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Content

List of Abbreviations

AAU	Assigned amount unit
AEWA	Agreement on the Conservation of African-Eurasian Migratory Waterbirds
AnaEE	Analytical and experimental infrastructure for ecosystems
AOs	Aviation organizations
AS CR	Academy of Sciences of the Czech Republic
AUFAR	European Facility for Airborne Research
B100	Hundred percent biodiesel
B30	Alternative fuel for diesel engines, diesel fuel blended with 30% of the fatty acid methyl esters of rapeseed oil
BaP	Benzo(and)pyrene
BAT	Best Available Techniques
BDC	Bilateral Development Cooperation
BDMW	biologically degradable municipal waste
BMP	best management practices
BPEJ	estimated pedologic-ecological unit
BR3	3rd Biennial Report of the Czech Republic
BREF	Best Available Techniques Reference Documents
CAP	Common Agriculture Policy
CAS	Czech Academy of Sciences
CBD	Convention on Biological Diversity
CDA	Czech Development Agency
CDM	Clean Development Mechanism
CEI	Czech Environmental Inspectorate
CEMC	Czech Environmental Management Centre
CEMC	Czech Ecological Management Centre
CENIA	CENIA, Czech Environmental Information Agency
CEPA	Center for European policy Analysis
CEPF	Czech Environmental Partnership Foundation
CER	Certified emission reduction
CETS	Council of Europe Treaty Series
CF4	Tetrafluoromethane
CFC	Chlorofluorocarbons
CGS	Czech Geological Survey
CH_4	Methane
CHMI	Czech Hydrometeorological Institute

CHP	Biogas a hydro instalations
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLIDATA	Database of the CHMI with climatology data
CLRTAP	Convention on Long-Range Transboundary Air Pollution
CMS	Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)
CNB	Czech National Bank
CNCS	Czech Nature Conservation Society
CNG	Compressed natural gas
CO	Carbon monoxide
CO_2	Carbon dioxide
CO_2eq.	Carbon dioxide equivalent
COP	Conferences of the Parties
COSMC	Czech Office for Surveying, Mapping and Cadastre
CPB	Cartagena Protocol on Biosafety
CRF	Common Reporting Format
CSEUR	Consolidated System of EU Registries
CTF	Common Tabular Format
CUEC	Charles University Environment Centre
CZK	Czech crown
CzSO	Czech Statistical Office
DC	Development Cooperation of the Czech Republic
DES	Data Exchange Standards
E85	Alternative fuel - a blend of 85 percent bioethanol produced from agricultural raw materials and 15 percent gasoline
EC	European Commission
ECCP	European Climate Change Programme
ECOP	Education for Competitiveness Operational Programme
ECU	European currency unit
EE&A	Environmental education and public awareness
EEA	European Environment Agency
EFA	ecological focus area
EFISCEN	European Forest Information Scenario Model
EMAS	Eco-Management and Audit Scheme
ERO	Energy Regulatory Office
ERU	Emission reduction unit
EU	European Union

EU ETS	European Union Emission Trading System
EUA	European Union Allowances
EUAA	European Union Aviation Allowances
EUR	EURO currency
EUROBATS	Agreement on the Conservation of Populations of European Bats
EUTL	European Union Transaction Log
EVVO	Environmental education and awareness raising and environmental consulting
FACCE	Food security, Agriculture and Climate Change
FAME	Fatty Acid Methyl Ester
FDC	Foreign development cooperation
FEP	Framework educational programmes
F-gases	fluorinated greenhouse gases
FMI	Forest Management Institute
FSF	fast start finance
GA CZ	Czech Science Foundation
GAECs	Good Agricultural and Environmental Conditions
GAV	Gross added value
GAW	Global Atmosphere Watch network
GC	Global Change
GCM	Global climate models
GCOS	Global Climate Observing Systém
GCRI	Global Change Research Institute
GDP	Gross domestic product
GEF	Global Environment Facility
GEO	Group on Earth Observations
GEOSS	Global Earth Observations System of Systems
Gg	Gigagram
GHG	Greenhouse gas
GIS	Green Investment Savings (Programme) (Czech Green Investment Scheme)
GMES	Global Monitoring for Environment and Security
GMO	genetically modified organism
GOOS	Global Ocean Observing System
GSN	GCOS Surface Network
GTOS	Global Terrestrial Observing System
GWh	Gigawatt hour
GWP	Global Warming Potential
HCFC	Hydrochlorofluorocarbons

HDV	Rainwater management
HFC, HFCs	Hydrofluorocarbons
HOMS	Hydrological Operational Multipurpose System of WMO
HWP	harvested wood products
IBCS	Intergovernmental Board for Climate Services
IBRD	International Bank for Reconstruciton and Development
ICAO	International Civil Aviation Organization
ICOS	Integrated Carbon Observation System
ICT	Information and Communication Technology
IEA	International Energy Agency
IFER	Institute of Forest Ecosystem Research Ltd.
IGBP	International Geosphere-Biosphere Programme
IMF	International Monetary Fund
IPCC	Intergovernmental Panel on Climate Change
IPPC	Integrated Pollution Prevention and Control
IROP	Integrated Regional Operational Programme
IRS	Integrated rescue system
ISO	International Organization for Standardization
JI	Joint Implementation
Km	Kilometer
KP	Kyoto Protocol
kW	Kilowatt
LA	level assessment
LCA	Life Cycle Assessment methodology
lCER	Long-term certified emission reduction
LCV	light commercial vehicle
LED	Light Emitting Diode
LFA	less favorable areas
LFG	landfill gas
LHP	large hydropower plant
LNG	Liquefied Natural Gas
LPG	Liquified petroleum gas (Propane-butane)
LULUCF	Land Use, Land Use Change and Forestry
MDC	Multilateral Development Cooperation
MEAs	Multilateral Environmental Agreements
MERO	Methyl ester of rapeseed oil
MEYS	Ministry of Education, Youth and Sports

MFA	Ministry of Foreign Affairs
NH_3	Ammonia
MIT	Ministry of Industry and Trade
MoA	Ministry of Agriculture
MoE	Ministry of the Environment
MoT	Ministry of Transport
MRD	Ministry of Regional Development
MU Brno	Masaryk University Brno
MW	Megawatt
MWh	megawatt hour
N	Nitrogen
N_2O	Nitrous oxide, dinitrogen oxide
NA	not applicable
NAP	National Allocation Plan
NAP CM	National Action Plan for Clean Mobility
NASA	National Aeronautics and Space Administration
NATO	North Atlantic Treaty Organisation
NC6	6th National Communicaiton of the Czech Republic under the UNFCCC
NDA	National Designated Authorities
NE	not estimated
NEEAP	National Action Plan for Energy Efficiency for the Czech Republic
NER	New Entrant Reserve
NERP	National Emissions Reduction Programme
NF	Nutritional Footprint
NGO	nongovernmental nonprofit organization
NIR	National Inventory Report
NIS	National Inventory System (greenhouse gases)
NMVOC	Non-methane volatile organic compounds
NO	not occuring
NO	Nitrogen oxide
NOx	Nitrogen oxides
NPP	nuclear power plant
NSRF	National Strategic Reference Framework
O_3	Ozone
ODA	Official Development Assistance
ODS	ozone depleting substances
OECD	Organization for Economic Cooperation and Development

OECD-DAC	OECD Development Assistance Committee
OP EIC	Operational Programme Enterprise and Innovations for Competitiveness
OPE	Operational Programme Environment
OPEI	Operational Programme Enterprise and Innovations
OPT	Operational Programme Transport
OSCE	Organisation for Security and Co-operation in Europe
PAH	Polycyclic aromatic hydrocarbons
PaMs	Policies and Measures
PCF	Prototype carbon fund
PES	primary energy sources
PFC, PFCs	Perfluorocarbons
Ph.D.	Doctor
PJ	Petajoule
POPs	Stockholm Convention on Persistent Organic Pollutants
PPP	Purchasing power parity
PPS	Purchasing power standard
PRTR	Protocol Protocol on Pollutant Release and Transfer Registers
QA	Quality Assessment
QC	Quality control
R&D	research and development
R&D IS	Research and Development and Innovations Information System of the Czech Republic
RCM	Regional climate models
RES	renewable energy sources
RMU	Removal unit
SDG	Sustainable Development Goals
SDS	Sustainable Development Strategy
SEA	Strategic Environmental Assessment
SEEA-EEA	System of Environmental-Economic Accounting; Experimental Ecosystem Accounting
SEF	Stadard Electronic Format
SEF CR	State Environmental Fund of the Czech Republic
SEP	State Environmental Policy
SEPs	school education programmes
SES	supported of energy sources
SF_6	Sulfur hexafluoride
SFSD	Strategic Framework for Sustainable Development

SHMI	Slovak Hydrometeorological Institute
SHP	small hydropower plant
SLE	significant landscape elements
SMW	solid municipal waste
SO_2	Sulphur dioxide
Sox	Sulphur oxides
SP EE and EC	State Programme of Environmental Education and Eco-counselling
SPA	specially protected areas
$(S)PM_{10}$	Suspended particulate matter under 10 microns in size
$(S)PM_{2.5}$	Suspended particulate matter under 2.5 microns in size
T.G.M. W.R.I.	T. G. Masaryk Water Research Institute
TA	trend assessment
tCER	Temporary certified emission reduction
TEN-T	Trans-European Transport Networks
TMA	maximum temperature
TMI	minimum temperature
TRC	Transport Research Centre
TSES	Territorial System of Ecological Stability
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa
UNDP	United Nations Development Programme
UNECE	The United Nations Economic Commission for Europe
UNEP	United Nations Environmental Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
USD	American dollar
VOC	Volatile organic compounds
WAM	with additional measures
WCP	World Climate Programme
WEM	with existing measures
WHO	World Health Organisation
WHRU	waste heat recovery unit
WMO	World Meteorological Organisation
WMP	Waste Management Plan
WP	Work Package

WSEP	World Scouting Environmental Education Program
WTO	World Trade Organization
WWTP	waste water treatment plant

1 SUMMARY

Introduction

The Czech Republic, as a Party to the United Nations Framework Convention on Climate Change (Convention/UNFCCC), acceded to the Kyoto Protocol (KP) on 15 November 2001 and became a Party to the Paris Agreement on 4 November 2017. In March 2004 Czech Government adopted a National Programme to Abate the Climate Change Impacts in the Czech Republic which was dealing mainly with mitigation and adaptation policies and measures by 2020. In March 2017 the Czech Government adopted a new Climate Protection Policy of the Czech Republic replacing the original National Programme.

The Climate Protection Policy of the Czech Republic (Policy) sets new GHG reduction goals by 2020 and 2030 with a longer term outlook until 2050 which corresponds to the existing EU climate and energy goals, policies and legislation in place. The commitment of the Policy is to to achieve emission reduction targets in a cost-efficient manner. Measures are proposed in the following key sectors: energy, final energy consumption, industry, transport, agriculture and forestry, waste, science, research development, cross-cutting measures and voluntary tools.

Primary emission reduction targets

- Greenhouse gas reduction of 32 Mt CO_2eq. compared to 2005 until 2020
- Greenhouse gas reduction of 44 Mt CO_2eq. compared to 2005 until 2030

Indicative emission reduction targets

- Indicative level towards 70 Mt CO_2eq.of emitted greenhouse gases in 2040
- Indicative level towards 39 Mt CO_2eq.of emitted greenhouse gases in 2050

The first evaluation of the Policy is planned in 2021 and on the basis of such evaluation the Policy will be updated by 2023 accordingly.

The Strategy on Adaptation to Climate Change in the Czech Republic (Strategy) has been adopted by the Czech Government in October 2015 and is implemented by the National Action Plan on Adaptation to Climate Change (Action Plan) from January 2017. The Strategy presents observed climate change in the Czech Republic and defines the adaptation measures including their mutual linkages in connection to anticipated impacts of these changes.

National conditions

The Czech Republic is a parliamentary democracy; the supreme legislative body is a two-chamber Parliament. Executive power rests within the Government that is based on results of general elections into the lower house of Parliament – Chamber of Deputies. The Czech Republic is a member of UN, EU, NATO, OECD, WTO, IMF and many other notable international organizations.

Czech population reached 10 578 820 on 31 December 2016; 70% of population lives in urban areas. Demographic projections indicate slight growth in population by 2020 (by approximately 5%). Large number of scattered municipalities is characteristic feature of the country (as of 1. 1. 2016 there were 6 253 municipalities). As of 1 January 2016, 6 cities had population exceeding 100 000 (Prague, Brno, Ostrava, Pilsen, Liberec and Olomouc).

With 78 870 km^2 of territory the Czech Republic belongs among middle-sized European countries. Average elevation above sea level is 430 m, which exceeds the average European elevation of 290 m. The main European watershed traverses the country between the North, Baltic and the Black Sea. Long-term precipitation is 637 mm and approximately 25% of this volume is drained in the form of surface water. Alluvial plains and lowlands are mostly cultivated – cropland and meadows. Woods cover 1/3 of the territory and significantly influence micro- and mezzo-climate. Most of the woodland (economically exploited monocultures with prevalence of spruce and pine populations) has been artificially planted and does not correspond to natural species compositions.

The state of the environment considerably improved in the last 25 years, especially the ambient air quality and with respect to water protection and waste management. Significant levels of polycyclic aromatic hydrocarbons (PAHs) and particulate matter (PM) emissions however persist, generated by household coal-fired heating boilers and internal combustion engines. After 1990 the Government adopted key environmental legislation, which is continuously being improved upon in line with EU legislation. A number of strategic environmental documents were drafted in recent years addressing principles of sustainability. The most important document in this domain was *The Strategic Framework for Sustainable Development* of the Czech Republic (SFSD), adopted by the Czech Government in 2010. SFSD determined long-term objectives for three basic pillars of modern society development (economic, social and environmental). In 2017 the original SFSD was replaced by a new overarching strategic document *the Czech Republic 2030* which should help to improve the quality of life in the Czech Republic for present and future generations. . This documend is also deemed as part of a joint effort for the sustainable development of the European Union and a contribution of the Czech Republic to the achievement of the global sustainable development goals adopted by the United Nations in 2015.

Climate

The Czech Republic lies within the Atlantic-continental area of the moderate climate zone of the northern hemisphere. Average annual temperature fluctuates in relation to geographic factors between 1.1 and 9.7 °C. Average spring and fall season temperature reaches 7 to 8 °C, during the summer the temperature rises to 16 or 17 °C; in winter the average is -1 °C. Changes in average annual temperature over the last 150 years indicate incremental rise in temperature; between 1861 and 1910 the average annual temperature reached 7.4 °C, between 1911 and 1960 also 7.4 °C while between 1961 and 2015 the average temperature rose to 7.7 °C.

Regardless of considerable year-to-year fluctuations, there is an apparent trend of gradual rise in average annual temperature amounting to approximately 0.2 °C over 10 years. Average number of days with extreme weather / temperature and their changes over decades demonstrate that over the last decade there has been a marked increase of average number of days with high temperatures and reduction in the number of days with low temperature. Number of summer days during the year increased on average by 7 days, tropical days by 13 and conversely, number of freezing days dropped by 24.

Similar trends in precipitation development are not apparent. During the last two decades, there has been an indistinctive rise in annual precipitation amount. Decreases in the spring precipitation are balanced out by summer precipitation mainly in the form of rainstorms. Average annual precipitation between 2011 and 2015 was approximately 4% lower than between 1961 and 1990. Year-on-year variability in precipitation amount is high; for instance in 2002 we have recorded the third highest precipitation amount, but in the following year –

2003 – the annual precipitation was the second lowest in 207 years of observations. Rainstorms became more numerous over the last two decades as well.

Economy and greenhouse gas emissions

In 2013 the Czech economy moved on the trajectory of renewed recovery. The increasing consumer confidence was supported by low inflation and growing employment. Positive macroeconomic development culminated in 2015, mainly due to one-off factors. While ending of the previous financial perspective 2007–2013, the strengthened investment activity and coinciding plunge in the oil price led to strong GDP growth at 4.5% in 2015. The subsequent slump in gross fixed capital formation after the extraordinary year 2015 was partly compensated by a positive contribution of foreign trade at 1.1 pp. Following a short period of stagnating economic convergence, GDP per capita in PPP increased from 83% to 87% of the EU-28 average during the period 2012–2015. Economic growth and low inflation was reflected in the labour market dynamics. The unemployment rate has been the lowest in the whole EU since the beginning of 2016. Strong employment growth rates in 2015 and 2016 amplified labour shortage connected with a skill mismatch which is most notable in the manufacturing industries. A gradual start of drawing of EU funds from the 2014–2020 programming period resulting in the positive contribution is assumed.

The energy intensity of the Czech economy decreased by 23.8% between 2005 and 2015 and reached 249.9 kg oil equivalent/thousand EUR. The Czech Republic generates electricity predominantly in coal fired power plants. Steam power plants, which predominantly use lignite as a primary fuel, accounted for production of 53.4% (44 816.5 GWh) of electricity in 2015. Another significant source are nuclear power plants (Dukovany and Temelín), which accounted for 32.0% (26 840.8 GWh) of all electricity generated in 2015.

Exploitable lignite and hard coal deposits are low and the operational life of existing mines is roughly estimated from 10 to 50 years. Hard coal deposits in the Czech Republic are estimated to be depleted by 2030 (estimated deposits by the CGS are 42 million of tons in the whole country). Therefore, the sustainable development needs depend especially on the proliferation of renewable and nuclear sources and energy savings.

The Czech Republic generates sufficient volume of electricity to cover all of its domestic demand and therefore it is able to export a considerable portion abroad. The Czech Republic exported in 2015 a total of 28.8 TWh of electricity, i.e. 34.2% of the total electricity produced, and imported only 16.1 TWh. The net exports of electricity in 2015 was 12.7 TWh, which amounts to 14.9% of the total electricity generated in the Czech Republic (83 888.3 GWh). The Czech Republic thus currently belongs to the largest European electricity exporters. However, due to the expected gradual decline in power generation capacity, mainly due to decommissioning of old lignite power plants, the exported volumes of electricity are expected to decline.

In 2015, RES produced 9 423 GWh of electricity, which represents year-on-year increase of 2.7%. RES production in 2015 represents 11.2% of the total gross generated electricity in the Czech Republic, which was 83 888 GWh (in 2014 this share was 10.7%). Volume of heat generated using RES has been steadily growing; 2014/2015 year-on-year increase was 4.0%. In 2015, RES accounted for 19.82% of final consumption in heating and cooling sector. The largest volume is produced from solid biomass (87.5%), where the decisive factor is use of wood in household sources. The Czech Republic committed itself, in line with the EU targets, to achieve 13% share of RES in the gross final consumption of energy sources by 2020. This target includes gross consumption of electricity, final consumption in the sector of heating and cooling and final consumption of energy in transportation. In 2015 the Czech Republic already achieved 15.1% of RES in the final consumption of energy sources (electricity: 14.1%; transportation 6.5%; heating and cooling 19.8%).

Individual automobile transportation recorded a steady increase in passenger transport, from 58 % in the year 1990 to 71 % in 2015. Within the transport performance of road freight transport was recorded a fluctuating trend in the years 2010-2014 with an increase in 2015. The performance and also the number of passengers have increased in the passenger railway transport. Values of transport performance of the freight railway transport show variable trend. Railway transportation in 1990 processed almost 70 % of the total freight transportation in Czech Republic, while today it is only approximately 21 %. The vast majority of freight in the Czech Republic is transported by road.

In 1990, the transportation-generated emissions amounted to mere 6.1 % of total CO_2 emissions in the Czech Republic. In 2009 this value raised to 17.7 % and maximum of value was reached in 2014 – 18 %. Greenhouse gasses (CO_2, N_2O and CH_4) from this sector show increasing trend from 1990 to present. The values of these emissions decreased between years 2009 – 2013 only due to the economic crisis and reduction of fuel consumption what positively affected the emission impact of transport on the environment.

The Czech Republic is traditionally an industrial country and industry represents 27% of the Czech GDP. In 2015, industrial production grew by 4.6 % year-on-year. The sector with the highest growth rate was manufacture of wearing apparel which grew by 16.9% year-on-year, the rise mainly reflected base effects. Industry with high level of growth was manufacturing apparel which grew by 12.7%. The increase with high impact on total/manufacturing industry is connected to the automobile industry which grew by 12.1% year-on-year. As in the previous years growth of industrial production was driven by growth of foreign demand (increased by 8.0% year-on-year). The industries with a significant decrease were repair and installation of machinery and equipment (dropped by 6.3% year-on-year) and printing and reproduction of recorded media (dropped by 4.6% year-on-year).

Total waste generation in the Czech Republic reached 37.338 million tons in 2015, which is 15.7% more than in 2009. Total production of municipal waste in the Czech Republic reached approximately 5.274 million tons, i.e. about 500 kg per inhabitant. Between 2009 and 2015 the growth in material recovery of municipal waste has been apparent, growing from 22.7% to 35.6%, nevertheless, there is still a large volume of waste that is being landfilled. In 2015 a total of 47.4% of municipal waste was landfilled. Mixed municipal waste represents the largest share of waste that is landfilled. From the total municipal waste produced in 2015 35.6% had been materially recovered, energy recovery processed only 17.6% of waste.

Cropland represented 53.4% of the total area of the country (approximately 7.9 million ha) in 2015 (in 2003 the figure was 54.1%). Wheat remains the predominant crop. Production of rapeseed grew in the recent years (due to its use as a component in motor fuel).

Bio components in fuel include rapeseed oil methyl-ester (MERO – FAME) and bio ethanol produced mainly from sugar beet. Agriculture contributed to the total amount of greenhouse gas emissions in 2015 by about 6.7%. N_2O emissions from agriculture amounted to 73.1% of the total national emissions of this particular gas in 2015.

Woodland area has been steadily growing, especially as a result of afforestation of infertile cropland (in recent years the annual gain was approximately 2 000 ha). The total area of woodland in 2015 reached 2 668 thousand ha, which represent approximately one third of the Czech territory (33.83% of the entire state territory) and slightly exceeds European average.

National Greenhouse Gas Inventory System and emissions trends

Emission inventory is being maintained in line with the standard IPCC methodology. Emission factors and activity data that were used are included in the annual National Inventory Report[1]. National Inventory System (NIS) has been launched in 2005. The body responsible for its administration is the Ministry of the Environment, which delegated these powers to the Czech Hydrometeorological Institute (CHMI) as the organization responsible for coordination of emission inventory preparation and elaboration of the required data and text outputs.

CHMI has been tasked especially with the following:

- Management of sectoral data sources,
- Determination of uncertainties using the Tier 2 Monte Carlo methods,
- QA/QC review procedures,
- Reporting of data in the prescribed CRF format (Common Reporting Format),
- Elaboration of the National Inventory Report (NIR),
- Maintenance of the inventory archiving and documentary system.

Official greenhouse gas inventory outputs (CRF, NIR) are completed by the CHMI and submitted to the Ministry of the Environment for approval. The Ministry of the Environment cooperates further with other departments and state organizations, especially with the Czech Statistical Office (CzSO). Besides that, the Ministry of the Environment communicates with the European Commission and the UNFCCC Secretariat.

In 2013, the inventory team completed preparations for designation of key categories using the Tier 2 method, i.e. including uncertainties. This method will be implemented in the coming years.

QA processes include control activities and review undertaken by third party, which is not involved in national inventory preparation. CHMI cooperated on QA processes with Slovak experts, who are involved in preparing the Slovak national inventory. The Ministry of the Environment, to whom CHMI submits national inventory results for evaluation and approval, also carries out reviews.

Results of the greenhouse gas inventories between 1990 and 2015 were provided in basic sectoral categories in and separate Annex 1 (CTF Tables 1a, 1b, 1c) and Annex 2. Total greenhouse gas emissions incl. LULUCF decreased in the Czech Republic from 191.5 million tons CO_2 equivalent to 1990 to 121.3 million tons CO_2 equivalent in 2015. Emissions excluding LULUCF decreased from 197.9 million tons to 127.9 million tons CO_2 equivalent, which means that in terms of 1990 figures there has been a reduction in national emissions by 36.7%. Emission inventory also included HFC, PFC and SF_6 (the so-called F-gases) emissions. Individual gas shares on the total greenhouse gas emissions (excl. LULUCF) reached in 2015 the following amounts: 81.6% for CO_2, 10.7% for CH_4, 4.8% for N_2O and 2.8% for F-gases.

The emission reduction trend has been permanent since 1994 and potential fluctuation are caused for instance by different temperatures during winter, year-on-year changes in GDP or by the degree of implementation of adopted measures. A noticeable decrease is apparent in the Energy sector (stationary combustion) and in Agriculture sector; on the contrary, emissions produced by Transport sector have been steadily rising over long term. Additional reductions

[1] National Inventory Report and inventory data sets for each year are available at http://www.chmi.cz/files/portal/docs/uoco/oez/nis/nis_uv_cz.html

of emission are apparent in the manufacturing sector and in other sectors including housing, institutions and services. Given the fact that the total greenhouse gas emissions have decreased by 2015 in comparison with 1990 by 36.7% (incl. LULUCF), respectively by 35.4% (excl. LULUCF), there is a very high probability of successful achievement of the national emission target for the second commitment period under the Kyoto protocol (2013 – 2020).

Manufacturing sector and construction sector, as well as households and public institutions and services sectors have all contributed to the reduced emissions between 1990 and 2011. Trends indicating reduced use of solid fuels and increase in natural gas consumption have had positive impact which may be also assigned to energy savings (new technologies, modern equipment and household appliances, heating insulation of buildings etc.). Between 2010 and 2015, emissions in the Transport sector have slightly increased (by 4.31%).

F-gases emissions increased since 1995 (reference year) from 84.1 to 3 549.88 Gg CO_2 equivalent in 2015 and relative share of F-gases on total emissions grew similarly (0.1% in 1995 to 2.8% in 2015). These substances are not being manufactured in the Czech Republic and their entire consumption is met by imports. Increase in these emissions is caused by substituting ozone depleting substances but also by increased application of F-gases in new technologies, especially in cooling equipments (HFCs), electronics (SF_6) and in some specialized manufacturing processes (low-energy windows, fire extinguishers, propellants for aerosols and expanding agents, etc.).

