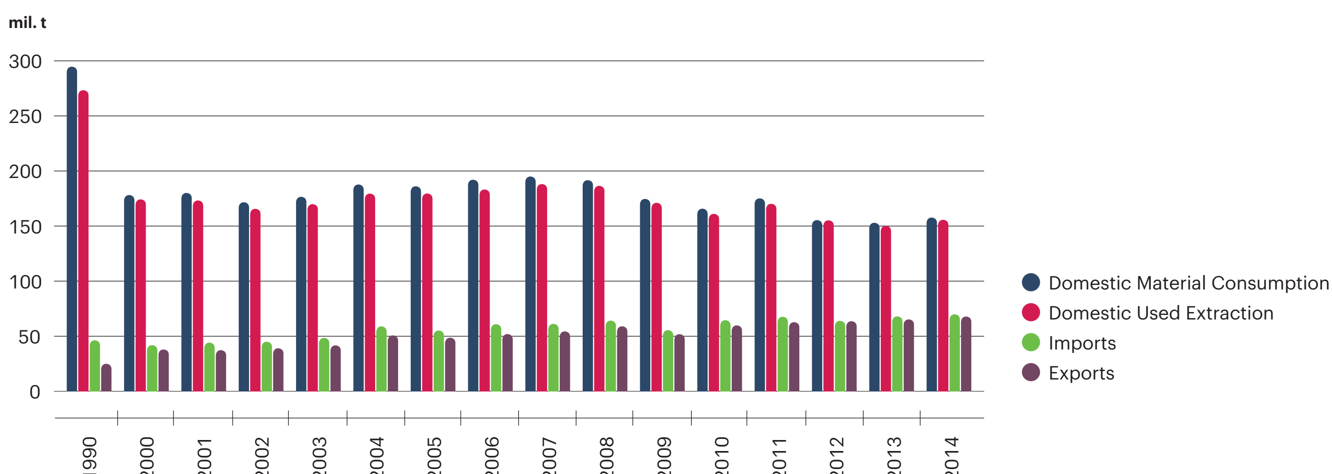
Impacts on human health and ecosystems

The material consumption influences the extent of environmental burdens that are associated with resource use and waste flows of the national economy, in particular in the form of emissions to air, water pollution and waste generation. The extraction of raw materials and the cultivation of biomass in large agrosystems causes pressures on the landscape, affect the status of ecosystems and can lead to the loss of biodiversity. Emissions to air and water have a negative effect on human health and ecosystems and burning of fossil fuels is also a significant source of greenhouse gas emissions.

Indicator assessment

Chart 1

Development of domestic material consumption and its components in the Czech Republic [mil. t], 1990, 2000–2014

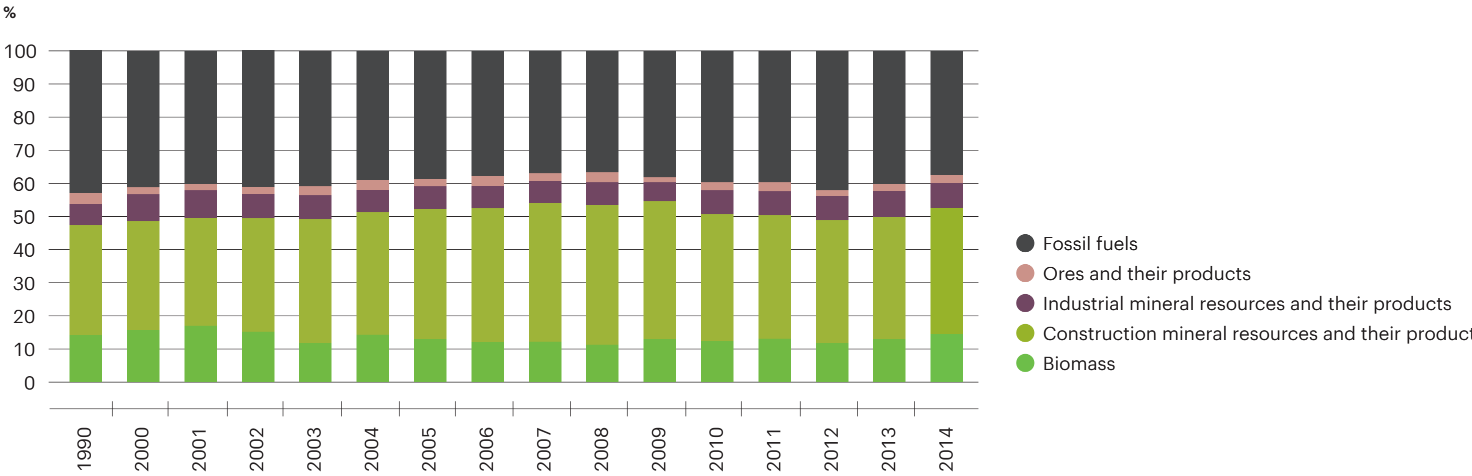


Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: Charles University Environment Center

Chart 2

Development of the structure of domestic material consumption in the Czech Republic according to material groups [%], 1990, 2000–2014



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

Source: Charles University Environment Center

Domestic material consumption (DMC[2]) in the Czech Republic in 2014[3] grew by 3.1% (4.7 mil. t). Despite this annual growth, the value of DMC in 2014 was by 9.5% lower than in 2009, by 11.3% below the level of 2000, and at about half the value compared to the early nineties of the 20th century (Chart 1). The long-term trend of the DMC, and hence the environmental burden associated with extraction of natural resources and the use of materials, continues to decrease; the development of the DMC is, however, accompanied by fluctuations associated in particular with the fluctuation of the performance of the economy.

In terms of material groups, in the long term, the largest share on the overall DMC accounted **for construction minerals and fossil fuels** (together approx. 76%), the consumption trends of these material groups thus most affected the development of the total DMC (Chart 2). **The consumption of mineral materials for construction** initially increased in the period 2000–2014, it increased by about 23 mil. t (38.7%) between the years 2000 and 2007, in other years it experienced a decline due to the slow-down of construction production and the drop in demand for construction materials. In 2014, however, there was a year-to-year increase in consumption of mineral materials for construction by 6.6% to a level higher by 2.7% than in 2000, in response to the growth in construction activities, the construction production index in constant prices increased year-to-year by 4.3%.

The consumption of **fossil fuels** as a whole continues in a gradual decline; in the year-to-year comparison in 2014 it decreased by 3.8% (2.4 mil. t), in the period 2000–2014 by 19.1%. The downward trend in **coal consumption** gradually goes into stagnation, continuing decrease in consumption of brown coal influenced by developments in the energy sector (the year-to-year decrease in 2014 by 2.2%) is compensated by the growth of consumption of black coal as a result of the development of industrial production; in 2014 by significant 21.2%. **The domestic brown and black coal mining** is falling, in the course of the five-year period 2009–2014 mining of brown coal dropped by 15.4% (7.0 mil. t), and the mining of black coal by 21.5% (2.3 mil. t). The slow-down of the mining sector causes also a decline in the export of coal; however, due to the saturation of the domestic demand the import of coal is significantly rising. In the period 2009–2014, imports of black coal increased by 77.1% (1.4 mil. t), imports of brown coal increased in this period by more than eight times. The development of consumption and mining of coal is heading towards a decrease in national self-sufficiency on the supply of these raw materials.

Oil consumption in 2014 increased by 8.3% (0.7 mil. t); in the longer development the oil consumption copies the development of transport with a growth at the beginning of the 21st century and a decline in the period 2008–2013. In comparison with the year 2000, the oil consumption in 2014 was higher by 13.7%; in the period 2009–2014 decreased by 11.0%. **Natural gas consumption** does not have a clear trend and there are fluctuations according to the temperature conditions of the winter

[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.

[3] Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

seasons. In 2014, due to the warm winter, natural gas consumption significantly decreased year-to-year (according to the DMC indicator[4]) by 41.0% to 4.7 mil. t, which is the lowest level since 2000. Since it is possible to attribute the decrease in the consumption of natural gas in 2014 to climate factors, it cannot be assessed from the perspective of the environment as a reversal of a desirable trend of substitution of solid fuels by liquid and gaseous fuels.

The consumption of **industrial minerals** stagnates; a more pronounced decline in consumption occurred only at the beginning of the 21st century, and in the crisis year 2009, in 2014 the consumption of this group of materials was by 16.9% less than in 2000. **Metallic minerals** consumption varies according to the development of industrial production, in the year-to-year comparison it grew in 2014 by 9.7% (0.4 mil. t), in the period 2009–2014 by 34.2%, however, it was by 3.0% less than in 2000. The industrial production index rose in 2014 in the year-to-year comparison by 5.0%, while the growth was significantly contributed to by the manufacturing sector processing metals, in particular the sector of manufacturing of motor vehicles, trailers and semi-trailers.

The consumption of **renewables**, after reaching lows in 2012, increased year-to-year in 2014 by 14.1% (2.9 mil. t), however, was by 18.2% lower than in 2000. The **share of renewables** in the total DMC in 2014 increased to 14.4%, however, in the European context remains considerably below average. From an environmental perspective, the small share of renewables on the total DMC is disadvantageous, since the consumption of renewable energy sources is associated with smaller environmental pressures than the consumption of non-renewable resources.

Material dependence on foreign countries, i.e. the share of imports on DMC reached 45.4% in 2014, which means interannual stagnation, however, in the year 2000 it reached 24.8% and in 1990 only 16.6%. The growth of material dependency for the Czech Republic is unfavourable from the strategic reasons. In terms of material groups, the Czech Republic is considerably or completely dependent on imports of oil, gas and metal minerals.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[4] DMC measures only the apparent consumption of natural gas, i.e. production plus imports minus exports; it does not allow you to accurately track its end consumer consumption, which can be covered also from stocks. According to the data of the Energy Regulatory Office, natural gas consumption in the Czech Republic in 2014 dropped by 12.0% to 7.3 bil. m³.

37 | Material intensity of GDP

Key question

Is the material intensity of GDP generation decreasing in the Czech Republic?

Key messages

The material intensity of the Czech economy is decreasing in the long term, in the period 2000–2014[5] it decreased by 36.7%. The decline in material intensity results in reduced environmental burden caused by material consumption per unit of GDP generated.

In 2014, the material intensity due to the growth of the DMC grew slightly by 1.1%. A long term state in which the economy is growing and the environmental burden caused by material consumption is decreasing, i.e. so called absolute decoupling, is not being attained. The interdependence of economic development and material consumption therefore still remains significant.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

Europe 2020 – A European strategy for smart, sustainable and inclusive growth
- ensuring sustainable growth
- reduction of material intensity of economy (DMC/GDP)

7th Environmental Action Programme until 2020
- transition to a green, competitive and low-carbon resource-efficient economy

Czech Republic's Waste Prevention Programme
- creation of conditions for lower consumption of primary resources and gradual reduction of waste generation

Strategic Framework for Sustainable Development of the Czech Republic
- increase of energy and raw material efficiency of the economy

National Reform Programme
- streamlining of the life cycle of natural resources and reduction of material and energy intensity of the Czech economy

Secondary Raw Materials Policy of the Czech Republic
- 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

[5] *Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.*

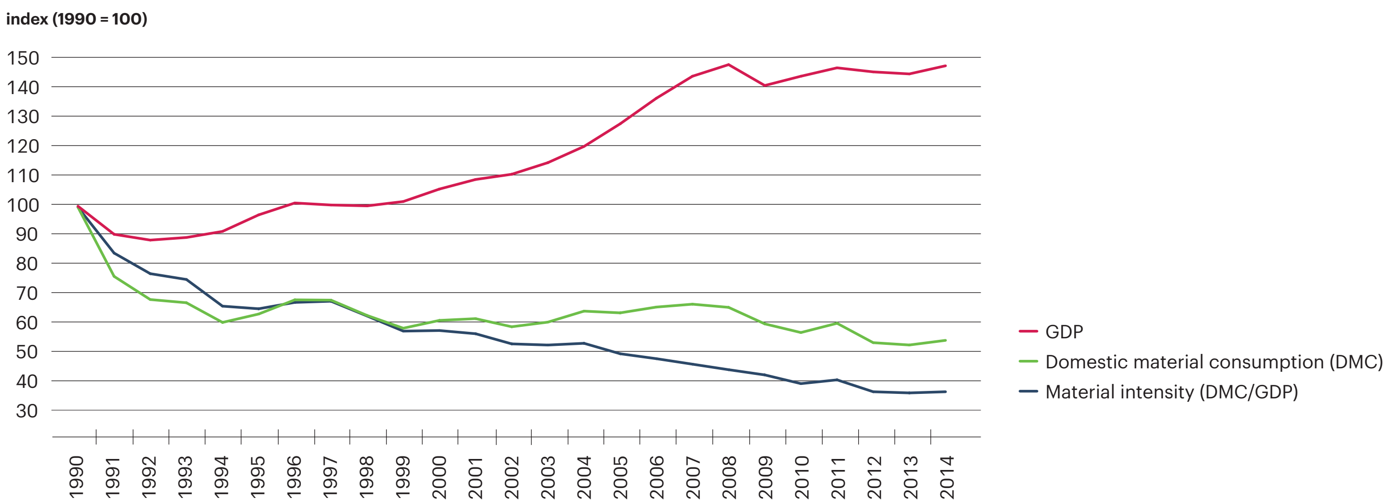
Impacts on human health and ecosystems

The material intensity of GDP measures the efficiency in transforming materials entering into economics to economic output and thus the extent to which the economy affects the state of ecosystems and human health. The material consumption is associated with the environmental burden (see indicator of Domestic material consumption) that affect the state of the individual elements of the environment, and thus the impact on the health of the population and ecosystems. Material intensity in the Czech Republic has, due to the high proportion of fossil fuel at the material consumption, also a close link to the intensity indicators of greenhouse gas emissions per capita and per unit of GDP, thus on the potential of reducing overall emissions.

Indicator assessment

Chart 1

Material intensity, domestic material consumption and GDP in the Czech Republic [index, 1990 = 100], 1990–2014

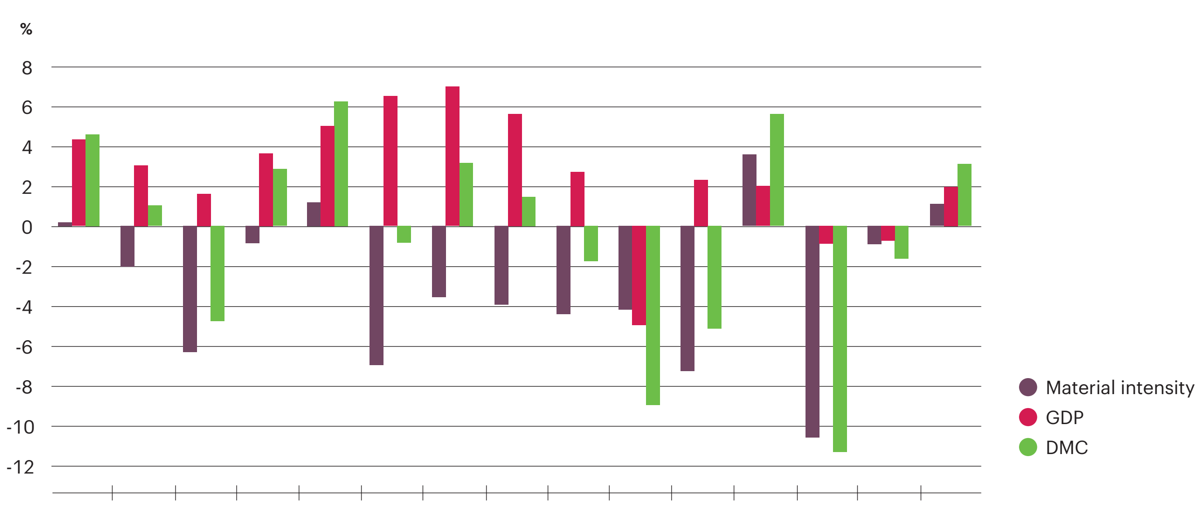


GDP figures in constant 2010 prices.
Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: Charles University Environment Center, Czech Statistical Office

Chart 2

Year-to-year development of material intensity, DMC and GDP [%], 2000–2014



GDP figures in constant 2010 prices.
Data for the year 2015 are not, due to the methodology of their reporting, available at the time of publication.

Source: Charles University Environment Center, Czech Statistical Office

The material intensity of the economy of the Czech Republic in 2014[6] slightly grew, in interannual comparison by 1.1% to 39.4 kg.1,000 CZK GDP^{-1} (Chart 1), the economy growth by 2.0% was accompanied by stronger growth of DMC by 3.1% (see indicator of the Domestic material consumption). The increase in material intensity was affected by the fact that the economic growth in 2014 was based on the sectors with higher material intensity, the share of the manufacturing industry on the year-to-year growth of gross value added of approx. CZK 98.3 bil. was 48.9%.

Despite this year-to-year fluctuation in 2013–2014, **the long-term trend of material intensity** remains to decline, which indicates the increasing efficiency of transformation of material inputs into economic performance and also the decrease of environmental burden per unit of GDP. In the period 2000–2014 the material intensity of the economy dropped by 36.7%, since 1990 by 63.6% and in 2014 it has been less than half compared to the early nineties.

In the period 1990–2000 the **decrease of material intensity** resulted mainly from the decline in domestic material consumption caused by structural changes in the national economy, GDP declined at the beginning of 90s of the 20th century. In the period 2000–2007, the positive development of material intensity influenced the economic growth (Chart 2), which, however, was based on the economy sectors with higher material intensity and therefore the domestic material consumption in this period slightly grew. In the period from the year 2008 the decline in material intensity continued mainly due to the declining DMC, the economic development stagnated after the initial decline in 2009, and a more significant economic recovery occurred after 2014. The declining trend of material intensity in this period was influenced in particular by reducing the share of solid fuels in the energy mix, by a decline of construction production as well as by reducing the energy intensity of transport.

The development of material consumption in the period 1990–2014 as a whole represents the so-called **decoupling**, i.e. the separation of the development of the economy and environmental burden. However, absolute decoupling, i.e. an ideal state from an environmental point of view, in which the economy is growing and the environmental burden represented by material consumption is decreasing, is not being attained in the long term. **Relative decoupling**, which consists in the similar trends in the development of material consumption and economy, while the consumption of materials is increasing in relative terms to a lesser degree than the economy or decreasing to a larger degree than the economy, was achieved in most years of the monitored period of 1990–2014. In the reference period, absolute decoupling was reported only in the years 1993–1994, 1999, 2002, 2005, 2008 and in the year 2010 for the last time.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

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

38 | Total waste generation

Key question

Is total waste generation declining?

Key messages

Total waste generation in the period from 2009 rather stagnated, but in 2015, in year-to-year comparison, there was a more distinct increase by 16.6%.

Overall assessment of the trend

Change since 1990	Change since 2009[7]	Last year-to-year change
N/A	negative	negative

References to current conceptual, strategic and legislative documents

Directive 2008/98/EC of the European Parliament and of the Council on waste
- minimising adverse impacts of the generation and treatment of waste
- prioritisation of practical implementation of the waste hierarchy

State Environmental Policy of the Czech Republic 2012–2020
- reducing adverse environmental impacts of waste
- preventing the generation of waste, in particular through environmental awareness of people
- supporting uses of waste as a substitute of natural resources
- supporting the development and generation of easily repairable, recyclable and materially usable products
- reducing waste generation through the use of the latest available technologies, reuse of waste and support of waste-free technologies
- preventing the generation of hazardous waste through reducing the content of hazardous substances in products

Government Regulation No. 352/2014 Coll., on the Waste Management Plan of the Czech Republic for the period 2015–2024
- preventing the generation of waste
- the reduction of the specific generation of waste, including hazardous waste
- maximising the recovery of waste as a substitute of primary resources and transition to the circular economy

Czech Republic's Waste Prevention Programme
- minimizing adverse impacts of the generation of waste on human health and environment
- reducing the quantity and dangerous properties of generated waste
- maximising the recovery of waste as a substitute of primary resources
- prevention in the form of reuse of product and improved generation efficiency

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

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 Innovations for Competitiveness)
- 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
- removing barriers to the increased use of secondary raw materials

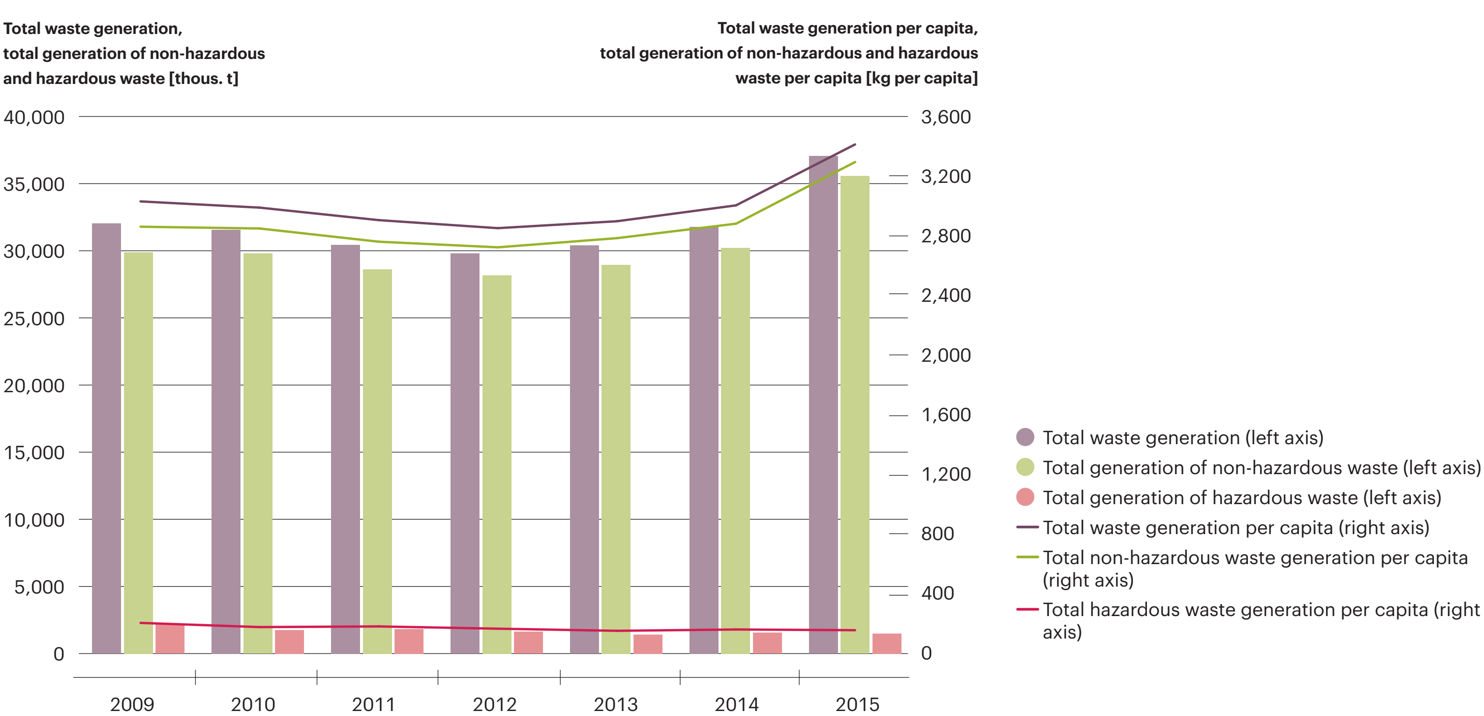
Impacts on human health and ecosystems

Waste is an inseparable product of human activities, which is why emphasis is placed on its prevention and the use of the best available technologies. Due to its quantity and composition, the generation of waste may pose risks both to human health and ecosystems. The objective is to minimize adverse impacts of the generation of waste on the environment and to reduce the exploitation of resources. In particular, waste should substitute natural materials, raw materials and primary energy resources. The generation and subsequent treatment of waste may involve activities in the course of which non-indigenous substances escape into the atmosphere, pollute water and soil, or cause pollution of food and occupation of land. Through the food chain, substances contained in waste can find their way into the human body, which especially the waste with dangerous properties causes irreversible changes to.

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], 2009–2015

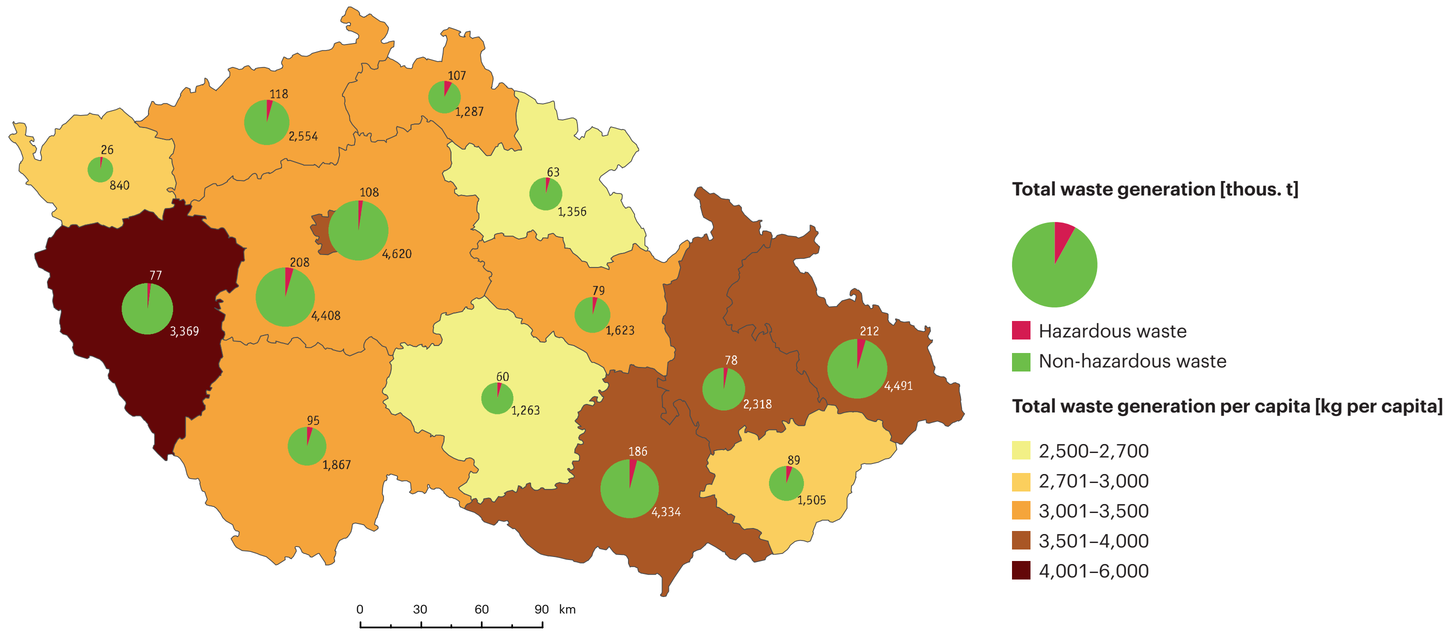


The data was determined according to the methodology Mathematical Expression of Calculating the "Waste Management Indicator Set" applicable for a given year.
Czech Statistical Office is the source of data on the population of the Czech Republic (mid-year population).

Source: CENIA, Czech Statistical Office

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], 2015

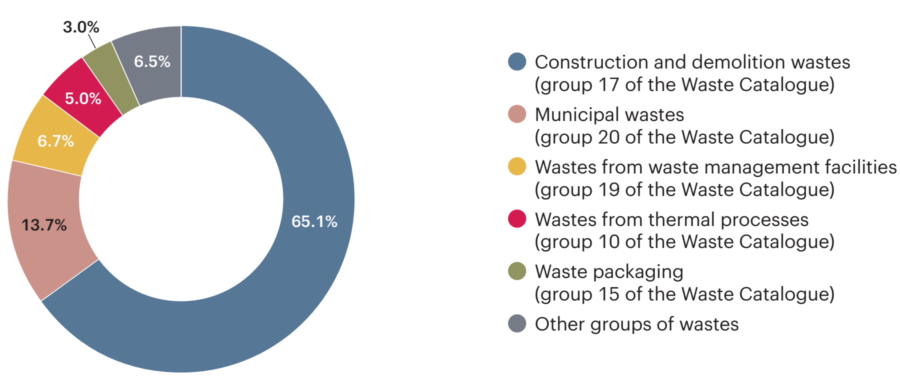


The data was determined according to the methodology Mathematical Expression of Calculating the "Waste Management Indicator Set" applicable for a given year.
Czech Statistical Office is the source of data on the population of the Czech Republic (mid-year population).

Source: CENIA, Czech Statistical Office

Chart 2

Structure of total waste generation in the Czech Republic [%], 2015



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 non-hazardous and hazardous waste generation) in the evaluated period from 2009 rather stagnated until 2015, when it grew year-to-year by 16.6% to the value of 37,338.3 thous. t. Between 2009–2015 it was an increase by 15.7%. Another important indicator is the **total waste generation per capita**, which was 3,541.5 kg per capita in 2015. In the period 2009–2015, the value of this indicator was increased by 466.0 kg per capita, which was contributed to by the significant increase of 498.4 kg per capita between the years 2014–2015 (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 65.1% of the generated waste come from construction (group 17 of the Waste Catalogue). This waste group generation in the year 2015, dramatically increased especially in connection with investments in modernisation and construction of transport infrastructure (road and rail) by 5,167.3 thous. t for a total of 24,291.9 thous. t.

Total generation of non-hazardous waste (Chart 1) from the year 2009 increased by 19.0% to 35,834.3 thous. t, mainly because of a significant increase between the years 2014 and 2015 by 17.6%. **Total generation of non-hazardous waste per capita** since 2009 grew by 529.3 kg per capita to 3,398.9 kg per capita in 2015 and in year-to-year comparison of 2014–2015, there was also an increase by 504.5 kg per capita.

Hazardous waste represents only a relatively small portion of the total waste generation, just 4.0%. 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 since 2009 fell from 6.7% to 4.0% in 2015 and in year-to-year comparison of 2014–2015 it decreased from 4.9% to 4.0%. A positive trend can also be observed in an absolute reduction of the total generation of hazardous waste. Between 2009 and 2015, the total generation of hazardous waste dropped by 30.4% to the total of 1,504.0 thous. t and from 2014 it dropped by 4.0%. **Total hazardous waste generation per capita** in 2015 amounted to 142.7 kg per capita between the years 2009–2015 it was reduced by 63.4 kg per capita and in the last year-to-year comparison of 2014–2015 by 6.1 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 reclamation of historically 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, the Moravian-Silesian region and the Central Bohemian region, the highest total waste generation per capita in the Pilsen region, Moravian-Silesian region and South Moravian region (Figure 1).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

39 | 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

The total municipal waste generation during the monitored period, i.e. since 2009, shows a stagnating trend.

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 energy recovery of municipal waste.

Overall assessment of the trend

Change since 1990 N/A

Change since 2009[8]

Last year-to-year change

References to current conceptual, strategic and legislative documents

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 (BMW) to 35% (of weight) of the total amount of BMW (produced in 1995) by 2020

State Environmental Policy of the Czech Republic 2012–2020
- adhering to and complying with the hierarchy of municipal waste treatment
- increasing the proportions of municipal waste used for material and energy recovery
- reducing the proportion of landfilling in the disposal of municipal waste
- increasing the proportion of selected household and similar waste prepared for reuse and recycling to 50% of weight by 2020

Government Regulation No. 352/2014 Coll., on the Waste Management Plan of the Czech Republic for the period 2015–2024
- introducing separate collection of waste at least for paper, plastics, glass and metals by 2015
- increasing at least to 50% of the weight the overall level of preparation for reuse and recycling at least for waste from materials such as paper, plastic, metal, glass, originating from households, and, where appropriate, the waste of different origin, if such waste streams are similar to waste from households by 2020
- using mixed municipal waste particularly for energy recovery (after sorting the components for material recovery, hazardous components and biodegradable waste) in installations intended for that purpose, in accordance with the applicable legislation
- reducing the maximum amount of biodegradable municipal waste deposited to a landfill so that the share of this component is in 2020 no more than 35% of the weight of the total amount of biodegradable municipal waste produced in 1995

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

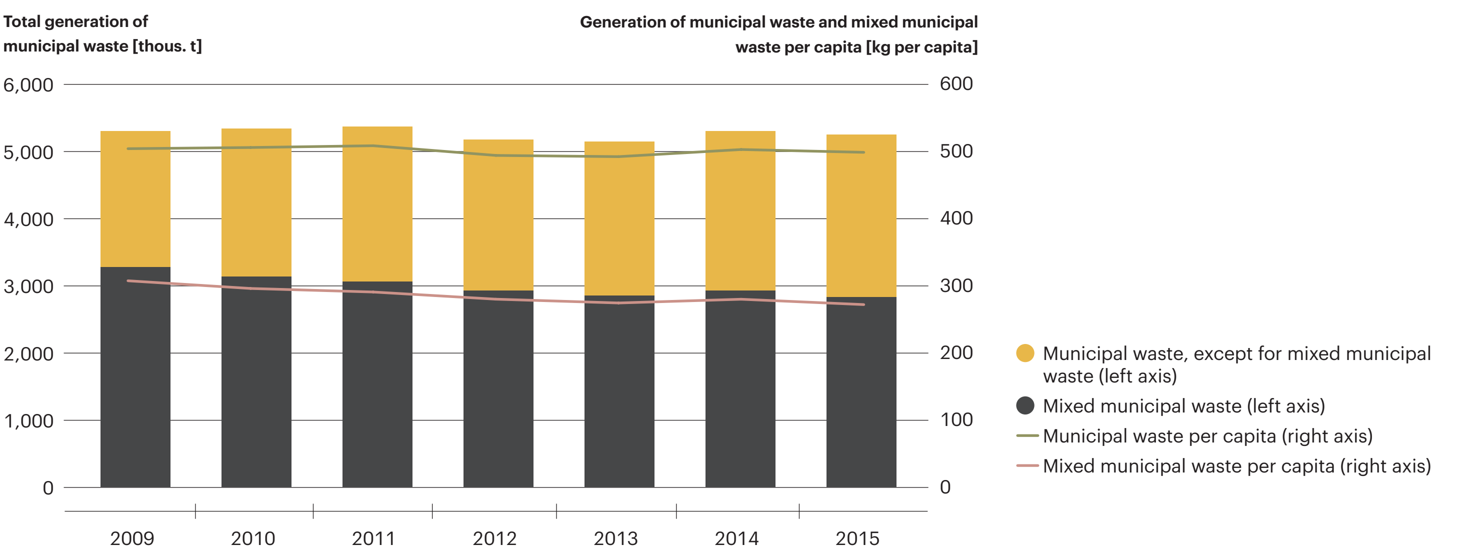
Impacts on human health and ecosystems

The definition of municipal waste laid down in the Waste Act indicates that the generation of municipal waste is closely related to the place of residence of every individual and that the waste can affect the state of health and aesthetic perception of the human society. While mixed municipal waste is not classified as hazardous, it may contain, if unsorted, various hazardous components, including batteries and accumulators, paints, solvents, drugs etc. If not properly treated of, the substances contained in municipal waste may find their way into the environment, namely into the atmosphere, water and soil. Here they may be deposited in biomass for extended periods of time and propagate further through the food chain. Other effects of the generation and treatment of municipal waste include adverse impacts on the landscape character and function related to the operation of waste treatment facilities. Landfilled BMW is a source of greenhouse gases and, if the landfill is not properly secured, also of eluates in seepage water and soils. Through animals, its harmful components may find their way into the food chain and adversely affect human health. However, if municipal waste is properly separated and processed, its effects on the environment and human health are positive (use of BMW as compost or anaerobic digestate as a biofertilizer).

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], 2009–2015

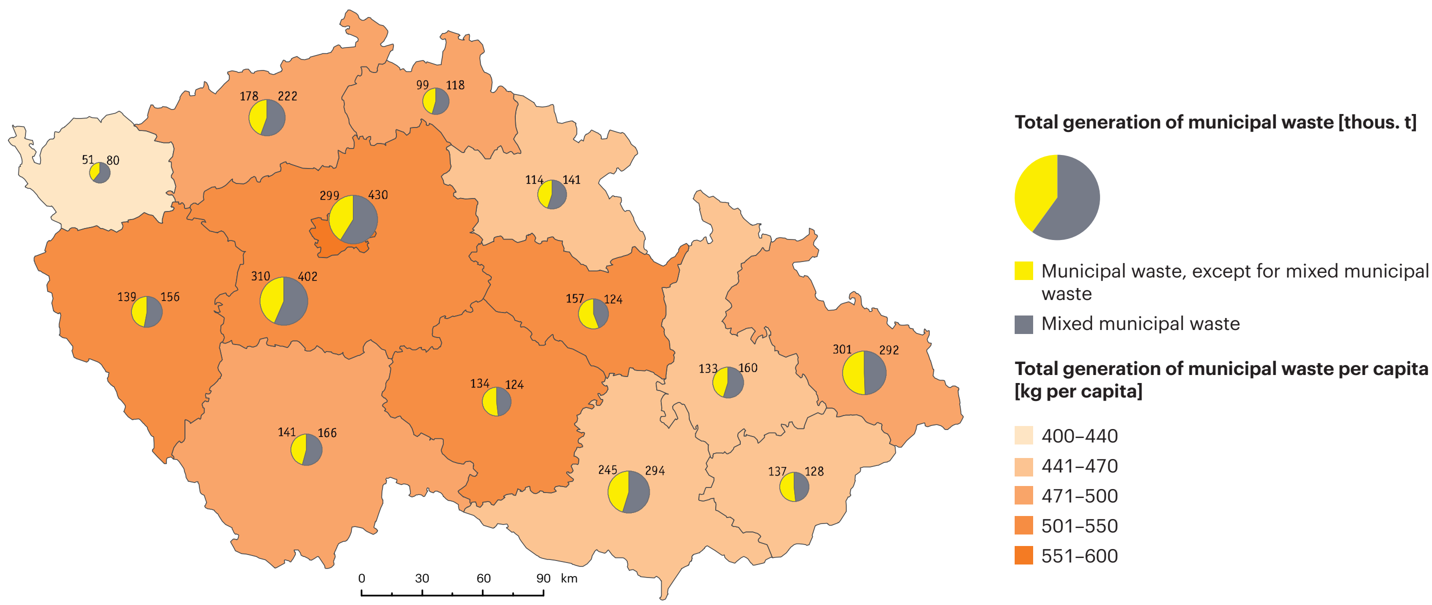


The data was determined according to the methodology Mathematical Expression of Calculating the "Waste Management Indicator Set" applicable for a given year.
Czech Statistical Office is the source of data on the population of the Czech Republic (mid-year population).

Source: CENIA, Czech Statistical Office

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], 2015



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 [%], 2009–2015

Treatment method [%]	2009	2010	2011	2012	2013	2014	2015
Proportion of municipal waste used for energy recovery	6.0	8.9	10.8	11.8	11.9	11.8	11.8
Proportion of municipal waste used for material recovery	22.7	24.3	30.8	30.4	30.2	34.7	35.6
Proportion of municipal waste disposed of by landfilling	64.0	59.5	55.4	53.6	52.2	48.3	47.4
Proportion of municipal waste disposed of by incineration	0.04	0.04	0.04	0.04	0.05	0.07	0.07

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, and beverage cartons), large-volume waste, but also hazardous waste.

Since 2009, the **total generation of municipal waste** is stagnating or, more precisely, oscillating around a value slightly above 5 mil. t (Chart 1).

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 2015, the average generation of municipal waste per capita was equal to 503.2 kg per capita. More specifically, the indicator's value in 2015 was 500.3 kg per capita. Since 2009, there has thus been a slight decline of 7.2 kg per capita, and between 2014 and 2015 by 5.6 kg per capita (Chart 1).

The category of **mixed municipal waste** includes waste falling under catalogue number 20 03 01. It is 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 the years 2009–2015 the mixed municipal waste generation has decreased by 13.6% and in 2015 dropped year-to-year by 3.4% to a total of 2,836.8 thous. t. The proportion of mixed municipal waste in the total municipal waste generation amounts to 53.8%. 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 2015, the total generation of mixed municipal waste per capita dropped by 43.9 kg per capita; however, there was a year-to-year increase of 9.9 kg per capita between 2014 and 2015, to 269.1 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 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, the prevailing method of disposal is **landfilling**. Since 2009, however, there was a slight decline in the quantity of landfilled municipal waste every year (Table 1). In the year-to-year comparison of 2014–2015 the amount of municipal waste removed by landfilling was decreased by 71.2 thous. t to a total of 2,498.7 thous. t. The proportion of municipal waste disposed of by landfilling in the total generation of municipal waste between 2009 and 2015 fell from 64.0% to 47.4%.

Another important municipal waste treatment method is its use for **material recovery**, the proportion of which increased from 22.7% in 2009 to 35.6% in 2015. Between 2014 and 2015, the quantity of municipal waste used for material recovery rose by 27.6 thous. t to 1,877.4 thous. t.

Step by step, the use of municipal waste for **energy recovery** is also becoming more important. Since 2009, the percentage of municipal waste used for this purpose grew from 6.0% to 11.8%. Between 2014 and 2015, the quantity of municipal waste used for energy recovery slightly rose by 6.9 thous. t to the total of 620.3 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

40 | Waste treatment structure

Key question

How is the structure of the waste treatment changing?

Key messages

Between 2009 and 2015, the proportion of waste used for material recovery rose from 72.5% to 83.2%. The proportion of waste disposed of by landfilling in the total waste generation was declining in 2009–2015.

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[9]

Last year-to-year change

References to current conceptual, strategic and legislative documents

Directive 2008/98/EC of the European Parliament and of the Council on waste
- waste treatment in compliance with environmental and human health protection
- supporting implementation of the hierarchy of waste treatment

State Environmental Policy of the Czech Republic 2012–2020
- 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
- maximising the recovery of waste
- reducing the proportion of landfilled waste in the total quantity of waste that is disposed of
- preventing unlawful treatment of hazardous waste
- minimising risks of transport of waste and its environmental impacts

Government Regulation No. 352/2014 Coll., on the Waste Management Plan of the Czech Republic for the period 2015–2024
- minimising adverse impacts of the waste treatment on human health and environment
- the 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 Czech Republic
- refraining from jeopardising human health and the environment of the Czech Republic resulting from the cross-border movement of waste

Secondary Raw Materials Policy of the Czech Republic
- 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 Innovations for Competitiveness)

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

- 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
- promoting voluntary agreements between manufacturers and businesses, using the products for their business (e.g., flat glass, plastics)

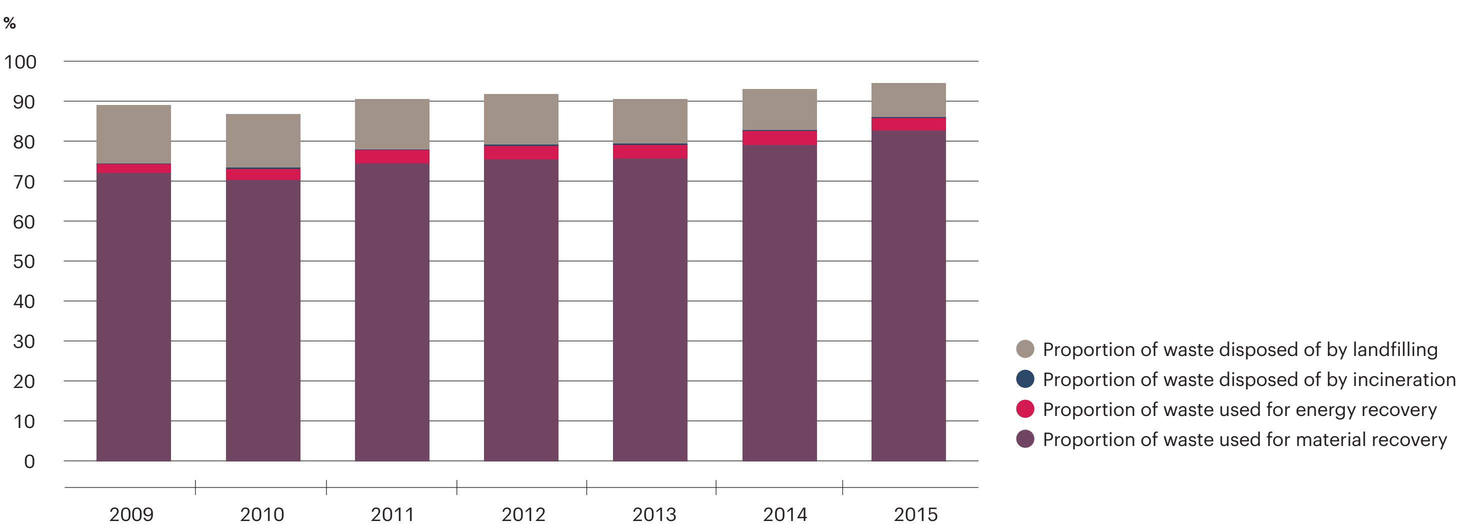
Impacts on human health and ecosystems

Waste must be treated of in a manner that does not pose a threat to human health and components of the environment, is not a nuisance because of the noise or odour it generates, and does not adversely affect the landscape or sites of special interest. In a broader sense, the term waste treatment includes gathering, collection, purchase, handling, transport, storage, treatment, recovery and disposal of waste. All of these operations can cause a release of pollutants into the environment. Compliance with safe waste treatment rules and adherence to the hierarchy of waste treatment, with priority assigned to preventing the generation of waste, are therefore essential. Other effects of waste treatment may include adverse impacts on the landscape character and functions caused by the construction and operation of waste treatment facilities. Landfilling poses another environmental threat, as it uses up land and is a source of emissions of greenhouse gases; if the landfill is not properly secured, there is also a possibility of eluates seeping into surface water and groundwater and also into soils. The odour and noise produced by waste treatment facilities are not inconsiderable as well.