National emission trading registry

The Czech greenhouse gas emissions trading registry (ETR) has been administered since 2005 by OTE corp. under authorization of the Ministry of the Environment. As of June 2012 the single Union Registry has been established. The ETR allows access only to duly authorized representatives of the account holders. All legal entities operating its instalations which have the obligations, pursuant to Act No. 383/2012 Coll., on conditions of trading with GHG emission allowances have the obligation to open an account in ETR. Since 2012 the same obligation is imposed to aircraft operators who fallinto the EU Emissions Trading System (EU ETS).

The Registry information system had been reviewed, in terms of DES, by the UNFCCC Secretariat within the framework of the initiation procedure prior to integration with EUTL[2] and further by using and set of testing scenarios. The Registry has undergone all these tests successfully and received the necessary certifications on 1 July 2012.

Policies and measures

In the Czech Republic, there are several levels of measures used to reduce greenhouse gas emissions (strategic, legislative and programming) or to help to adapt to climate change negative impacts. Since 2000, the Czech Republic has been implementing a system of strategic and operational planning, which is being continuously modified in line with the Czech international commitments and relevant EU climate and energy policies and legislation. Legislative framework determines institutional responsibilities for coordination and implementation of programmes as well as imposing regular review of their impacts.

The set of strategic instruments includes especially the following measures:

[2] European Union Transaction Log

- Climate Protection Policy of the Czech Republic (adopted by the Czech Government in 2017 and setting goals till 2030 with outlook till 2050)
- Strategic framework Czech Republic 2030 (adopted by the Czech Government in 2017),
- National Reform Programme (which is updated annually, last update in 2017),
- Strategy of the Regional Development for 2014 – 2020 (approved by the Czech Government in July 2013),
- Strategy on Adaptation to Climate Change in the Czech Republic (adopted by the Czech Government in 2015),
- National Action Plan on Adaptation to Climate Change (adopted by the Czech Government in 2017).
- Concept for the Prevention of the Drought of the Czech Republic (adopted by the Government in 2017).
- State Energy Policy (Adopted by the Czech Government in 2015)

Programming documents with direct or demonstrable indirect impact on greenhouse gas emissions include:

- State Environmental Policy 2012-2020 (SEP)
- The medium-term Strategy for Improving Ambient Air Quality (by 2020), which also includes the National Emission Reduction Programme (scenario involving additional measures within this programme anticipates implementation of the following measures: reducing the share of solid fuels in the energy mix, increased efficiency of energy production and distribution, considerable investments into household heating, support focusing on savings to be achieved in buildings etc.)
- National Action Plan for Clean Mobility
- National Action Plan for Energy Efficiency
- National Renewable Energy Action Plan
- Waste Management Plan 2015 - 2024

Additionally, the following legislation has been adopted or amended in the recent years, having direct impact on greenhouse gas emissions:

- Act No. 383/2012 Coll., on conditions of trading with greenhouse gas emission allowances,
- Act No. 201/2012 Coll., on protection of ambient air,
- Act No. 73/2012 Coll., on substances damaging ozone layer and on fluoride greenhouse gases,
- Act No. 76/2002 Coll., on integrated prevention and limiting pollution and on integrated pollution register, as amended,
- Act No. 406/2000 Coll. on energy management, as amended,
- Act No. 458/2000 Coll., on business conditions and public administration in the energy sectors (Energy Act), as amended,
- Act No. 310/2013 Coll. on supported energy sources, as amended.

Emission projections scenarios

Projections have been revised in line with Guidelines,[3] Decision 280/2004/EC and Decision 2005/166/ES for the following scenarios:

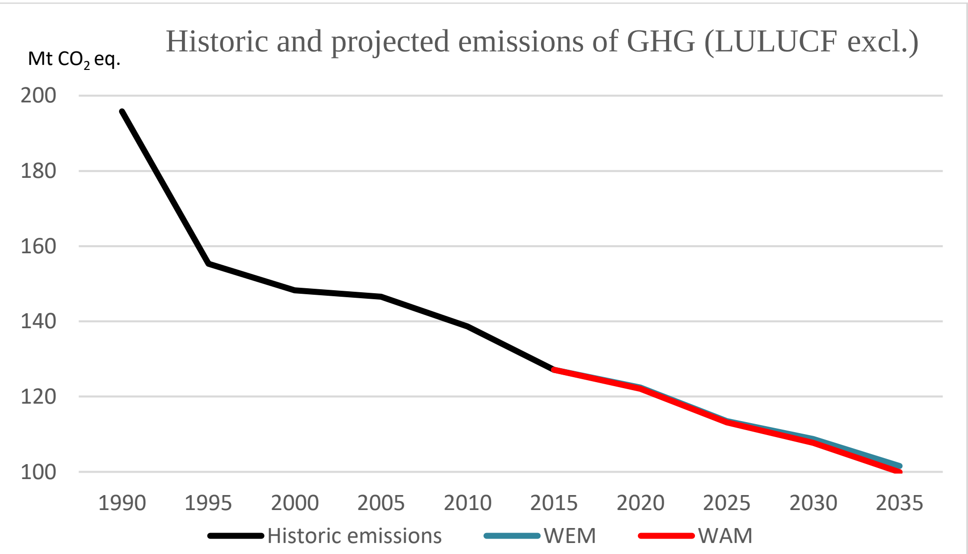
- With existing measures (WEM), i.e. implemented measures which came into force before the projection preparation period (June, 2016);
- With additional measures (WAM), i.e. with existing measures and measures, which are to be implemented shortly or which are being planned.

Additional measures included in projections are especially:

- Sustainable Development Strategy (2004),
- Strategic Framework for Sustainable Development (adopted by Government in 2010),
- National Strategic Reference Framework (2007 – 2013),
- National Reform Programme (updated annually, last in 2017),
- Strategy of the Regional Development 2014 – 2020 (adopted in June 2013).

The methodology for preparing emission projections has been already used in preparation of the Fifth and the Sixth National Communication, which enables their mutual comparison. Scenarios used in creating projections are based on the above-mentioned strategic and programming documents. Historical emissions along with both projections (WEM and WAM) are given in graph below.

Figure 1.1: Historical emissions and emission projections (Mt CO_2 eq./year)



Source: CHMI

Mechanisms according to Art. 6, 12 and 17 of the Kyoto Protocol

The Czech Government approved the Framework agreement on cooperation in implementing projects seeking reduction of greenhouse gas emissions with the International Bank for Reconstruction and Development (IBRD) and other investor countries by its Resolution No.

[3] UNFCCC *Reporting Guidelines on National Communication*, FCCC/CP/1999/7, part II

648 dated 30. 6. 2003. In 2012, there were 85 Joint Implementation (JI) projects approved. During the first commitment period of the Protocol (2008 – 2012) there have been issued approximately 0.883 million ERUs annually. Implementation of all JI projects during 2002-2012 generated approximately 7.446 million AAUs, and from this amount the issued ERUs reached 4.413 million. Act No. 383/2012 Coll., on conditions of trading with greenhouse gas emission allowances allows use of free AAUs to support project according to Art. 6 of the Protocol. From the perspective of the total reduction of emissions between 2008 and 2012 the JI projects contribution to total reduction is estimated at 3.5 – 4% and the share of the GIS programme ("Green Savings" programme) at 2.5 – 3%. The Czech Government also supported selected specific private sector projects within the Clean Development Mechanism (CDM) in developing countries.

Estimated vulnerabilities, climate change impacts and adaptation measures

Integration of the regional climate model (RCM) ALADIN–CLIMATE/CZ with emission scenario A1B for the 1961 – 2050 period, with horizontal resolution of 25 km, was completed in 2008. The short-term estimate (midpoint in 2030) shows that the average annual air temperature in the Czech Republic will increase, according to the ALADIN-CLIMATE/CZ model, approximately by 1 °C; temperature growth in the summer and winter is only slightly less than in the spring and autumn. Simulations also indicate that change in temperature is linked to certain related temperature characteristics. In the summer, we may anticipate slight increase in the number of summer and tropical days and nights, in the winter a decrease in the number of frost, ice or arctic days.

Total precipitation changes are more complex. Most nodal points in winter show in simulation decrease of precipitation (depending on specific location by up to 20%), while in the spring the same show increase (by 2 to approximately 16%); in the summer and especially in the autumn the situation varies place to place (some locations show slight decrease by several per cent in the autumn, while elsewhere an increase by up to 20–26%, in the summer slight decrease prevails, but in some location (for instance in Western Bohemia) there is an increase by up to 10%). Between the begining of autumn until the beginning of the summer the anticipated increase of precipitation is accompanied by identical increase in territorial evapotranspiration caused by increased temperature. In the summer, there is a decrease in precipitation and due to a drop in water reserves in the soil, this will probably not lead to a significant increase in territorial evapotranspiration. An important factor is a shift in snow cover melt in higher altitudes due to higher temperature, roughly from April to January/February.

In medium-term timeframe (midpoint in 2050), the simulated warming becomes more significant, temperature will rise the most in the summer (by 2.7 °C), least in the winter (by 1.8 °C). The medium-term perspective makes winter decrease in precipitation more apparent (for instance in Krkonoše, Českomoravská Vysočina, Beskydy by up to 20%) and its increase in the autumn. During the summer, the decrease in precipitation becomes dominant factor, which will be even more significant in long-term horizon, while decrease of winter precipitation will be lower in comparison with the preceding period.

More frequent occurrence of extreme meteorological events is already being reflected in changes in the water regime, in agriculture and forestry and partly also affect the state of health of the population. In the medium term (around 2030, see the scenario for the 2010 – 2039 period), it can be expected that there will be a further increase, especially in detrimental impacts on the individual components of the natural environment, and it has been relatively newly pointed out that impacts will be felt in the energy sector, potential for recreation and tourism and overall wellbeing of the population, especially in larger residential agglomerations.

Water management

In the medium term, it can be expected that the average flow rates will decrease in many river basins by 15 – 20% (“optimistic” scenario) to 25 – 40% (“pessimistic” scenario), which would lead to fundamental changes in the overall hydrological regime. Decrease in flow rates will be demonstrated in changes in the quality of surface waters through an increase in the water temperature and its subsequent eutrophication. This will augment the water deficits in the summer and autumn months, even in relatively wetter regions Intense precipitation episodes that occur during summer thunderstorms will present a greater risk of flash floods even when the long-term total precipitation does not change much.

Agriculture

Adaptation of the agriculture sector to climate change relates not only to ensuring food supply and general food security, but also to maintaining sustainability of ecosystem services provided by the agriculture. Climate change will affect plant and fodder production as well as production of other raw materials, it will also affect genetic diversity in agriculture, soil fertility and erosion, quality and availability of water and recreational potential of the landscape.

Changes in vegetative seasons may affect plant compositions, especially those, which find it harder to adapt to changing conditions. Climate change will also influence changes in environment in terms of extending territory for diseases and pests.

Forestry

Anticipated increase in average temperature will be manifested in a shift in the occurrence of many tree species to higher altitudes. For example, an increase in the average annual temperature by 1 – 2 °C can lead to a shift in the tree line by 100 to 200 meters.

From climate change perspective drought remains the most pronounced risk factor, increasing the risk of forest fire, and having a negative effect on forest ecosystem production and services they provide. Climate change effects will play a significant role in terms of worsened health and stability of regulated area felling tree stands which are mostly spruce monocultures, in lower and medium altitude locations, which are locations which are pivotal for logging in the Czech Republic. At the same time, they contribute to more frequent occurrences of calamities caused by abiotic effects during sudden climatic events (destructive gusty winds, wet snow, landslides after extreme rainfall, forest fires etc.).

Biodiversity

From climate change perspective, the most vulnerable ecosystems in the Czech Republic include alpine ecosystems and ecosystems consisting of residues of the original grasslands. Changes are manifested most in ecosystems above the shifting upper boundary of forests, where their relatively small area exacerbates the vulnerability. Approximately one tenth of monitored plant species will be in danger of extinction by the end of the century, while one fifth of plant species can rapidly and effectively adapt to a changing climate. Climate change will enable the spreading of invasive non-indigenous species, i.e. species whose intentional planting or inadvertent introduction and subsequent spreading endangers biological diversity, biotopes or even entire ecosystems.

Urbanized landscape

Climate change will affect housing, technological constructions and construction sector as such. The fluctuations between temperature minima and maxima will be dramatic, affecting exposed materials and buildings. More intensive precipitation events and strong winds, among other, will increase the danger of building constructions being damaged, lowering their value and lifetime, thus increasing repair and maintenance costs.

Health and hygiene

Climate change may affect health of the population by an entire complex of direct and indirect impacts. Direct impact is a consequence of changes in physical climate value (temperature change, consequences of more frequent and intensive extreme weather events, increase UV radiation etc.). Indirect impacts are a combination of environment with other living conditions accentuated and modified by climate change, for instance air pollution, depleted ozone layer, pollen, which may trigger increase in seasonal occurrence and duration of allergies and changes in occurrences of contagious diseases.

Population migrations related to climate change will represent health risk both for the migrants and for the receiving population. Deteriorating conditions may lead to higher population mobility. There may be increased demand for humanitarian aid and healthcare for the migrant groups, demanding more healthcare capacity and pharmaceuticals.

Emergency events and protection of the population and the environment

It is anticipated that the intensity and frequency of extreme meteorological events will rise (extreme heat, precipitation, wind) as well as long-term droughts, large-scale flooding, landslides, rock formation collapses and large-scale forest fires. If there will be more disasters in the future, triggered by climate change, there will be more need and demand on civil protection, more demand on resources, crisis and risk and rescue management.

We must also anticipate the possibility of increase in local and cross-border conflicts related to lack of access to basic natural resources, which could trigger migration waves into EU and to a certain degree to the Czech Republic.

Tourism and recreation

There has been a trend in shortening of the winter skiing season in recent years, and this can be expected to continue in the future. Artificial snow and its production on ski slopes and cross-country ski tracks, which could prolong the season, will be increasingly complicated by lack of water sources and energy barriers (especially increasing prices). The expected increase in summer temperatures could increase interest in summer recreation around natural and artificial water reservoirs, but prolonged high temperatures will cause substantial heating of water volumes with subsequent reduction in water quality, accompanied by the growth of blue-green algae.

Transport

Extreme weather fluctuations such as sudden intensive rain or snow fall, flooding, heat waves or low river water levels may significantly affect road, railway, river and also air transport. More frequent occurrences of extreme weather events will cause unavailability of transport infrastructure due to flooding, physical damage or destruction, fallen trees etc. Landslides falling on roads and railways may also considerably disrupt traffic.

Industry and energy sector

As a result of climate change, the energy sector in Europe will most probably suffer from differences between available energy supply and demand for energy. Climate change will also affect volume and distribution of precipitation during the course of the year and that will have effects on hydropower electricity generation. Climate change may also affect transmission and distribution networks, which may make it difficult to cope with demand for cooling during summer peaks, but also with damage caused by high winds or flooding.

Lack of precipitation may lead to reduced production of biomass used in generation of electricity and heat, and limit production in sectors which are water intensive (such as paper or chemical plants). Conversely, heavy precipitation / flooding may disrupt electricity supply networks and product pipelines as well as limit or shutdown deliveries by road or railway, disable production in industrial plants, disrupt hydropower plants operation and cause hazardous materials leakages.

Adaptation measures

The Strategy on Adaptation to Climate Change in the Czech Republic (Strategy) was adopted by the Czech Government in October 2015 and is implemented by t*he National Action Plan on Adaptation to Climate Change* (Action Plan) since January 2017. The Strategy presents observed climate change and defines the adaptation measures including their mutual linkages in connection to anticipated impacts of these changes. Moreover *the Concept for the Prevention of the Drought of the Czech Republic* was approved by the Government in July, 2017. The main objective of the Concept for Drought Protection for the Czech Republic is to create a strategic framework for the adoption of effective legislative, organizational, technical and economic measures to minimize the impacts of drought and water scarcity on the lives and health of the population, environment and the overall quality of life in the Czech Republic.

<u>Forest management</u>

Adaptation measures will be implemented within the framework of the National Forestry Programme II, which is the key document for forestry-related policies (approved by Government Resolution No. 1221/2008). This mainly involves ensuring species, age and spatial diversity of forests, prioritizing natural recovery and stabilisation of carbon bound in forest ecosystem. Some specific solutions and measures for forestry have been included in the adaptation NAP.

<u>Agriculture</u>

Sustainable use of cropland (e.g. protection against erosion and degradation, restoration of its water retention capacity, and preservation of soil fertility) is a key condition for climate change adaptation. Solutions should be based on the principles promoting sustainable farming and good agricultural practices. Some practical solutions and measures for agriculture have been included in the adaptation NAP.

<u>Water regime in the landscape and water management</u>

Water retention in the landscape, achieved by optimizing its structure and by utilization of effective and close-to-nature technical preventive measures, forms a fundamental basis for protection against extreme hydrological events. To these ends the following measures are being implemented:

- measures to ensure the stability of water regime in the landscape,
- systems of rainwater management and water re-use,
- river basin plans and flood risk management plans.

<u>Urban landscape</u>

Adaptation measures in urbanized landscape are implemented in connection to and following onto water management measures. Additional measures are being supported especially via provisions aiming at minimization of surface runoff, reduced pollution of water, variability of the urbanized area and stable system of urban greenery. Moreover there are specific measures in the field of urban development and architecturewhich reduce the risks associated with higher air temperatures and summer heat waves.

Biodiversity and ecosystem services

The most important implemented or planned measures include:

- analyses of climate change impacts on biodiversity,
- protection, restoration, and improvement of ecosystems and natural or close-to-natural areas and elements contributing to adaptation to the impacts of climate change (protection and management of urban vegetation, revitalization of ecosystems and natural elements in open landscape),
- increasing the capacity of ecosystems to provide key services,
- protection and restoration of the connectivity and permeability of the landscape (implemented via Territorial System of Ecological Stability/TSES),
- measures preventing and limiting the spread of invasive species,
- protection and improvement of the status of populations of rare and endangered species in key biotopes (protection and management of specially protected areas (SPA) and NATURA 2000, revitalization of landscape elements, measures supporting nesting / breeding of bird populations, bio-corridors, protection and implementation of TSES etc.),
- ensuring interlinkages between adaptation and nature protection measures.

Health and hygiene

Policies and measures in the healthcare sector include:

- monitoring of pathogens and distribution of information to clinical and laboratory experts,
- research into zoonotic contagion cycles with emphasis on changes in vector and reservoir animal ecology,
- identification of risk areas, seasonal changes and groups of population which is especially vulnerable to risk factors, whether of contagious or non-contagious nature and preparation of early-warning system,
- raising awareness about healthcare within the public.

Emergency events and protection of the population and the environment

Measures in this particular sector include:

- protection of the population, early warning systems,
- development and further strengthening of Integrated rescue system (IRS), which ensures coordinated actions of all its units (Fire Rescue and fire protection units, Police and emergency services),

- measures protecting critical infrastructure,
- environmental security, including crisis management for drought, flood, forest fire situations, improved meteorological and hydro-meteorological services,
- security research and development.

Financial resources and technology transfers

Key strategic documents include *Development Cooperation Strategy of the Czech Republic 2010-2017* and *Multilateral Development Cooperation Strategy of the Czech Republic 2013 – 2017*.

The Czech Republic is not a party to Annex II to the Convention and as such is not obliged to adopt measures, in line with Article 12.3 of the Convention and fulfil obligations pursuant to Articles 4.3, 4.4 and 4.5 of the Convention and provide additional financial sources. Nevertheless, the Czech Republic as the EU member state, along with other developed countries committed itself at the 15th session of the Conference of Parties to the *United Nations Framework Convention on Climate Change* in December 2009 in Copenhagen, to a goal of mobilizing jointly USD 100 billion annually by 2020 to address the needs of developing countries in the context of meaningful mitigation and adaptation actions and transparency on its implementation. Therefore, the Czech Republic is pleased to provide on voluntary basis available information on the support provided to developing countries for activities related to climate change (see chapter 7).

Research and systematic observation

The objective of the research policy in the Czech Republic is to contribute to the knowledge of the causes and effects, size and time of climate change factors and their sectoral, economic and social impacts. Attention is also given to international cooperation, respectively exchange of scientific, technical and socio-economic information. Research of the current state and development of the global climate system as well as regional climate is the aim of the the following institutions:

- Technology Agency of the Czech Republic,
- Environmental Committee of the Academy of Sciences of the Czech Republic,
- National Forestry Committee,
- Research institutes of Academy of Sciences of the Czech Republic, universities and other state research organizations, especially the CzechGlobe - Global Change Research Institute of the Czech Academy of Sciences (CAS).

Systematic observation of the climate system is undertaken in required extent by the CHMI, which acts as the responsible state body in the air protection, hydrology, water quality, climatology and meteorology with competences to establish and manage state monitoring and observation networks, including international data / information exchanges according to the WMO principles.

During the period described in this National Communication there were up to 100 projects involved in research, development and innovations which were connected with climate change. Projects were focused on development of climate scenarios for the Czech Republic, evaluation of water management vulnerabilities, including supply of drinking water, statistical assessments of the probabilities of climate extremes, variability of agricultural production, food security and development of new low-carbon technologies.

CHMI establishes and operates national monitoring and observation systems which record the quantitative and qualitative states of atmosphere and hydrosphere and causes leading to their pollution and damage; it processes the results, measurements and monitoring in compliance with EU legislation, creates and administers databases and provides information on the state of atmosphere and hydrosphere, including forecasts and alerts to dangerous hydro-meteorological events.

Environmental education and public awareness

National policy relating to environmental education and public awareness (EE&A) in the Czech Republic is based mostly on Chapter 36 Agenda 21 of Aarhus Convention on Access to Information, participation of the public on decision-making and access to legal protection of the environment, which the Czech Republic ratified in 2004 and the Regional Strategy (UNECE) for education for sustainable development, adopted in 2005. The obligation to promote environmental education and public awareness (EE&A) arises from valid legislation, the fundamental statute being Act No. 123/1998 Coll., on the right to information on the environment awareness and Act No. 561/2004 Coll. on School Education. The key strategic and cross-sectional document for elaboration of detailed environmental programmes, including climate change, is the State Environmental Policy 2012 – 2020 (SEP).

2 NATIONAL CONDITIONS

2.1 Structure of the State administration

The fundamental constitutional arrangement, defining positions and tasks of the major state institutions, is laid down by the Constitution of the Czech Republic, which was adopted in 1992. The Czech Republic is a parliamentary democracy with division of powers between the legislative, executive and judicial branches of the Government. President is the head of the State, elected directly by the electorate for a five years term. The supreme legislative body of the land is the two-chamber Parliament, comprising of the Chamber of Deputies (lower house) and the Senate, which adopts all proposed bills, approves international treaties, conventions, protocols and other important political strategic documents in the industrial, military, environmental, agricultural and other sectors. The executive powers rest with the Government, which is formed on the basis of elections into the Chamber of Deputies. Its members usually come from the political parties, which obtained the strongest mandate from the electorate.

Since 1 January 2000, constitutional Act No. 347/1997 Coll., established 14 higher territorial self-governing units – Regions – whose size corresponds to similar administrative units in the EU defined as NUTS 3. Regional Authorities act as the local bodies exercising delegated powers of the state Government; a Director General heads Regional Authority. The head of each regional county is a governor; in Prague the head is the Mayor.

Regions represent a self-governing level between the Government and local municipalities, be it cities, towns or smaller units. Regions ensure selected functions and services to citizens within the framework of socio-economic and other development (incl. environmental services) based on their specific regional needs, better local knowledge and independent financial governance. Municipalities are currently the only self-governing units managed by the locally elected municipal and city boards of representatives headed by mayors.

In the environmental sector, the highest executive body is the Ministry of the Environment established on 19 December 1989 by Act No. 173/1989 Coll. as of 1 January 1990 to function as the central body of State administration and supreme supervising body in all matters related to the environment.

The Ministry of the Environment acts as the central executive body of the State administration in the following areas:

- protection of natural accumulation of water
- protection of water sources and protection of subsurface and surface water quality
- protection of air
- protection of climate system
- protection of nature and landscape
- protection of agricultural land fund
- performance of state geological service
- protection of mineral deposits, incl. protection of natural resources and ground water
- geological work and ecological supervision of mining
- waste management

- evaluation of environmental impact assessment and its impact on the environment, incl. cross-border impacts
- game-keeping, fishery and forestry in national parks
- state environmental policy.

In order to exercise control activities of the Czech Government, the Ministry of the Environment coordinates activities of all other ministries and other central State administration bodies in all matters relating to the environment.

At present time, the Ministry of the Environment is divided into five expert sections (Directorate of EU Funds, Economics and Voluntary Instruments, Directorate of State Administration, Directorate of Nature and Landscape Protection, Directorate of Technical Protection of Environment and Directorate of Environmental Policy and International Relations).

The Ministry of the Environment is also the founding body of expert institutions such as the Czech Hydrometeorological Institute, the T.G. Masaryk Water Research Institute, the Agency for Nature Conservation and Landscape Protection of the Czech Republic, CENIA – Czech Environmental Information Agency, the State Environmental Fund of the Czech Republic, the Czech Geological Survey, the Silva Tarouca Research Institute for Landscape and Ornamental Gardening.

The Czech Environmental Inspectorate (CEI) is an independent organizational unit of the Ministry of the Environment. CEI is an expert body of State administration charged with supervision and enforcement of compliance with environmental standards in the Czech Republic. It also supervises compliance with binding decision issued by other state bodies in the environmental sector. CEI was established in 1991 by Act No. 282/1991 Coll. on the Czech Environmental Inspectorate.

2.2 International activities

The Czech Republic is a member of the UN, EU, NATO, OECD, WTO, WHO, IMF, World Bank, Council of Europe, OSCE; it is a part of the Schengen area, member of the Visegrad Group and other notable international structures. The Czech representatives take active role in environmental activities and sustainable development of all these organizations with emphasis being placed on cooperation within the framework of the EU, OECD and UN (especially the UN Environment Programme – the UNEP). The Czech Republic was actively involved in the preparation of the UN conference on sustainable development – Rio + 20 (June 2012), which was the watershed event in the international environmental protection of this decade.