Indicator assessment

Chart 1

Proportions of selected waste treatment methods in the total waste generation in the Czech Republic [%], 2009–2015

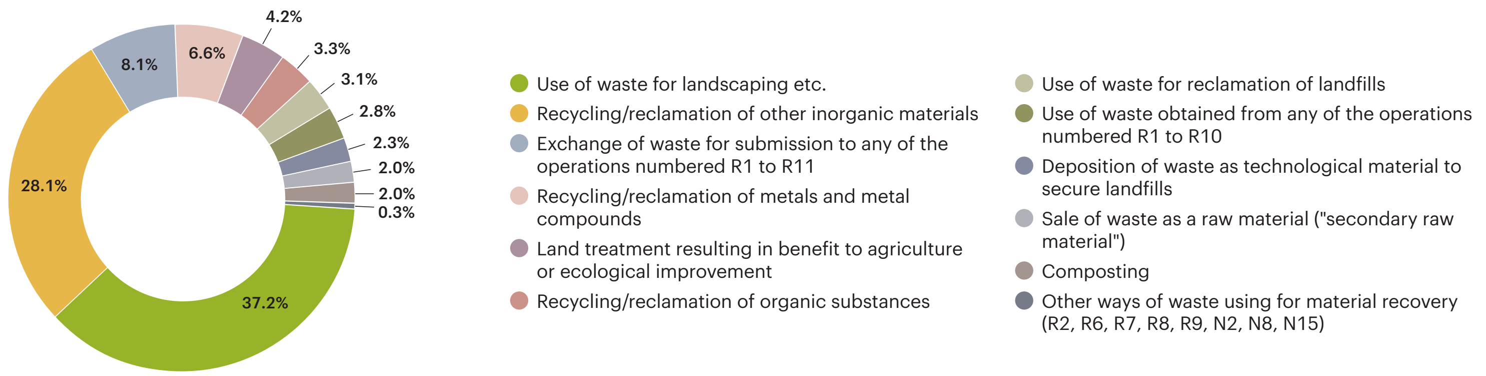


The data was determined according to the methodology Mathematical Expression of Calculating the "Waste Management Indicator Set" applicable for a given year.

Source: CENIA

Chart 2

Structure of waste used for material recovery in the Czech Republic [%], 2015



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 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.

Similarly, there has also been a positive trend in the **use of waste for material recovery**; between 2009 and 2015, the proportion of waste used for this purpose rose from 72.5% to 83.2%. Between 2014 and 2015, the quantity of waste used for material recovery increased by 5,603.3 thous. t to 31,070.2 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 use of waste for material recovery includes its use for landscaping (particularly construction and demolition wastes) and recycling of other inorganic materials and metals still rank among the most frequently employed methods (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 2015, the percentage of waste used for energy recovery rose from 2.2% to 3.1%, and there was also a slight increase of the amount of waste used for this purpose between 2014 and 2015, by 43.3 thous. t to 1,153.6 thous. t (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 8.6% in 2015. The 2014–2015 year-to-year comparison indicates a decline of the amount of landfilled waste by 86.2 thous. t to 3,207.3 thous. t (Chart 1).

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 2015, inspectors of waste management department in the field of waste management, packages and chemical substances carried out 3,643 inspections, of which 1,330 were planned and 2,313 unplanned, of which 545 inspections were based on an obtained proposal or submission delivered. The aggregate amount of fines levied on the basis of the inspections was CZK 59,774 thous. In comparison with the previous year it was about CZK 8,599 thous. less.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

41 | 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

Between 2009 and 2015, the generation of packaging waste increased by 21.3%, but the percentage of recycled packaging waste was increasing as well. 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	Change since 2009[10]	Last year-to-year change
N/A		

References to current conceptual, strategic and legislative documents

European Parliament and Council Directive 94/62/EC on packaging and packaging waste

- minimizing 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

State Environmental Policy of the Czech Republic 2012–2020

- minimizing the quantity of packagings used
- 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

- increasing in the total packaging recycling to the level of 70%, the total recovery of waste from packaging to a level of 80%, the recycling of plastic packaging to a level of 50% and recycling of metal containers to a level of 55% by 2020
- achieving 55% of the total use of sales packaging intended for the consumer and achieving 50% of recycling of sales packaging intended for the consumer by 2020

Act No. 477/2001 Coll., on packaging

- 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 60% and the level of overall recovery of packaging waste to 65% by December 31, 2015 (the objectives are set every year)

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

Secondary Raw Materials Policy of the Czech Republic

- 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 Innovations 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

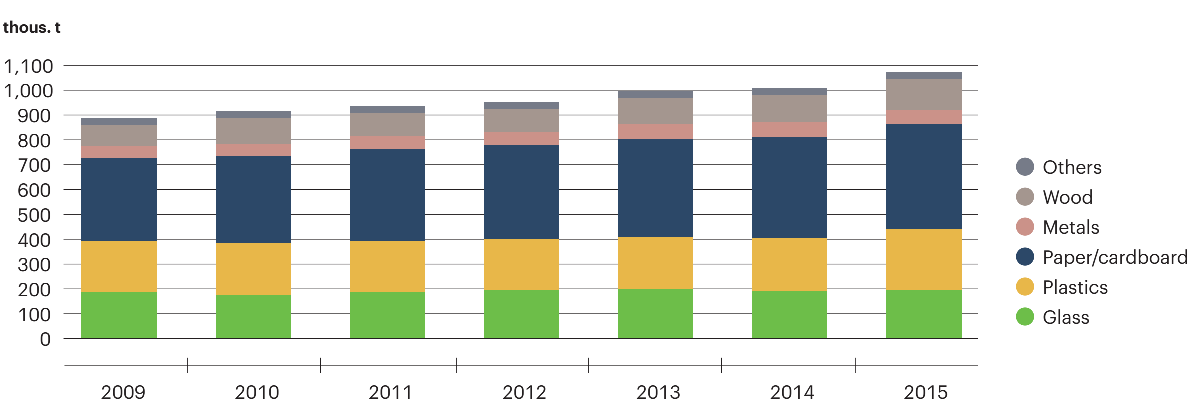
Impacts on human health and ecosystems

One of the phenomena characterising the consumer society is the generation of packaging waste. On the one hand, it results in an increased pressure on the environment; however, material recycling of packaging waste significantly reduces the pressure, as it saves, inter alia, natural resources and reduces energy demands of the production process. Both the generation of packagings and packaging waste treatment facilities are environmental burdens, particularly with respect to harmful pollutants they release into the atmosphere or water, which subsequently have an adverse impact on human health. The presence of heavy metals is also a factor of environmental pollution (including organisms), which is why their use in packagings is regulated by the Packaging Act. When looking for a suitable packaging, i.e. one which is environmentally friendly, it is necessary to consider the entire packaging system (raw material acquisition, generation of packaging, transport, consumption, usability, recyclability and suitable methods of disposal). Packaging waste affects the character of the landscape, and may change the development of different plant and animal species or influence their biotopes.

Indicator assessment

Chart 1

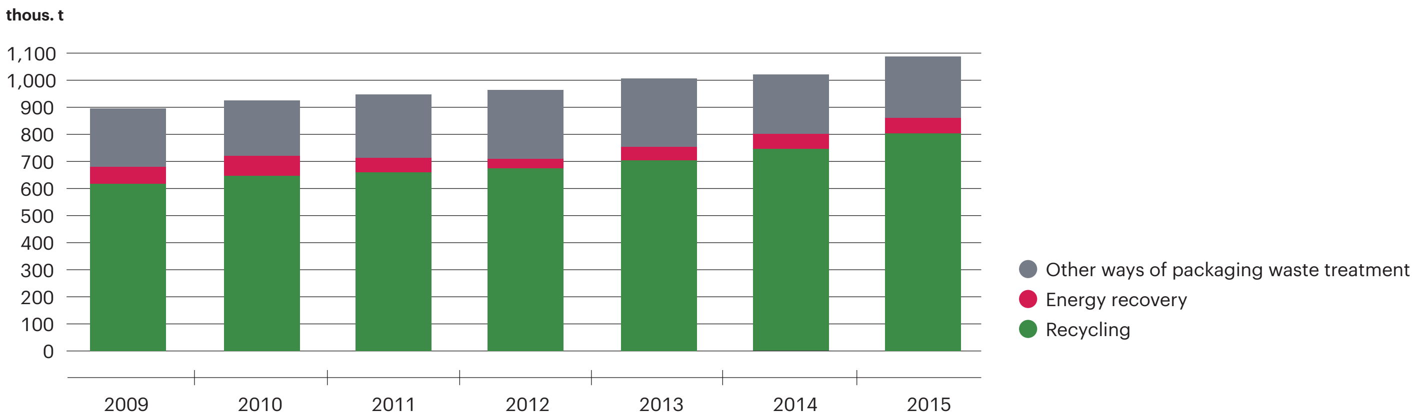
Packaging waste and packaging waste material structure in the Czech Republic [thous. t], 2009–2015



Source: Ministry of the Environment

Chart 2

Recovery of packaging waste in the Czech Republic [thous. t], 2009–2015



Source: Ministry of the Environment

Table 1

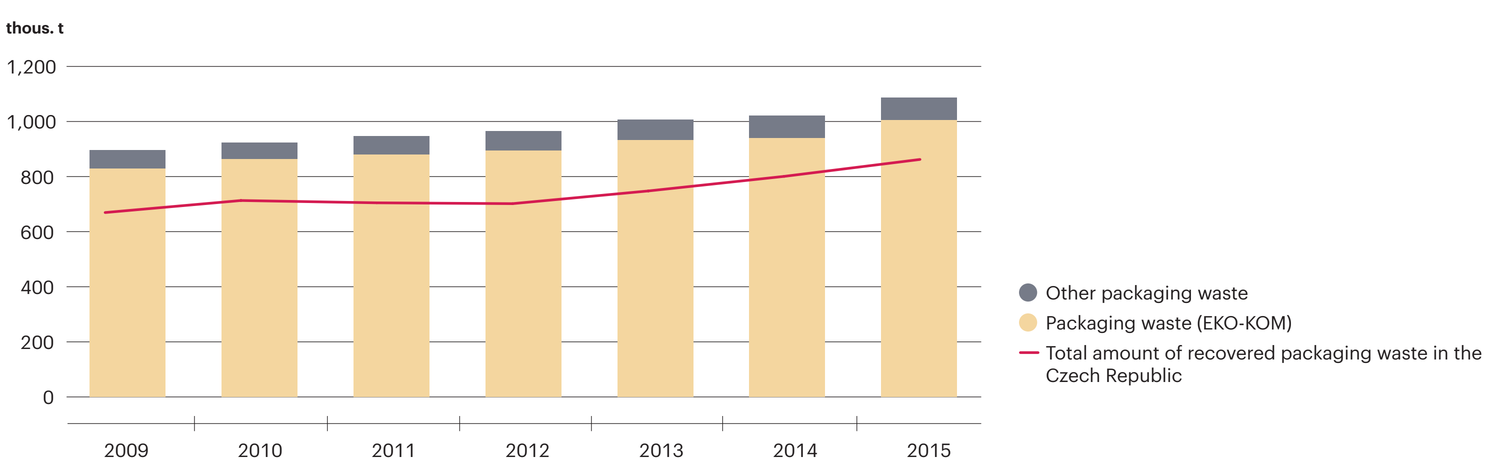
Number of entities that are obligated to utilise packaging waste or to provide take-back and that participate in the EKO-KOM system, and the number of municipalities that participate in the EKO-KOM system, 2009–2015

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

Source: EKO-KOM, a.s.

Chart 3

Generation and recovery of packaging waste (within the EKO-KOM system and elsewhere) in the Czech Republic [thous. t], 2009–2015



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 2015, the generation of packaging waste rose by 21.3%. In 2015, the generation of packaging waste in the Czech Republic amounted to 1,084.8 thous. t, a 6.4% increase compared to 2014. The year-to-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 (39.4% in 2015), a long way ahead of plastics (22.7%) and glass (18.1%). The structure is relatively stable in the course of years. The year-to-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 2015 was 858.8 thous. t, i.e. 79.2% of the total generation of packaging waste. The legislative objective (65%) for 2014 was thus met. Since 2009, the amount increased by 180.6 thous. t, i.e. 26.6%, and the year-to-year increase between 2014 and 2015 was 57.5 thous. t, i.e. 7.2% (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 186.8 thous. t and in the year-to-year comparison of 2014–2015 by 58.1 thous. t of the total 802.4 thous. t. While the proportion of recycled packaging waste in the total generation of packaging showed only a slight increase between 2009 and 2015 (to 74.0%), it still significantly exceeds the legislative objective for that year (60%). The second most frequent recovery is energy; however, the proportion of packaging waste used for this purpose dropped from 7.0% in 2009 to 5.2% in 2015. However, the last year-to-year comparison between 2014 and 2015 showed a slight decrease of 0.5 thous. t to 56.4 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 2015 (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 2015, the number of clients involved in the system of the authorised packaging company EKO-KOM therefore reached 20,382. The number of municipalities making use of the system was gradually growing; by 2015, their number was 6,085 (out of the total number of 6,253 municipalities in the Czech Republic), with 10,479 thous. inhabitants (i.e. roughly 99% of the Czech population). The number of new entrants in 2015 was 12. In 2015, the proportion of packaging waste registered in the EKO-KOM system accounted 92.5% of the total generation of packaging waste (Chart 3).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

42 | 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

Since 2009, the generation of waste from selected products rose, as it also did between 2014 and 2015. The take-back of selected products from the year 2009 in most cases also increased, even in the last year-to-year comparison. 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[11]

Last year-to-year change

References to current conceptual, strategic and legislative documents

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
- reaching the minimum collection of electrical and electronic equipment in the amount of 4 kg per capita per year

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 following 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

State Environmental Policy of the Czech Republic 2012–2020
- increasing levels of collection, recovery and reuse of waste electrical and electronic equipment

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

- achieving the following minimum levels of collection of batteries and accumulators (percentages of the total quantity of products placed on the market per year): 25% up to 26 September 2012; 45% to 26 September 2016

Government Regulation No. 352/2014 Coll., on the Waste Management Plan of the Czech Republic for the period 2015–2024
- achieving a high level of separate collection of waste electrical and electronic equipment and ensuring a high level of recovery, recycling and preparation for reuse of waste electrical and electronic equipment
- increasing the level of separate collection of waste portable batteries and accumulators and achieving high recycling efficiency of processes of recycling waste batteries and accumulators
- achieving high recovery rates in the processing of end-of life vehicles (car wrecks)
- increasing the level of separate collection of waste tyres and achieving a high recovery rate in the processing of waste tyres

Secondary Raw Materials Policy of the Czech Republic
- 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 Innovations 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

Act No. 185/2001 Coll., on waste
- ensuring a minimum take-back level of used tyres in the amount of 35% for each calendar year

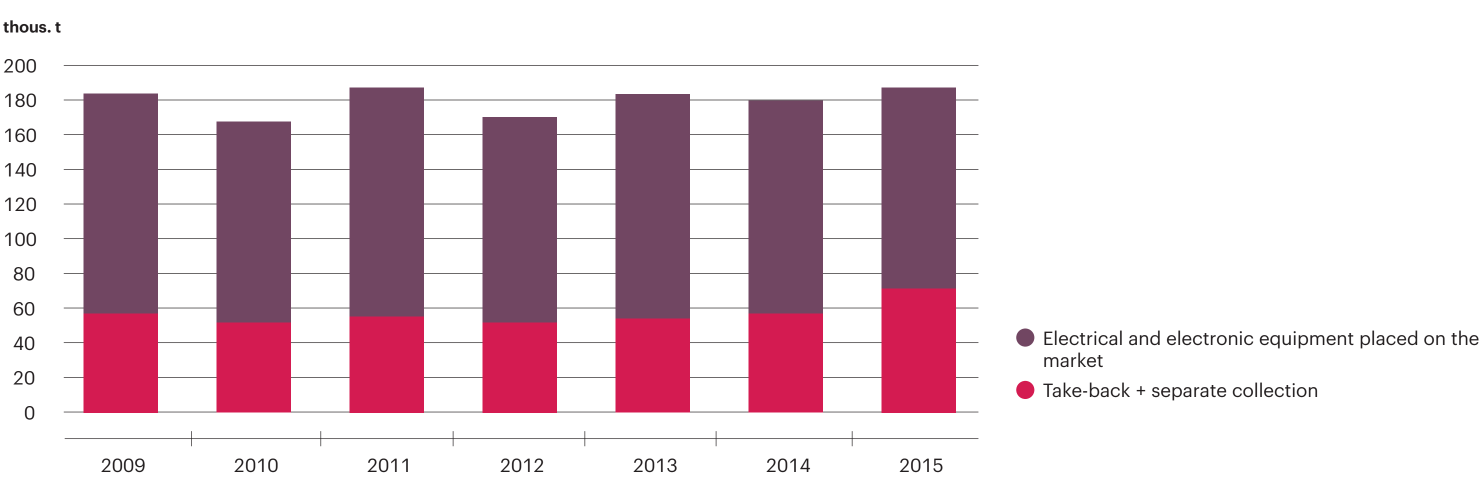
Impacts on human health and ecosystems

Waste from selected products (electrical and electronic equipment, batteries and accumulators, car wrecks, tyres) contain substances which, if treated improperly, may find their way into the environment, namely into the atmosphere, water and soil, and pose a risk for the environment and human health. In order to maintain and improve quality of the environment and to save energy, the content of such substances in products must be reduced, and waste resulting from the products must be treated properly, usually by special procedures specific for different products. The amount of this waste and its adverse impacts on the environment and human health can be reduced by, for example, developing clean and reusable products and special technologies used to manufacture them.

Indicator assessment

Chart 1

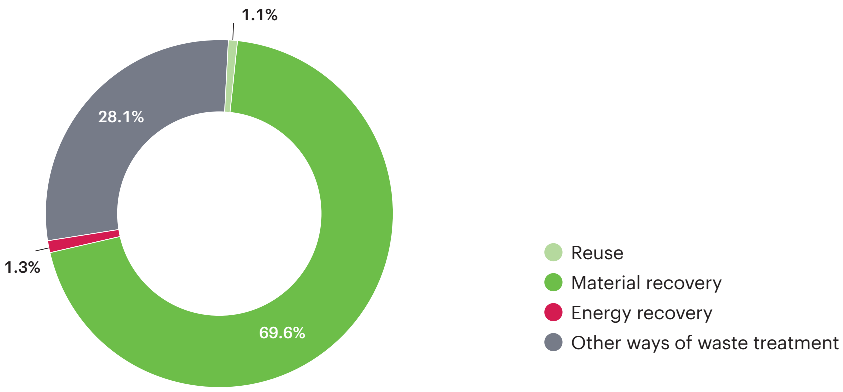
Quantity of electrical and electronic equipment placed on the market and the take-back rate of electrical and electronic equipment and separate collection of waste electrical and electronic equipment achieved in the Czech Republic [thous. t], 2009–2015



Source: Ministry of the Environment

Chart 2

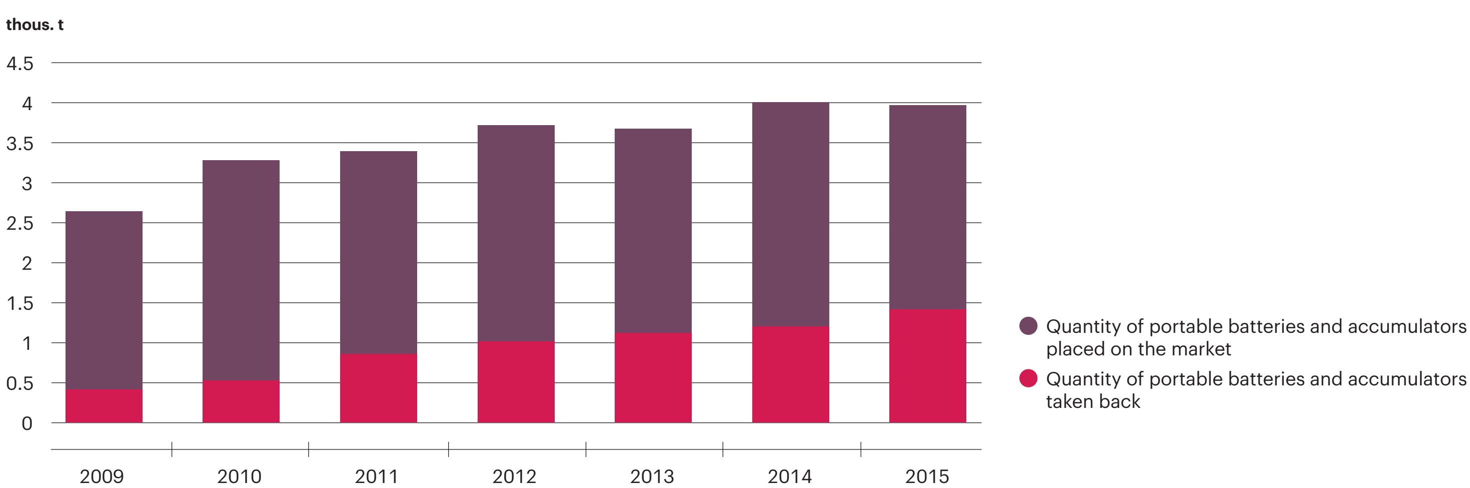
Electrical and electronic equipment and waste electrical and electronic equipment treatment methods in the Czech Republic [%], 2015



Source: Ministry of the Environment

Chart 3

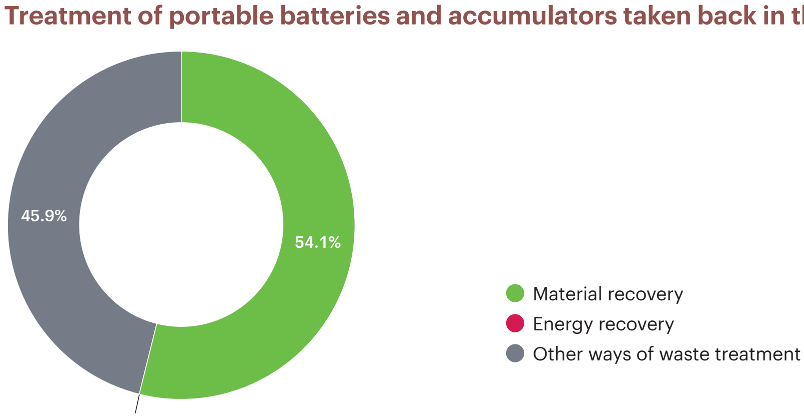
Quantity of portable batteries and accumulators placed on the market and quantity of portable batteries and accumulators taken back in the Czech Republic [thous. t], 2009–2015



Source: Ministry of the Environment

Chart 4

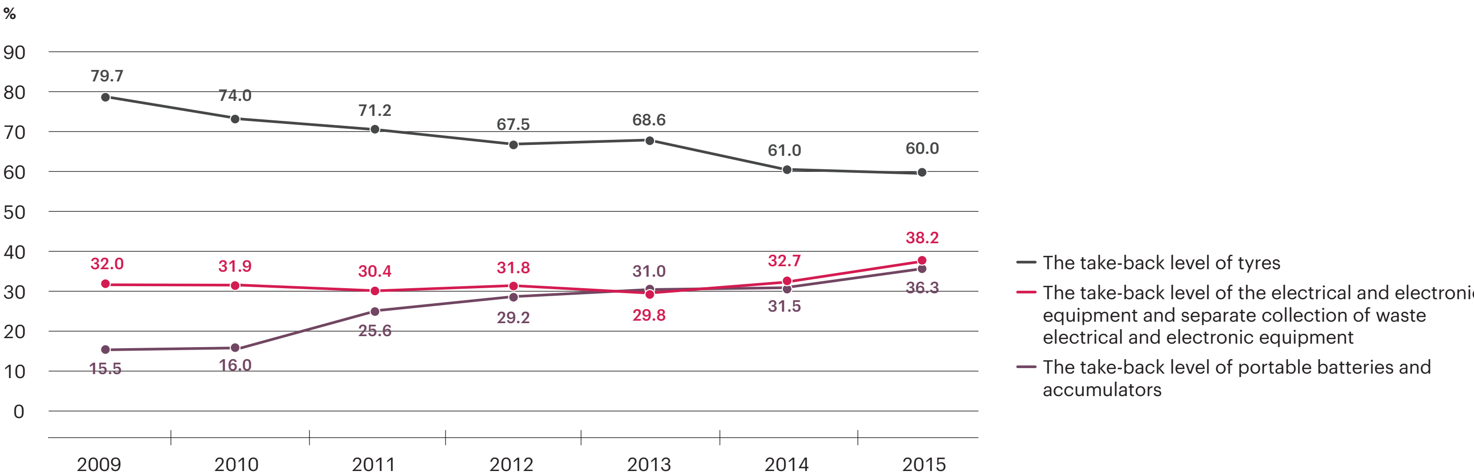
Treatment of portable batteries and accumulators taken back in the Czech Republic [%], 2015



Source: Ministry of the Environment

Chart 5

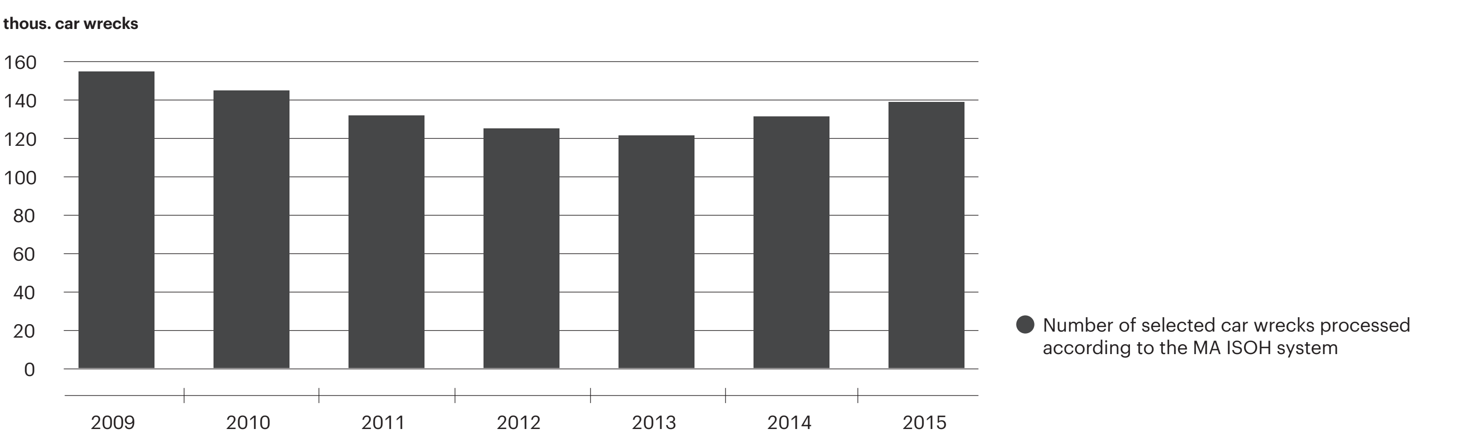
Development of the take-back level of selected products in the Czech Republic [%], 2009–2015



Source: Ministry of the Environment

Chart 6

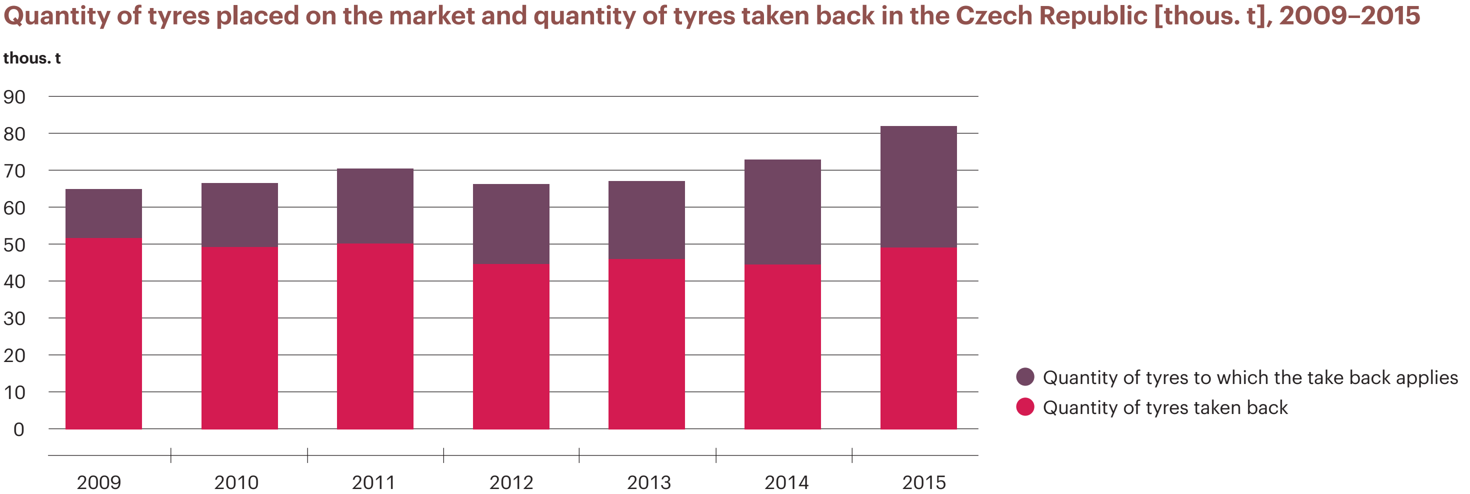
Number of selected car wrecks processed in the Czech Republic according to the MA ISOH system [thous. car wrecks], 2009–2015



Source: Ministry of the Environment

Chart 7

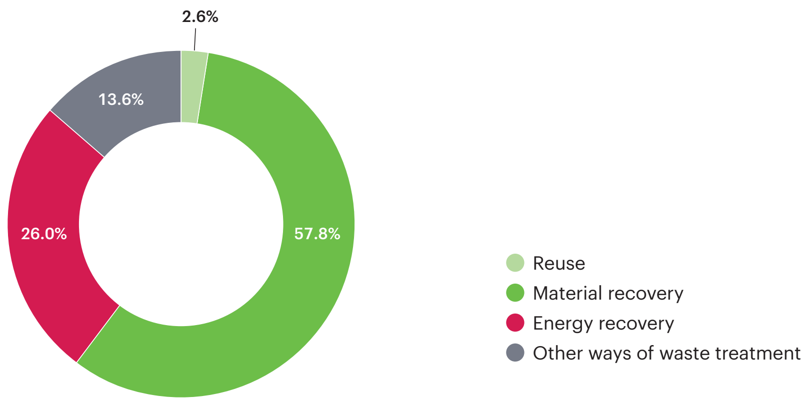
Quantity of tyres placed on the market and quantity of tyres taken back in the Czech Republic [thous. t], 2009–2015



Source: Ministry of the Environment

Chart 8

Treatment of tyres in the Czech Republic [%], 2015



Source: Ministry of the Environment

Between 2009 and 2015, the **quantity of electrical and electronic equipment**[12] **placed on the market** showed a slight increase of 0.1%, and the same increase, i.e. 1.5%, was also registered between 2014 and 2015, bringing the total to 182.0 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 by 18.5% to the value of the 69.4 thous. t (Chart 1). Between 2009–2015 it was a growth of 19.3%. 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 38.2% and in the year-to-year comparison of 2014–2015 increased from 32.7% to 38.2% (Chart 5). To achieve the objectives of the directive it will need to further increase the level of their collection. However, the requirement for a minimum electrical and electronic equipment collection specified by the directive (4 kg per capita per year), was successfully fulfilled in 2015, with the value of 6.6[13] kg per capita per year.

In 2015, the most frequent **utilisation of electrical and electronic equipment and waste electrical and electronic equipment** was material recovery, which accounted for a 69.6% of all methods of treatment. The use of the waste for energy recovery was 1.3% and reuse accounted for 1.1% (Chart 2). Between the years 2014–2015 has increased the proportion of material recovery from 68.9% to 69.6%, i.e. on the amount of 50.8 thous. t. Energy recovery decreased year-to-year from 2.1% to 1.3% and the share of reuse fell from 1.1% to 1.3%.

When assessing data on **batteries and accumulators**[14], 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 2015, the generation of portable batteries and accumulators was found to grow by 50.3%. Between 2014 and 2015, the generation of portable batteries and accumulators slightly decreased by 0.9% to a total amount of 4.0 thous. t (Chart 3).

[12] *http://www.mzp.cz/cz/odpadni_elektronicka_zarizeni_nakladani_cr*

[13] *The take-back rate of electrical and electronic equipment and separate collection of waste electrical and electronic equipment achieved in the Czech Republic related to the number of inhabitants of 10,542,942, mid-year population (data source Czech Statistical Office).*

[14] *http://www.mzp.cz/cz/ukazatele_odpadoveho_hospodarstvi_baterie_akumulatory*

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 244.0% to 1.4 thous. t. The year-to-year increase between 2014 and 2015 was equal to 17.9% (Chart 3).

Between 2009 and 2015, the **take-back level** of portable batteries and accumulators increased from 15.5% to 36.3%. On a year-to-year (2014–2015) basis, the take-back level increased from 31.5% to 36.3%. 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 objective for 2012 (25%) was achieved, as the actual take-back level was 29.2% (Chart 5). Insofar as the 2016 target figure (45%) is concerned, however, the existing growth rate is not sufficient.

As to **methods employed to treat of** portable batteries and accumulators taken back in 2015, the dominant position belonged to material recovery, with a 54.1% share, as they are not used for energy recovery (Chart 4). Between 2010 and 2015, the percentage of portable batteries and accumulators used for material recovery grew from 46.7% to 54.1%, i.e. to 0.9 thous. t. In the year-to-year comparison of 2014–2015, there was an increase in the quantity portable batteries and accumulators used for material recovery by 0.2 thous. t.

According to the directive, recycling processes must achieve a prescribed recycling efficiency. In 2015, the recycling efficiencies of lead-acid batteries, nickel-cadmium batteries and accumulators and other waste batteries and accumulators were 73.5%, 94.6% and 60.4%, respectively. The target figures were thus achieved in all the groups.

Annual reports of manufacturers are, to some extent, irrelevant and year-to-year comparisons and general assessments are not possible due to many reasons. This is why the assessment of data is based on the **Car Wrecks**[15] Module of the Waste Management Information System (in Czech acronymized as MA ISOH) into which car wrecks processing entities and companies enter data directly. An assessment of the numbers of processed car wrecks according to the MA ISOH system shows that there was a decline of 10.2% between 2009 and 2015, although an increase of 5.7% to 139.5 thous. car wrecks was registered between 2014 and 2015 (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 86.3% and reuse and material recovery at 80.3%.

The quantities of **tyres**[16] 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.

Since 2009, the quantity of tyres which the take-back applies rose by 26.3%. As to the 2014–2015 period, the quantity increased by 12.4% to 82.1 thous. t (Chart 7).

As to the quantity of tyres taken back, a decline of 5.0% was registered between 2009 and 2015; despite the year-to-year increase by 10.4% to 49.3 thous. t in 2015 (Chart 7).

The take-back level of tyres since 2009 decreased from 79.7% to 60.0% and in the year-to-year comparison of 2014–2015 there was a slight decline from 61.0% to 60.0%. The legislative objective (35%) for 2014 was thus met (Chart 5).

In the period of 2009–2014, unlike the other groups of products mentioned above, waste tyres are predominantly used for energy recovery, but in 2015 the situation has turned in favour of material recovery (57.8% in 2015). For energy recovery were used 26.0% of tyres in 2015 (Chart 8). The reuse is minimal (1.3 thous. t), which indicates that retreading of tyres takes place outside the waste treatment system. The material recovery of tyres in the years 2009–2015 dramatically increased from 14.5% to 57.8% and in 2015 the amount of tyres used for material recovery increased by 16.2 thous. t for a total of 28.6 thous. t. Between 2009 and 2015, the share of waste tyres used for energy recovery significantly dropped from 71.8% to 26.0%. In the year-to-year comparison, in 2015, the amount of tyres used for energy recovery was significantly reduced by 13.1 thous. t to a total of 12.9 thous. t. In comparison with the previous years, there was a large 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

[15] *http://www.mzp.cz/cz/modul_vraky_isoh*

[16] *http://www.mzp.cz/cz/vybrane_ukazatele_odpadoveho_hospodarstvi*

between 2009 and 2015 was reduced from 3.4% to 2.6% and in the year-to-year comparison of 2015 a decrease was recorded in the quantity of reused tyres by 0.5 thous. t.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

Material flows in the global context

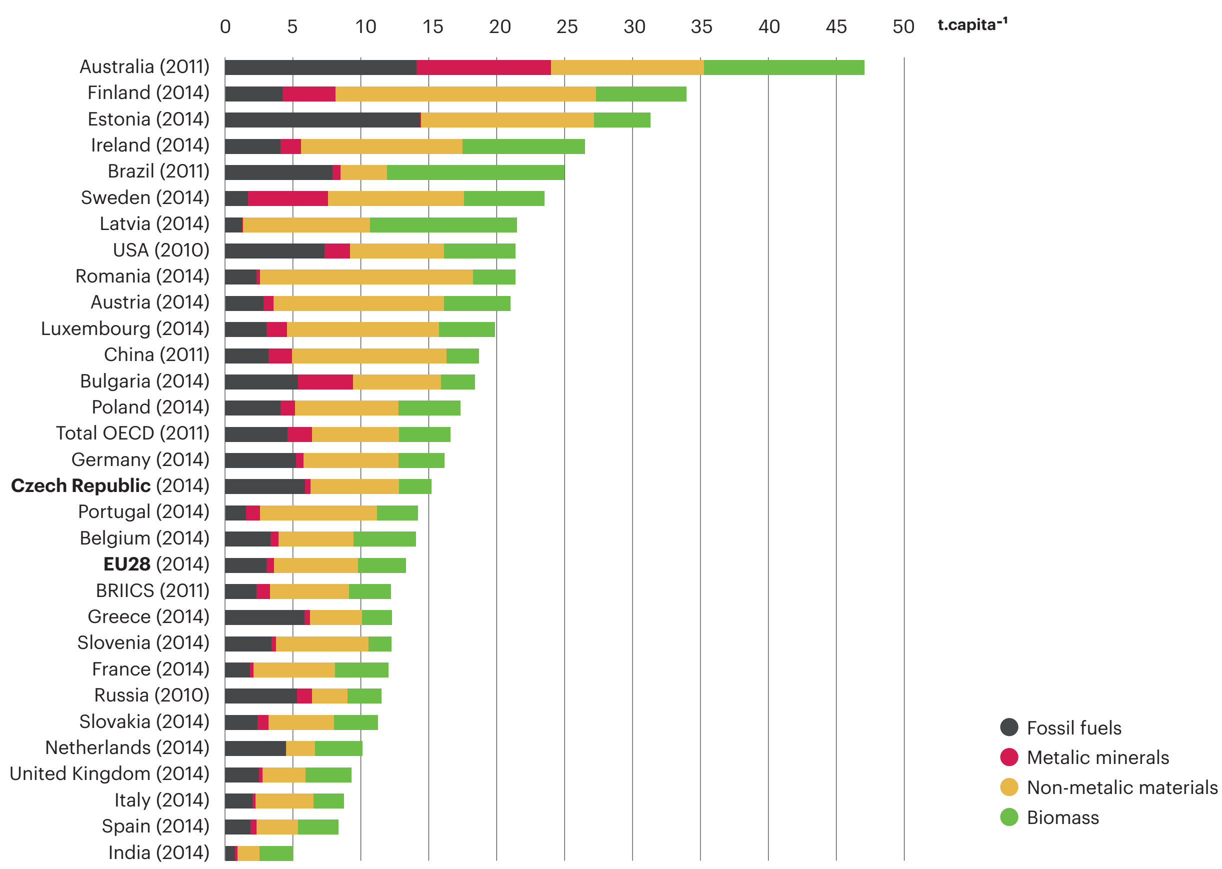
Key messages

- The domestic material consumption (DMC) per capita and material intensity of the economy in the Czech Republic were above the average of EU28 countries in 2014. In a global comparison the values of specific material flow indicators of the Czech Republic are approximating the average of OECD countries, while a significantly higher material intensity of the economy than the Czech Republic and EU28 countries are in BRIICS countries, in particular, in China and Brazil.
- 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 in the Czech Republic among the lowest in the EU and on the global scale.