The Czech Republic is a party to more than 40 multilateral environmental agreements (MEAs). The list of those most important MEAs is provided in Table 2.1 below. The country is involved in a number of projects abroad, which seek to fulfil tasks stemming from broader international commitments. In the area of development cooperation, the Czech Republic provides aid especially to the less developed countries, by providing expert assistance and supporting international development programmes (OECD, UNDP etc.). Since 2013, the Czech Republic has been a member of DAC OECD, which attests to the quality of the Czech development cooperation activities abroad.

Table 2.1: Multilateral environmental agreements, which the Czech Republic is a Party to (list of the most important MEAs)

Area	Name / Title
Climate change	United Nations Framework Convention on Climate Change (UNFCCC) Kyoto Protocol Paris Agreement
Nature and landscape protection	Convention on Biological Diversity (CBD) Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization (ABS Protocol) United Nations Convention to Combat Desertification in Those Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa (UNCCD) Framework Convention on the Protection and Sustainable Development of the Carpathians (Carpathian Convention) Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention) European Landscape Convention
Species protection	Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Convention on the Conservation of Migratory Species of Wild Animals (CMS or Bonn Convention) Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention) Agreement on the Conservation of Populations of European Bats (EUROBATS)
Biological security	Cartagena Protocol on Biosafety (CPB)
Air protection	Convention on Long-Range Transboundary Air Pollution (CLRTAP)
Ozone layer protection	Vienna Convention for the Protection of the Ozone Layer Montreal Protocol on Substances that Deplete the Ozone Layer
Water protection	Convention on the Protection and Use of Transboundary Watercourses and International Lakes
Chemicals	Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade Stockholm Convention on Persistent Organic Pollutants (POPs) Minamata Convention on Mercury
Waste	Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal
Industrial accidents	Convention on the Transboundary Effects of Industrial Accidents
Public access to information on the environment	Convention on Access to Information, Public Participation in Decision–Making and Access to Justice in Environmental Matters (Aarhus Convention) Protocol on Pollutant Release and Transfer Registers (PRTR Protocol)
Environmental Impact Assessment	Convention on Environmental Impact Assessment in a Transboundary Context (Espoo Convention) Protocol on Strategic Environmental Assessment (SEA Protocol)

Source: MoE

2.3 Population

The Czech Republic had population of 10 578 820[4] as of 31 December 2016, which places it at the 11th place in European Union.

Average population density of 134 inhabitants per km^2 makes the Czech Republic one of relatively densely populated countries in Europe. High population density and high urban dwellers ratio (70%) means that a large number of inhabitants live in areas with disrupted

[4] http://www.czso.cz/csu/redakce.nsf/i/obyvatelstvo_lide

environment, especially due to emissions from intensive traffic, household heating using solid fuels mostly in smaller municipalities and other local negative impacts.

In 2013 the Czech Statistical Office projections related to demographic development in the Czech Republic indicate that the future trends are nearly identical to the EU-15 trends: the Czech population will slightly grow until 2020, reaching 10.7 million. This demographic projection also anticipates that the share of inhabitants over 65 will be higher by approximately 5% in 2020 in comparison with the existing numbers (20.5% against currently approximately 15%).

From the perspective of demographics, one of the issues with principal importance is the change in education structure. According to the study published by the Faculty of Economics, the University of Economics, Prague,[5] it is anticipated that by 2020, the number of inhabitants with completed university education will grow. Given that emphasis is put on the increased environmental awareness from the lowest levels of school education, it is anticipated that the population's awareness of importance of prevention and resolution of environmental issues will also grow.

2.4 Geographic conditions

With area of 78 870 km^2, the Czech Republic is one of the small to mid-sized countries and currently ranks at the 15th place in Europe by size. The highest mountain is Sněžka in the Giant Mountains (1 603m above sea level), lowest point in the country is located near Hřensko, in place where the River Elbe crosses into Germany (115m above sea level). From the perspective of altitude, the lowlands and territory generally under 200m above sea level take up 5.0%, areas between 200 – 500m above sea level take up 74.1%, areas 600 – 1 000m above sea level take up 19.3% and areas with altitude exceeding 1 000m above sea level take up 1.6% of the territory. Average altitude is 450 m, which is higher than the average altitude in Europe (315 m).

The divide among the main watersheds of Europe passes through the Czech Republic (the North, Baltic and Black Seas). This position on the main European divide is not favorable from the standpoint of water management, as most rivers have their source here. Thus, precipitation becomes the main source of water. The long-term average precipitation equals 637 mm and approximately 25% of this amount flows out of the country in watercourses. The river network in the Czech Republic has a density of 0.73 km/km^2. The vast majority of the territory of Bohemia is drained by the Elbe into the North Sea, the major part of Moravia is drained by the Morava River into the Danube and Black Seas and part of Moravia is drained by the Odra River into the Baltic Sea. The fan-shaped river network in the Odra watershed is characterized by the concentrated confluence of larger rivers in the Ostrava basin with an elevated risk of floods. Compared to the surrounding countries, there are only a very few lakes here (in the Šumava area). Artificial water reservoirs are far more numerous, with more than 24 000 located in the country, the vast majority of which are fishponds. Mineral springs are very common, occurring in about 350 locations.

The current condition of the biosphere is the result of natural developments over the last several thousand years. The vegetation in valley floodplains and lowlands corresponds mainly to agricultural land. Lowland meadows cover large areas. Forests are the most important of all plant communities (about 1/3 of the area of the country), and form a microclimate and mezoclimate, absorb more solar radiation, reduce wind speed and affect outflow conditions.

[5] http://kdem.vse.cz/resources/relik09/Prispevky_PDF/Fiala_Langhamrova_Hulik.pdf, p 10

Most present-day forest stands were planted artificially and do not correspond to the original species composition of the forests. They consist mostly of single-species stands with a predominance of spruce and pine. The development of the contemporary landscape is affected primarily by secondary ecosystems. Original, natural ecosystems are scarce in the landscape. A large part of the country consists of fields, vineyards, orchards and gardens, used for food production.

The Czech Republic is characterized by scattered settlement structure, based historically on the large number of municipalities (there were 6,253 municipalities as of January 1, 2016) – only a small fraction of these municipalities can be called towns by international standards. Six cities have more than 100 thousand inhabitants (Prague, Brno, Ostrava, Plzeň, Liberec and Olomouc). Compared to the other countries of Central Europe, the Czech Republic has a smaller number of medium-sized and especially large cities. Territorial differences in the character of settlements are significantly affected by natural conditions. The areas of the uplands of central, southern and western Bohemia, which do not have very favorable conditions for agriculture, have a dense network of small settlements, while the more fertile lowlands of Bohemia and especially central and southern Moravia have larger rural settlements, frequently with 1-2 thousand inhabitants.

2.5 Protection of the Environment

2.5.1 Development of legislation and strategic documents

The state of the environment has markedly improved over the course of the last twenty years, especially with regard to air quality, water protection and waste management. On the other hand, the environment remains in several aspects unsatisfactory (for instance the dust particle emission levels) and represents, in the affected areas, a risk to both human health and the ecosystems.

A number of key component legislative acts were adopted after 1990, and this is being continuously updated to comply with EU legislation, especially in the areas of protection of air, water, waste management and protection of nature and the landscape. The following norms belong among the most important legislation:

- Act No. 134/2016 Coll. on Public Procurement
- Act No. 165/2012 Coll., on supported sources of energy, as amended
- Act No. 383/2012 Coll., - on Conditions of Trading with Greenhouse Gas Emission Allowances
- Act No. 201/2012 Coll., on Air Protection (hereinafter “new Air Protection Act”) came into effect on 1. 9. 2012 and determines primarily rights and obligations of pollution source operators, instruments reducing the amount of substances which pollute the air, competence of administrative bodies and measures leading to remedies and sanctions. Additionally, an Act was adopted last year regulating ozone depleting substances and fluorinated greenhouse gases;
- Act No. 73/2012 Coll., on ozone depleting substances and fluorinated greenhouse gasess, as amended
- Act No. 254/2001 Coll. regulates Protection of Waters, their use and associated rights;

- Act No. 185/2001 Coll. on Waste management defined fundamental principles of waste management, objectives and measures leading to their fulfilment as defined in the Waste Management Plan of the Czech Republic 2003-2013;
- Act No. 114/1992 Coll. on Protection of nature and the landscape defines what constitutes general protection of territories and species;
- Act No. 100/2001 Coll., on Environmental Impact Assessment;
- Act No. 76/2002 Coll., on Integrated prevention and limiting pollution and integrated pollution register;
- Act No. 289/1995 Coll., on Forests.

In addition, a number of strategic environmental documents covering protection of the environment incl. principles of sustainable development were adopted. The most important of these are: the State Environmental Policy (SEP), updated in 2016, the Strategy for Sustainable Development of the Czech Republic (2004), the **Strategic Framework for Sustainable Development of the Czech Republic (SFSD)**, adopted by the Czech Government on 11 January 2010 and its replacement, the strategic framework **Czech Republic 2030**. The SFSD determines the long-term objectives in three basic areas of modern social development – economic, social and environmental. This document is structured into 5 priority axes:

- Society, man and health;
- Economy and innovations;
- Territorial development;
- Landscape, ecosystems and biodiversity;
- Stable and secure society.

The Czech Government approved the **State Environmental Policy** in 2013; the Policy defines main priorities for the protection of the environment for 2012 – 2020 taking into account the condition and development of the environment; it focuses, in line with the Czech international commitments, on the 4 key areas:

- <u>Protection and sustainable use of resources</u> including protection of natural resources, ensuring protection of water and improvement of its condition / quality, preventing waste generation, ensuring maximum waste recovery and limiting its negative influence on the environment, protection and sustainable use of soil and mineral deposits / environment.
- <u>Climate protection and improvement of air quality</u> aiming to reduce greenhouse gas emissions, limiting negative impact of climate change in the Czech Republic, reducing the levels of air pollution and support to efficient and environmental-friendly use of renewable sources of energy and achieving energy savings.
- <u>Protection of nature and the landscape</u> focusing on protection and strengthening of ecological functions of the landscape, maintenance of natural and landscape values and improvement of urban environment quality.
- <u>Safe environment</u> including prevention of natural disasters / risks (floods, droughts, landslides, erosion etc.), and prevention of anthropogenic risks.

The SEP contains a detailed implementation section outlining the individual objectives, measures, responsibilities and deadlines. In the area of greenhouse gas emissions, the SEP emphasizes simultaneous and synergic resolution of air emissions posing greatest health risks (primarily PAH, PM 2.5, PM10, PM1, STS).

The 2016 update of SEP focused on the key area Safe environment, including new measures for natural risks management and adaptation to clime change.

On 19 April 2017 the Czech Government adopted an overarching strategic document **Czech Republic 2030** which effectively replaced the SFSD. It indicates the direction for sustainable development of the Czech Republic for the next decade. The document sets out goals and targets to be accomplished by the 2030 and consists of a detailed development analysis and strategy for sustainable development that should be reflected in all sectoral and regional strategies. It outlines six national priority areas (people and society; economic model; resilient ecosystems; municipalities; global development; and good governance). Another segment of the document consists of an impact analysis of global megatrends on national development.

Among strategic goals of the Czech Republic 2030 which should directly contribute to accomplishment of the Agenda 2030 goals and targets is the active participation of the Czech Republic in international organisations based on national priorities, supporting good governance for sustainable development (SDG 16), ensuring policy coherence and mainstreaming the Agenda 2030 into both national and foreign policies.

2.5.2 Air condition development

Solid polluting substances (STS) represent the main air pollutant in the Czech Republic, primarily $PM_{2.5}$ and PM_{10}, SO_2, NO_x, VOC, PAH and NH_3. Current significant sources of these emissions include generation of electricity and heating (from the perspective of SO_2 and NO_x production), transportation (producing NO_x, STS and VOC), household heating (STS and PAH) and metallurgy industry, including coking plants (STS, PAH, NO_x and SO_2). Agriculture is one of the main sources of NH_3, sectors using solvents are the main producers of VOC.

There has been a decrease in ground-level ozone precursors (VOC, NO_x, CO and CH_4) by 68.7% between 1990 – 2015. Between 2005 and 2015 the NO_x emissions dropped by 40.9%, SO_2 emissions by 45.1%. Positive development in terms of lowered emission burden was caused primarily by reduced emissions generated by transportation due to upgrades of the vehicle pool and emissions generated by stationary sources (energy sector). At present, the Czech Republic complies with valid national emission ceilings. Despite reduced emissions there has been very little improvement in air quality in the Czech Republic since 2000, which is mostly due to emissions, besides meteorological factors, that continue to be generated by transportation and probably also by increased emissions from low-emission sources, which are mostly represented by household heating appliances, where there has been detected a trend of a return to solid fuels, while the technical level of these combustion appliances remains very low.

Currently (according to 2015 data), the imission limits for PM_{10}, $PM_{2.5,}$ ground-level ozone, and benzo(a)pyrene (BaP) are repeatedly exceeded in certain areas. In addition the emission limit for NO_2 is being exceeded in two locations with high traffic intensity in Prague.

Production of SO_2 emissions is caused mostly by coal use in electricity and heat generation. From the perspective of SO_2 volumes, the largest group of sources consist of public and industrial energy sector sources, which provide for approximately 85% of emissions; in this sector, it is anticipated that there will be a significant drop in these emission in the future due to strengthened emissions limits. Almost the entire remainder of these emissions (nearly 15%) is generated by local household heating appliances, where there has been only a very slight step away from burning solid fuels.

NO_x compounds are being discharged into air mostly by Energy and heat sector (34% in 2014) and transportation (23%).

VOC emissions are generated mostly by the mananufacturing processes and solvent use with about 52% share in 2015. Heating of households generates about 17% of VOC emissions and transportation 15%. Ammoniac is produced in connection with farming; industrial sources represent a smaller share. Transport and small sources have little influence on NH_3 emissions.

2.5.3 Water condition development

Similarly to air, pollution of surface water is decreasing, and there has been positive improvement in its quality. Quality is affected mostly by point sources (cities and municipalities, industrial plants and industrial cattle farming facilities), as well as area sources (farming and application of mineral fertilisers and barnyard manure and other chemical compounds, atmospheric depositions and erosion runoffs).

The number of inhabitants connected to drinking water supply systems is increasing steadily, with 94.4% of the population having access to high quality drinking water.

In long-term perspective, there has been a steady improvement in sewerage infrastructure and waste water treatment plants (WWTP). Between 2000 and 2016, the size of the sewerage network has more than doubled, the numbers of people connected to sewerage increased from 75% to 85% and the number of people connected to sewerage terminated in a WWTP rose from 64% to 96%; the ratio of treated waste water has increased slightly from 95% to 97%.

2.5.4 Urbanized landscape

Settlements in the Czech Republic are characteristically rather dispersed, there are 6 253 municipalities, mostly small with population not exceeding 500 and that makes it considerably different from other EU Member States.

During historical development, the original natural landscape has been more or less modified on the majority of the Czech territory and the natural ecosystems became artificial. In 2016, the agricultural land took up 53.4% of the Czech territory, and its area has been steadily decreasing. Forests take up 33.8% and their area has been gradually increasing. The remainder of the territory are water surfaces, wetlands, built-up areas and other surfaces.

Changes commencing in 1989 are characterised primarily by the suburbanization processes. The most significant changes in the last two decades are therefore very intensive changes in functional use of suburban and urban landscapes; extensive development of commercial zones and residential districts with increased transportation demands connected with daily commuting to places of work. Suburbanization processes, and other real estate developments, take up quality crop land, limit natural diffusion of floods on floodplains and fragmentation of the landscape generally.

2.5.5 Nature

There are currently four national parks (Krkonoše (Giant Mountains), Šumava, Podyjí and České Švýcarsko (Czech Switzerland)) taking up 1 195 km^2 and 26 smaller protected landscape areas (11 435 km^2), which represent about 16% of the territory of the Czech Republic. Upon accession to the EU, the Czech Republic created the corresponding network of European system of sites of Community importance and bird areas – the so-called Natura 2000 system (comprising of 41 bird habitats and 1112 sites with European significance). The total area of the Natura 2000 network exceeds 11 115 km^2, i.e. 14% of the entire Czech territory (EU average is 18.1%). Most of the naturally significant sites are protected by a special regime pursuant to Act No. 114/1992 Coll., on protection of nature and the landscape, as amended.

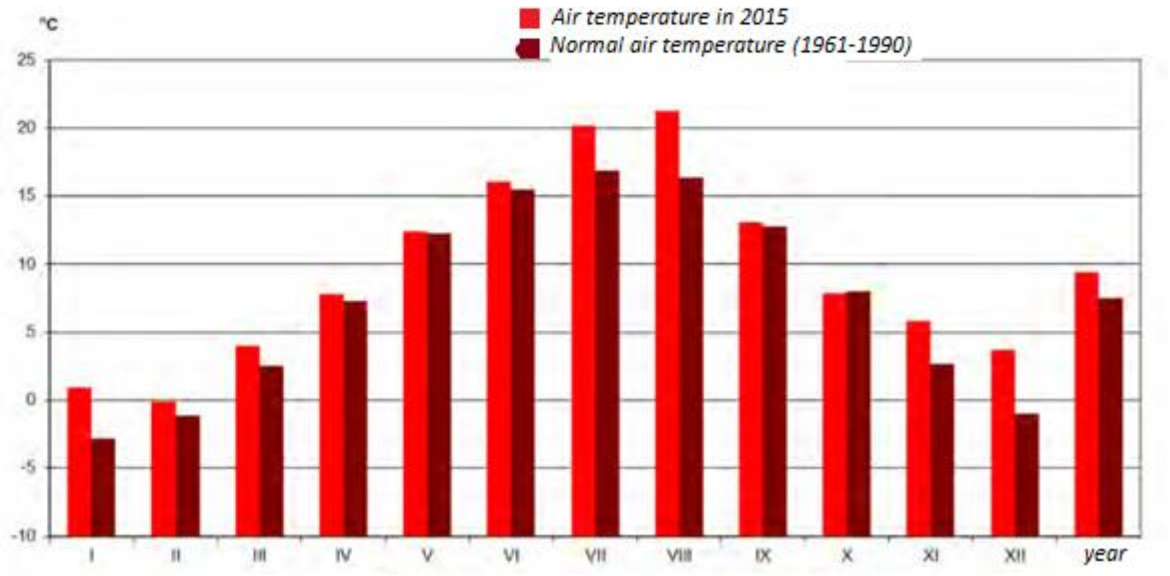
2.6 Climate

The following description of the climate features is based on long-term data recorded during the previous decades and the National Action Plan on Adaptation to Climate Change adopted by the Government in 2017.

The Czech Republic lies within the Atlantic-continental area of the moderate climate zone of the northern hemisphere. Average annual temperature fluctuates in dependence on geographic factors between 1.1 to 9.7 °C. The lowest temperature averages are recorded in mountainous regions along the northern, eastern and south-western borders of the territory. The warmest regions lie in altitudes not exceeding 200 m (lowlands in southeast and along the Elbe River). Average spring and autumn temperature oscillates around 7 or 8 °C, during the summer months the temperature rises to 16 and 17 °C on average, in winter the temperature drops to about -1 °C on average. Prague represents a specific region, as within its heat island[6] the average annual temperature is higher by approximately 1 to 2 °C above the value normal for its geographic location.

[6] Beranová, R., Huth, R. (2003): Prague heat island during different synoptic conditions. Meteorological Bulletin, 56, no. 5, pp 137-142, ISSN 0026-1173.

Figure 2.1: Average monthly air temperature (territorial temperatures) compared to 1961-1990 in 2015

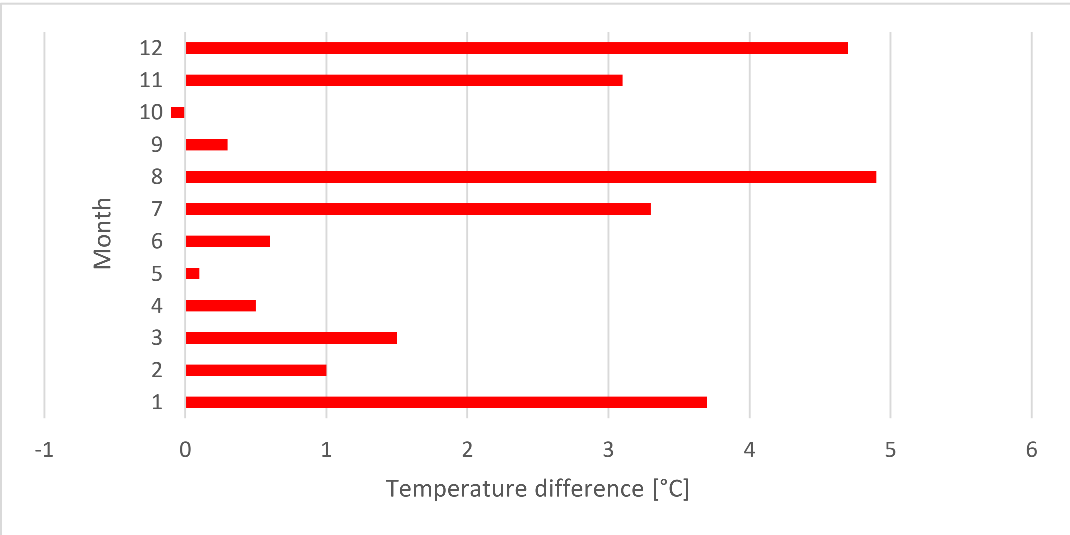


Source: CHMI

The annual course of average air temperature assumes the shape of a simple wave with the minimum in January and the maximum in July and August (Figure 2.1). Comparing temperature trends in 1961 – 1990 and 2015 (Figure 2.2) indicates that the average annual temperature between these two periods increased by 1.9 °C, with highest increase in December (by 4.7 °C); in October there has been a decrease by 0.1 °C.

During the summer and winter months the fluctuations of average temperature are more significant; in the spring and autumn they are lower. Table 2.2 gives values of these fluctuations from average temperature (°C) supplemented with changes in precipitation levels between 1961–1990 and 2015. Increased precipitation in the autumn and winter is mostly attributed to storm rainfall. Average precipitation in 2015 is approximately 21% lower than during 1961–1990.

Figure 2.2: Average monthly temperature deviations between the 1961-1990 period and 2015



Source: CHMI

Table 2.2: Changes in average temperature (°C) and precipitation amounts between the 1961–1990 and 2015

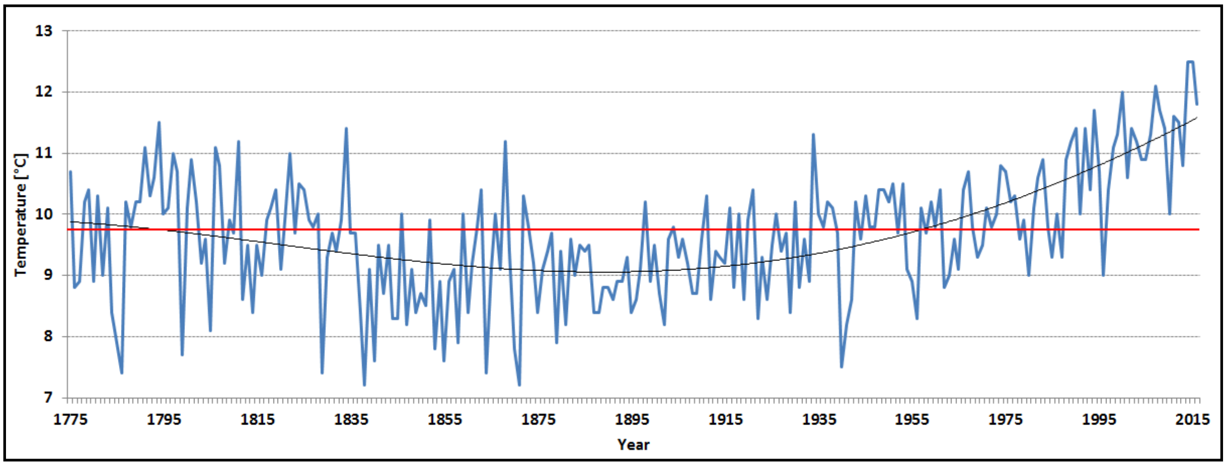
	I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
Temperature °C)	3.7	1.0	1.5	0.5	0.1	0.6	3.3	4.9	0.3	-0.1	3.1	4.7	1.9
Precipitation (ratio)	1.26	0.32	1.20	0.64	0.66	0.69	0.46	0.86	0.62	1.24	1.51	0.42	0.79
Precipitation (%)	+26	+32	+20	-36	-34	-31	-54	-14	-38	+24	+51	-58	-21

Source: CHMI

The records registered at the Prague-Klementinum[7] meteorological station, which keeps temperature records since 1775 and precipitation since 1805 (Figure 2.3 and 2.4), may be used to illustrate, for orientation, the long-term development of the temperature and precipitation regime in the Czech Republic. It is apparent that the end of the 18th century had been warmer and that the first half of the 19th century had been colder. From the second half of the 19th century the temperature gradually rose, the rise steadied in the mid-20th century, but temperature began rising steadily and markedly since the 80s of the 20th century again. Similar trends apply to seasonal cycles.

Year-on-year fluctuations of precipitation amounts are very high; for instance, for 2002 we record the third highest annual precipitation amount, while for 2003 the annual precipitation was second lowest in the 207 years of records. Despite that, there is an indistinctive trend of decreasing precipitation since the thirties of 20th century.