Indicator assessment

Chart 1

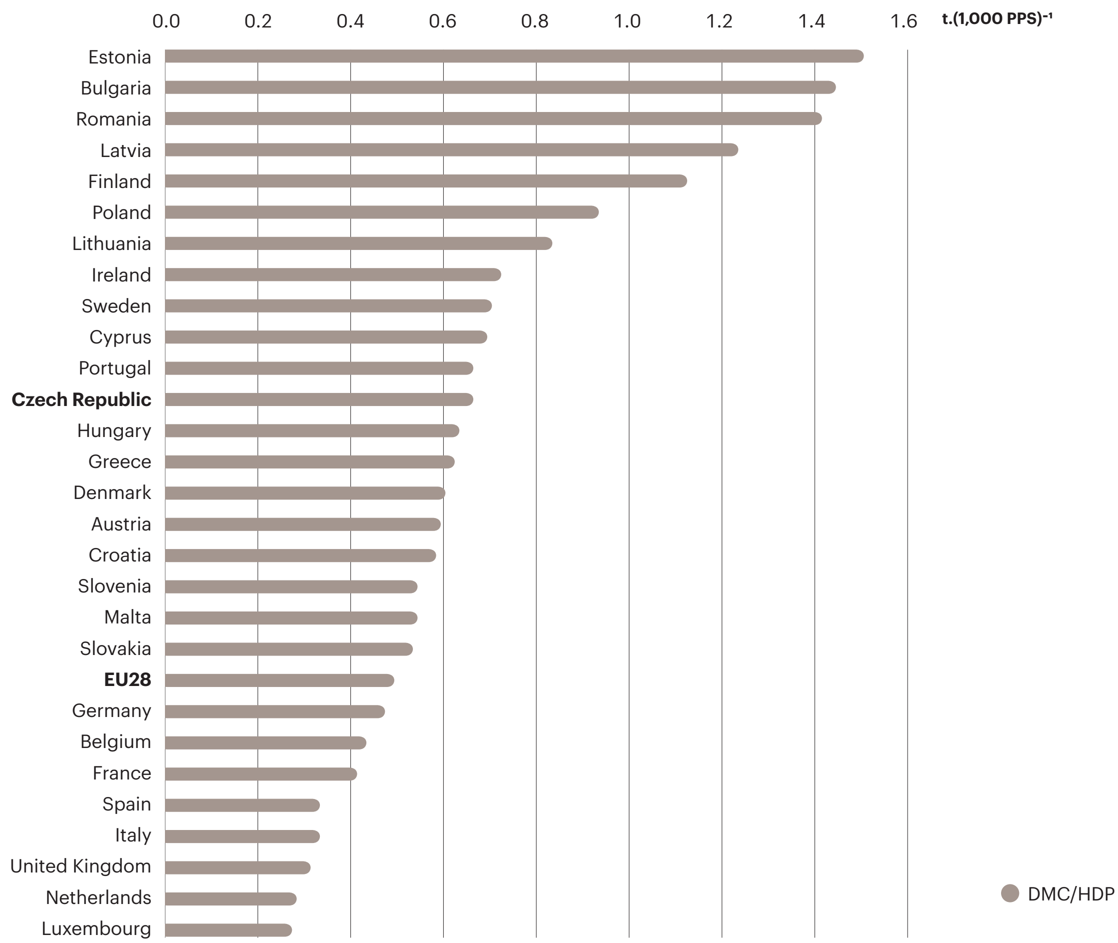
Domestic material consumption per capita, according to material groups [$t.capita^{-1}$], year – see country labels



Source: Eurostat, OECD

Chart 2

Material intensity of the economy [t.(1,000 PPS)$^{-1}$], 2014



Source: Eurostat

Intensity indicators of material consumption in the Czech Republic are still in the context of the EU28 countries above average. Among the causes of this condition there is particularly a high proportion of material-intensive sectors on the total GDP, in particular the manufacturing industry, and the composition of the energy mix, with a declining, though still high share of coal. In the global context, however, the entire region of EU28, including the Czech Republic, shows a low material-intensity of the economy, affected by a higher economic performance in combination with below-average domestic material consumption per capita.

Domestic material consumption per capita in the Czech Republic in 2014 was 15.2 t.inhabitant^{-1}, which is about 14.3% above the average of the EU28 and 8.9% lower than the average of OECD 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 the countries where the energy system is based on fossil fuels (Estonia). Worldwide, among the countries with the highest per capita material consumption there is Australia[17] due to the rich material and energy resources and the mining of iron ore and fossil fuels.

In the structure of DMC per material groups, the Czech Republic has an above average proportion of fossil fuels (38.8%, the average of the EU28 is 22.8%), and on the other hand, in the European and global comparison, it was one of the lowest shares of biomass (14.4%) on the total DMC.

Compared with the EU28 the **material intensity of the Czech economy** is significantly above average; in 2014 it was 0.66 t.(1,000 PPS)$^{-1}$ (year-to-year increase by 1.5%) and was higher by 35.0% than in the EU28. The western European countries

[17] *Data for the year 2011.*

with high GDP per capita have the lowest material intensity, while higher material intensity is typical for countries with high DMC per capita (Finland) or with lower economic performance in combination with above-average DMC per capita, such as Romania, Estonia and Bulgaria (Chart 2). Globally, the highest material intensity can be seen in the rapidly emerging economies of BRIICS countries, especially in China and Brazil[18], that have a material intensity more than four times higher in comparison with the EU28 average and the average of the OECD countries.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

[18] *Data for the year 2011.*


10
Financing

43 | Total environmental protection expenditure

Key question

How much financing in the form of investment expenditure or non-investment costs is spent on maintaining and improving the environment?

Key messages

The total expenditure on environmental protection in 2015 confirmed the upward trend in the long term, when from 2014 to 2015 they increased by 5.1% to almost CZK 96.2 bil. What contributed to the growth was a significant increase in investment expenditure for the environmental protection of 27.8% to CZK 40.1 bil., and despite the decline in the non-investment costs by 6.7% to CZK 56.1 bil. The proportion of total expenditure on environmental protection, also due to the growing performance of the Czech economy, remained at the level of 2.1% of GDP.
In terms of the programming focus, as in previous years, the most of the resources was spent in the area of waste management (CZK 40.1 bil. in total), followed by the area of the waste water treatment with the total amount CZK 26.3 bil. and the protection of air quality and climate change with the amount of CZK 16.4 bil.

Overall assessment of the trend – investment expenditure

Change since 1990

Change since 2000

Last year-to-year change

Overall assessment of the trend – non-investment costs

Change since 1990 N/A

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

State Environmental Policy of the Czech Republic 2012–2020
- increasing investment in using clean technologies, renewable energy resources and more economical use of resources of a non-renewable nature
- 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
- supporting research and analysis aimed at cost-effective policies leading to minimising the costs of achieving environmental protection targets

National Research, Development and Innovation Policy of the Czech Republic in 2009–2015 and the National Priorities of Oriented Research, Experimental Development and Innovations (further referred as "RDI Priorities")
- increasing the proportion of investment in supporting science, research and innovations in environmental protection as one of the conditions for ensuring sustainable development of the Czech Republic and its competitiveness (under the RDI

Priorities, the aim is to secure up to 18% of the total research, development and innovation budget for each thematic area "environment for a good life" and "sustainability of energy and material resources")

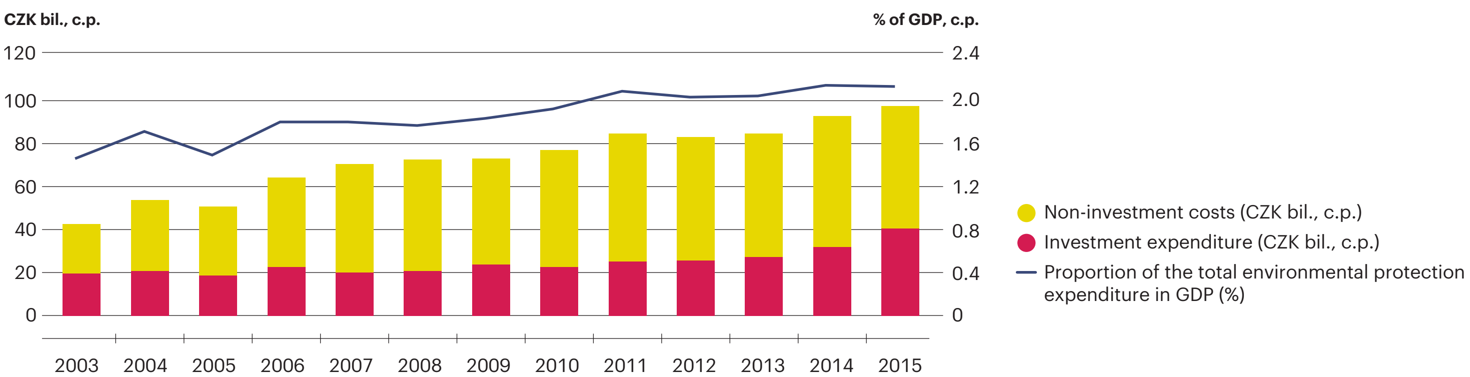
Strategic Framework for Sustainable Development in the Czech Republic
- supporting the dynamics of the national economy and strengthening competitiveness
- supporting an increase in the proportion of environmentally friendly technologies (e.g., low-waste and BAT technologies)
- supporting research, development and innovations in the area of environmentally friendly and knowledge-based technologies with a high added value and lower demands on material consumption

Europe 2020: Strategy for smart, sustaninable 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)

Indicator assessment

Chart 1

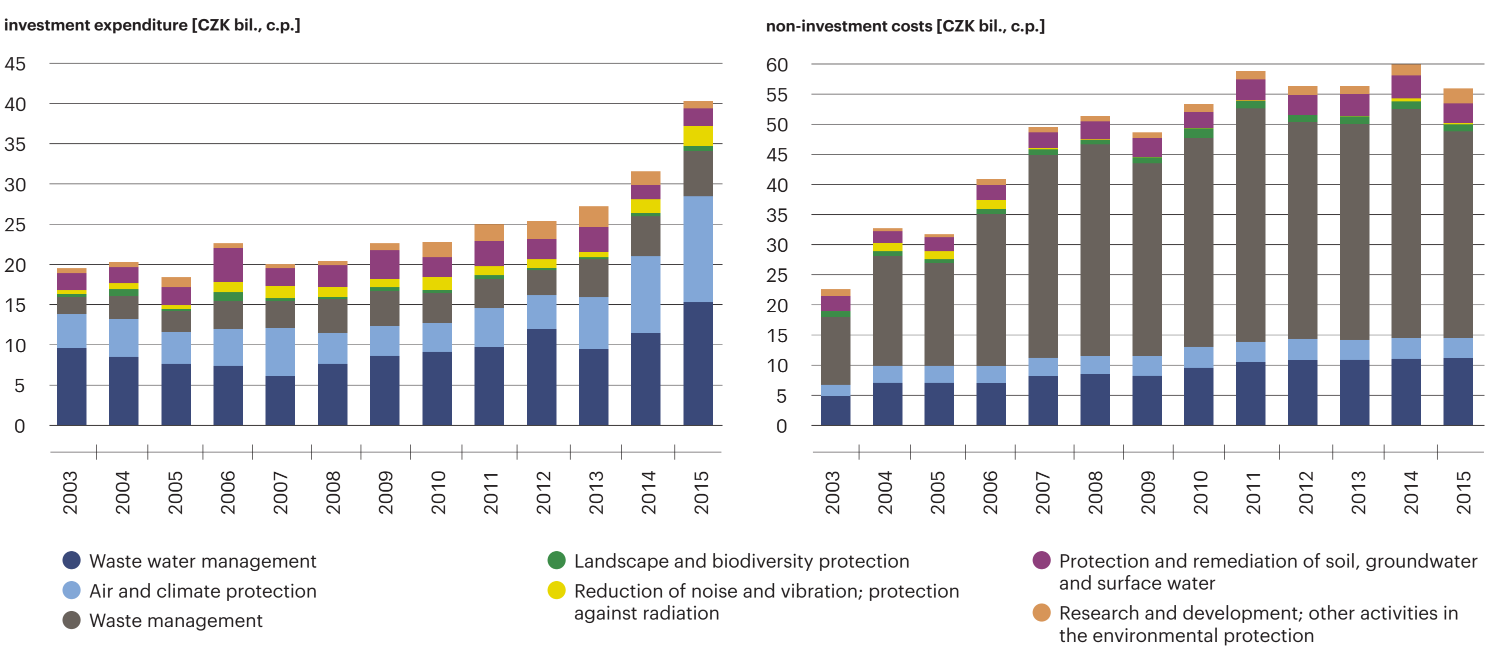
Total environmental protection expenditure in the Czech Republic [CZK bil., % of GDP, current prices], 2003–2015



Source: Czech Statistical Office

Chart 2

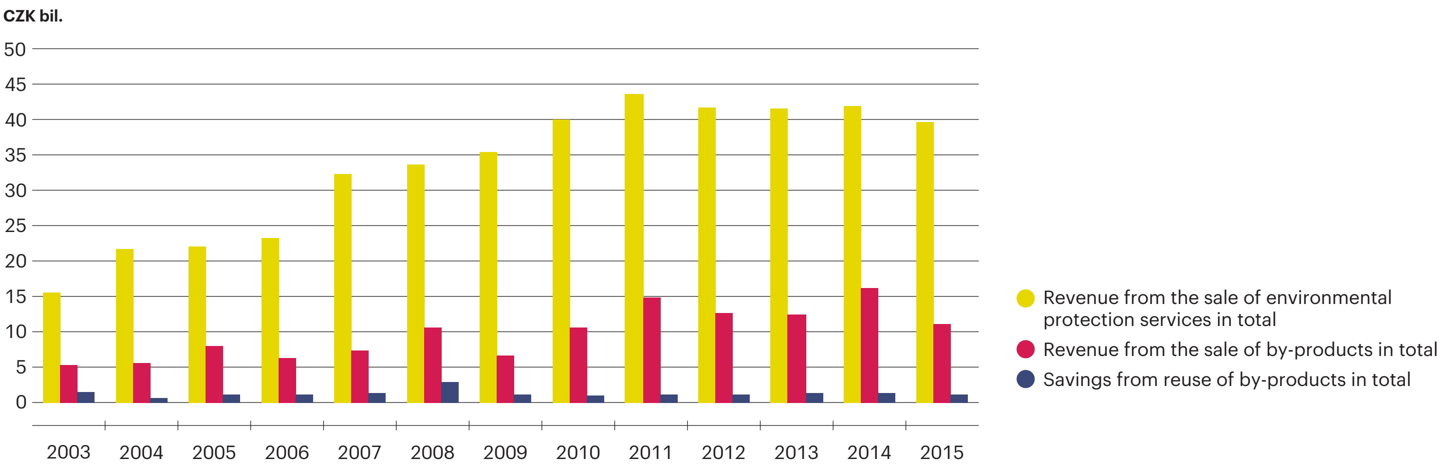
Investments and non-investment costs for environmental protection according to the programme focus in the Czech Republic [CZK bil., current prices], 2003–2015



Source: Czech Statistical Office

Chart 3

Economic benefit of environmental protection activities in the Czech Republic [CZK bil.], 2003–2015



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 collection of source data is carried out by the Czech Statistical Office.

In 2015, **the total expenditure** on environmental protection amounted to CZK 96.2 bil., an increase of 5.1% compared to 2014. The growth was contributed to mainly by investment expenditure, which increased interannually by CZK 8.7 bil. to CZK 40.1 bil. and thus confirmed the steadily growing trend in the amount of investment funds dedicated to environmental protection. The overall increase in expenditure on environmental protection in 2015 copied the increase in the economic performance of the Czech Republic represented by GDP, and thus their share settled at 2.1% of GDP, as well as in 2014 (Chart 1).

Investment in environmental protection

In the context of **investment**, expenditures on terminal equipment (i.e. to remove pollution) were slightly over expenditure on the integrated equipment (i.e. to avoid pollution). Despite that 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.

As in previous years, in 2015 investment expenditure increased interannually by significant CZK 8.7 bil. (i.e. 27.8%) to CZK 40.1 bil. The reason was, in particular, the strengthening of investment in the field of waste water management and the protection of air and climate, where in terms of the **programme focus** most resources were also invested. In the field of waste water management in 2015 the amount of CZK 15.2 bil. (+33.5% compared to the year 2014) was spent, in particular for the reconstruction of the sewerage and waste water treatment plants and building new ones. In the protection of air and climate CZK 13.1 bil. was invested (increased by 38.1% since 2014) within the framework of further emission reductions, for example in the context of the IED directive on industrial emissions and emission standards in transportation. The third most significant area in terms of the volume of investments was in 2015, waste management with CZK 5.6 bil. (+13.6% since 2014). In comparison with 2014 there was an increase in investment expenditure also in other key areas of environmental protection, with the exception of other activities for the protection of the environment (Chart 2).

In terms of **economic activities sectors** of the investing entity (CZ-NACE) it was the public administration, defence, compulsory social security (41.4% of total investments in 2015) and also energy, i.e. the production and the distribution of electricity, gas, heat and climatised air (21.9% of total investments), and manufacturing industry (16.5% of total investments) contributed the most to total long-term investments. A significant share of the total investment is reached also by the water supply, including activities related to waste water management, waste management and remediation (12.0% of total investment).

Concerning the division into **corporate and government sectors**, in 2015 the private and public non-financial enterprises invested CZK 22.9 bil. and the government sector (on both the central and regional levels) CZK 17.2 bil. As in previous years it was the corporate sector which contributed more on the investment 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 overall decline in sales in 2015, in all three groups of benefits continued to be clearly dominated by the area of waste management. While this area contributed 70.8% to revenues from the sale of services and 83.7% to savings on the use of by-products, its proportion in the sale of by-products was as high as 94.5%.

Non-investments costs of environmental protection

The **non-investment costs** have a long-term upward trend, despite the year-to-year decrease in 2015 by CZK 4.0 bil. (i.e. by 6.7%) to CZK 56.1 bil. Despite that, the non-investment costs continued to comprise a substantial part of total environmental protection expenditure (about 60% in 2015), with the greatest amount of non-investment costs being expended on material and energy consumption and on wages.

Financing in terms of **programme focus**, in 2015, just like in previous years, most of the funds were spent on waste management (CZK 34.5 bil., which, along with investment expenditure, comprises the biggest part of total environmental protection expenditure) and waste water treatment (CZK 11.1 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 (both identically CZK 3.3 bil. in 2015). As regards the year-to-year changes in the volume of non-investment costs within the main areas of environmental protection, in 2015 their decline or stagnation was recorded, with the exception of other activities in environmental protection.

In terms of **economic activities sectors** of the investing entity (CZ-NACE), in 2015, just like in the previous year, the biggest proportion of non-investment costs for environmental protection was spent in the water supply sector and in activities related to waste water, waste and remediation (50.9% of total non-investment costs), in the manufacturing industry (18.9% 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

44 | Public environmental protection expenditure

Key question

What is the structure and the volume of funding from national and international public resources to protect the environment?

Key messages

The volume of expenditure from central resources (i.e. particularly from the State budget and State funds), as well as from local budgets in 2015, has reached the border of 1% of GDP. Expenditure on environmental protection from central resources have increased in 2015 by 12.2% to CZK 43.1 bil. and from the local budgets by 32.5% to the total CZK 44.9 bil. The reason for this increase is in both cases the increased financial support in the area of water protection, aimed at the collection and treatment of waste water. Another priority area of state aid was, in addition to the protection of biodiversity and landscape and waste management, also the air protection, especially in connection with the implementation of programmes aimed at the promotion of thermal insulation, energy efficiency and heating technology changes (e.g. New Green Savings Programme).
In the framework of the original Operational Programme Environment 2007–2013, almost the entire financial allocation (99.7%) of a total of EUR 4.6 bil. has been paid by the end of 2015, while in the evaluated year 2015 the record number of EUR 1.3 bil. was paid out from EU funds. In 2015 a follow-up programme for the Operational Programme Environment 2014–2020 was also approved, with a total allocation of EUR 2.6 bil. In the context of the already concluded calls in the follow-up Operational Programme Environment, there were 1,138 project applications registered in 2015 with the value of EUR 0.5 bil. from EU funds.