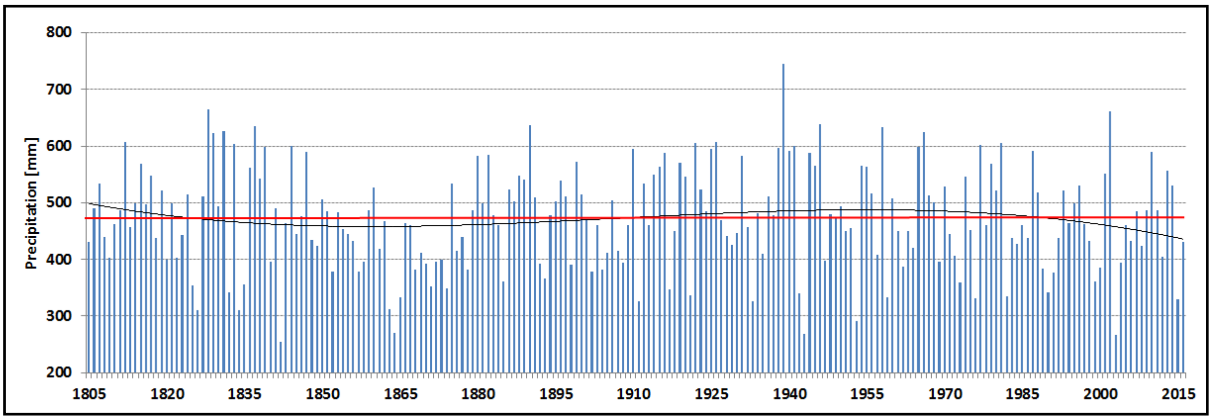
Figure 2.3: Average annual air temperatures (°C) between 1775 and 2015, Prague-Klementinum



Source: CHMI

[7] Temperature progression can be used for an entirely demonstrable manner of detection of temperature change due to climate change only with difficulty because the station is very specific urban-type station and measured values are affected by the so-called heat island within city, which is a value proportional to the degree of urbanization and urban development. It is clear that in the period 1775-2012, the city gradually increased urbanization from a completely unknown value to the present level of around 2.0 to 2.4 ° C and in no case can be this anthropogenic heat contribution filtered from the measured temperature curve. For precipitation progression, the influence of the station position in the centre of the city may be only negligible.

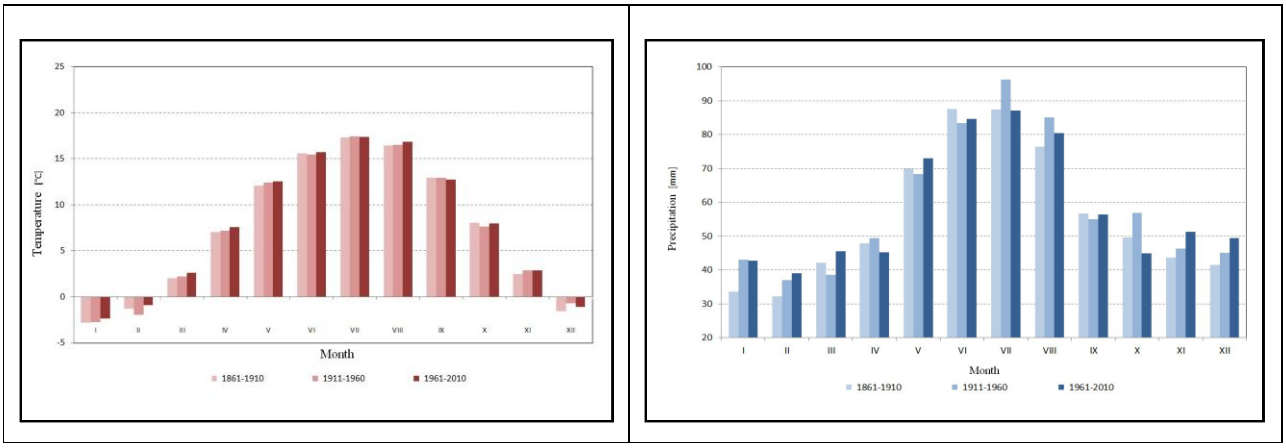
Figure 2.4: Average annual precipitation (mm) between 1805 and 2015, Prague-Klementinum



Source: CHMI

Fluctuation of average annual temperature over the last 150 years in the Czech Republic indicates that there is an incremental growth of the temperatures; between 1861 and 1910 the average annual temperature in the Czech Republic was 7.4 °C, between 1911 and 1960 also 7.4 °C and between 1961 and 2015 it was 7.7 °C. Similar change in the development of precipitation cannot be discerned, however the basic rhythm of precipitation remains the same – maximum precipitation happens in the summer, minimum in winter (Figure 2.5).

Figure 2.5: Development of average annual temperature (left) and average annual precipitation (right) in the last 150 years

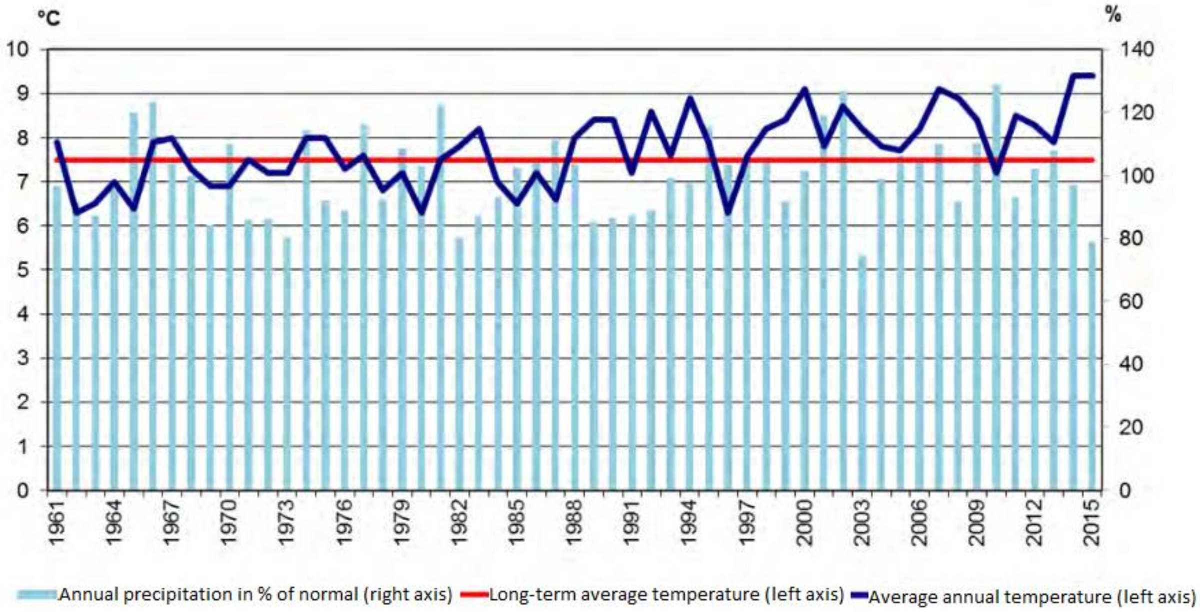


Source: CHMI

The two fundamental indicators of climate (temperature and precipitation) and their development may be described in a more precise manner using time series of territorial temperatures, respectively territorial precipitation, which are available since 1961. Territorial temperatures represent average air temperature reduced to medium altitude, considering results from the entire station network run by the CHMI, and illustrate the character of temperature regime development in the Czech Republic over the last 50 years; territorial precipitation models are construed in similar way.

Despite significant year-on-year changes, Figure 2.6 makes the trend of gradually increasing annual average air temperature apparent – see growth by approximately 0.35 °C/10 years. The differences between periods of the year are not marked – higher growth trends are apparent in the summer and winter; in the spring and autumn, the average temperature growth trend is, in comparison with other seasons, lower. In the summer, Moravia heats up quicker, in the winter and in the spring Bohemia warms up quicker. The differences between Bohemia and Moravia do not exceed temperature change of more than 0.05 °C/10 years and remain almost the same in the autumn. Considering the substantial year-on-year fluctuation of precipitation amounts, similar changes are statistically entirely negligible. For instance, in 2002 and 2010 precipitation levels were the highest in the entire run of records, while in 2003 and 2015 the annual precipitation was the lowest over the same period.

Figure 2.6: Average annual territorial temperature and precipitation in the Czech Republic in 1961–2015



Source: CHMI

The number of days when maximum (TMA) or minimum (TMI) air temperature exceeded or failed to reach the determined threshold limit is a climatological characteristic used to describe thermal regime of a monitored location or territory. In order to describe the course and etremalities of the warm part of the year, we use the number of summer days (TMA ≥ 25 °C), and tropical days (TMA ≥ 30 °C) and tropical nights (TMI ≥ 20 °C). The course and etremalities of the cold part of the year is characterised by and number of frost days (TMI < 0 °C), and ice days (TMA < 0 °C) and arctic days (TMA ≤ -10 °C). In order to get bearings on the potential development of the so-called "heat waves" these statistics are being supplemented by analysis of the number of days when the TMA ≥ 35 °C.

Average numbers of days with extreme temperatures and their change between two periods of time (Table 2.3, values are rounded up to whole days) show that in the last two decades there has been an increase in average number of days with high temperature and decrease in days with low temperature in the Czech Republic, which complements the gradual growth of temperatures and growing temperature extremality. Number of summer days has increased by 11 on average, number of tropical days by 8, and conversely the number of frost days dropped by 14 on average and ice days by 11. Similar trend has been recorded with respect to tropical nights and arctic days; however, statistically significant changes are not being recorded. Numbers of days with temperatures exceeding ≥ 35 °C occur, depending on actual weather, so far only exceptionally and their changes are also statistically negligible.

Table 2.3: Changes in average number of days with extreme temperatures in 1961–1990, 2011-2015 periods

		Year
Summer days TMA ≥ 25 °C	1961–1990	33
	2011–2015	44
	change	**11**
Tropical days TMA ≥ 30 °C	1961–1990	5
	2011–2015	13
	change	**8**
Frost days TMI < 0 °C	1961–1990	120
	2011–2015	106
	change	**-14**
Ice days TMA < 0 °C	1961–1990	39
	2011–2015	28
	change	**-11**

Source: CHMI

Numbers of days with precipitation level above a certain threshold are an important characteristic illustrating precipitation amounts in a territory generally. Precipitation days with precipitation amount exceeding ≥ 5 mm and ≥ 10 mm occur in the Czech Republic during the entire course of the year and their monthly numbers correspond to the annual course of precipitation – there is more precipitation in the summer, less in the winter. Days with precipitation exceeding ≥ 20 mm occur almost exclusively in the warm parts of the year, occurrence in the cold period is extraordinary.

Table 2.4, gives average precipitation and their changes between the two monitored period show, that there has not been any statistically significant change in the last 50 years. Primary cause of this results is that significant precipitation events with strong (often rainstorm-level) precipitation are considerably inhomogeneous due to terrain topography over time and area and cannot be always recorded within the framework of existing weather stations. Radar data however confirm that the frequency of rainstorms have grown over the last two decades.

Table 2.4: Change in average precipitation amounts (mm) in 1961–1990, 2011–2015 and 2015

		I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	Year
mm	2015	53	12	48	30	49	58	36	67	32	52	74	20	532
	1961–1990	42	38	40	47	74	84	79	78	52	42	49	48	674
	Change [%]	**126**	**32**	**120**	**64**	**66**	**69**	**46**	**86**	**62**	**124**	**151**	**42**	**79**
	1961–1990													674
	2011–2015													646
	Change [%]													**96**

Source: CHMI

Relative humidity, cloud amount, sunshine, snow cover and duration trends remain mutually consistent and correspond to temperature trends and their amplitudes. Winter, spring and summer are characterised by extended sunshine, lower cloud amount and lower relative humidity. Conversely, in the autumn, when temperature and daily amplitude drops, we record the opposite. Average number of days with snow cover in altitudes below 600m above sea level and in higher altitudes has dropped in the last two decades in comparison with the usual number of days in the second half of the 20th century. Snow cover maxima have decreased in lowlands and also in uplands. Similar trends are also recorded for overall new snow total precipitation.

2.7 Economy

The manufacturing industry plays the most important role in the Czech economy, in terms of both gross value added and employment, which is reflected by a persistent trade balance surplus. The most significant macroeconomic advantages include balanced banking system, stable and low inflation, qualified labour force and relatively low public debt. On the other hand, some improvements are needed in legal system and labour market flexibility. The Czech economy is substantially reliant on the performance of its trade partners (mostly Germany and other EU countries).

The Czech economy began to utilize benefits of the common market after accession to the EU in 2004. The customs-free zone accession resulted in the unprecedented improvement in the trade balance. The foreign trade development turned into the thriving domestic figures, the employment growth reached almost 2% in 2007. Consequently, the domestic demand and gross fixed capital formation generated the vast majority of economic growth in these years. The convergence tendency of the Czech economy was characterized by an intense appreciation of Czech koruna in 2007. After a series of years with high GDP growth the Czech economy followed the financial crisis and fell into a recession at the end of 2008. This considerable downturn was reflected by worsening all relevant economic fundamentals. Modest growth in 2010–2011 was followed by another recession in 2012. Low level of confidence affected development of domestic consumption and investment that erased positive contribution of foreign trade.

In 2013 the Czech economy moved on the trajectory of renewed recovery. The increasing consumer confidence was supported by low inflation and growing employment. Positive macroeconomic development culminated in 2015, mainly due to one-off factors. While ending of the previous financial perspective 2007–2013, the strengthened investment activity and coinciding plunge in the oil price led to strong GDP growth at 5.3% in 2015. The subsequent slump in 2016 in gross fixed capital formation after the extraordinary year 2015 was partly compensated by a positive contribution of foreign trade at 1.2 pp. Following a short period of stagnating economic convergence, GDP per capita in PPP increased from 83 % to 88 % of the EU-28 average during the period 2012–2016. Economic growth and low inflation was reflected in the labour market dynamics. The unemployment rate has been the lowest in the whole EU since the beginning of 2016. Strong employment growth rates in 2015 and 2016 amplified labour shortage connected with a skill mismatch which is most notable in the manufacturing industries.

2.7.1 Anticipated development

High levels of confidence indicators and good economic conditions of households point to the favourable growth of domestic demand. The household consumption is anticipated to be the key driver of economic growth in the next years. A gradual start of drawing of EU funds from the 2014–2020 programming period resulting in the positive contribution is assumed. Inflation rate might overcome the Czech National Bank's 2% inflation target this year. Real GDP growth could reach 4.1% in 2017 driven especially by growth of strong private consumption. The Ministry of Finance expects also an apparent GDP growth rate for period 2018–2020 driven by the domestic demand. Some industries might continue to report adverse development, e. g. construction or mining and quarrying where a decline in gross value added was recorded in

2016 quarterly data. There are predominantly external risks underlying the forecast. Besides migration crisis and the upcoming elections in Europe, United Kingdom's withdrawal from the EU is associated with a high degree of uncertainty.

Table 2.5: Development in population growth and main economic indicators in 1995 - 2016

Year	1995	2010	2013	2014	2015	2016
Number of inhabitants (thousand)	10 331	10 517	10 516	10 512	10 538	10 554
GDP (billion CZK)	1580.1	3953.7	4098.1	4313.8	4595.8	4773.2
GDP (PPS[a]) per capita	11 548	21 100	22 400	23 800	25 300	25 600
Average gross monthly wage of employees in the national economy (CZK)	8 010	23 864	25 035	25 768	26 591	27 575
Inflation rate (%)	9.1	1.5	1.4	0.4	0.3	0.7
Price indexes in the consumer sphere, total (2005=100)	64.5	114.9	122.7	123.2	123.6	124.4
Foreign direct investments in the Czech Republic (billion CZK)	68.0	194.7	144.0	168.1	41.6	158.8
Foreign debt of the Czech Republic (billion CZK)	457.3	2164.4	2733.0	3023.9	3195.8	3528.1
Average annual exchange rate CZK vs EUR (ECU)	34.31	25.29	25.98	27.53	27.28	27.03
Average annual exchange rate CZK vs USD	26.54	19.11	19.57	20.75	24.60	24.43
Unemployment level (%)	4.0	7.3	7.0	6.1	5.1	4.0
Balance of foreign direct investment (billion CZK)[b]	-67.0	-95.0	7.4	-80.4	49.7	-141.0

a) PPS (Purchasing Power Standard); average purchasing power 1 PPS corresponds to average purchase power of 1 EUR in EU-28.
b) + outflow / - inflow of investment

Source: CzSO, CNB

Table 2.6: Sources of GDP in current prices in 1995 – 2016 period, in million CZK (Part 1)

Year / Sector	Agriculture, forestry, fishery	Mineral resources – mining	Manufacturing industry	Generation and distribution of electricity, gas and water	Construction sector	Commerce, automobile repairs and consumer goods	Hotel industry / accommodation, food service	Transport, warehouses, post and telecoms
1995	62 908	32 906	341 494	77 314	109 229	149 890	45 768	100 626
2002	68 731	29 347	602 222	106 732	153 439	289 432	63 668	170 691
2003	66 374	27 539	617 309	106 381	165 534	294 762	66 479	185 972
2004	70 609	33 642	703 950	122 097	183 603	306 030	70 629	189 039
2005	72 190	36 828	752 014	126 410	197 029	332 290	64 260	190 495

2006	72 821	41 760	827 397	145 787	203 255	363 025	67 516	205 921
2007	75 389	44 822	901 750	155 893	225 677	381 854	75 585	224 039
2008	77 800	50 933	894 785	189 699	239 307	394 309	76 509	227 157
2009	64 525	43 669	812 564	211 119	239 190	357 448	73 410	215 561
2010	60 217	45 029	840 146	186 559	246 127	375 160	72 103	220 918
2011	86 632	48 181	889 814	184 897	224 714	376 540	73 167	212 741
2012	95 396	42 979	902 251	187 584	213 612	383 154	71 774	211 471
2013	98 504	31 957	911 016	192 400	210 879	377 535	72 104	209 301
2014	106 720	39 274	1 043 300	180 092	214 628	403 612	72 975	217 799
2015	102 390	37 658	1 108 858	183 417	232 259	449 382	81 488	233 344
2016	105 308	33 905	1 162 392	183 466	234 341	471 827	85 971	242 045

Source: CzSO

Table 2.7: Sources of GDP in current prices in 1995 – 2016 period, in million CZK (Part 2)

Year / Sector	Financial sector / insurance	Real estate, enterprise services, R&D	Public administration; defence; social security	Education	Healthcare, veterinary and social services	Other public, social and personal services	Gross added value in basic prices
1995	48 096	177 082	99 529	58 112	49 195	37 633	**1 439 752**
2002	65 532	358 076	179 001	95 959	94 528	63 036	**2 451 226**
2003	86 731	366 202	187 461	107 700	99 200	69 046	**2 567 430**
2004	92 112	394 020	192 617	113 063	105 610	70 990	**2 772 866**
2005	93 913	426 656	205 371	122 597	113 976	71 967	**2 949 463**
2006	99 820	457 501	214 699	130 100	120 365	80 243	**3 191 413**
2007	126 764	505 950	227 184	139 641	123 040	84 064	**3 473 464**
2008	149 991	559 506	235 442	146 165	135 335	81 977	**3 647 113**
2009	159 791	565 115	243 872	151 454	145 033	81 580	**3 553 172**
2010	169 583	559 433	244 690	151 520	146 746	80 946	**3 582 869**
2011	168 816	558 461	232 773	155 772	155 080	84 899	**3 640 335**
2012	164 197	556 409	232 889	157 831	159 859	82 865	**3 648 512**
2013	170 694	568 088	235 930	161 565	161 732	82 134	**3 668 332**
2014	168 093	587 104	244 185	167 684	172 069	85 398	**3 898 599**
2015	177 087	619 953	254 186	173 517	178 540	91 313	**4 135 579**
2016	181 421	646 237	264 559	180 392	186 353	93 592	**4 292 397**

Source: CzSO

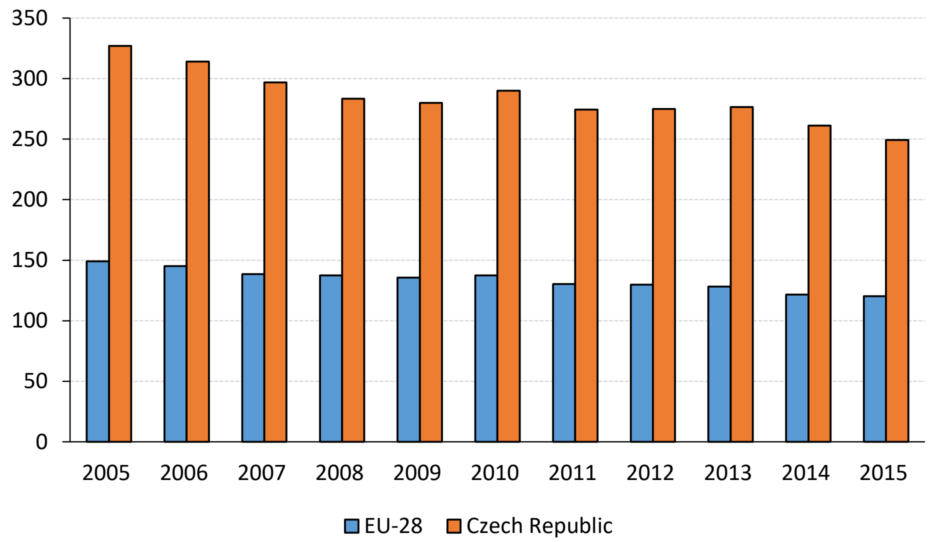
2.8 Energy and energy intensity of economy

The energy intensity of the Czech economy has been decreasing over the long term, among other also due to use of technologies that are less energy intensive, heat insulation of buildings and savings achieved by households. The Czech Republic however remains one of the countries with high energy intensity per GDP unit in international comparison.

The **energy intensity** since 2005 has been decreasing with the exception of years 2010 and 2013. Both of these were caused by periods of economic recession, when the energy consumption has been temporarily growing faster than GDP. Besides economic growth, this situation has been also influenced to a large degree by implementation of domestic measures and utilisation of EU structural funds in energy efficiency programmes and projects.

The energy intensity of the Czech economy decreased by 23.8% between 2005 and 2015 and reached 249.9 kg oil equivalent/thousand EUR. The largest shares on energy intensity in **sectoral structure** are contributed by transportation, industry and agriculture.

Figure 2.7: Energy intensity of the economy [kg oil equivalent / thousand EUR]

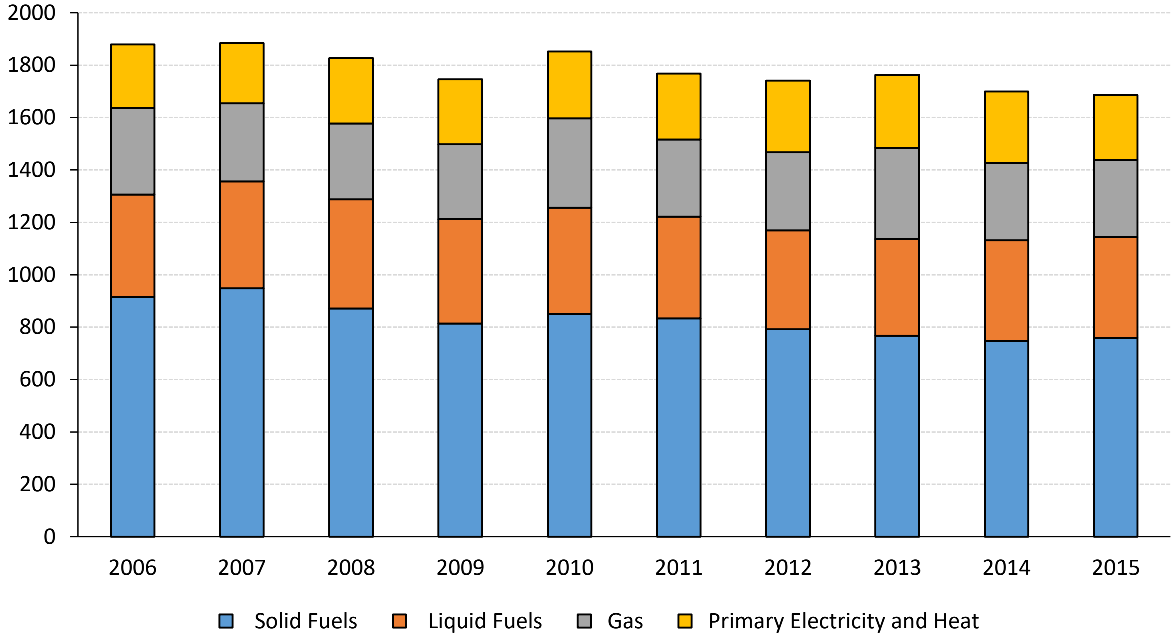


Source: Eurostat

2.8.1 Development of energy consumption

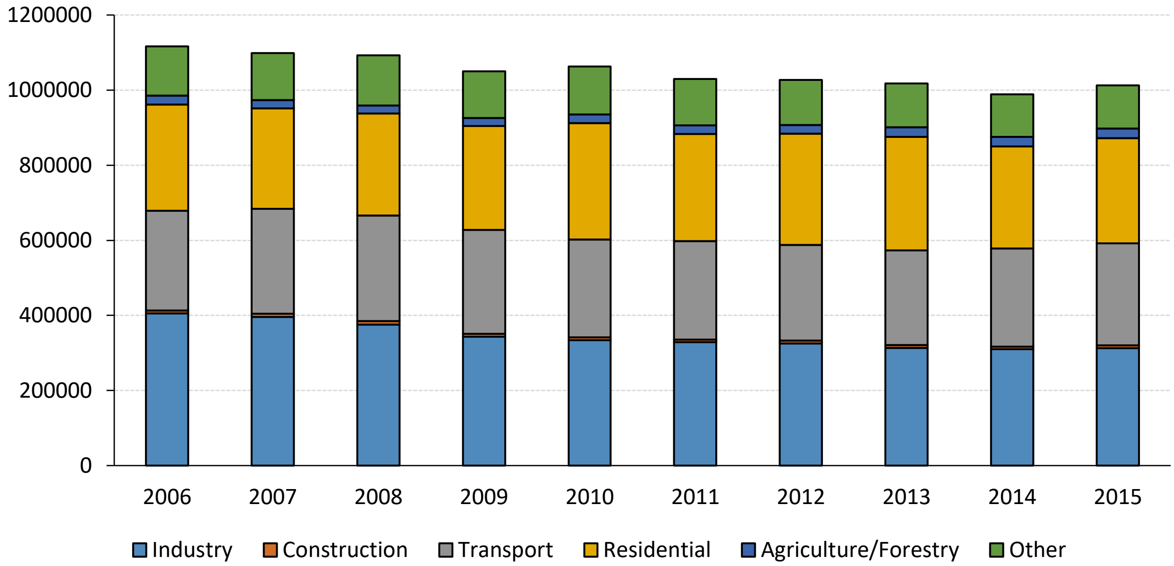
The primary energy consumption (refer to Figure 2.8) is marked by a decreasing trend since 2007, despite increases in 2010 and 2013. Causes of this decrease include, besides savings, also various impacts of the economic crisis as energy consumption in the Czech Republic is by largest degree influenced by the industrial sector, which lost its output. The share of solid fuels in primary energy consumption has decreased most significantly, driven mainly by energy efficiency measures, support for renewable sources of energy, depleting of domestic coal reserves and more stringent environmental standards.

Figure 2.8: Primary energy consumption according to energy sources, Czech Republic [PJ]



Source: CzSO

Figure 2.9: Total end-user energy consumption according to sectors, Czech Republic [PJ]



Source: CzSO

From the viewpoint of the total end-user energy consumption according to sector, the industrial sector is the most energy intensive (30.9% in 2015). Energy consumption in this sector has fluctuated but since 2006, and thanks to restructuring of the sector and efforts to introduce less energy intensive technologies, there has been steady annual decrease until 2014. Energy savings are being implemented both in the energy transformation area (replacement of less efficient technology in steam-driven power plants and heating plants, which are near the end of their useful life) as well as in the area of consumption – by application of the best available technologies, use of energy-saving appliances, construction of energy-saving buildings, use of high-quality insulation, use of energy audits, labelling of appliances, increased efficiency of energy cycles, obligation to combine electricity generation with heat generation and host of other measures.

Significant year-on-year fall in consumption occurred in 2009 as a consequence of the economic crisis, followed by a slower decrease until 2014. In 2015, the consumption was stimulated by economic growth and year-on-year consumption in the industrial sector grew again. The most energy intensive areas in the manufacturing industry include metallurgy, production of non-metal mineral products, chemical and oil-manufacturing industry.

Other significant contributors to total energy consumption in the Czech Republic are households (consuming 27.7% of total energy in 2015). Heating takes up most of the household energy consumption.

Transportation sector contributed to total consumption in 2015 by 26.8%. This sector is the only sector steadily growing in the past, and in recent years its consumption is marked by fluctuations.

2.8.2 Electricity generation structure

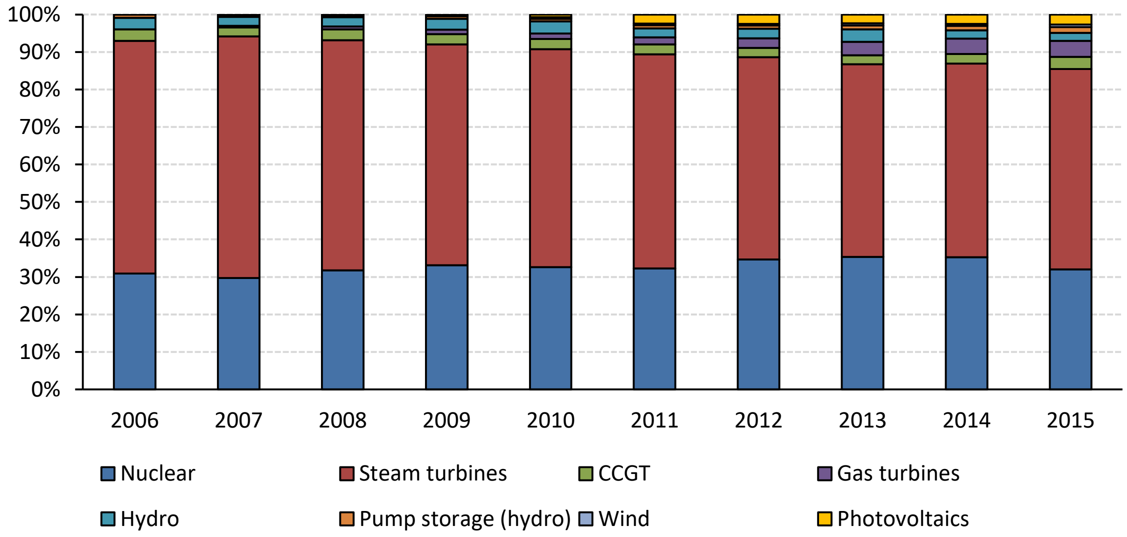
The Czech Republic generates electricity predominantly in coal fired power plants. Steam power plants, which predominantly uses coal as a primary fuel, accounted for production of 53.4% (44 816.5 GWh) of electricity in 2015.

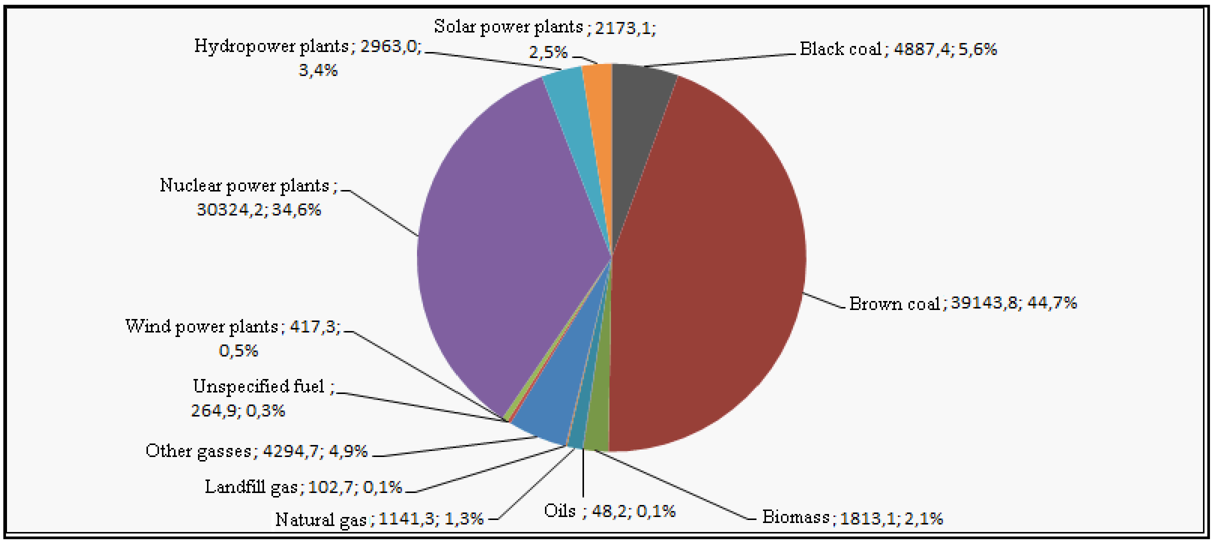
Another significant source of electricity are nuclear power plants (Dukovany and Temelín), which accounted for 32.0% (26 840.8 GWh) of all electricity generated in 2015. In recent years there was also significant increase in installed capacity of renewable energy, espcecially photo-voltaic and biogass (details in 2.8.4).

The share of electricity generated in nuclear power plants has been growing; however future of nuclear power in the Czech Republic remains a widely discussed topic. On one hand, it represents almost emission-free technology, which is very beneficial to the environment, especially air and climate; on the other hand it produces waste which final disposal or recovery has not been resolved yet.

Structure of electricity generation according to technology is given in Figure 2.10.

Figure 2.10: Structure of electricity generation according to technology, Czech Republic, 2006 - 2015 [%]





Source: ERO, MIT

Total production of electricity fluctuates. In comparison with 2010, there was 2.4% less electricity generated in 2015; however in 2013 the production was 1.3% higher compared to 2010. The year-on-year decrease (2014/2015) reached 2.6%.

The Czech Republic generates sufficient volume of electricity to cover all of its domestic demand and therefore it is able to export a considerable portion abroad. The Czech Republic exported in 2015 a total of 28.8 TWh of electricity, i.e. 34.2% of the total electricity produced, and imported only 16.1 TWh. The net exports of electricity in 2015 was 12.7 TWh, which amounts to 14.9% of the total electricity generated in the Czech Republic (83 888.3 GWh). The Czech Republic thus belonged to the largest European electricity exporters. However, due to the expected gradual phase-out of old power generation capacities, mainly coal fired power plant, the exported volumes of electricity are expected to decline.

2.8.3 Heat production structure

The Czech Republic produces heat mostly in power plants and heating plants (70.9%) and in district heating plants (19.6%). Other sources contribute only single-digit percentage points.

Overall, the volume of produced heat is falling, which demonstrates economic and prudent use of heat and efforts leading to lowering of heat consumption in the industrial and public sector. Net heat production in 2015 reached 159 334 TJ, which marks a year-on-year decrease by 7.2%. The Czech Republic is one of the countries with a very high utilization of centralized heating systems.

2.8.4 Energy and renewable energy sources

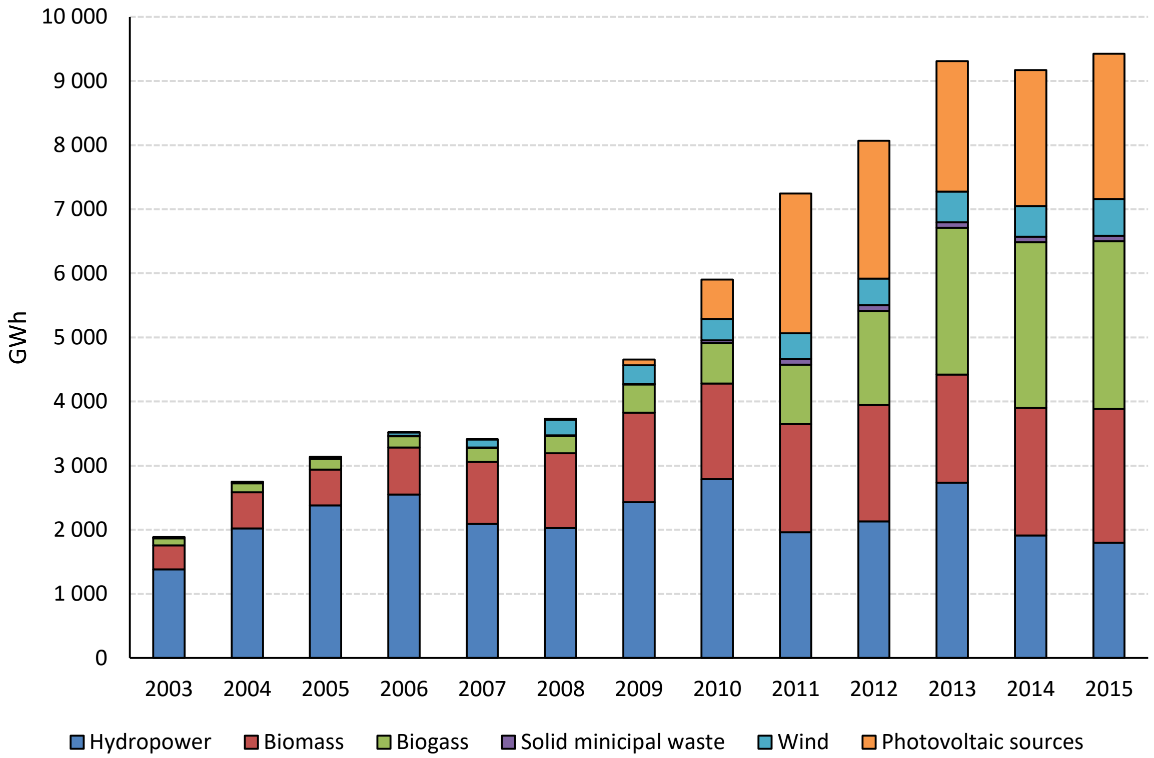
The significance of renewable energy sources (RES) in the Czech energy sector has been steadily growing. The volume of produced energy has been growing annually (see Figure 2.11) as well as its share in the total electricity generation. Before 2011, the largest sources of RES energy in the Czech Republic were hydropower plants, but these were overtaken in 2011 by photovoltaic power plants. However, in the year 2015 the highest share of renewables in terms of electricity generation was from biogas stations, electricity from biogas more than quadrupled since 2010. Considerable electricity production also comes from biomass. In 2015 hydropower plants were the fourth largest source of electricity.

Structure of electricity generation from RES in 2014 was as follows: biogas (27.7%), photovoltaic sources (24%), biomass (22.2%), hydropower (19.1%), wind (6.1%) and energy produced by incineration of solid municipal waste (0.9%).[8]

In 2015, RES produced 9 423 GWh of electricity, which represents year-on-year increase of 2.7%. RES production in 2015 represents 11.2% of the total gross generated electricity in the Czech Republic, which was 83 888 GWh (in 2014 this share was 10.7%).

This increase is a result of development in wind, photovoltaics, biomass and biogas production, where electricity generation rose year-on-year by 20.2%, 6.6%, 5.0% and 1.2%. Other RES recorded adecrease, hydropower (-6.0%) and solid municipal waste (-1,5%).

Figure 2.11: Electricity generation from RES and renewable waste in the Czech Republic [GWh] between 2003 and 2015



Source: MIT

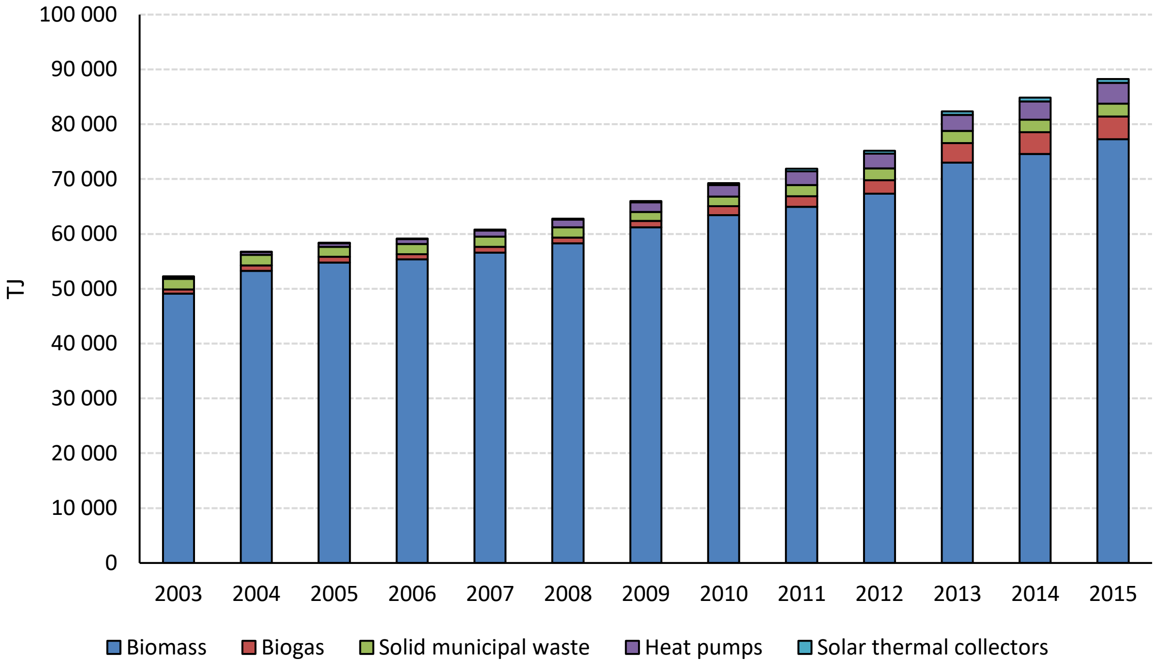
Volume of heat generated using RES has been steadily growing; 2014/2015 year-on-year increase was 4.0% (see Figure 2.12). In 2015, RES accounted for 19.82% of final consumption in heating and cooling sector. The largest volume was produced from solid biomass (87.5%), where the decisive factor was the use of wood in households. Year-on-year increase of biomass heat production (2014/2015) was 3.6%. Other sources contribute far less (renewable waste 2.6%, biogas 4.7%, heat pumps 4.3%, solar thermal collectors 0.8%).

The Czech Republic committed itself, in line with the EU targets, to achieve 13% share of RES in the gross final consumption of energy sources by 2020. This target includes gross consumption of electricity, final consumption in the sector of heating and cooling and final consumption of energy in transportation. In 2015 the Czech Republic already achieved 15.1%

[8] *Note: rounding up the figures results in the sum not totalling 100 %.*

of RES share in the final consumption of energy sources (electricity: 14.1%; transportation 6.5%; heating and cooling 19.8%).

Figure 2.12: Heat production using RES and renewable waste in the Czech Republic [GJ] in 2003 – 2015



Source: MIT

Composition of fuels and technologies involved in generation of energy from RES increases diversification, which assists in improved security of energy supplies and reduces CO_2 emissions. Production of energy from RES is currently costlier, in the majority of cases, than the use of conventional fuels, but these differences have been gradually diminishing, especially when the related external costs connected with production of greenhouse gas emissions and air pollutants are counted in.

In comparison with other EU Member States, the Czech Republic is among countries with lower RES utilization in terms of electricity production despite continues growing annual trends in recent years. The main reason lies in lower available potential of certain RES in the Czech Republic, as there is no large potential for new hydropower such as in Norway or Austria, or wind turbines such as in Germany or Denmark. Biomass potential is comparable with other countries in Central Europe.

Table 2.8: Electricity balance (GWh)

GWh	2011	2012	2013	2014	2015
Gross production	87 561	87 574	87 065	86 003	83 888
Own consumption	6 533	6 485	6 207	6 117	6 007
Net consumption	81 028	81 088	80 858	79 886	77 881
Imports	10 457				
Exports	27 501				
Import – export	-17 044	-17 120	-16 887	-16 300	-12 516
Overdraft reserve	944	982	1 217	1 363	1 660
Transmission losses	4 405	4 187	4 098	3 847	4 067
Energy sector consumption	1 875	6 485	6 207	6 117	6 007
Final consumption	56 653	58 799	58 656	58 295	59 280

Source: ERO

Table 2.9: Gross electricity production from renewable energy sources (GWh)

	2012	2013	2014	2015
Hydropower	2 129 166	2 734 740	1 909 223	1 794 807
SHP < 1 MW	391 425	478 721	465 482	445 888
SHP 1 up to < 10 MW	525 548	614 803	546 192	555 909
LHP ≥ 10 MW	1 212 193	1 641 216	897 549	793 010
Biomass total	1 817 337	1 683 272	1 992 217	2 091 495
Wood chips etc.	0	190	595	268
Cellulose	881 041	787 970	971 632	1 064 771
Plant materials	535 848	623 117	714 459	687 784
Pellets and patent fuel	102 761	104 445	104 926	100 042
Other biomass	295 591	165 045	198 499	236 546
Liquid biofuel	0	0	0	0
Biogas total	1 467 684	2 293 593	2 583 363	2 614 065
Municipal WWTP	85 902	90 206	91 091	86 878
Industrial WWTP	8 517	8 800	17 419	16 537
Biogas stations	1 264 273	2 083 546	2 363 319	2 411 843
Landfill gas	108 992	111 041	111 534	98 808
Biologically degradable parts of Solid Municipal Waste	86 686	83 842	87 946	86 652
Wind	415 817	480 519	476 544	572 612
Photovoltaic plants	2 148 624	2 032 654	2 122 869	2 263 846
Total	8 065 314	9 308 620	9 172 162	9 423 476

Source: MIT

Table 2.10: Heat production from renewable energy sources (TJ)

	2012	2013	2014	2015
Biomass total	67 340,1	73 018,6	74 578,7	77 263,7
Biomass outside households	16 447,3	20 053,9	20 369,0	22 214,8
Firewood	425,2	514,4	488,0	477,7
Wood chips etc.	8 397,4	10 012,7	10 896,9	12 313,6
Cellulose	6 602,1	7 827,0	7 611,8	7 962,9
Plant materials	513,4	687,4	660,8	654,4
Pellets and patent fuel	479,5	1 007,5	707,6	801,1
Other biomass	0,0	0,0	0,0	0,0
Liquid biofuel	29,7	4,9	3,9	5,1
Biomass – households	50 892,8	52 964,7	54 209,7	55 048,8
Biogas total	2 452,9	3 571,1	3 964,5	4 158,5
Municipal WWTP	681,9	664,6	598,9	617,8
Industrial WWTP	105,0	85,1	148,0	218,7
Biogas stations	1 580,8	2 724,3	3 129,4	3 239,7
Landfill gas	85,2	97,1	88,2	82,2
Biologically degradable parts of Solid Municipal Waste	2 136,9	2 204,5	2 284,6	2 306,9
Heat pumps	2 700,0	2 911,1	3 335,4	3 809,8
Solar thermal collectors	561,7	630,3	690,9	741,8
Total	75 191,6	82 335,7	84 854,1	88 280,7

Source: CzSO

2.9 Resources management

The Czech Republic has relatively large mineral resources potential, especially in the field of industrial minerals and construction materials deposits. Some mineral resources, for example energy reserves, have been already depleted. Surplus of cheap imported hard coal in the world market has led to suppression of hard coal mining. Lignite mining in open strip mines has considerable negative environmental impacts, but covers still approximately half of electricity production in the Czech Republic. From the perspective of sustainable development, the increased use of renewable energy and energy savings are well justified. Recycling of industrial and consumer waste and its energy recovery is still small, but increasingly an important factor. Secondary raw materials market (aluminium, steel, glass, plastics etc.) reacts sharply to the prices of primary raw materials and fossil fuels.

2.9.1 Mineral resources

Mineral resource mining reached approximately 1.1% on the total GDP in 2015. The Czech economy depends on imports of a number of mineral resources, especially from the group of energy fuels (as crude oil and natural gas) or ores and metals. At present time, from the field of metals, the Czech Republic has mineral deposits of gold, tungsten and lithium, some of which can be significant in the future. Mineable reserves of lignite and hard coal are partly limited by administrative decisions, partly (in case of hard coal) by difficult situation in the world hard coal market. The country has sufficient supply of certain non-metallic and construction raw materials, with deposits sufficient for tens up to hundreds of years. The Czech Republic has raw material basis especially for development of traditional industrial sectors – glass-making (silica sand, feldspars), ceramics and porcelain (wide variety of ceramic clays, feldspars, china, kaolin) and paper-making (paper kaolin). Technical quality of cement production, lime and plaster are comparable with production in the highly developed EU countries. Former mineral deposits of natural gas and oil are used for underground storage of natural gas.

At present time, the Czech Republic mines the following mineral resources: brown coal (lignite), black coal, crude oil, natural gas, uranium, kaolin, clays, bentonite, feldspar, silica sand, limestones, diatomite, dolomites, gypsum, and wide variety of decorative stones, building stone, sand and gravel and brick-clay. In terms of volume (2013-2016), the most important is bown coal mining in open mines, which fluctuates between 38 - 40 million tons annually. Black coal mining is still quite significant (6 - 9 million tons annually), limestones (around 10 million tons annually) as well as production of construction materials (especially exclusive building stone and sand and gravel).

2.10 Transport

The Czech Republic's central location within Europe makes it a crossroad for all kinds of transportation; at the same time, the country has one of the densest transportation infrastructures within the EU. The fundamental pillar is combination of road and railway transportation.

In terms of transportation output in personal transportation there had been a decrease in 2010 and 2012 (Table 2.11), which may had been caused by a rapid growth of consumption tax and fuel prices in this period. Another factor which contributed to decrease of personal transportation output, but also freight transport, in 2009, was economic crisis in the 2008. Individual automobile transportation recorded, except the years 2010 - 2013, a steady increase in passenger transport, from 58% in the year 1990 to 71% in 2015 (Table 2.12) of the total personal transportation output. Its decrease between years 2009 – 2012 was to certain degree a positive development, because cars contribute to the worsening of the air quality in highly urbanized areas. Biking became more popular in this period especially in smaller cities and towns, which had been greatly assisted by development of safe infrastructure. In towns with 5000 up to 50 000 inhabitants, biking-related transportation reaches 2 to 25% of transportation to and from work. Within the transport performance of road freight transport was recorded a fluctuating trend in the years 2010-2014 with an increase in 2015 (Table 2.20). The performance and also the number of passengers have increased in the passenger railway transport since the significant decline in 2009. Values of transport performance of the freight railway transport show variable trend. Railway transportation in 1990 processed almost 70% of the total freight transportation in the Czech Republic, while today it is only approximately 21%. The vast majority of freight in the Czech Republic is transported by road. This is a problem particularly in terms of the high intensity of freight transport on the main routes, increased air pollution and degradation of transport network. Data for air transportation (Table 2.14) represent domestic carriers on domestic and international commercial routes as well as charter flights (persons and freight).

Table 2.11: Personal transportation output in 1990 – 2015 (million vehicle-kilometres)

	1990	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Personal	22 918	26 597	30 701	34 945	34 230	35 086	34 594	34 802	35 672	39 532
Personal-petrol	21 394	24 766	27 216	28 551	25 014	24 976	23 647	23 525	23 547	25 453
Personal-diesel	1 456	1 755	3 421	6 338	9 180	10 074	10 897	11 223	12 033	13 967
LCV	146	543	1 279	2 231	3 159	3 345	3 531	3 717	3 9002	4 088
Heavy trucks	3 514	5 480	7 525	9 063	8 128	8 240	7 899	7 792	7 909	9 031
Buses	790	790	665	639	472	478	459	453	460	522
Total	**27 698**	**33 740**	**40 480**	**47 169**	**46 381**	**47 541**	**46 875**	**47 156**	**48 335**	**53 566**

Source: TRC

Table 2.12: Personal transportation output in 1990 – 2015 (billion person-kilometres)

	1990	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Road – on own account	39.90	54.50	63.94	68.64	63.57	65.49	64.26	64.65	66.26	69.71
Road – public	12.34	7.67	9.35	8.61	10.34	9.27	9.02	8.97	10.01	9.99
Road – total	52.24	62.17	73.29	77.25	73.91	74.76	73.28	73.62	76.27	79.70
Railway transportation	13.36	8.01	7.30	6.66	6.59	6.71	7.26	7.60	7.79	8.30
Air transportation	2.18	3.03	5.86	9.74	10.90	10.59	10.61	9.60	9.76	9.70
Water-borne transportation	0.00	0.01	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.01
Total	67.78	73.22	86.45	93.66	91.41	92.07	91.17	90.83	93.84	97.71

Source: MoT

Table 2.13: Transport output – freight 1990 – 2015 (billion tkm)

	1990	**1995**	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Road – on own account	8.01	9.60	7.67	5.33	3.87	4.92	4.88	4.68	4.47	5.58
Road – public	8.81	22.90	31.36	38.12	47.97	49.91	46.35	50.21	49.63	53.14
Road – total	16.82	32.50	39.04	43.45	51.83	54.83	51.23	54.89	54.09	57.20
Railway	41.14	25.50	17.50	14.87	13.77	14.32	14.27	13.97	14.57	15.26

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Air transportation	0.06	0.03	0.04	0.05	0.02	0.02	0.02	0.02	0.04	0.03
Water transportation	1.41	1.23	0.77	0.78	0.68	0.70	0.67	0.69	0.66	0.59
Total	59.43	59.26	57.34	59.14	66.31	69.86	66.18	69.58	69.36	73.08

Source: MoT

Table 2.14: Air transportation 2000 – 2015

Indicator	2000	2008	2009	2010	2011	2012	2013	2014	2015
Total number of flights	53 040	105 083	101 153	95 617	87 334	85 259	72 937	71 483	62 227
Total number of km flown (thousand)	61 554	111 024	110 729	105 926	105 372	107 996	105 156	102 913	97 463
Total number of persons transported (thousand)[2)]	3 483	7 158	7 354	7 466	7 525	6 420	6 155	5 623	5 393

[2)] Only Czech commercial operators *Source: CzSO*

The railway network density is comparatively high (12.1 km of railways per 100 km^2). The railway infrastructure however required substantial upgrade, which extends for several years. Modernization of the first transit corridor started in 1993 and it has been mostly completed except the 10 km of track and some major railway junctions. Modernization of the second transit corridor started in 1997 and it was completed except railway junctions Přerov and Ostrava. Modernization of third and fourth transit corridor started shortly after year 2000 and 2005. Works on these corridors still continues and modernization will bring an increase in speed of train sets up to 160 km per hour. Currently, debate on high-speed lines, which could be built in the Czech Republic is in progress. Start of the construction is not expected before the year 2030.