Overall assessment of the trend

Change since 1990

Change since 2000

Last year-to-year change

References to current conceptual, strategic and legislative documents

State Environmental Policy of the Czech Republic 2012–2020
- reinforcing financing of research and development in the area of climate change scenarios and identifying and monitoring their impact
- increasing investments in protecting and retaining ecosystem services, protecting biodiversity and promoting development and across-the-board expansion of sustainable agriculture, fishing and forestry
- reinforcing financing of the creation of tools and technologies 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

Strategic Framework for Sustainable Development in the Czech Republic
- 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
- ensuring long-term sustainability of public financing

National Reform Programme of the Czech Republic, 2015
- support for the realisation of the near-nature and technical measures as well as flood control measures to mitigate the risk of drought in the context of climate change impacts

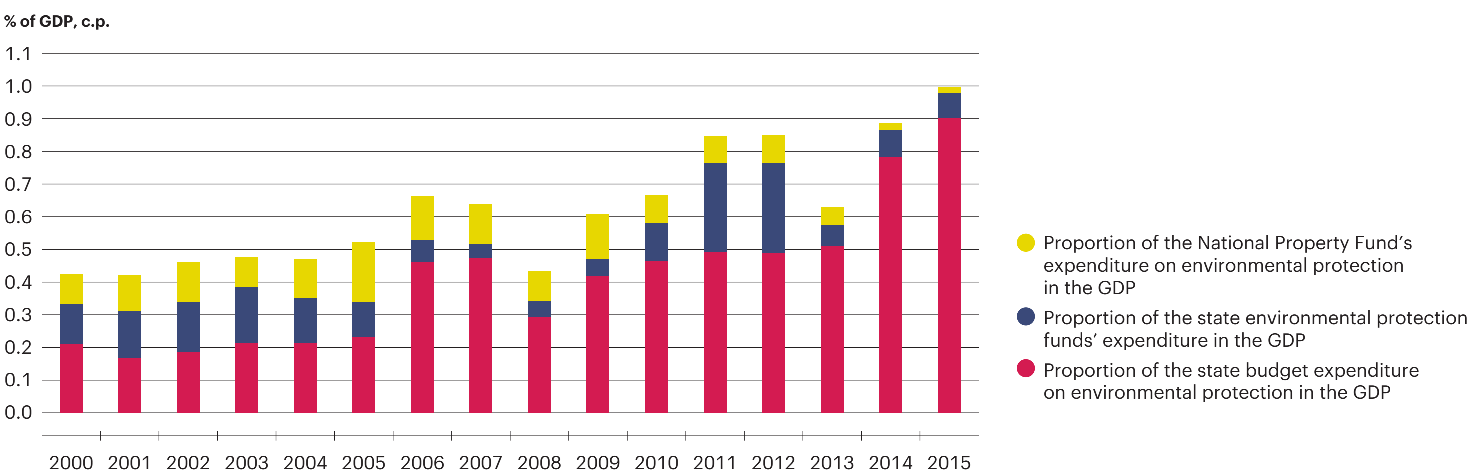
Operational Programme Environment 2014–2020
- allocating financial assistance of EUR 2.6 bil. to the Operational Programme Environment 2014–2020 (contribution from the Cohesion Fund and European Regional Development Fund) into the following priority axes (PA):

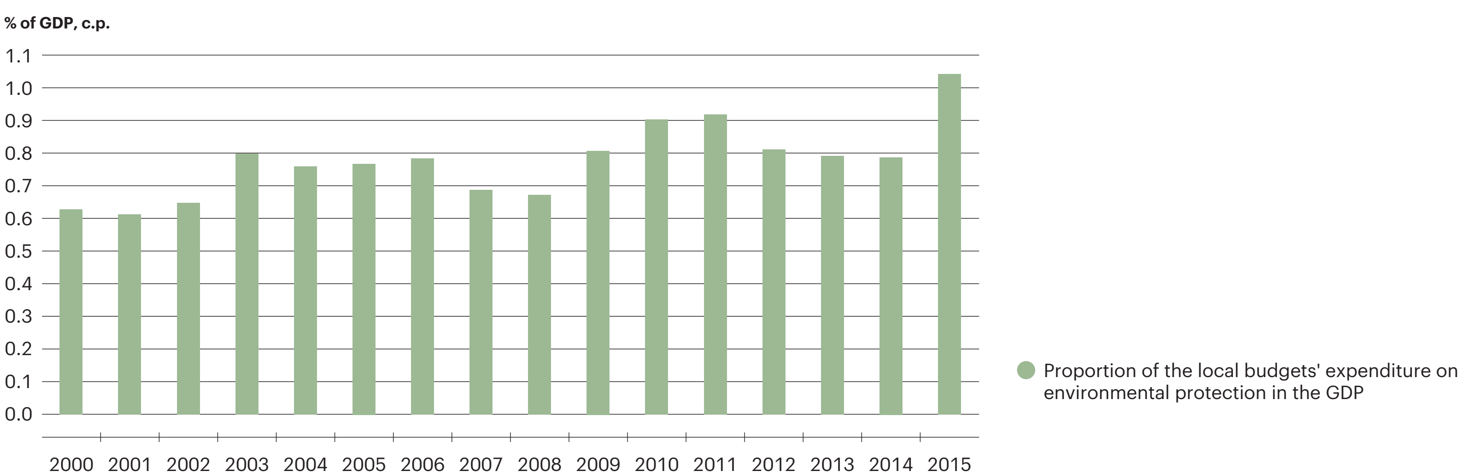
PA 1 – Improvement of water quality and reduction of flood risks: 29.2% of the total programme allocation
PA 2 – Improvement of air quality in human settlements 17.2% of the total programme allocation
PA 3 – Waste and material flows, environmental burdens and risks 17.4% of the total programme allocation
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

Indicator assessment

Chart 1

Proportion of public environmental protection expenditure in GDP in the Czech Republic by source type [% of GDP, current prices], 2000–2015



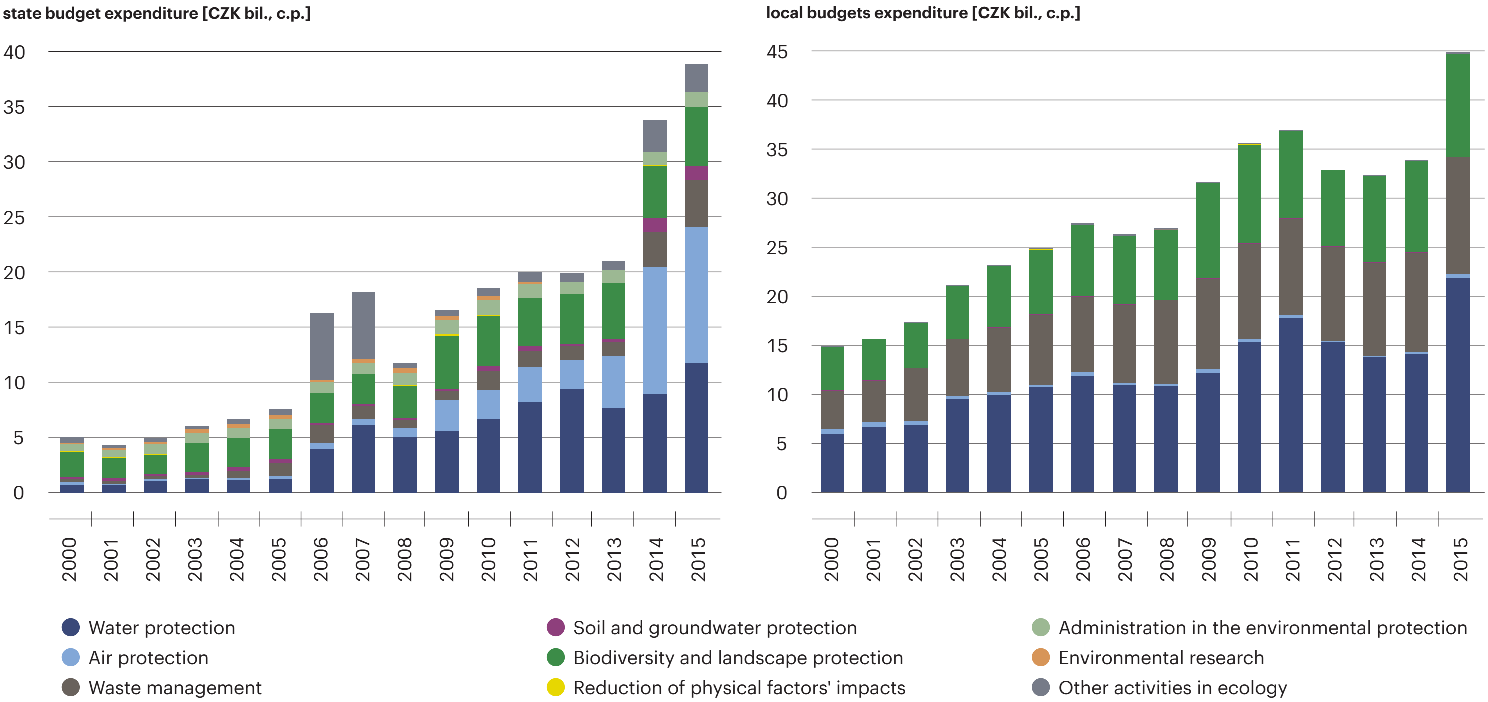


National Property Fund of the Czech Republic was cancelled as at 1. 1. 2006. Both its competencies and resources spent on removal of old contaminated sites that originated prior to privatisation are now in the remit of the Ministry of Finance of the Czech Republic.
A part of public environmental expenditure 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

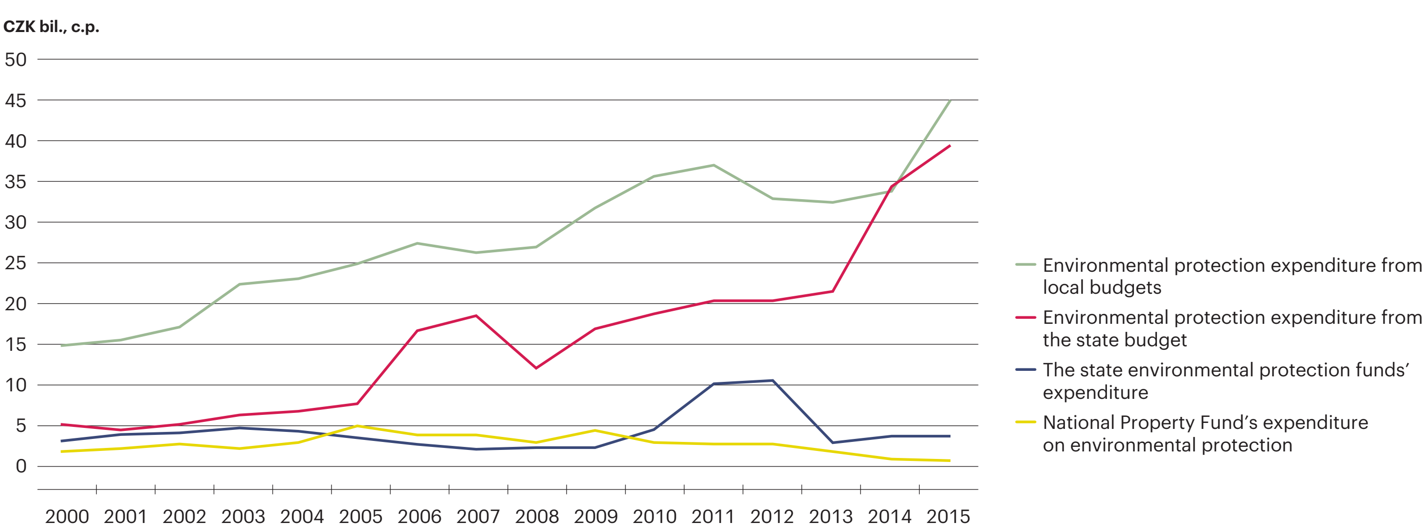
Public environmental protection expenditure from the state budget and local budgets in the Czech Republic by programme orientation [CZK bil., current prices], 2000–2015



Source: Ministry of Finance of the Czech Republic

Chart 3

Public environmental protection expenditure in the Czech Republic by source type [CZK bil., current prices], 2000–2015

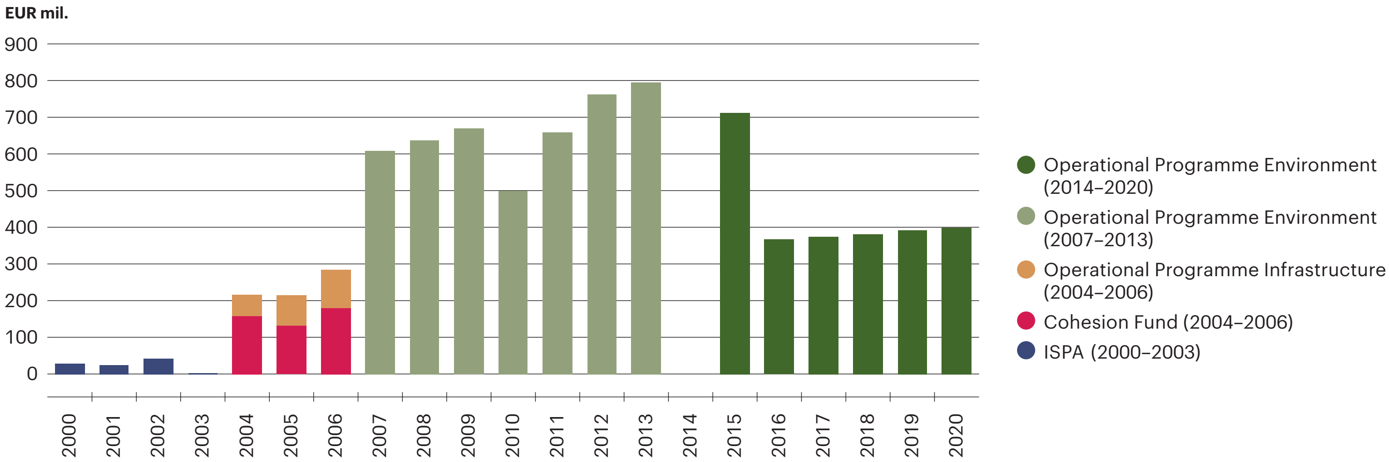


National Property Fund of the Czech Republic was cancelled as at 1. 1. 2006. Both its competencies and resources spent on removal of old contaminated sites that originated prior to privatisation are now in the remit of the Ministry of Finance of the Czech Republic.
A part of public environmental expenditure of local budgets may be a duplication of expenditure from central sources.

Source: Ministry of Finance of the Czech Republic

Chart 4

The 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 from central sources and local budgets. An appropriate measure of the adequacy of the expenditure incurred in the field of environmental protection is to compare them with the gross domestic product, which represents the economic possibilities and performance of the Czech Republic. In 2015 a positive development continued both for the expenditure of the central resources as well as for the expenditure of local budgets (Chart 1). In both cases in 2015, for the first time in the history of monitoring, the level of 1% of GDP was achieved, respectively exceeded – the proportion of the expenditure of the central resources accounted for 1.00% of GDP (year-to-year growth of 0.11 p.p.), the expenditure of the local budgets amounted to 1.04% of GDP (year-to-year growth of 0.25 p.p.). In addition to the improving Czech economy, more effective utilisation of resources from national programmes and EU funds, to which co-financing resources from public budgets are bound, contributed to the growth.

Public expenditure from central sources

The state budget is the most significant central source of funding, especially subsidies or returnable financial aid. Other central sources of environmental protection expenditure 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.

The long-term trend of the development of **public expenditure from central sources** is clearly growing. In the past two years, it is possible to register also a significant proportion of more efficient drawing of financial resources from the EU structural and investment funds, which is associated with drawing other resources from central sources in the form of co-financing or pre-financing of projects and actions to protect the environment.

The largest central source of public expenditure on environmental protection is a **State budget**, in the long-term. Compared to the year 2014 expenditure from this source have increased in 2015 by 15.2% to CZK 38.9 bil. The most supported area within the State budget, was the area of the air protection (CZK 12.3 bil., i.e. +7.6% compared to 2014), particularly in relation to support insulation and energy savings programmes or programmes to change heating technology or eliminate emissions of solid pollutants (Chart 2). This was followed by the water protection area, within the framework of which the spending in 2015 accounted for CZK 11.7 bil., i.e. +30.8% compared to the year 2014. The growth was particularly due to increased expenditure on drainage and waste water treatment.

In the overall support it was followed by the area of the protection of biodiversity and landscape, accounting for CZK 5.3 bil. (i.e. + 11.8% compared to the year 2014). 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 the remediation of the soil after extraction and excavation activities. Expenditure on waste management grew significantly from the previous year (by 32.2% to CZK 4.2 bil.), especially due to the support of the collection and transport of municipal waste.

Concerning environmental protection expenditures from the state funds, the **State Environmental Fund of the Czech Republic** (and also the State Agricultural Intervention Fund or the State Transport Infrastructure Fund etc.) is the largest extra-budgetary central source of environmental protection financing. In 2015 expenditure on environment State Environmental Fund of the Czech Republic stagnated at the level of CZK 3.5 bil. The importance of the State Environment Fund of the Czech Republic is currently associated mainly with the provision of subsidies within the **New Green Savings Programme**, which falls under insulation and energy savings programmes or programmes to change heating technology and under measures to reduce greenhouse gas production. In 2015, within the 2nd and 3rd call under this programme, there were 5,571 applications registered from home owners for subsidies totalling CZK 1.2 bil. (status as at 31. 12. 2015). The third call is also conceived as a continuous, within which it is possible to apply for a subsidy continuously. The programme is funded by revenues from the sale of emission allowances under the EU ETS. The programme's total allocation will depend on the amount of this income (estimated amount: up to CZK 27 bil.). This programme is administered by the State Environmental Fund of the Czech Republic, however, these are financial resources of the state budget. The State Environmental Fund of the Czech Republic also uses its own resources to co-finance expenditure from the European funds. For example, under the Operation Programme Environment, State Environmental Fund of the Czech Republic co-financed projects both in the form of subsidies or a combination of subsidies and special loans, providing CZK 2 bil. in 2015.

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 income from fees or dues was in 2015 for the State Environmental Fund of the Czech Republic, in particular support for the collection, treatment, recovery and disposal of selected car wrecks (CZK 387.5 mil.), groundwater withdrawals (CZK 357.0 mil.) or air pollution (CZK 282.0 mil.).

From the financial resources of the dissolved **National Property Fund of the Czech Republic**, which are administered by the Ministry of Finance of the Czech Republic and intended for removal of old pre-privatisation environmental contamination, CZK 0.8 bil. were spent in 2015 (Chart 3).

Public expenditure from local budgets

Territorial budgets of municipalities and regions represent the second most important addition to the State budget of a public source of funding of environmental protection in the Czech Republic (Chart 3), respectively the financing of actions that are implemented on an ongoing basis based on the competencies of the municipalities or counties. After a period of decline or stagnation after 2011, due to lower activity in drawing resources from national programmes and from the EU funds, which are bound to co-financing resources from public budgets, in 2015 there has been a significant interannual increase of 32.5% to the total of CZK 44.9 bil.

The reason of that growth was, in particular, the enhanced support for actions in the field of water protection, specifically within the collection and treatment of waste water, which is among the main priorities of its **component of environmental protection** at the level of municipalities and regions. In 2015, CZK 21.8 bil. were spent for water protection, i.e. by 54.6% more than in 2014 (Chart 2). Waste management, especially municipal waste collection, was the second greatest item in financing (in total CZK 11.8 bil., i.e. +17.3% compared to 2014), followed by biodiversity and landscape protection focusing in particular on the care for appearance of towns and villages and for public greenery (a total of CZK 10.4 bil., i.e. +12.8% compared to 2014). In 2015, the growth of expenditure in the field of air protection continued, especially in relation to measures to reduce air pollution from local incinerators using solid fuel. In 2015 the amount of CZK 0.5 bil. was spent in this area (by 103.9% more than in 2014). A fundamental initiative in this area was the implementation of the Joint Programme to Promote Replacement of Boilers (the so-called boiler subsidy).

Financing by 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 expenditures on environmental protection are 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 the State Environment 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.

In the framework of the 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. (Chart 4). Throughout the programme period, more than 29,708 project proposals have been submitted in Operational Programme Environment with a request for financing from the EU funds in the amount of EUR 10.3 bil., of which in 2015 there were almost 3 thousand proposals with a request for financing from EU funds in the amount of approx. EUR 0.5 bil. Of the proposals submitted, 19,941 projects totalling EUR 5.7 bil. were recommend for financing before the end of the year 2015. In 2015, the Decision to Provide a Subsidy was issued for 4,285 projects amounting to EUR 0.6 bil. from EU funding, due to which 102% of the program allocations was distributed at the end of 2015. Recipients were then paid almost the entire financial allocation (99.7%) designed for the programming period 2007–2013. Due to the intensive implementation of measures to speed up and streamline the withdrawal of funds the recipient received for the last 2 years 54% of funding paid from the beginning of the programming period, and in 2015 the record number of EUR 1.3 bil. were paid from EU funding. The remaining unpaid financial allocations should be paid to the beneficiaries in the first half of 2016.

As a result of the measures implemented in the framework of the projects supported by the Operational Programme Environment there was a reduction in the burden of air pollution, an improvement in the quality of surface and groundwater, and an improvement of waste management, a recultivation of areas after mining of raw materials, halting the decline in biodiversity, a reduction in soil erosion and an increase the ecological stability of the landscape. All of these impacts have been implemented through the priority axes 1–7, for example thanks to construction, modernisation and intensification of waste water treatment plants, reconstruction of boiler rooms, implementation of energy savings (e.g. insulated claddings, an exchange of windows), thanks to the construction of collecting yards, recultivation of landfills or by introducing corporate BAT. Since the beginning of the programming period thus there was approximately 21 thous. ha of the land and approx. 207 km of watercourses revitalised, more than 130 waste water treatment plants were intensified, expanded or refurbished with a capacity of over 2,000 population equivalent, more than 254 thous. population equivalent were newly connected to the waste water treatment plants and thus more than 120 Sites of Community Importance were created with the completed first phase of the implementation of Natura 2000 network. Specific impacts in those areas are listed in the annual reports of the Operational Programme Environment, available at www.opzp2007-2013.cz, or possibly in the annual reports of the State Environmental Fund of the Czech Republic at www.sfzp.cz.

On 30. 4. 2015 a follow-up programme for the Operational Programme Environment 2014–2020 was approved by the European Committee, with a total allocation of EUR 2.6 bil. In 2015, a total of 26 calls were announced with a total allocation of EUR 0.9 bil. from EU funding. The applicants were thus enabled to submit grant applications for more than 30% of the programme allocation, i.e. EUR 0.3 bil. from EU funding. In the context of the already concluded calls there were 1,138 project proposals registered in 2015 with the value of EUR 0.5 bil. from EU funds, and thus it significantly exceeded the allocations for the concluded calls. Still in 2015, some regions, being the applicants, received the first funds from the Operational Programme Environment 2014–2020 in the total amount of approx. EUR 0.1 mil. The funds were intended for non-investment expenses of applicants, for example also to promote the publicity of the boiler subsidies.

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz

Environmental protection expenditure in the global context

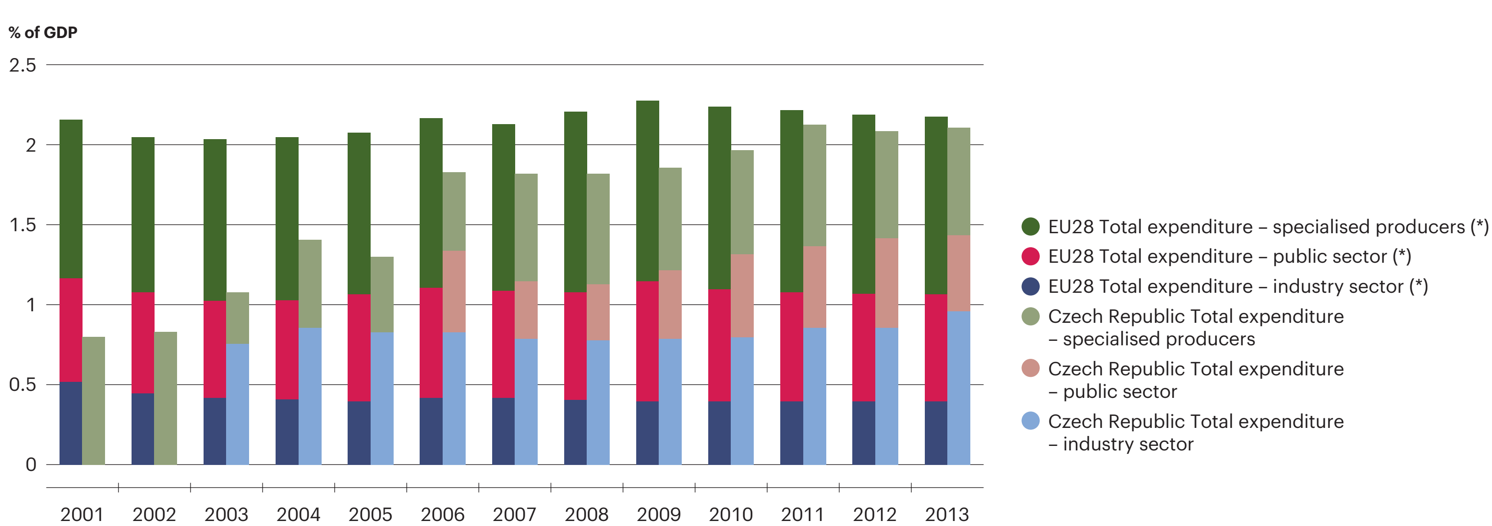
Key messages

- 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. Together with the sector of specialised companies providing environmental services (specialised producers), these investments amounted to a total of 0.67% of GDP in 2013, compared with 0.41% of GDP in the EU28. The reason for increased investment in the Czech Republic is first the need to fulfil the conditions of the EU and the requirements of the respective European legal regulations and the need to resolve the high environmental burden which resulted from age-long unresolved problems related to intensive industrial production and mining in the last century.
- Due to a smaller amount of current expenses spent on environmental protection in the Czech Republic, however, total expenditure (i.e. the investments and current expenses together) on environmental protection remained slightly below the EU28 average (2.11% of the GDP in the Czech Republic, 2.18% of the GDP in the EU28). This difference, however, is decreasing steadily due to the substantial contradictory development of environmental protection investments in the Czech Republic: while the proportion of investments in GDP within the EU28 fell by 0.07 p.p., it grew by 0.17 p.p. in the Czech Republic.