The road network also required modernization and construction of new roads and motorways. In 2015 the road infrastructure density was 70.67 km/100 km^2. In 2012 the modernization of the busiest highway D1 has begun. Modernization consists of extension of the width of the road from 26.5 m to 28 m for the possibility of operation in mode 2 + 2 lanes in one direction during one lane closures. Total renovation of the repaired section of highway is included in modernization of D1. 21 sections will be repaired in 2018. Construction of new highways and motorways is in progress. Length of highways increased from 734 km in 2010 to 776 km in 2015 and length of motorways increased from 422 km in 2010 to 459 km in 2015. Technical neglect of road infrastructure was a permanent issue. This technical neglect was mostly caused by transport failures, insufficient capacity, quality and also inadequate parameters. Currently the quality of roads is gradually improving thanks to a continuous increase of investment in transport infrastructure.

In 1990, the transportation-generated emissions amounted to mere 6.1 % of total CO_2 emissions in the Czech Republic. In 2009 this value raised to 17.7 % and maximum of value was reached in 2014 – 18 %. Greenhouse gasses (CO_2, N_2O and CH_4) show increasing trend from 1990 to present. For the first time the values of these emissions decreased between years 2009 – 2013 due to the economic crisis and reduction of fuel consumption. This trend positively affected the emission load from transport to the environment.

Table 2.15 gives an overview of the number of vehicles in the Czech Republic between 1990 and 2015. Vehicle numbers nearly doubled over the last 25 years and reached a total of

6.8 million in 2015 – which is 46 passenger cars per 100 inhabitants in 2015 (in 1990 this number was 23).

Table 2.15: Number of motor vehicles in the Czech Republic 1990 – 2015 (in thousands)

	1990	1995	2000	2005	2010	2011	2012[1)]	2013	2014	2015
Single-track	1 172	915	748	794	924	944	977	977	999	1 046
Personal cars	2 411	3 043	3 439	3 959	4 496	4 582	4 706	4 729	4 833	5 115
Trucks	156	203	276	415	585	586	595	593	609	647
Buses	26	20	18	20	20	20	20	20	20	20
Total	3 765	4 181	4 481	5 188	6 025	6 131	6 299	6 319	6 461	6 829

[1)] Data valid as of 1. 7. 2013 – due to changes in the vehicle registration system triggered by the EU legislation the data for 31. 12. 2012 are not available *Source: MoT, TRC*

Despite continuous improvements in the structure of vehicle fleet the average age of all categories of vehicles in the Czech Republic remains high and continues to increase. Vehicles older than 10 years represent 66.36 % of vehicle fleet in Czech Republic to date 30. 9. 2015. Number of cars complying with higher EURO standard has been growing same as the number of motor vehicles operated on alternative fuels.

Table 2.16 gives data on static structure of personal cars according to vehicle age. In 2015 number of passenger cars older the 10 years is 3.1 million cars, in 2010 it was 2.7 million passenger cars. Distribution of passenger cars in static composition of vehicle fleet according to age in 2015 is following: 19.8 % cars 0-5 year old, 20.1 % cars 6-10 year old and 61.1 % cars more than 10 years old. Data on dynamic structure, which are collected every five years, indicate significantly higher use of newer cars compared to older cars, which improves real environmental parameters of the vehicle fleet as a whole. In 2010, distribution of personal cars according to age was the following: 31.10% of cars fell within 0-5 years of age; 30.14% of vehicles were 6-10 years old and 38.76% of cars were 10 years old or older. Collection of these data is parallel to collection of national transportation, but unlike the national census, it concerns only several areas in the Czech Republic (data in 12 profiles), and therefore may be relatively uncertain. Data about dynamic structure of vehicle fleet from 2015 is not available.

Table 2.16: Share of personal cars registered in the Czech Republic according to their age

	2009	2010	2011	2012	2013	2014	2015
0-5 years	17.55	17.81	18.09	23.64	21.08	20.31	19.86
6-10 years	23.15	22.17	21.51	22.20	21.54	20.81	20.09
10 years or older	59.31	60.02	60.40	54.16	57.38	58.88	60.05

Source: TRC, MoT

Table 2.17 gives fuel consumption in individual transport sectors. Fuel consumption data shows a downward trend from 2010 to 2014 in consumption of road petrol (from 1 755 to 1 455 thousand tons). Road petrol consumption increased in 2015 by 11 thousand tons. There was recorded a decrease in consumption of road diesel between years 2008 – 2010 and afterwards an increasing trend has appeared again (from 3 301 in 2010 to 3 799 thousand tons in 2015) related to the increasing number of diesel vehicles.

Table 2.17: Fuel consumption by sector (thousands of tons)

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
road - petrol	1 069	1 637	1 845	2 039	1 755	1 684	1 569	1 474	1 455	1 466

road - diesel	904	1 252	1 741	3 228	3 301	3 318	3 356	3 406	3 570	3 799
road - LPG	-	12	62	70	76	74	71	69	75	76
road - CNG	-	2	2	3	7	8	10	15	21	31
road - biodiesel	-	-	70	3	196	271	248	253	284	264
road - bio ethanol	-	-	-	-	90	94	87	83	102	98
railway - diesel	208	106	104	92	92	90	87	85	86	83
water-borne - diesel	18	18	5	5	4	3	5	2	3	4
air - AVGAS	45	4	3	2	2	1	2	2	2	3
air - kerosene	169	180	192	318	310	307	286	276	283	287

Source: CzSO

Table 2.18 gives overview of fuel price development. The average prices of gasoline with an octane rating of 95 and higher as well as diesel oil are holding at a level above 30 CZK/l from 2010. LPG price had increasing trend since 2005 with the decline in 2009 and 2015. CNG prices show slightly increasing trend from 2010.

Table 2.18: Fuel price development (CZK/l)

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
Petrol 91 oct. – Special	16.00	19.08	28.33	28.02	31.28	33.75	36.26	35.55	-	-
Petrol 95 oct.- Natural	12.40	19.29	28.71	28.48	31.74	34.58	36.68	36.17	36.16	31.37
Diesel – cars	9.80	15.65	24.70	27.87	30.57	34.25	36.46	36.11	36.31	36.21
LPG	-	-	-	26.15	26.98	31.74	32.87	32.26	32.46	27.19
CNG	-	-	-	20.13	23.03	23.79	24.81	25.26	25.91	26.25

- Data is not available *Source: TRC*

Table 2.19 demonstrates available infrastructure for alternative fuels. Data shows that there has been a favourable development in petrol station infrastructure in terms of the number of stations where alternative fuels may be purchased. 74 fuel stations were newly registered in 2015 (including 52 newly built fuel stations) and 77 fuel stations were discarded from the evidence. The increase of the number of LPG filling stations by 15 was recorded in 2015. The total number of public CNG filling stations increased by 14. The number of fuel stations offering biodiesel B100 increased by 8 in 2015, diesel blend B30 by 1 and ethanol E85 by 8.

Table 2.19: Available infrastructure – alternative fuel

	2010	2011	2012	2013	2014	2015
Total	6 591	6 690	6 790	6 918	7 013	7 010
Public	3 672	3 717	3 728	3 745	3 792	3 844
LPG	812	819	822	847	880	895
CNG	21	27	28	35	43	57
B30	93	111	209	217	233	234
B100	33	43	58	74	110	118
E85	37	53	118	147	189	197

Source: TRC

The financial crisis in the yars after 2008 influenced decrease in industrial output as well as transport (freight) in 2009 (see Table 2.20). The value of transport performance in freight transportation in 2009 (58.36 bill. tkm) had reached its lowest level since 2001 (57.87 bill. tkm). Except for the year 2009 the data of transport performance in freight transport show long time fluctuating trend.

Table 2.20: GDP development and development of transportation output/freight

	1990	1995	2000	2005	2010	2011	2012	2013	2014	2015
GDP (billion CZK)	-	-	2 372.6	3 258.0	3 953.7	4 033.8	4 059,9	4 098.1	4 313.8	4 554.6
Transportation output / freight (bill. tkm)	59.43	59.26	57.34	59.14	66.30	69.86	66.18	69.58	69.36	73.08

- Data is not available *Source: MoT and TRC*

The financial crisis also caused reduction in investment directed into development of transportation network in the Czech Republic. The largest investment was directed to transportation in 2008, amounting to nearly 83 billion CZK, which is more than double the amount in 2012. The volume of investment in infrastructure in 2013 has been the lowest in the last 10 years and amounted to approximately 27 billion CZK (see Table 2.21). Since 2008 investment to transport infrastructure has been falling each year to the year 2014. Total investment for transport infrastructure in 2015 was over 57.5 billion CZK. The amount is about 87.4% higher compared to 2014.

Tab 2.21: Total investment into transportation infrastructure (millions CZK)

Type of infrastructure	2000	2005	2010	2011	2012	2013	2014	2015
Railway	13 200	14 428	14 245	10 987	9 594	8 718	12 787	31 785
Road[1)]	10 988	42 137	43 494	31 799	22 036	22 036	16 827	16 632
National water courses	402	303	1 462	549	433	186	263	413
Air transportation	993	7 045	2 059	983	1 187	1 445	991	993
Pipelines	399	164	231	135	149	192	290	155
Total	**25 983**	**64 078**	**61 490**	**44 454**	**33 400**	**27 368**	**30 963**	**57 502**

[1)] Data given for road infrastructure include motorway costs as well as I., II. and III. class roads

Source: MoT

The Ministry of Transport completed in June 2013 *the Transport Policy of the Czech Republic for 2014 – 2020 with the Prospect of 2050*. The document for 2014 – 2020 was immediately built upon the Transport Policy for 2005 – 2013 and it was based upon the analysis of its fulfilment so far. The document identifies main challenges for the transport sector and proposes measures to address them. No change has occurred to the fundamental principles of the new Transport Policy in comparison to the previous one. The Transport Policy declares what the Government is committed to do in the transport sector (international commitments, contracts), what it intends to do (safety, sustainable development, economy, environment, public health) and what it is able to do (financial and spatial aspects).

In August 2013 The Ministry of Transport completed its proposal for *2nd phase of Transport Sectoral Strategy*, which outlines medium-term of transportation infrastructure development with long-term outlook. This document represents the fundamental departmental concept formulating priorities and objectives for transportation development and transportation infrastructure over medium-term horizons until 2020 and framework for development up to 2050. This strategy anticipates growth in transportation intensity on roads by 11% in terms of personal transportation and by 22% for freight, as shown in Table below (calculated using arithmetic averages of proposed intensities in the entire set of road clusters). A positive aspect is anticipated in connection with reconfiguration of territorial distribution of road intensity on existing roads, which are currently overloaded and locally significantly impact air quality.

Table 2.22: Theoretically anticipated change in daily transportation intensity if all contemplated measures within the Transport Sectoral Strategy are implemented by 2050

Possibilities of transportation infrastructure development in the Czech Republic	Modelled transportation intensity (thousand vehicles/day) Arithmetic average of modelled intensities in the entire set of road clusters	
	Personal	Freight
Starting position on existing infrastructure in 2050	9 238	2 584
Target on complete set of proposed measures in 2050	10 232	3 145
Target intensity on complete set of proposed measures in 2050 / starting intensity on existing infrastructure in 2050	111%	122%

Source: MoT, sourced from http://www.mdcr.cz/Dokumenty/Strategie/

In 2013, *the National Strategy for Development of Bicycle Transportation of the Czech Republic 2013–2020* has been also adopted, updating the previous strategy for 2004–2011. The main objective of the strategy is to support cycling so that it becomes a fully-fledged form of transportation supplementing other forms of transportation. This strategy aims to increase the contribution of cycling on the total transportation output to 10% by 2020 (on average for the entire Czech Republic).

In November 2015, the Czech Government approved *the National Action Plan for Clean Mobility*. The Action Plan develops an alternative fuel infrastructure - electromobility and natural gas (and partly also hydrogen). It sets requirements for the construction of filling and refueling stations with a time horizon between 2020 and 2030.

The Czech Republic is a member of the International Civil Aviation Organization (ICAO). Regarding ICAO, measures to limit or reduce emissions of greenhouse gases from aviation bunker fuels are implemented within the EU ETS system (for more details refer to Chapter 4.4.1). In 2016 the Government of the Czech Republic approved the Conception of the Aviation transport for 2016 – 2020. The document is a strategy for achieving of goals of the Transport Policy of the Czech Republic for 2014 – 2020 with the Prospect of 2050. In chapter “Environmental Protection” the document deals with reducing of the impact of aviation on the environment in the area of noise and emissions.

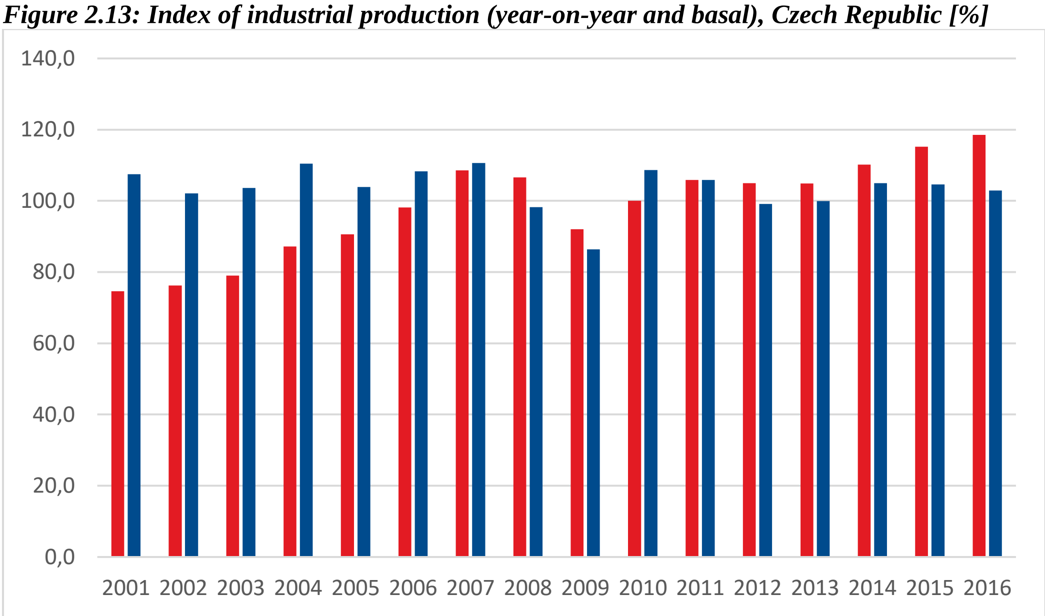
The Czech Republic is a member of the International Maritime Organization (IMO). As regards the IMO, the Czech Republic doesn´t have any emissions of greenhouse gases from marine bunker fuels. However, the EU and its member states are currently discussing and preparing the monitoring, reporting and verification system of marine emissions. The EU is active within both ICAO and IMO and strives to reach an agreement on the establishment of a market-based measure to limit or reduce emissions of greenhouse gases from aviation and marine bunker fuels.

2.11 Industrial production

Industry in the Czech Republic generates 27% of the GDP in 2015 and therefore it is one of the decisive sources of economy**.** In environmental terms, it is also a considerable producer of a wide spectrum of pollutants and waste as well as consumer of non-renewable sources of energy and raw materials. This sector has a huge impact on environment, especially in the areas where large industrial complexes are concentrated emitting large volumes of pollutants (Moravian-Silesian Region, Usti Region and Central Bohemian Regions). Relation between industry and the environment is best demonstrated by development in industrial production (according to its indexes) with development of energy intensity of industry, pollutant emissions and emission of greenhouse gases, waste and expenses directed to ecologization of production. The objective is environmental stability, which means ensuring satisfactory quality of the environment in the Czech Republic as well as limiting negative impact outside its borders.

Regardless of slight fluctuations in industrial production, the trend since 2000 has been growing. So far, industrial production in the Czech Republic has grown far faster in comparison with EU-28. Only since 2008 it had begun to stagnate and decrease in connection with global economic crisis, which had only became fully apparent year later (see Figure 2.13).

Figure 2.13: Index of industrial production (year-on-year and basal), Czech Republic [%]



Legend: Year-on-year index of industrial production (previous year=100 %) | Basal index of industrial production (2010=100 %)

Source: CzSO

In 2011, the Czech economy overcame the crisis and returned to the pre-crisis values. Year-on-year industrial production had grown by 5.9%. Growth of the domestic economy was driven mainly by foreign trade while domestic demand fell. Automobile industry, machinery, electronic and plastics and rubber industry have responded favourably.

In 2012, the growth of industrial production dropped by 0.8% year-on-year. While in the first quarter of the year the industrial production continued to grow, in the second and next quarters it began falling. After two years of growth, there was and year-on-year decrease in 2012, amounting to 0.8%. This development was influenced by weaker industrial production in the Eurozone, which in turn affected industrial production in the Czech Republic. Another factor that weakened growth was weak domestic demand in a situation where households begun to lower its consumption.

In 2013, the level of industrial production was almost the same as in 2012 (it dropped by 0.1 percentage point). While in the first half of the year the industrial production continued to slow down, in the second half it began to grow. The decrease with high impact on total/manufacturing industry is connected to the automobile industry which dropped by 3.3% year-on-year. The division with the highest growth was manufacture of computer, electronic and optical products which grew by 16.1% and growth of the industrial production was driven by growth of foreign demand (non-domestic new orders increased by 4.8% year-on-year). Industries with high level of growth were manufacture of other transport equipment (increased by 10,1% year-on-year); manufacture of wood and products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (increased by 8.4% year-on-year). The other industry with substantial decrease in production was manufacture of leather and related products (dropped by 7.3% year-on-year).

In 2014, the level of industrial production increased by 5.0% year-on-year. The division with the highest level of growth was manufacture of computer, electronic and optical products which grew by 18.4% and growth of the industrial production was driven by growth of foreign demand (increased by 12.9% year-on-year). Industries with high growth were automobile industry (increased by 13.5% year-on-year) and manufacture of coke and refined petroleum products (increased by 11.8% year-on-year). The industry with high decrease was manufacture of wearing apparel (dropped by 5.7% year-on-year).

In 2015, industrial production grew by 4.6 % year-on-year. The sector with the highest growth rate was manufacture of wearing apparel which grew by 16.9% year-on-year, the rise mainly reflected base effects. Industry with high level of growth was manufacturing apparel which grew by 12.7%. The increase with high impact on total/manufacturing industry is connected to the automobile industry which grew by 12.1% year-on-year. As in the previous years growth of industrial production was driven by growth of foreign demand (increased by 8.0% year-on-year). The industries with a significant decrease were repair and installation of machinery and equipment (dropped by 6.3% year-on-year) and printing and reproduction of recorded media (dropped by 4.6% year-on-year).

In 2016, the growth rate of industrial production slowed down (increased by 2.9% year-on-year). The growth rate during the quarters was good (>2.7% year-on-year) except second quarter which grew only by 0.3% year-on-year. The sector with the highest level of growth was printing and reproduction of recorded media which grew by 13.6% year-on-year, the rise mainly reflected base effects. Industry with high level of growth was automobile industry which grew by 11.0% year-on-year. Growth of foreign demand (increased by 6.4% year-on-year) was also important. The other industry with substantial decrease in production was manufacture of chemicals and chemical products (dropped by 7.0% year-on-year). The decrease in manufacture of chemicals and chemical products was linked to two accidents in company Unipetrol (the processing was renewed in October 2016).

The whole period 2011–2016 was influenced by a gradual decline of mining and quarrying sector and moderate decreases in the section of electricity, gas, steam and air conditioning supply (see Table 2.23).

In terms of industry's impact on the environment, there is an apparent connection between structural changes in industry, changes in production technologies and the condition of the environment generally. In the manufacturing industry, there had been large structural changes between 2000 and 2008, resulting in "lighter" production structure, i.e. growth in sectors producing technologically more demanding products with higher added value using less energy and producing fewer emissions (cars, electronics, computer technologies). Practically all sectors underwent technological innovation, especially car production, electronics, optics as well as restructured metallurgy. Drop in industrial production following 2008 economic crisis and beyond had positive impact on emissions of pollutants and on the environment, as the industrial sector produced fever emissions.

The emission production is not evenly distributed among individual sectors; the most intensive sectors are steel and metal works, refineries, cement and lime production. In a number of sectors, notably in paper and cellulose manufacture, glass-making, ceramics and chemical production and industrial energy generation (production of technological steam and electricity for own consumption) there has been a stabilization of emissions or even reduction. Industrial technologies, emitting large volumes of greenhouse gases, are covered by EU ETS.

Emissions generated by the industry may be divided into 2 groups – emissions from industrial energy generation involve mostly NO_x and SO_2 as well as CO, where steel works in Ostrava and Třinec produce vast majority thereof. Industrial processes without combustion are specific according to production types and have varying emission levels burdening the environment. In 2008–2009, emissions were favourably affected by economic crisis and therefore there had been a temporary drop in all types of emissions. In 2010, the recovery of the industry affected emissions in this sector, and some emissions increased. In 2011, the total emissions from industrial sector have decreased along with the falling curve of industrial production, for most of the monitored pollutants. The sole exceptions were CO emissions, where there was a year-on-year increase of 2.4%. All other monitored compounds demonstrated considerable decrease: $PM_{2.5}$ by 23.3%, PM_{10} by 18.9%, NO_x by 14.1%, SO_2 by 12.5% and VOC by 7.2% *(Source: Cenia).*

Energy intensity of the industry has been falling considerably. While in 2010 the energy intensity of the industrial sector reached 302.3 MJ/thousand CZK, in 2015 this value was only 261.7 MJ/thousand CZK (calculated using ratio of final consumption of energy in industry and gross added value (GAV) of a sector). This trend is favourable for the environment, as higher energy consumption means increased burden on the environment during its production. In 2015, there was a slight year-on-year growth of GAV in industrial sector; however, there has been an increase in energy consumption (by 1.6%). Energy intensity of the industry decreased in total by 3.6%. Introduction of new technologies, BAT and measures leading to energy savings drove for the decrease of energy intensity in industry.

From the perspective of investment in the industrial sector, most of the investment went to protection of the environment in the manufacturing industry. In 2015, the investment into the protection of the environment reached 6.6 billion CZK, which is an increase by 76% in comparison with 2010. The dampening of economic crisis, which in previous years caused decrease in investment, has caused increased investment in this sector. Processing industry is in the third place in terms of investment into the protection of the environment (17% share on all investment into the protection environment), after public administration (41%) and electricity, gas, steam and air conditioning supply (22%). Most of the funds within the manufacturing industry went to the protection of air and climate and to waste water management.[9]

[9] https://www.czso.cz/csu/czso/vydaje-na-ochranu-zivotniho-prostredi-2015

Table 2.23: Index of industrial production according to sectors (year-on-year index, previous year=100 %)

Selected sections/divisions	Index of industrial production					
	2011	2012	2013	2014	2015	2016
Industry, total	**5,9**	**-0,8**	**-0,1**	**5,0**	**4,6**	**2,9**
Mining and quarrying	**1,1**	**-4,3**	**-11,3**	**-3,0**	**-2,4**	**-9,0**
Manufacturing	**7,5**	**-0,7**	**0,8**	**6,7**	**6,0**	**3,7**
Manufacture of paper and paper products	1,1	-1,0	3,1	6,9	6,4	2,5
Manufacture of coke and refined petroleum products	-7,2	1,4	-6,6	11,8	-	-
Manufacture of chemicals and chemical products	-4,6	4,8	-3,1	9,5	-4,4	-7,0
Manufacture of rubber and plastic products	6,9	-2,2	1,3	5,2	7,1	4,9
Manufacture of basic metals	5,8	-8,1	-1,8	3,5	-1,4	-0,5
Manufacture of machinery and equipment n.e.c.	10,8	1,9	2,8	3,4	2,6	1,0
Manufacture of computer, electronic and optical products	-2,7	-18,9	16,1	18,4	2,8	5,6
Manufacture of motor vehicles, trailers and semi-trailers	21,2	1,1	-3,3	13,5	12,1	11,0
Manufacture of other transport equipment	21,6	-0,7	10,1	4,5	5,4	1,1
Other manufacturing	4,2	1,6	7,8	5,5	12,7	0,9
Electricity, gas, steam and air conditioning supply	**-1,5**	**-0,5**	**-1,5**	**-3,0**	**-2,7**	**0,5**

Source: CzSO

2.11.1 Research, development and innovations

Situation in the research and development sector (R&D) can be characterized by relatively low total expenditures on R&D on the total GDP. The long-term trend with respect to R&D expenditures in the Czech Republic, as calculated in regular prices, has been growing (with the exception of 2008, which demonstrated a slight decrease due to fall in private investment). Despite this trend, the total R&D expenditures in the Czech Republic remains below the usual R&D levels in the developed EU countries, which contribute about 2 – 3 % of their GDP to research and development.