Indicator assessment

Chart 1

Total environmental protection expenditure by the main sectors in the Czech Republic and in the EU28 [% of GDP], 2001–2013

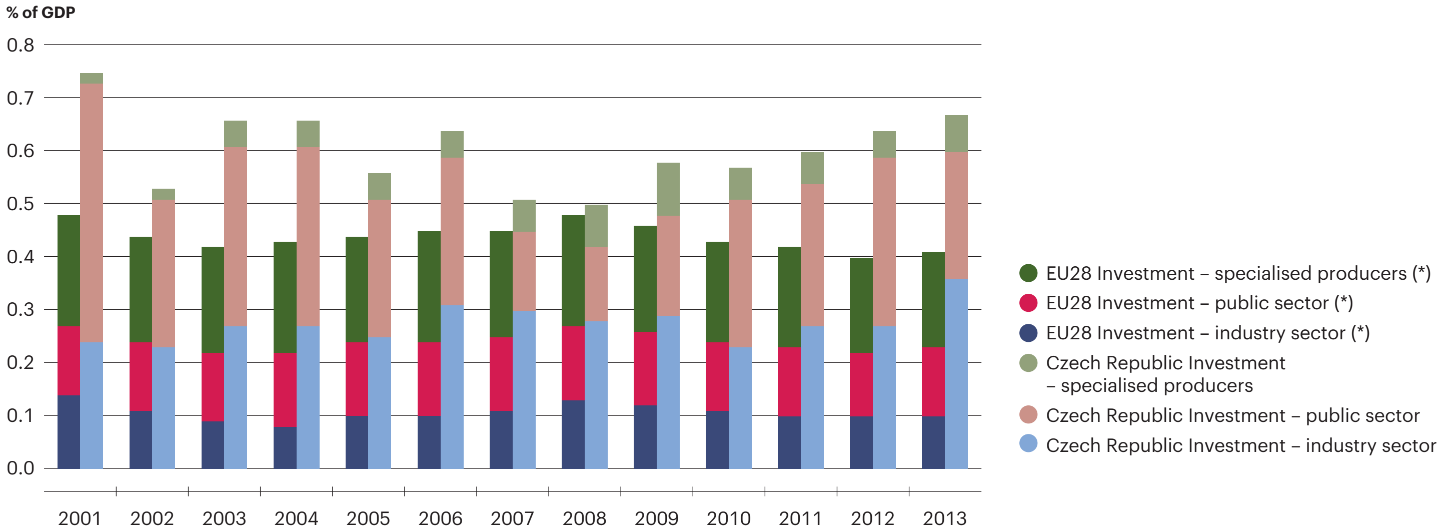


** Estimate. Data for all sectors monitored in the Czech Republic are available since 2006.*
Data for the year 2014 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

Chart 2

Investment in environmental protection by the main sectors in the Czech Republic and in the EU28 [% of GDP], 2001–2013



** Estimate.*
Data for the year 2014 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

Chart 3

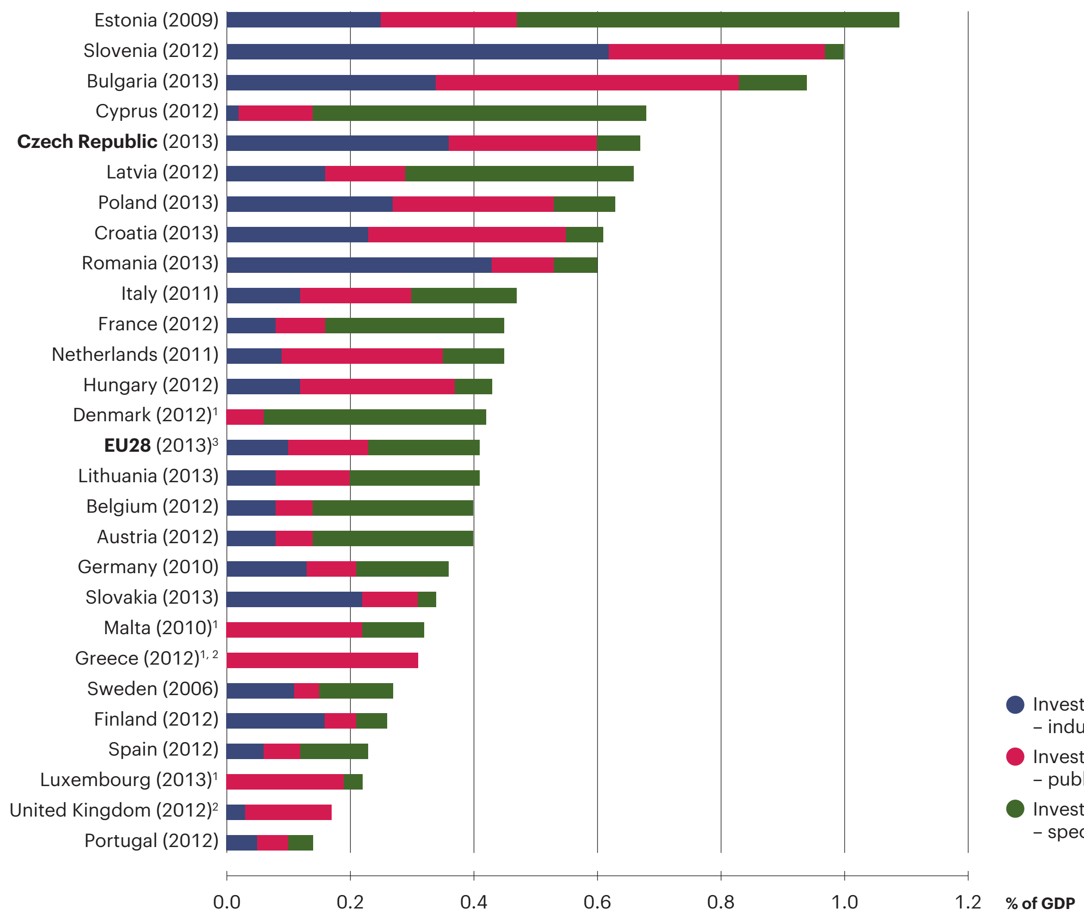
Non-investment costs (current expenditure) on environmental protection by the main sectors in the Czech Republic and in the EU28 [% of GDP], 2001–2013

** Estimate. Data for all sectors monitored in the Czech Republic are available since 2006.*
Data for the year 2014 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

Chart 4

Investment in environmental protection by the main sectors [% of GDP], the last year available



(1) Data for the industry sector are not available, (2) data for specialised producers are not available, (3) an estimate. Data for the year 2014 are not, due to the methodology of their reporting, available at the time of publication.

Source: Eurostat

Within an international comparison of the **total expenditure on environmental protection** which was carried out by Eurostat, these expenses can be looked at from the perspective of three main sectors: the public sector, the industry sector (i.e. mining and quarrying; manufacturing, electricity, gas and water distribution) and the sector of specialized companies providing environmental services (i.e. public and private companies focused on environmental protection services, such as waste collection).

Just like in the Czech Republic, it is possible to divide the total environmental protection expenditure 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. Monitoring the proportion of environmental protection expenditure in GDP is important as this is an indicator of the important of environmental protection in relation to the overall economic activities of the country concerned.

Concerning the total expenditure on environmental protection, the Czech Republic has slightly below-average values in comparison with the EU average (2.11% of the GDP in the Czech Republic, 2.18% of the GDP in the EU28), Chart 1. This fact is caused mainly by a lower amount of non-investment costs, which is, however, partially balanced by above-average investments (see below for more detail). This difference, however, is decreasing steadily due to the substantial contradictory development of environmental protection investments in the Czech Republic: while the proportion of investments in GDP within the EU28 fell by 0.07 p.p., it grew by 0.17 p.p. in the Czech Republic. The reason for this diverging trend with respect to investment, and thereby also total environmental protection expenditure, is the different impact of the financial and economic crisis on the economies of the various EU member states.

Just like in the Czech Republic and even within the EU28, the greatest proportion of expenditure on environmental protection is spent on waste management, waste water collection and treatment and air protection.

From the perspective of the first subgroup under total expenditure, i.e. **investment activities in environmental protection**, it can be concluded that the Czech Republic has a very good position compared with the EU28 average, within both the public and industry sectors (Charts 2 and 4). 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 EU conditions and requirements of the relevant EU legislation. Possible use of the EU funds or other foreign subsidy programs also enhances the investment level (see the indicator "Total environmental protection expenditure").

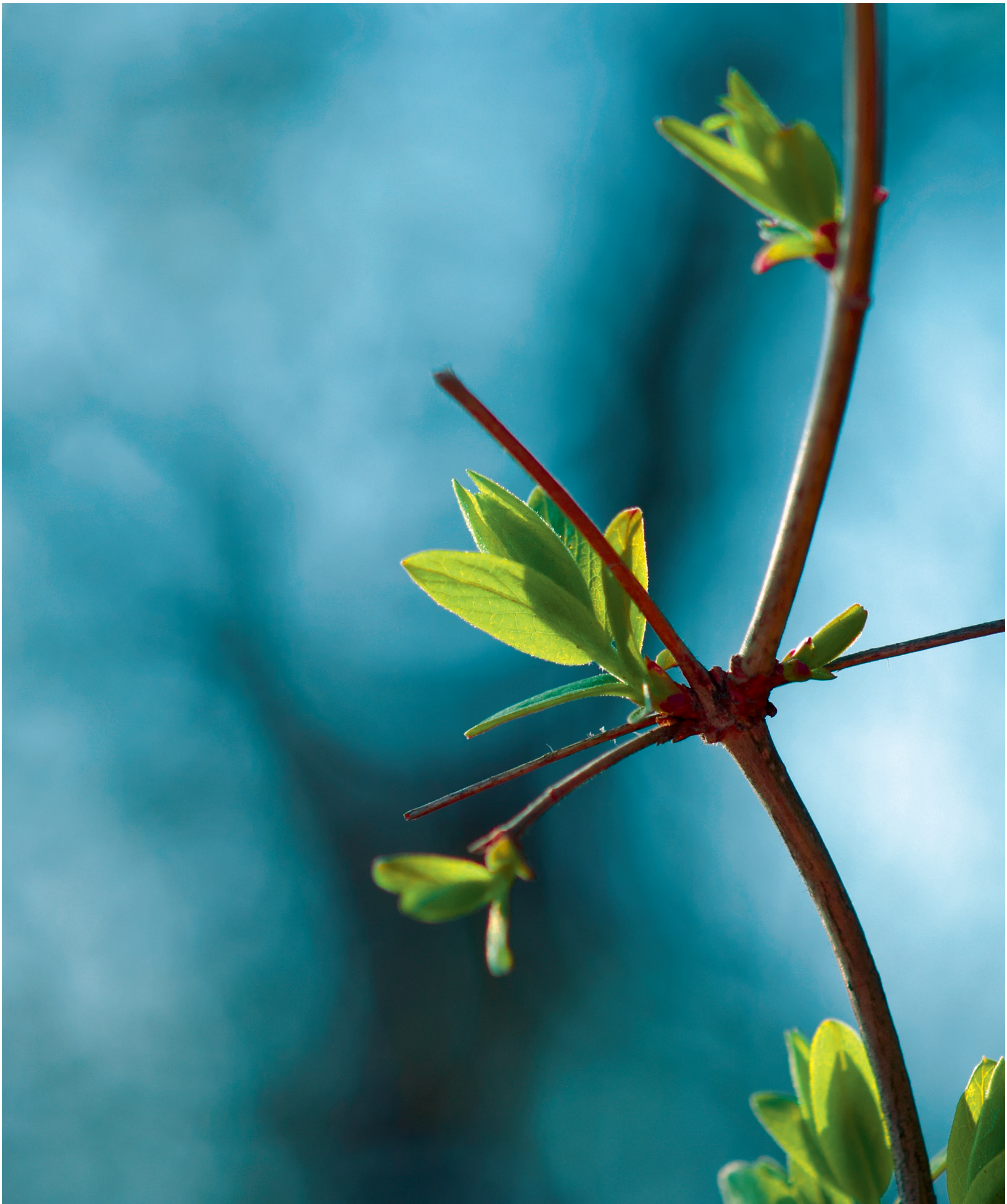
Conversely, the Czech Republic shows worse investment activity in the sector of specialised companies providing environmental services, which includes especially companies working in waste management (e.g. waste collection companies) and waste water cleaning. A lower proportion of these investments compared to the European average is caused, inter alia, by the fact that some of the specialised companies' services can be provided by the public sector itself (e.g. investment in waste collection or waste water treatment plants organised by municipalities), including the relevant investment expenditure. Another reason for the different rates of investment in the sector of specialised enterprises is the specialisation and concentration of individual industrial activities within individual countries – for example, the treatment of waste water or waste management can be realised by industrial plants due to recycling or reuse of portions of their own waste in the next production process. Fundamental investments into these facilities then increase the investment activities of the industrial companies at the expense of specialised producers which also deal with recycling.

The second subgroup under total environmental protection expenditure is **operating, respectively current expenses on environmental protection**, which include, in addition to the costs of maintenance and the facility's operation, especially payroll costs, payments for rent, energy and other material. While in the case of investment expenditure in the Czech Republic, the industry and public sectors took the decisive part in its amount compared with the EU average, concerning current expenses, specialised producers cover the greatest part, just like in the EU28 (Chart 3). The reason lies especially in financially intensive processes in waste management and waste water treatment which these companies administer either within their property or on the basis of a contract (mandate from the public sector).

Detailed indicator assessment and specifications, data sources

CENIA, key environmental indicators

http://indicators.cenia.cz



Strategies and policies in the environmental sector

The **Report on the Environment of the Czech Republic** asesses 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.

The main covering document that sets out a plan for the implementation of effective protection of the environment of the Czech Republic, is the **State Environmental Policy of the Czech Republic 2012–2020**. Its main 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 unsatisfactory 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 limit values, especially in the Moravian-Silesian region and in Ústí region.
- 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 Community interest has improved, but in the case of the originally endangered species there is a rather negative trend in the long term. So far, a favourable conservation status has been reached only 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 Concept of environmental safety 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.

Figure 1

Map of the strategic documents of the Ministry of the Environment

Air and Climate Protection	Nature and Landscape Protection	Protection of Accumulated Water, Water Resources and Water Quality	Environmental Risks	Environmental Information System, Environmental Monitoring, Environmentally Friendly Products and Services, EMAS	Waste Management
State Environmental Policy of the Czech Republic 2012–2020					
Strategy on Adaptation to Climate Change in the Czech Republic				The State Programme of Environmental Education, Awareness and Environmental Consultancy of the Czech Republic	Czech Republic's Waste Prevention Programme
National Emission Reduction Programme of the Czech Republic	National Biodiversity Strategy of the Czech Republic for the period 2016–2025	National River Basis Management Plans of the Elbe, the Oder and the Danube River	Updated National Implementation Plan for the Stockholm Convention on Persistent Organic Pollutants 2012–2017		
The National Programme to Abate Climate Change Impacts in the Czech Republic	State Nature Conservation and Landscape Protection Programme of the Czech Republic	Flood Risk Management Plans of the Elbe, the Oder, the Danube River Basin Districts		Environmental Consultancy Development Programme in the Czech Republic for the period 2008–2013	Waste Management Plan of the Czech Republic for the period 2015–2024
Air Quality Improvement Programmes	Concept of the Preservation Programmes and Care Programmes	The Concept of Making the Czech River Network Passable, 2014 update	Strategy of Environmental Security 2016–2020, with an outlook to 2030	Updated EMAS Programme National Programme of Environmental Labelling	
Medium-term Strategy (by 2020) to Improve Air Quality in the Czech Republic		The Concept of the Solution of the Problems of Flood Protection in the Czech Republic, using Technical and Near-natural Measures		Concept of local Agenda 21	
Climate Protection Policy of the Czech Republic					
R&D&I Concept					
National Cleaner Production Programme					

Source: CENIA, adjusted according to the output of a project to streamline the activities of the Technology Agency of the Czech Republic in the area of research, development and innovation, and support of the strengthening of the expertise of organisations of public administration in the area of research, development and innovation, key activity 1: output of the Strategic map of resorts, the Strategic map – Ministry of the Environment

Among other key strategic documents of the Ministry of the Environment there is the **Medium-term Strategy (by 2020) for Air Quality Improvement in the Czech Republic**, 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 follows the **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 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 Programme 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 National Programme to Abate Climate Change Impacts in the Czech Republic, which is no longer up-to-date, has been replaced by the **Climate Protection Policy of the Czech Republic**[1]. The 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 to 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 Policy is thus complementary to Government-approved Strategy on Adaptation to Climate Change in the Czech Republic.

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 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 Management Plans of the Elbe, Oder, Danube River Basin 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 Basin are mainly used for regional planning and water-related construction proceedings. 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

[1] *Acknowledged by the Government of the Czech Republic on 22. 6. 2016.*

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.

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 has released the publication "The European Environment – State and Outlook 2015". 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) and the OECD (OECD Environmental Outlook to 2050), the data from which are included in this chapter.

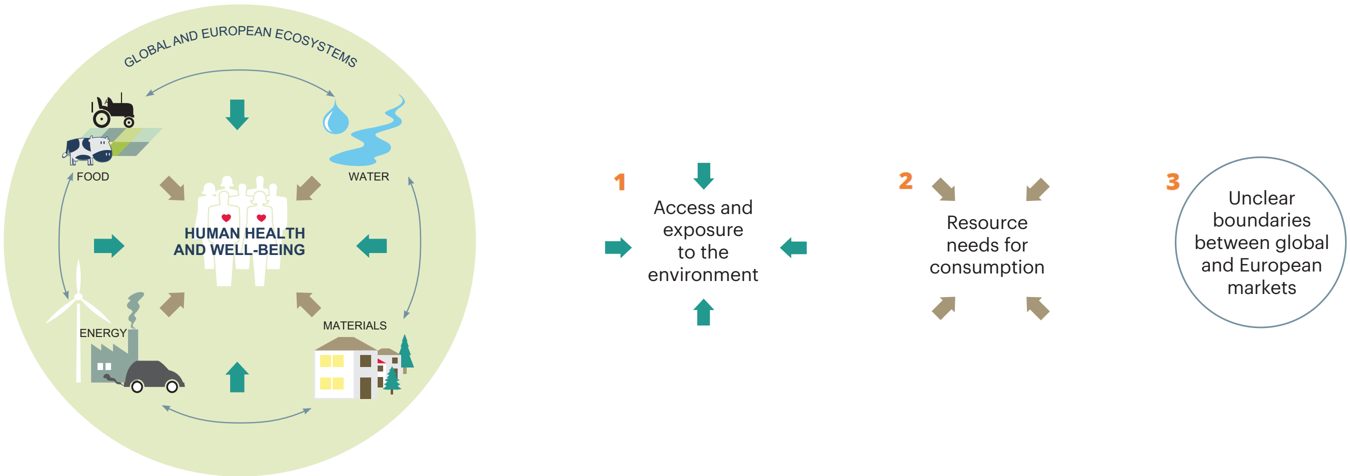
The systemic nature of many of today's environmental problems

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 challenges



Source: European Environment Agency

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[2]
- 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 60s, the population doubled to 7 billion and should continue to grow (until 2050 to 9.6 bil.), 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[3].

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[2] *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 (UNEP, 2012a), 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.*

[3] *OECD, 2012, OECD Environmental Outlook to 2050, Organisation for Economic Co-operation and Development, Paris, France.*

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 1950's 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 raises concerns with regard to coordination, efficiency, and accountability.

Source: European Environment Agency

The influence of European production and consumption patterns on the European and the global environment

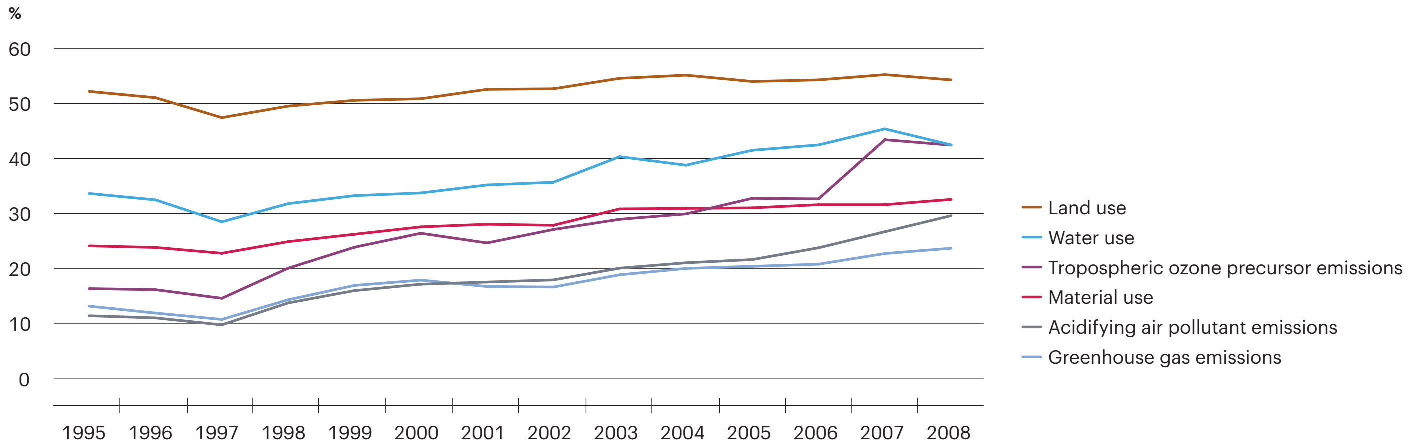
The environmental consequences of European production and consumption can be viewed from two different perspectives. The view of "production" focuses on the burdens caused by the use of resources, emissions and the degradation of ecosystems in Europe. On the other hand, the view of "consumption" is more 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[4]. 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).

[4] *EEA, 2014, Environmental indicator report 2014: Environmental impacts of production-consumption systems in Europe, European Environment Agency, Copenhagen, Denmark.*

Figure 2

The 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: European Environment Agency [5]; according to an analysis of the Joint Research Centre/Institute for Prospective Technological Studies – World Input-Output Database, European Commission[6]

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%[7]. 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 from the demanded production (including import) by 1.6% per annum[8]. This distribution of production centers and consumption centers in the world explains why in 2005, 7% of the world's greenhouse gas emissions was 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[9].

At the aggregate level the difference between the burden of production and consumption is illustrated through the "stop" principle[10,11]. 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

[5] *EEA, 2014, Environmental indicator report 2014: Environmental impacts of production-consumption systems in Europe, European Environment Agency, Copenhagen, Denmark.*

[6] *EC, 2012, Global Resources Use and Pollution, Volume 1, Production, consumption and trade (1995–2008), EUR 25462 EN, European Commission, Joint Research Centre, Institute for Prospective Technological Studies.*

[7] *However, we must not forget that the emissions data arising due to consumption, have a higher level of uncertainty, and are available in shorter time series; and during their quantification it is also difficult to determine the boundaries of the entire system (EEA, 2013g).*

[8] *OECD (2011e), Towards Green Growth: Monitoring Progress, OECD Green Growth Studies, based on IEA data. http://dx.doi.org/10.1787/888932570430*

[9] *Dalin, C., Konar, M., Hanasaki, N. and Rodriguez-Iturbe, I., 2012, 'Evolution of the global virtual 25 water trade network', Proc. Natl. Acad. Sci, 109, pp. 5,989–5,994.*

[10] *Tukker, A., Tatyana Bulavskaya, Giljum, S., Arjan de Koning, Stephan Lutter, Moana Simas, Konstantin Stadler and Richard Wood, 2014, The Global Resource Footprint of Nations. Carbon, water, land and materials embodied in trade and final consumption calculated with EXIOBASE 2.1, Leiden/Delft/Vienna/Trondheim.*

[11] *WWF, 2014, Living Planet Report 2014 — Species and spaces, people and places.*

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%[12]. 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 Co-operation 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.

The 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.

The 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 Focal Point for cooperation with the EEA is CENIA, within the Management Board the Czech Republic is represented by the Ministry of Environment.

Information provided by the EEA are from a wide spectrum of sources of the EIONET, which is made up of individual experts, the so-called NRCs, and European thematic centers, the so-called ETCs. In 2015, there were a total of 6 ETCs, 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 Impacts, Vulnerability and Adaptation (ETC/CCA),
- European Topic Centre on Waste and Materials in a Green Economy (ETC/WMGE).

Visegrad Group
- 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 Visegrad Group 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.

[12] *WWF, 2014, Living Planet Report 2014 — Species and spaces, people and places.*

The Czech Republic presided over the Visegrad Group 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 has currently has concluded 73 bilateral agreements with a total of 30 countries of the world (see Statistical Environmental Yearbook of the Czech Republic, 2015). 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 Paris Agreement, 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 Convention to Combat Desertification, the Nagoya Protocol on access to Genetic Resources and the Fair and Equitable Sharing of Benefits arising from their Utilization;
- species protection: The agreement on the conservation of African-Eurasian Migratory Waterbirds, the 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 on the Conservation 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 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, the Convention on Environmental Impact Assessment in a Transboundary Context, the Protocol on Strategic Environmental Assessment to the Convention on Environmental Impact Assessment in a Transboundary Context.

List of abbreviations

AEO agri-environment measures
AOT40 accumulated ozone exposure over a threshold of 40 parts per billion
AOX adsorbable organically-bound halogens
AZZP agrochemical testing of agricultural soils
BaP benzo(a)pyrene
BAT Best Available Techniques
BMW biodegradable municipal waste
BOD_5 biochemical oxygen demand over five days
BRICS group of countries Brazil, Russia, India, China and South Africa
BRIICS group of countries Brazil, Russia, India, Indonesia, China and South Africa
c.p. current prices
CENIA CENIA, Czech Environmental Information Agency
CF Cohesion Fund
CLRTAP Convention on Long-Range Transboundary Air Pollution
CNG compressed natural gas
COD_{Cr} potassium dichromate digestion to chemical oxygen demand
CPP overall average growth
CRF Common Reporting Format
CSN Czech state standard
CSR Corporate Social Responsibility
CZK Czech crowns
CZ-NACE classification of economic activities
DDD dichlorodiphenyldichloroethylene
DDE dichlorodiphenyldichloroethane
DDT dichlorodiphenyltrichloroethane
DG AGRI European Commission's Directorate-General for Agriculture and Rural Development
DG ENV European Commission's Directorate-General for the Environment
DG JRC Directorate-General Joint Research Centre
DG MOVE European Commission's Directorate-General for Mobility and Transport
DMC domestic material consumption
EAFRD European Agricultural Fund for Rural Development
EC European Commission
EEA European Environment Agency
EEC European Economic Community
EFMA European Fertiliser Manufacturers Association
EFP eco-friendly product
EFS eco-friendly service
EMEP Co-operative Programme for Monitoring and Evaluation of the Long-range Transmission of Air Pollutants in Europe
END Environmental Noise Directive
EQS environmental quality standards
ERDF European Regional Development Fund
ETC/BD European Topic Centre on Biological Diversity
EU European Union
EU ETS European Union Emissions 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)
Eurostat Statistical Office of the European Union
FAME Fat Acid Methyl Esters
FC thermotolerant (fecal) coliform bacteria
FSC Forest Stewardship Council

GAEC Good Agricultural and Environmental Conditions
GDP gross domestic product
GVA gross value added
HCB hexachlorobenzene
HCH hexachlorocyclohexane
HRDP Horizontal Rural Development Plan
IAS individual or appropriate systems (individual or other compliant systems)
ICP Forests International Cooperative Programme on Assessment and Monitoring of Air Pollution Effects
ILCR Individual Lifetime Cancer Risk
ISPA Instrument for Structural Policies for Pre-accession
ISSaR Information System for Statistics and Reporting
IUCN International Union for the Conservation of Nature
LPG liquefied petroleum gas (propane-butane)
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
MEC Municipality with Extended Competency
N/A information is not available
NECD EU directive on national emission ceilings
NFR Nomenclature for Reporting Codes
NUTS nomenclature of units for territorial statistics
OCP organochlorine pesticides
OECD Organisation for Economic Co-operation and Development
OPE Operational Programme Environment
OPI Operational Programme Infrastructure
p.p. percentage point
PA priority axis
PAH polycyclic aromatic hydrocarbons
PCB polychlorinated biphenyls
PEFC Programme for the Endorsement of Forest Certification Schemes
PES primary energy sources
pkm people km
PM particulate matter
POPs persistent organic pollutants
ppb parts per billion, 1 billionth of a whole
PPS purchasing power standard
RDP Rural Development Programme
REACH Registration, Evaluation and Authorization of CHemicals
RES renewable energy sources
SAICM Strategic Approach to International Chemicals Management
tkm tonne-kilometre
TL tolerance limit
TOFP tropospheric ozone formation potential
UAT unfragmented areas by traffic
UN United Nations
UNECE United Nations Economic Commission for Europe
UNEP United Nations Program for the Environment
UNFCCC United Nations Framework Convention on Climate Change
USLE Universal Soil Loss Equation
VAT value added tax
VOC volatile organic compounds
WEEE waste electrical and electronic equipment
WEI Water Exploitation Index/index of water use
WHO World Health Organisation
WISE-SoE Water Information System for Europe – State of the Environment
WMO World Meteorological Organisation
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 resources. Agricultural land 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"). Agricultural land resources also include 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.
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.
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, similarly as fossil fuels.
BMW. 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.
BOD_5. Biochemical oxygen demand measured over a five day period. BOD_5 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.
BPEJ. The evaluated soil-ecological unit (BPEJ) is a five-digit numeric code associated with agricultural land plots. It expresses the main soil and climatic conditions, which affect the production capacity of agricultural land and its economic value.
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.
Community heating. Community heating is a system of generating heat in a centralized location which is then distributed through heat networks to multiple objects. The term district heating is an equivalent term to community heating.
Contaminated sites. 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.
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-degree. 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 valence. Ecological valence is 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.
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. 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 use of fertilisers, sewerage discharge etc. Excessive eutrophication leads to the overgrowth of algae in water and subsequently to the lack of oxygen in water. Soil eutrophication distorts its original communities.

Fungicides. Plant protection products intended to control fungi.

Government institutions. All institutional units whose competence extends either on the whole economic territory of the Czech Republic (central government, e.g. ministries or state funds) or to 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 Earths 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.

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).

Herbicides. Products intended for the disposal of unwanted plants, such as weeds or invasive plants.

Insecticides. Plant protection products intended to control insects.

Investment on environmental protection (= investment expenditure). Investment expenditure on environmental protection includes all expenditures for the acquisition of tangible fixed assets, spent by the reporting entity in order to acquire 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 enterprise 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.).

LULUCF. Land Use, Land Use Change and Forestry. The category covering emissions and removals 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 dependency on foreign countries. It expresses the share of imports on domestic material consumption. It is usually assessed for certain groups of materials (e.g. crude oil), which indicates whether the state of the economy of the given state is dependent on imports of this material and to what extent.

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. The pressure arises not only from the extraction of materials, but also from waste flows, e.g. emissions and waste.

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 and is 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 significantly 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 extremely below/above normal once every 50 years.
Organic (manure) fertilisers. 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).
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). 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.
PES. Primary energy sources. PES 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.
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.
Private non-financial corporations. All non-financial corporations, which are not controlled by governmental institutions, i.e. are privately owned. They are commercial companies, public benefit 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.
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.
Sorption capacity (ability) of soil. 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.

Steam power plant for solid fuel. Steam power stations are generally those that use steam to drive the generator of electricity, whereas water vapor 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 Energy Regulatory Office (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 then listed in a separate category.

Suspended particles. Solid or liquid particles that remain in the atmosphere for a long time due to their negligible stalling speed. Particles in the air pose a significant risk factor for human health.

Territorial systems of ecological stability. A territorial system of ecological stability 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 the territorial system of ecological stability are bio-centres, bio-corridors and interactive elements.

Traffic performance. This indicator evaluates the road network load. It is calculated as transport intensity expressed as the number of vehicles that pass through a certain road over a certain time period, multiplied by the road length. If we add up traffic performance of all roads, we reveal the traffic performance of the entire road network. Traffic performance is measured in vehicle-kilometres (vkm) and is not dependent on the vehicles' load.

Transport performance. 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.

UAT. 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.

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. Any 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 that can cause damage to plants.

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 administered by organizations both within and outside the environmental sector. Data for international comparison are provided by Eurostat, the European Environment Agency (EEA) and the Organisation for Economic Co-operation and Development (OECD).

The 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 environmental policy, strategies and international obligations under implementation;
- 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 in the DPSIR chain;
- 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. In recent years, for example, there has been a change in the number of thematic chapters including the presented indicators. Other greater modifications in the structure and number of indicators were made in the Report 2015, which contains 44 indicators.

The Report 2015 is extended under the theme of Industry and energy by the indicator 26 Extraction of raw materials and in the theme of Agriculture by the indicator 23 Consumption of fertilisers and plant protection products. Due to hydrometeorological situation in 2015, which caused a significant drought, in the Report 2015 there is the indicator 1 Hydrometeorological conditions (previously Meteorological conditions).

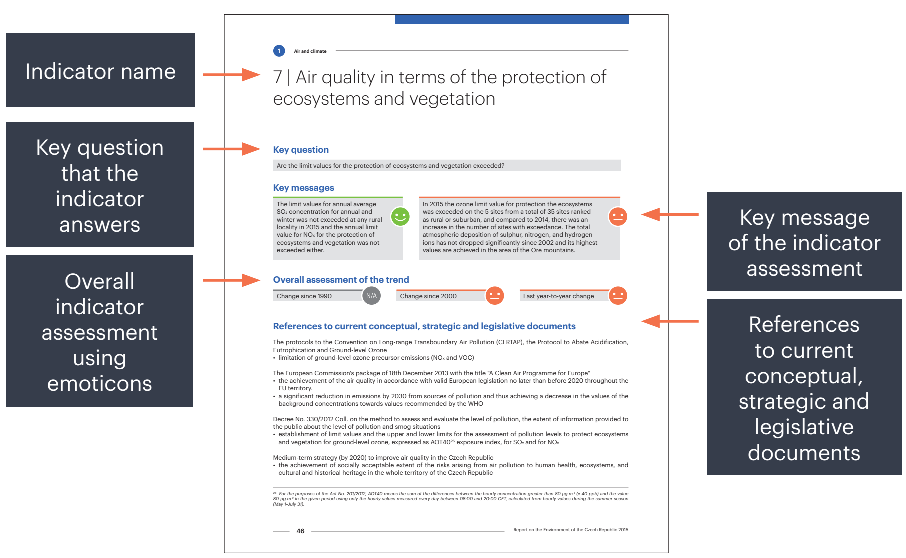
The Report 2015 is newly amended by a brief overview of the involvement of the Czech Republic in various international activities in the field of the environment. The Report 2015 is also the newly expanded by the final thematical part of the Strategies and policies in the environmental sector, dedicated to their short presentation and evaluation.

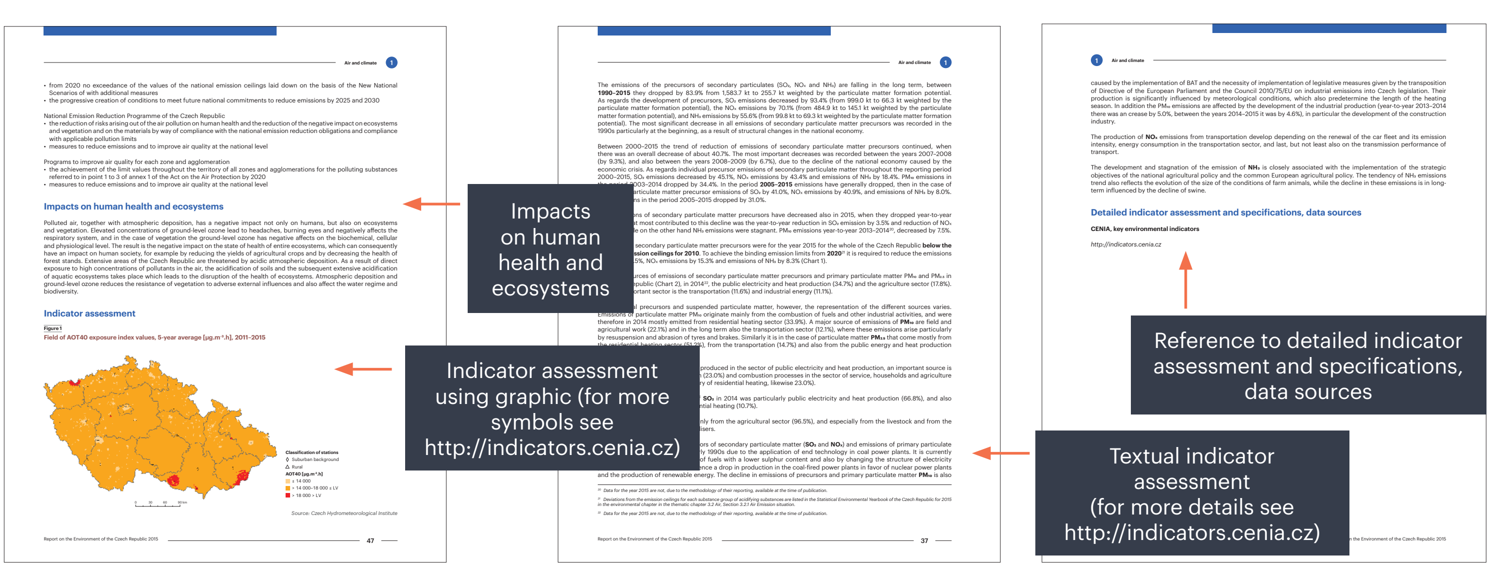
Indicators contained in the set of key indicators have been developed in cooperation with Czech expert institutions, which deal with these issues in the long term, or have been adopted from the internationally recognised indicator sets (EEA CSI, Eurostat, OECD, etc.).

Messages communicated via indicators

Assessment of the indicator in the Report is divided into several information levels. First, at the most general level, it provides comprehensive information – a key message, related (if currently possible) to a specific objective or another national or international commitment. This Report states also the conceptual, strategic, and legislative documents which were valid in the given assessed year, i.e. in this presented Report in 2015. General information also includes an overall assessment of the trend and impacts of the assessed phenomena on human health and ecosystems. Within a more detailed indicator assessment, the position of the Czech Republic in European and international context is also included at the end of each thematic chapter. Therefore, environmental conditions are compared with those in the other EU or EEA member states where verified data are available for the respective indicators.

Indicator assessment structure





Meanings of emoticons

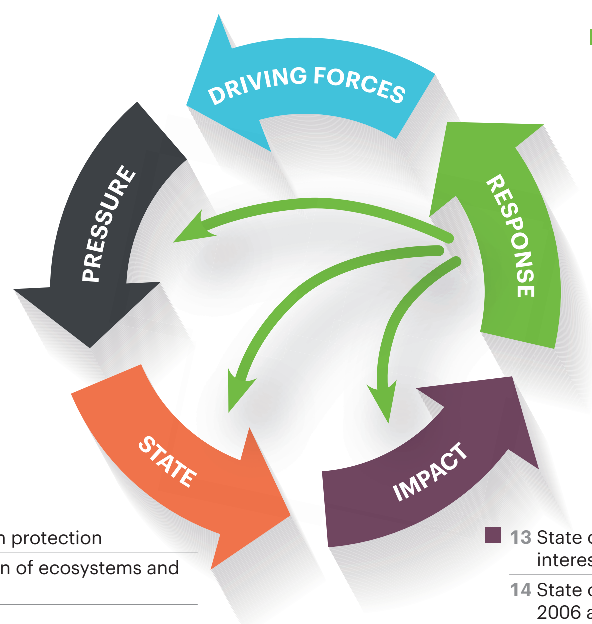
- (green smiling face) The trend is developing positively, in accordance with the objectives set.
- (orange neutral face) The trend is developing neither positively nor negatively and can be referred to as stagnating.
- (red frowning face) The trend is developing negatively, not in accordance with the objectives set.

The inclusion of indicators according to the DPSIR model

The indicators in the Report are arranged in thematic areas and their positions in the internationally applied model DPSIR (D – Driving Forces, P – Pressure, S – State, I – Impact, R – Response) is specified. DPSIR model shows the dependencies between factors affecting the state of the environment and instruments that are used to regulate them. The state indicators (S) include the state (quality) of individual environmental media (air, water, soil, etc.), pressure (P) directly affects the state (e.g. emissions, etc.). Driving force (D) are pressure factors (i.e. the energy intensity of the economy, the structure of the primary energy basis). Impacts (I) refer to the damage to the environment and human health and response (R) to the implemented measures.

- 01 Hydrometeorological conditions
- 26 Extraction of raw materials
- 27 Industrial production
- 28 Final energy consumption
- 29 Fuel consumption by households
- 30 Energy intensity of the economy
- 31 Electricity and heat generation
- 33 Transport performance and infrastructure
- 34 Emission intensity of transport
- 36 Domestic material consumption
- 37 Material intensity of GDP

- 02 Greenhouse gas emissions
- 03 Emissions of acidifying substances
- 04 Emissions of ozone precursors
- 05 Emissions of primary particulate matter and precursors of secondary particles
- 08 Water abstraction
- 09 Waste water discharge
- 19 Land use
- 20 Landscape fragmentation
- 22 Contaminated sites
- 23 Consumption of fertilisers and plant protection products
- 38 Total waste generation
- 39 Municipal waste generation and treatment



- 10 Waste water treatment
- 12 Nature protection
- 18 Responsible forest management
- 25 Organic farming
- 32 Renewable energy sources
- 40 Waste treatment structure
- 41 Packaging waste generation and recycling
- 42 Generation and recycling of waste from selected products
- 43 Total environmental protection expenditure
- 44 Public environmental protection expenditure

- 06 Air quality in terms of human health protection
- 07 Air quality in terms of the protection of ecosystems and vegetation
- 11 Water quality
- 17 Species composition and age structure of forests
- 24 Quality of agricultural land
- 35 Noise pollution burden of the population

- 13 State of animal and plant species of Community interest in 2006 and 2012
- 14 State of natural habitats of Community interest in 2006 and 2012
- 15 Common bird species indicator
- 16 Health condition of forests
- 21 Risk of soil erosion and slope instabilities

2015