Table 2.24: Overall expenditures for research and development in the Czech Republic

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015
Share on GDP (%)	1.17	1.23	1.31	1.24	1.30	1.34	1.56	1.78	1.90	1.97	1.95
billion CZK	38.1	43.3	50.0	49.9	50.9	53.0	62.8	72.4	77.9	85.1	88.7

Source: CzSO 2017, Annual statistical survey - Research and development VTR 5-01

The main sources of R&D expenditures in 2014 and 2015 have been the increase of investment from domestic private commercial sources and investment from public foreign sources, and furthermore since 2011, there has been a considerable increase in the support from the EU structural funds on R&D financing.

In 2015, 51.4% of total research and development expenditures came from private (domestic and foreign) sources. The contributions coming from foreign private sources have been growing, from 5% in 2005 – 2007 to 16.9% in 2015.

Another significant trend is strengthening of university research, where the share on total R&D expenditures gradually rose to 24.9% in 2015. The share of public research decreased to 32.2% in 2015.

A low level of cooperation between private and public research institutions remains an issue.

2.12 Waste

2.12.1 Strategies and legislation

The fundamental rules for waste management are defined by Act No. 185/2001 Coll., on Waste (Waste Act), as amended, and its implementing regulation, and Act No. 477/2001 Coll. on Packaging, as amended.

Ministry of the Environment prepared a new Act on Waste and also a new Act on End-of-Life Products. Interministerial procedure was completed during 2016.

The Czech Republic makes substantial steps for improvement of waste management performance in line with obligatory European waste hierarchy and with European Commission recommendations. Last changes in the Waste Act lead explicitly to support of waste recovery (landfill ban of mixed municipal waste, recyclable and recoverable waste from 2024) and the diversion of biodegradable waste from landfills (mandatory separation from 1 January 2015). These measures will lead to significant diversion of waste from landfills.

The State Environmental Policy of the Czech Republic 2012–2020 includes the following specific objectives for the waste sector:

- 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 zero-waste technologies
- preventing the generation of hazardous waste through reducing the content of hazardous substances in products

The Government of the Czech Republic adopted a new Waste Management Plan (WMP CR) for 2015 – 2024 on 22nd December 2014. The binding part of WMP CR is published by the mandatory Government regulation and therefore is mandatory for all regional WMPs. This ensures consistency between national WMP CR and each individual regional WMPs.

The new WMP CR contains all the targets arising from the EU legislation (level of recycling, the volume of biodegradable municipal waste at landfills) and specific measures for their achievement. The WMP CR is also designed in accordance with the waste management hierarchy according to the Waste Framework Directive. Regional WMPs also contain all the targets arising from the EU legislation (level of recycling, the volume of biodegradable municipal waste at landfills) and specific measures for their achievements.

The main principles of the Waste Management Plan include:

- preventing the generation of waste
- maximising the recovery of waste as a substitute of primary resources and transition to the circular economy
- 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

On 15th September 2014 the Government adopted The Secondary Raw Materials Policy of the Czech Republic which contains important objectives for material efficiency such as:

- 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.

2.12.2 European targets

A positive trend is identified in the area of target for recycling of municipal waste according to Article 11 of the Waste Framework Directive. In year 2015 the share of recycling reached 49.1% according to Ministry of the Environment and it is expected that the obligatory target of 50% recycling by 2020 will be achieved. The target for construction and demolition waste according to Article 11 (70%) has been already reached. In year 2015 82% was reported.

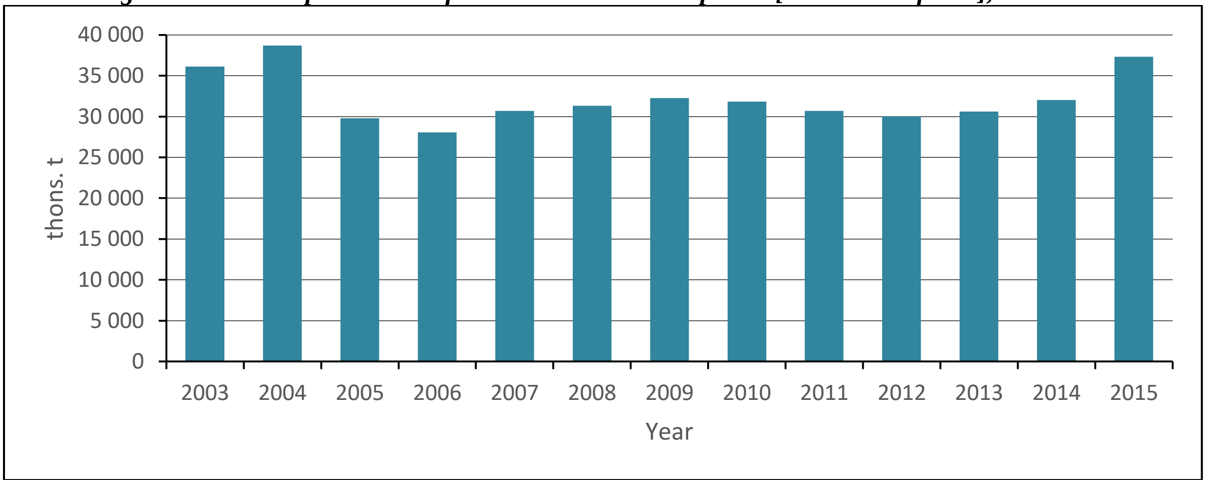
2.12.3 Total production of waste

The total production of all waste in the Czech Republic reached approximately 37.338 million tonnes in 2015. Total production of hazardous waste in 2015 reached 1.5 million tonnes. 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-on-year by 16.6% to the value of 37,338.3 thous. t. Between 2009 and 2015 it was an increase by 15.7%. Several factors influence the indicator's value. However, construction activities resulting from government contracts are reflected mostly in this indicator because 65.1% of the generated waste comes from construction. This waste group generation dramatically increased in the year 2015 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 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-on-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-on-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%. 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.

Figure 2.14: Total production of waste in the Czech Republic [thousands of tons], 2003–2015



Source: Report on the Environment of the Czech Republic 2015

Table 2.25: Total production of waste in the Czech Republic [thousands of tons], 2009–2015

Year	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
Total production of waste (thousands of tonnes)	32 267	31 811	30 672	30 023	30 621	32 028	37 338

Source: Ministry of the Environment - Waste Management Plan Indicators

2.12.4 Production and treatment of municipal waste

Since 2009, the total generation of municipal waste is stagnating or, more precisely, oscillating around a value slightly above 5 mil. t. In 2015 the production of municipal waste reached 5.274 mil. t.

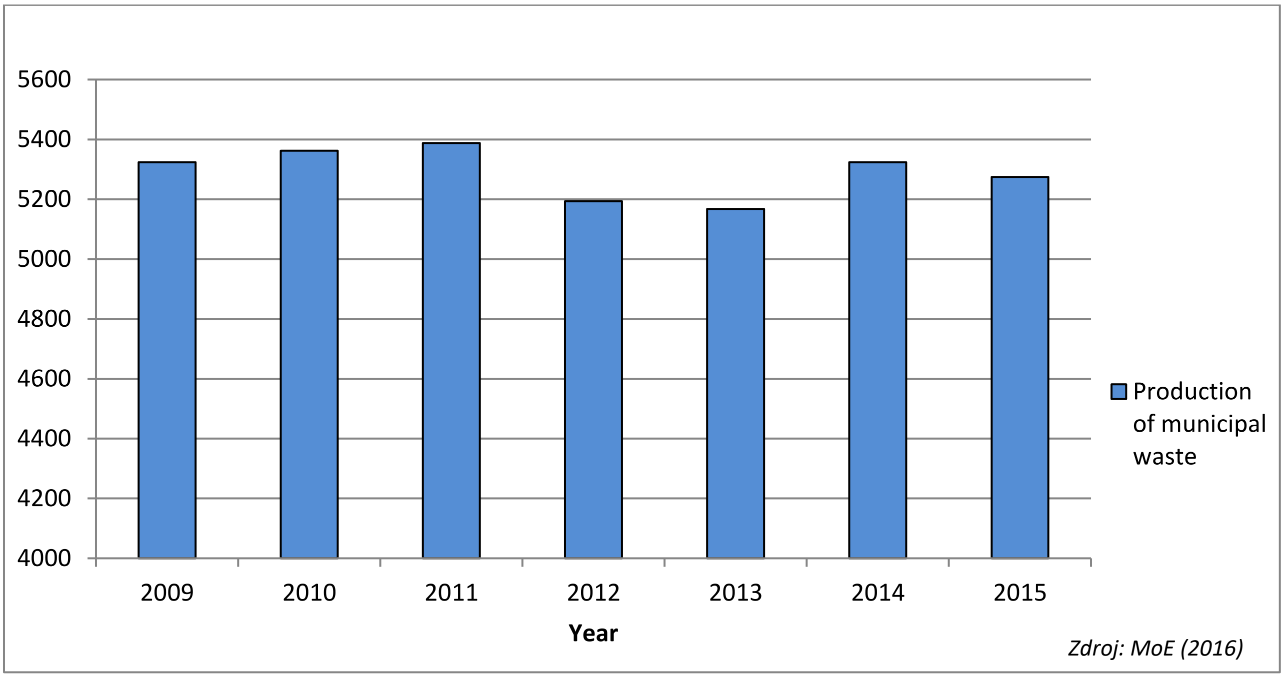
Between 2009 and 2015, the average generation of municipal waste per capita was equal to 503.2 kg per capita. More specifically, the indicator's value in 2015 was 500.3 kg per capita.

Table 2.26 Total production of municipal waste in the Czech Republic, 2003 - 2015

Year	2009	2010	2011	2012	2013	2014	2015
Total production of municipal waste (1000 t/year)	5 125	5 224	5 388	5 188	5 168	5 324	5 274

Source: Ministry of the Environment - Waste Management Plan Indicators

Figure 2.15: Production of municipal waste in the Czech Republic [thousands of tonness], 2009–2015



The main challenge for waste management is significant amount of landfilled municipal waste. According to Ministry of the Environment data 52% of municipal wastes were landfilled in 2013, 48% in 2014 and 47% in 2015. In the year-on-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.

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. Four facilities for energy recovery of municipal waste are in the Czech Republic: Prague, Brno, Liberec and Pilsen-Chotíkov.

As to incineration, the situation is dramatically different; the method is used to treat an almost negligible amount of municipal waste (its percentage is almost zero).

2.13 Agriculture

Agriculture has typical central European character with predominance of food production and high share of arable land (71.3%). Zonal character of agriculture is driven by altitude rather than latitude. Agricultural production is sufficient to cover domestic demand in terms of basic products. Crop production prevails over animal production. Yield converted to area is lower than in neighbouring countries. Contribution of agriculture to GDP is about average in the EU.

Cropland in the Czech Republic, same as in other EU Member States, suffers from real estate development; despite that the Czech Republic remains one of the countries with the large shares of crop land / total area in the EU. Then main crop is grain, especially wheat. Wheat fields have been growing in recent years to the detriment of forage crops. The largest area is taken up by wheat and barley fields, corn (mass and seeds), rape, sugar beet and oat fields. Yields from these main crops have been growing, but regardless of that the Czech Republic is among the medium successful wheat producers.

In the past there has been a marked drop in the number in livestock, despite that fact that livestock numbers grew in certain neighbouring countries. This is apparent in international comparison, where livestock numbers are below average even within the framework of the EU. Animal production corresponds to livestock numbers, and within the EU the meat production is also below average.

Table 2.27: Average animal breeding for 2012- 2015 (thousands of animals)

		2013	2014	2015
Cattle total	Thousand of animals	1 352.8	1 373.6	1 407.1
Particularly cows	Thousand of animals	551.9	564.0	580.1
Particularly suckler cows (non-dairy cows)	Thousand of animals	184.6	191.3	204.0
Pigs	Thousand of animals	1 586.6	1 617.1	1 559.6
Poultry	Thousand of animals	23 265.4	21 463.8	22 508.0
Particularly layers	Thousand of animals	8 752.2	9 160.0	8 899.2
Sheeps	Thousand of animals	220.5	225.3	231.7
Goats	Thousand of animals	24.0	24.3	26.7

Sources: Institute of Agricultural Economics and Information, MoA

From the total territory of the state (approximately 7.9 million ha) the agricultural / farming land took up 53.4% in 2015 (in 2003 it was 54.1%), which represents approximately 0.4 ha per inhabitant. Consumption of mineral fertilizer in recent years is shown in Table 2.29.

Development of organic farming shows a positive trend. The number of organic farms has been steadily growing in the recent years. Numbers of distributors and producers of bio food are also growing.

Table 2.28: Development of organic farms and area of cropland in the organic farming system in the Czech Republic

Year	**Total number of enterprises**	**Area in ha**	**Percentage share on agricultural land fund**
1990	3	480	-
1991	132	17 507	0.41
1992	135	15 371	0.36
1993	141	15 667	0.37
1994	187	15 818	0.37
1995	181	14 982	0.35
1996	182	17 022	0.40
1997	211	20 239	0.47
1998	348	71 621	1.67
1999	473	110 756	2.58
2000	563	165 699	3.86
2001	654	217 869	5.09
2002	721	235 136	5.50
2003	810	254 995	5.97
2004	836	263 299	6.16
2005	829	254 982	5.98
2006	963	281 535	6.61
2007	1318	312 890	7.35
2008	1 946	341 632	8.04
2009	2 689	398 407	9.38
2010	3 517	448 202	10.55
2011	3 920	482 927	11.40
2012	3 923	488 483	11.56
2013	3 926	493 896	11.70
2014	3 885	493 971	11.72
2015	4 115	494 661	11.74

Source: MoA

The number of registered enterprises and area of cropland involved in integrated production has also risen.

In 2007, the state introduced mandatory mixing of bio-compounds into fuels; this measure continues to apply. Bio compounds involved include rapeseed methyl-ester (MERO – FAME) and bio-ethanol, produced mostly from sugar beet. This measure resulted in growing area dedicated to growing rapeseed. Agriculture contributed in 2015 to production of all greenhouse gases in the Czech Republic by 7% (incl. LULUCF sector).

In 2015, the CH_4, N_2O and CO_2 emissions reached the total of 8483 Gg (kt) CO_2 eq. N_2O emissions in agricultural sector represented in 2015 73.1% of total N_2O emissions in the Czech Republic[10].

After 1990, when agriculture sector transformed, there has been a considerable decrease in the use of mineral fertiliser and calcic substances due to savings in funding. In 1994 the application of mineral fertiliser and calcic substances rose again and since then it has been fluctuating slightly. At present time, the fertiliser application in the Czech Republic in comparison with the EU average is, more often than not, lower.

Table 2.29: Development of mineral fertiliser use 1999 – 2015 (kg/ha)

Fertiliser type	Economic year													
	1999/ 2000	2002/ 2003	2003/ 2004	2004/ 2005	2005/ 2006	2006/ 2007	2007/ 2008	2008/ 2009	2009/ 2010	2010/ 2011	2011/ 2012	2012/ 2013	2013/ 2014	2014/ 2015
Total	**88.4**	**89.7**	**99.8**	**97.0**	**98.9**	**104.6**	**110.5**	**98.0**	**99.8**	**108.1**	**113.2**	**122.0**	**127.9**	**130.7**
In that:														
Nitric	67.4	65.2	73.7	71.7	74.1	77.6	82.2	78.1	80.2	84.9	88.3	94.4	97.2	98.7
Phosphate	12.6	14.1	15.6	15.0	14.9	16.3	16.9	12.4	12.4	14.2	15.3	17.0	18.4	19.0
Potassium	8.4	10.4	10.5	10.3	9.9	10.7	11.4	7.5	7.2	9.0	9.6	10.6	12.3	13.0

Note: In the Czech Republic, the figures for phosphate and nitric fertiliser give values for the amount of relevant oxides, while in number of countries the value means directly the amounts of phosphorus or nitrate. *Source: CzSO*

2.14 Forestry

The Czech Republic is one of countries with high forest coverage. The area of forests has been growing since the second half of the 20th century, mostly due to long-term trend of afforestation of infertile cropland (in recent years the annual gain is approximately 2 000 ha). Total area of forestland in 2015 reached 2 668 thousand ha, which is approximately one third of the Czech territory (33.8% of the total territory). During afforestation, there has been recent effort to increase the share of broadleaved species at the expense of conifers. In 2015, more than 72.3% of forests were coniferous forests (76.5% in 2000) and 26.5% broadleaved (22.3% in 2000). Total wood supply in the Czech Republic has been growing and in 2012 it reached 692.6 million m^3 (Table 2.30).

Table 2.30: Trends in the area of forest land in 1920 – 2015 (thousand ha)

	1920	1930	1945	1950	1960	1970	1980	1990	2000	2005	2010	2013	2014	2015
Area	2 369	2 354	2 420	2 479	2 574	2 606	2 623	2 629	2 637	2 647	2 657	2 664	2 666	2 668

Source: MoA, COSMC

Table 2.31: Trends in the total standing stock of wood in forests in 1930 – 2015 (million m^3)

	1930	1950	1960	1970	1980	1990	1998	1999	2000	2005	2010	2013	2014	2015
Standing stock	307	322	348	445	536	564	615	625	630	663	681	687	689	693

Source: MoA

[10] National Inventory Report (NIR), CHMI, 2017

Table 2.32: Trends in some basic characteristics of forest management in 1990 – 2015 (million m^3/year)

	1990	1995	2000	2005	2010	2013	2014	2015
Total harvesting	13.3	12.4	14.4	15.5	16.7	15.3	15.5	16.2
Salvage logging	9.8	7.9	3.3	4.5	6.1	4.2	2.5	8.5
Salvage logging in % from total harvesting	74%	64%	23%	29%	36%	27%	16%	52%
Total increment	17.0	18.0	19.8	20.5	21.2	21.7	21.8	21.8
Ratio of increment and harvesting	78%	69%	73%	76%	79%	70%	71%	74%

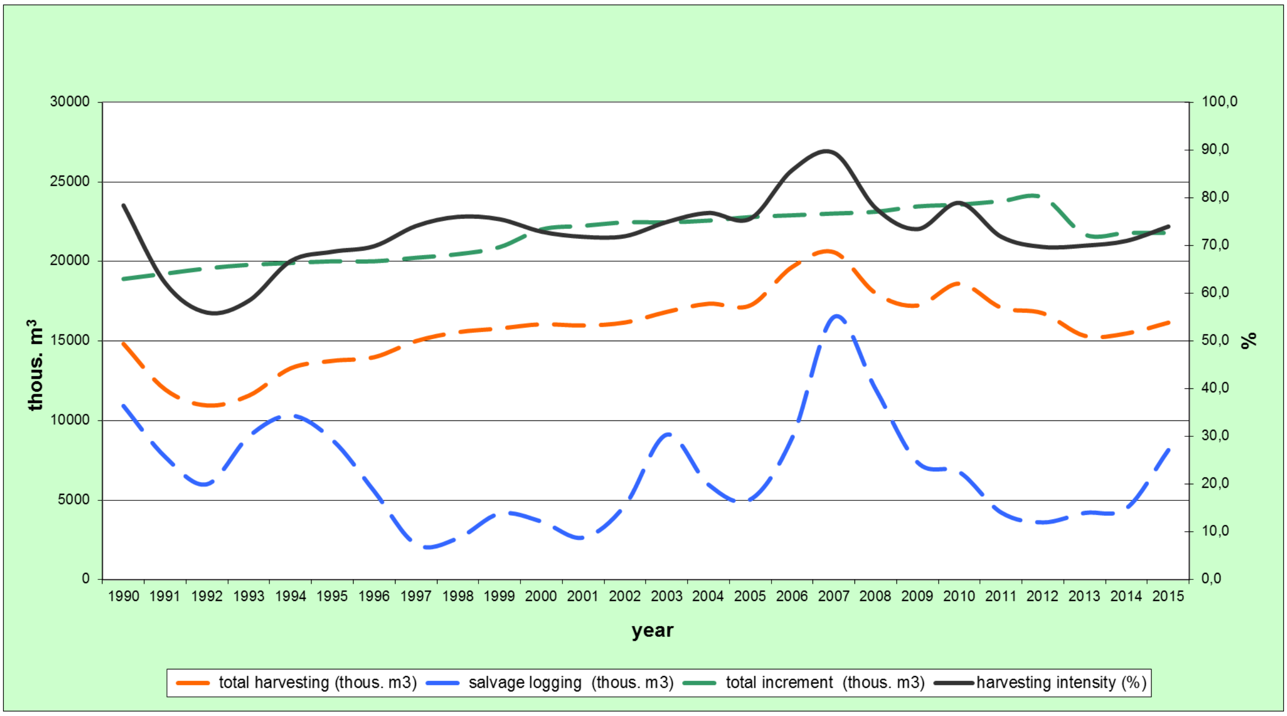
Source: MoA, FMI, CzSO

The basic information on the forest economy is given in Table 2.32 and Figure 2.16. Historically, salvage logging following the Kyrill windstorm in January 2007 caused the record-breaking logging yield in 2007.

With regard to the ownership, 58.69% of the forests is owned by the state, 16.96% by cities and municipalities, 19.28% by private persons, 3.01% by legal entities, 0.87% forest owned by church and religious entities and 1.18% by other owners (2015 data). Lesy CR, s.p. (Forests of the Czech Republic, a state enterprise), respectively Vojenske lesy a statky CR, s.p. (Military Forests and Farms Forests, a state enterprise) and National Park Administrations manage forests owned by the state. With regard to the function of forests, there are economic forests (74.4%), protective forests (2.1%) and special-use forests (23.5%). Economically driven forests growths are administered by the Ministry of Agriculture. Forests in national parks and in their protective zones are administered by the Ministry of the Environment. Forests in national parks are the so-called special-use forests. The share of forestry sector in the creation of gross value added fluctuates between 0.7 and 0.8% in recent years (in normal prices).

Forests have been severely damaged in previous decades by industrial exhalations. Despite dramatic decrease in pollutant emissions into air (especially SO_2) the health of the forests is improving only very slowly. The cause of the current damage to forests lies especially in the long-term cumulative degradation of forest soil due to pollutants burden. Forests are also being damaged by high concentrations of tropospheric ozone.

Figure 2.16: Comparison of total increment with harvesting [million m^3]



Source: FMI

Broadleaved species have been gaining at the expense of conifers in terms of forest composition, which is becoming more mixed, spruce and pine is on the retreat, being replaced by beech, oak, ash and maple tree. This is a result of a long-term effort to achieve a more balanced and natural composition of the forests in the Czech Republic and partially of a specific financial support of the state focusing on ensuring the necessary ratio of ameliorative and reinforcing woody species during restoration of the forests.

Air pollution has a great effect on the forest health and pollution weakens growth. Forest health condition is characterized mainly by the degree of defoliation. Significant reduction of air pollutants burden in recent years has undoubtedly influenced the condition of forests, where the impact is apparent with some delay. Forests however continue to demonstrate large degree of defoliation, which is among the highest in comparison with other European countries and in the long-term, despite certain fluctuations, it continues to slightly grow. High defoliation is caused by continuing effects of air pollutants, even if at lower rates, but also by the fact that stability of forest ecosystems has been disrupted in the long term due to ruinous air pollutants levels in the past. Defoliation is also caused by other negative factors of biotic and abiotic nature, some of which have been growing in significance over the recent years (climatic extremes, insect living under bark).

The **Land Use, Land-Use Change and Forestry** (**LULUCF**) sector closely relates to agriculture and forestry. The most important land category in LULUCF sector in the Czech Republic with regard to greenhouse gases emission balance are forested areas. Forestry in the Czech Republic is regulated by the Forest Act (Act No. 289/1995 Coll., on Forests, as amended), which forms the fundamental legislative instrument. While this Act does not directly determine the specific targets for forest carbon stocks, its provisions regulate carbon stocks and reduction of greenhouse gas emissions in many respects indirectly. The purpose of this Act is to determine conditions for the preservation, tending and regeneration of forests as national riches to enable the fulfillment of all their functions and to support sustainable forestry.

In general, the area of clear felling must not exceed one hectare and a cleared area of forest land must be afforested within two years. The most important instrument are the Forest Management Plans (or Guidelines for areas under 50 ha) which include binding provisions for maximum fellings and minimal share of soil-improving and reinforcing species and other provisions and recommendations.

In any event, a strong emphasis has been placed on issues related to carbon stocks and emissions from the forestry sector during negotiation and elaboration of the National Forestry Programme II. This programme has been approved by the Government Resolution No. 1221/2008 and should lead to a draft forestry bill, which will contain specific measures preventing climate change and promoting adaptation to climate change in the forestry sector. The National Forestry Programme contains "Key Action 6" – aiming to "Reduce impacts of anticipated global climate change and extreme meteorological events", which is itself based on 12 specific measures. These measures are generally focusing on creating more resilient forest ecosystems by supporting diversified growth with the highest possible use of natural processes, diverse wood plant composition, natural capacity for restoration and variability of afforestation methods.

Together with Principles of State Forest Policy (Decree No. 854 of 21 November 2012) which include also enhancing biodiversity in forest ecosystems, their integrity and ecological stability as one of the main principles, the above mentioned documents form a framework which ensures that the implementation of activities under Article 3.3 and 3.4 contribute to conservation of biodiversity and sustainable use of natural resources.

In 2015, the net LULUCF sink reduced total greenhouse gas emissions of the Czech Republic by 6.64 million tons of CO_2 eq. (Table 2.34), which is more than 5% of all discharged emissions. Currently, the LULUCF contribution to the total emission balance corresponds, approximately, to emissions of greenhouse gases generated by agriculture, the total volume of the sink remains, year-on-year variable.

Table 2.33: Area according to category IPCC [thousand ha]

Territorial category	1990	2010	2011	2012	2013	2014	2015
Forest Land	2 629.5	2 657.4	2 659.8	2 661.9	2 663.7	2 666.4	2 668.4
Grassland	832.5	985.9	989.4	991.5	994.5	997.2	1 000.6
Cropland	3 455.0	3 247.6	3240.2	3 232.9	3 225.4	3 218.4	3 211.3
Wetlands	157.5	163.1	163.4	163.96	164.4	164.8	165.5
Settlements	704.6	726.4	728.5	730.7	733.2	734.9	736.3
Other	107.2	106.1	105.7	105.7	105.6	105.1	104.9

Source: CHMI

Table 2.34: Emissions (+) and sink (-) from LULUCF in 2015 [Gg CO_2 eq.]

Emissions (+) and sink (-) [Gg CO_2 eq.]	CO_2	CH_4	N_2O	Total
LULUCF	**-6 735.41**	**81.91**	**12.81**	**-6 640.69**
Forest Land	-6 735.41	81.91	6.71	-6 052.84
Cropland	-0.31	-	4.98	4.67
Grassland	-550.34	-	-	-550.34
Wetlands	25.18	-	-	25.18
Settlements	88.12	-	-	88.12
Harvested wood products	-164.15			-164.15
Other	7.55	-	-	7.55

Source: CHMI

LULUCF contribution to the fulfilment of reduction commitment of the Czech Republic will be accounted for, in accordance with rules set forth by Kyoto Protocol (KP), at the end of the second Kyoto commitment period same as for the first commitment period. The Czech Republic has elected accounting of forest management activities pursuant to KP Art. 3.4 for the first Kyoto commitment period and continues to accounting this category in the second commitment period. This category remains most significant from the perspective of LULUCF sector emissions stocks (Tab 2.34). However contribution of forest management toward the Kyoto target will be considerably limited by the specific cap for this activity which is defined as 0.32 Mt C/year (i.e. -1,173 t CO_2).

Table 2.35: Additional information on emissions (+) and sink (-) from KP activities 2013 - 2015 [Gg CO_2 eq.]

Year	Activities as defined in KP Art. 3.3		Activities as defined in KP Art. 3.4
	Afforestation and reforestation	Deforestation	Forest management
2013	-492.61	234.27	-6405.31
2014	-549.75	231.19	-6280.87
2015	-589.37	179.73	-5075.56

Source: CHMI

It may be anticipated that forest management sinks will be decreasing in the coming years. The main reason is the age structure of forests in the Czech Republic. The temporary fall in sinks will be also contributed to by the planned increase in the share of broadleaved species. This measure is however a significant adaptation measure, which aims to ensure long-term stability of forest stands and therefore also carbon accumulation over long-term horizon. In the future, we also expect a more extensive use of biomass for energy purposes and larger volumes of carbon accumulated in harvested wood products.

3 INVENTORIES OF GREENHOUSE GAS EMISSIONS INCLUDING INFORMATION ON THE NATIONAL INVENTORY SYSTEM AND NATIONAL REGISTER FOR TRADING ALLOWANCES

3.1 Summary tables and inventory results

This chapter describes greenhouse gas emissions (GHGs) trends over time, covering period between 1990 and 2015. The Czech Republic is obliged to report on GHGs to the European Commission on the basis of the Regulation (EU) No. 525/2013 and to the Secretariat of the United Nations Framework Convention on Climate Change.

GHG Inventory results for 1990 - 2015 are provided, in sector-by-sector composition, in separate Annex 1 and Annex 2. These results come from the National Inventory Report (NIR), which was submitted to UNFCCC in April 2017 and officially resubmitted in May 2017. Annex 1 provides trend tables (CTF Tables 1a, 1b, 1c) that refer to the main gases CO_2, CH_4 and N_2O. Annex 2 refers to total (aggregate) GHGs expressed in CO_2 equivalents. This Table also gives figures for F-gases emissions.

Tables in Annex 1 and Annex 2 provide, in line with the Convention requirements, data giving emission aggregate sums including emissions and sinks from Land Use, Land Use Change and Forestry (LULUCF), and without including this sector. Emission estimates of indirect GHGs have been included in national inventory report since 2015 and thus total amount of greenhouse gas emissions include also indirect emissions. Total greenhouse gas emissions including sinks from LULUCF and indirect emissions, expressed in CO_2 eq., indicate decrease in the Czech Republic from 191.5 million tons to 121.3 million tons in 2015. Emissions (excl. LULUCF, incl. indirect emissions) decreased from 197.9 million tons in 1990 to 127.9 million tons, i.e. in comparison with reference year 1990 the emissions including LULUCF and indirect emissions decreased by 36.7% and excluding LULUCF with indirect emissions decreased by 35.4%. The inventory also includes emissions HFC, PFC, SF_6, NF_3 (substances containing Fluor, the so-called F-gases), which are also covered by the Kyoto Protocol. Their present share on total GHGs (excl. LULUCF, incl. indirect emissions) amounted in 2015 to 2.8%. CO_2 net emissions amounted to 81.6% of the total emissions (excl. LULUCF, incl. indirect emissions) in 2015; CH_4 share amounted to 10.7% and N_2O to 4.8%. Development of total emissions with reference to individual gases over years is provided in Table 3.1.

Figures 3.1 and 3.2 illustrate development of emissions and sinks in main inventory categories. Rapid decrease of total GHGs after 1990 was caused by decrease in production and subsequent restructuring of the economy, which was triggered by the change in the political system. Situation remains rather stable after 1994; potential fluctuations are caused by a variety of effects (varying temperature during winters, year-on-year change in GDP and impacts of adopted measures aiming to reduce GHGs etc.).

Table 3.1: Trends in greenhouse gas emissions in the 1990 -2015 period [Gg CO_2 eq.]

Year	CO_2[1]	CH_4 [3]	N_2O[3]	HFCs	PFCs	SF_6	NF_3	Total emissions incl. LULUCF	Total emissions excl. LULUCF
1990	161649.59	23568.21	10663.05	NO	NO	84.10	NO	191461.11	197948.82
1991	146035.42	21973.73	9161.23	NO	NO	83.94	NO	169551.36	179160.22
1992	141549.39	20585.38	8298.15	NO	NO	85.23	NO	162286.52	172382.80
1993	135570.11	19677.99	7395.39	NO	NO	86.40	NO	154836.15	164528.86
1994	129159.53	18541.72	7242.92	NO	NO	87.48	NO	149080.89	156649.89
1995	129736.95	18135.00	7465.74	0.32	0.01	88.47	NO	149006.34	157052.78
1996	132201.92	17977.30	7289.86	38.02	0.68	98.06	NO	150777.26	159170.91
1997	128839.99	17571.27	7268.04	119.96	1.73	95.83	NO	147958.95	155435.55
1998	123647.03	16900.65	7137.39	173.54	1.66	94.56	NO	141739.34	149360.65
1999	115416.47	16184.56	7001.90	196.78	1.10	95.53	NO	132258.04	140163.10
2000	125788.18	15328.91	6845.16	272.92	4.69	107.99	NO	140575.08	149380.15
2001	125486.45	15072.59	6927.14	411.01	9.75	98.41	NO	139859.53	148992.74
2002	122537.80	14657.49	6638.76	534.27	16.39	120.80	NO	136664.43	145430.10
2003	126092.53	14674.61	6269.15	671.81	8.55	144.19	NO	141471.41	148737.65
2004	126838.97	14239.85	6726.99	771.03	12.81	120.00	NO	141772.32	149560.41
2005	124558.95	14613.64	6512.18	867.74	14.89	111.18	NO	139478.29	147612.88
2006	125889.26	14892.02	6307.82	1166.49	31.09	108.28	NO	143339.59	149308.88
2007	127402.86	14472.58	6296.50	1624.43	29.00	93.41	NO	146971.94	150731.49
2008	122315.94	14563.20	6408.78	1902.14	39.76	93.29	NO	139251.38	146162.00
2009	114684.10	14183.66	5975.22	2010.82	45.44	96.06	NO	129863.57	137795.64
2010	116159.34	14392.54	5765.04	2348.97	48.01	80.23	NO	132393.21	139593.28
2011	114037.62	14295.87	5948.31	2620.17	8.13	85.39	NO	129474.60	137863.57
2012	110621.25	14298.29	5861.44	2765.99	6.36	89.63	1.80	125913.06	134465.77
2013	107102.93	13731.61	5903.14	2989.02	4.55	92.35	3.82	122640.95	130561.18
2014	102799.18	13701.64	6093.78	3229.53	3.02	94.73	2.35	118815.22	126616.31
2015	103769.75	13776.39	6125.54	3455.08	1.96	90.55	2.29	121284.84	127925.53
%[2]	**-35.81**	**-41.55**	**-42.55**	**100**	**100**	**7.67**	**100**	**-36.65**	**-35.37**

Note: Global warming potentials (GWPs) used (100 years time horizon): CO_2 = 1; CH_4 = 25; N_2O = 298; SF_6 = 22 800; NF_3 = 17 200; HFCs and PFCs consist of different substances, therefore GWPs have to be calculated individually depending on substances

[1]GHG emissions excluding emissions/removals from LULUCF

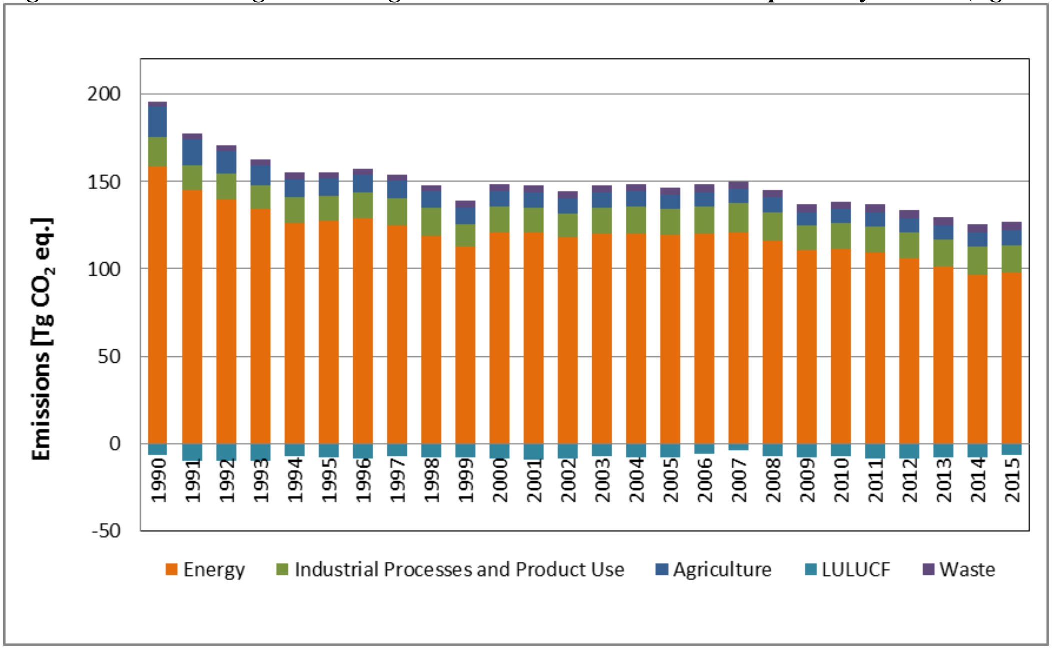
[2] relative to base year

[3]incl. LULUCF

Source: CHMI

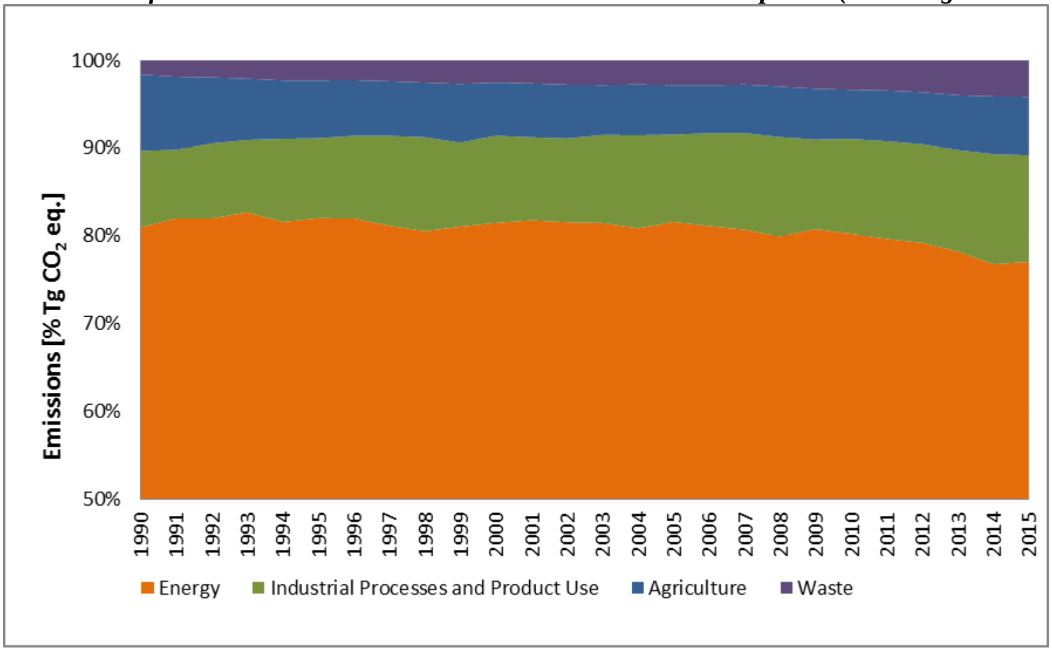
With regard to the fact that by 2015 the total GHGs decreased by 36.7% in comparison with reference year 1990 (incl. LULUCF, incl. indirect emissions), respectively by 35.4% (excl. LULUCF, incl. indirect emissions), the fulfilment of the commitment under the second commitment period of the Kyoto Protocol 2013 – 2020 can be anticipated with high probability.

Figure 3.1: Trends in greenhouse gas emissions in the 1990 – 2015 period by sectors (Tg CO_2 eq.)



Source: CHMI

Figure 3.2: Share of individual sectors on total GHGs in the 1990 – 2015 period (excluding LULUCF) (%)



Source: CHMI

3.2 Inventories of greenhouse gases

3.2.1 Introduction

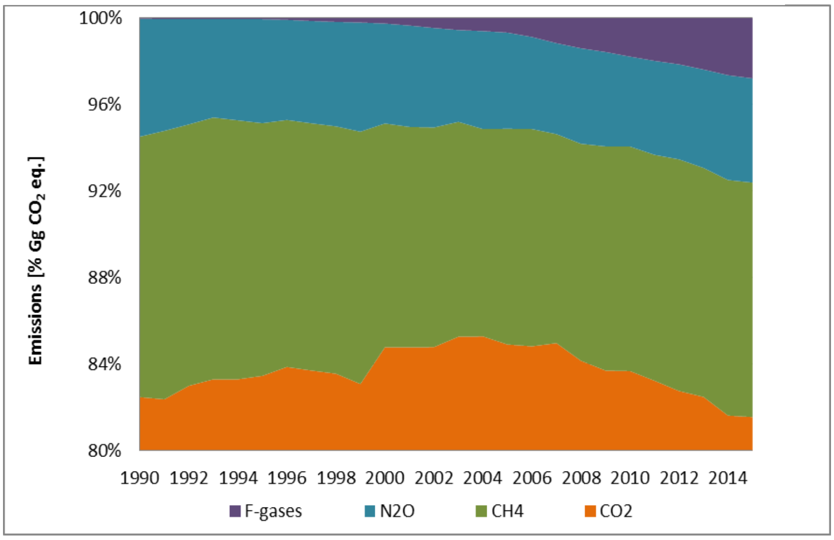
Inventories of greenhouse gases for the purposes of the UN Framework Convention on Climate Change monitor emissions and sinks of carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and F-gases emissions (HFCs, PFCs, SF_6 and NF_3). Besides these substances, the inventory also takes stock of precursors: volatile organic compounds (NMVOC), carbon monoxide (CO), nitrogen oxides (NO_X) and sulphur dioxide (SO_2). Emphasis is placed on accurate calculations of emissions of greenhouse gases with direct radiation absorption effect (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 and NF_3). The total impact of emissions of these gases is given as the aggregated emissions, expressed as the equivalent amount of carbon dioxide, taking into account the global warming potential values GWP for a time period of 100 years.

Greenhouse gas inventories are prepared in accordance with the standard IPCC method. A detailed description of the methodology, emission factors employed and activity data is contained in the National Inventory Report, which is updated annually[11].

3.2.2 Emissions of individual greenhouse gases

Figure 3.3 provides overview of shares and development of individual gases or their groups in the total greenhouse gases emissions (GHGs) over individual years. Changes are minimal year to year. There is a decreasing trend for methane due to decrease of fugitive emissions and Agriculture sector emissions and increase in share of F-gases (HFC, PFC, SF_6 and NF_3), which is a result of the process of replacing ozone depleting chlorofluorocarbons (freons, regulated by the Montreal Protocol), in cooling and their application in modern technologies. The most important greenhouse gas is carbon dioxide, which amounts to 80.5% of total emissions, followed by methane with 11.4%, N_2O with 5.1% and F-gases 2.8% (data for year 2015, emissions including indirect emission and LULUCF).

Figure 3.3: Shares and trends of individual gases on total emissions in the Czech Republic (including LULUCF)



Source: CHMI

3.2.2.1 Carbon dioxide

Carbon dioxide is the most significant anthropogenic greenhouse gas. In most developed countries it has the largest share on the national total aggregated emissions. In the Czech Republic, its share amounted to 80.5% (including indirect emissions and LULUCF) in 2015. CO_2 emissions are generated primarily by fossil fuels combustion, carbonate breakdowns during cement, lime and glass production, scrubbing and in metallurgic and chemical processes; CO_2 emissions and sinks (total sector balance indicates predominance of sinks) are apparent in the Land Use, Land Use Change and Forestry (LULUCF) sector. In the Czech Republic, the CO_2 emissions are coming from combustion of solid fuels, to a smaller degree by combustion of liquid and gaseous fuels.

Amounts of CO_2 produced by individual activities are given in the Annex 1 (CTF Table 1a). CO_2 emissions have been rapidly decreasing in early 90's, after 1994 the emissions have kept at average of 68% of the amount produced in 1990. Inter-annual decrease in CO_2 emissions

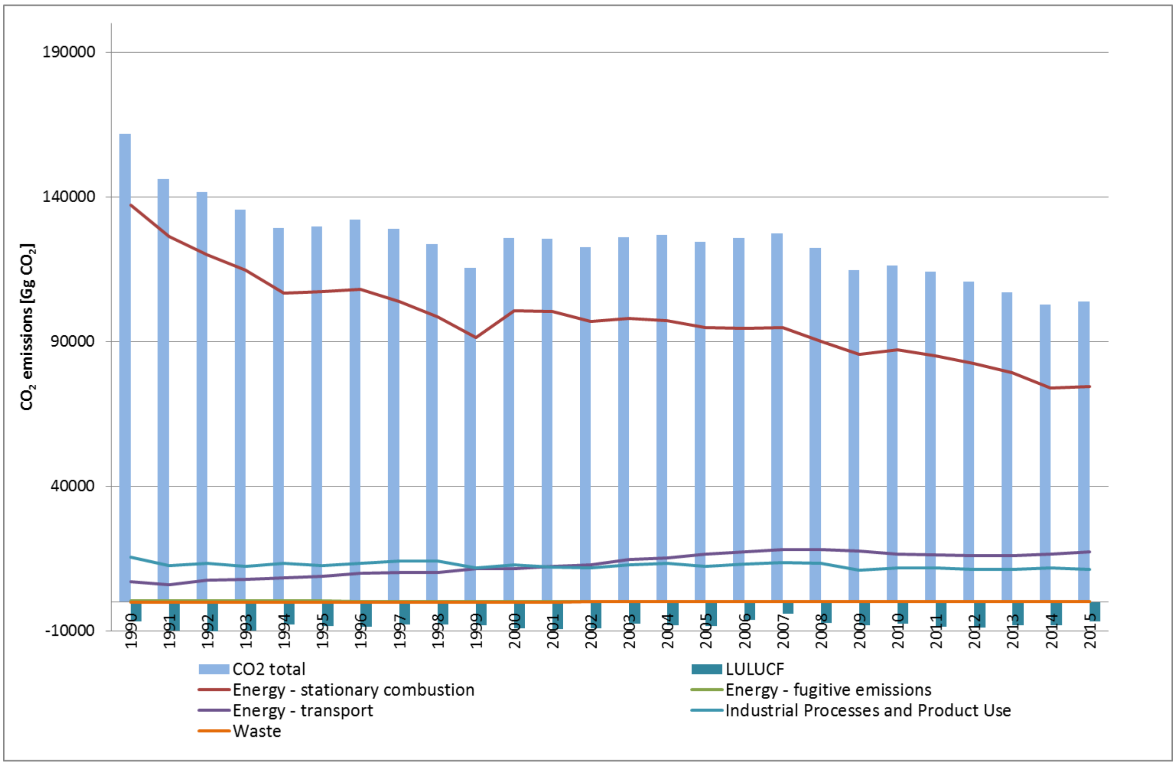
[11] National Inventory Report and data sets for each year are available at CHMI (http://portal.chmi.cz/files/portal/docs/uoco/oez/nis/nis_do_aj.html)

(excl. LULUCF) from 2010 to 2015 by 10.67% results the total decrease of 35.81% from 1990 to 2015. Quoting in absolute figures, CO_2 emissions and removals decreased from 161 649.59 to 103 769.75 kt CO_2 in the period from 1990 to 2015, mainly due to lower emissions from the 1 Energy category (mainly 1.A.2 Manufacturing Industries & Construction, 1.A.4.a Commercial/Institutional and 1.A.4.b Residential).

The main source of CO_2 emissions is fossil fuel combustion; within the 1.A Fuel Combustion category, 1.A.1 Energy Industry and 1.A.2 Manufacturing Industries & Construction sub-categories are the most important. CO_2 emissions increased remarkably between 1990 and 2015 from the 1.A.3 Transport category from 7 031.87 to 17 343.68 kt CO_2.

In line with the IPCC methodology, the CO_2 emissions produced by international air and sea transportation are not counted as part of national emissions, but they are reported separately. Similarly, emissions generated by biomass incineration are not included in national figures, as that would mean double counting. These emissions are included in the LULUCF sector. Figure 3.4 shows shares of individual sectors in total CO_2 emissions in the Czech Republic.

Figure 3.4: Trends of CO_2 emissions and shares of individual sector in the Czech Republic 1990 – 2015(Gg CO_2)



Source: CHMI

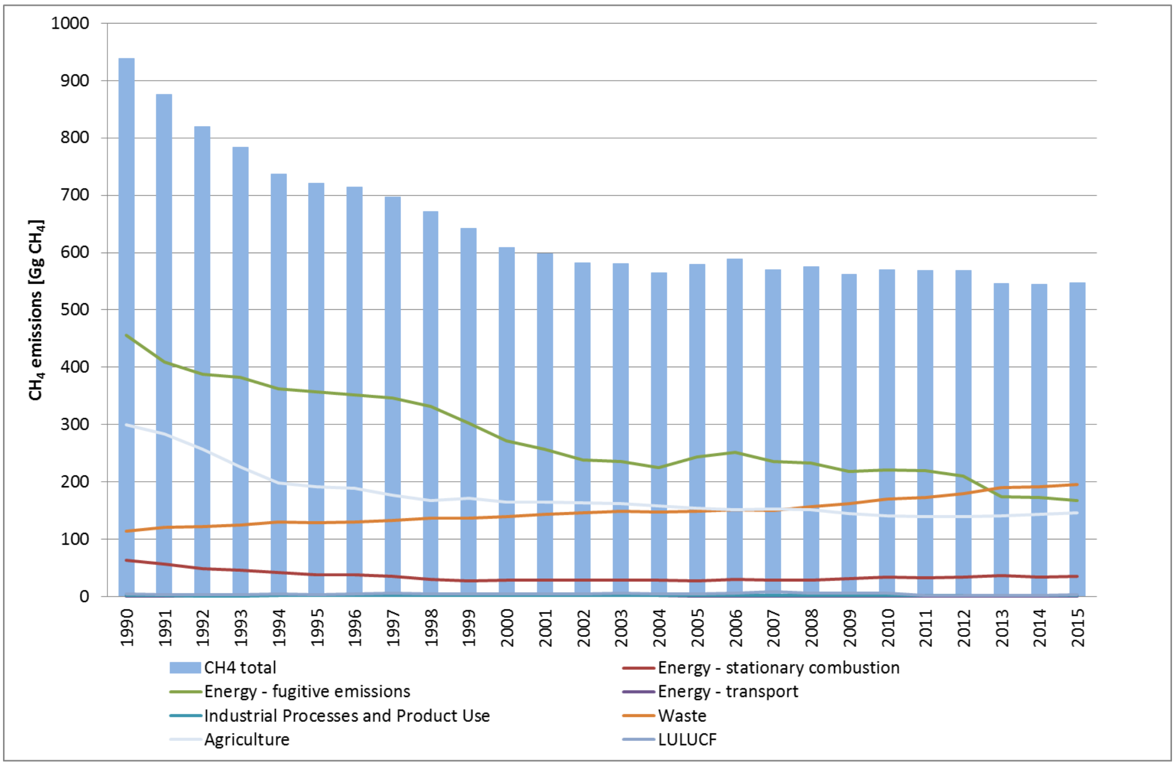
3.2.2.2 Methane

Anthropogenic emissions of methane are generated mostly by mining, fuel treatment and distribution; this type of source is designated as fugitive. Other significant sources of methane emissions are livestock, landfilling waste and treatment of wastewater. Livestock generates methane in digestive processes and during excrement decomposition. Landfilling produces methane during degradation of organic substances in anaerobic conditions; similar processes are present during anaerobic treatment of wastewater.

CH_4 emissions share decreased almost steadily during the period from 1990 to 2004, from 2004 methane fluctuated around 60% of its base year emissions. In 2015 CH_4 emissions were

41.60% below the base year level, mainly due to lower contribution of 1.B Fugitive Emissions from Fuels and emissions from 3 Agriculture and despite increase from the 5 Waste category. The main sources of CH_4 emissions are 1.B Fugitive Emissions from Fuels (solid fuel), 3 Agriculture (3.A Enteric Fermentation and 3.B Manure Management) and 5 Waste (5.A Solid Waste Disposal on Land and 5.B Wastewater Treatment and Discharge).

Figure 3.5: Trends of CH_4 emissions and shares of individual sector in the Czech Republic in the 1990 – 2015 period (Gg CH_4)



Source: CHMI

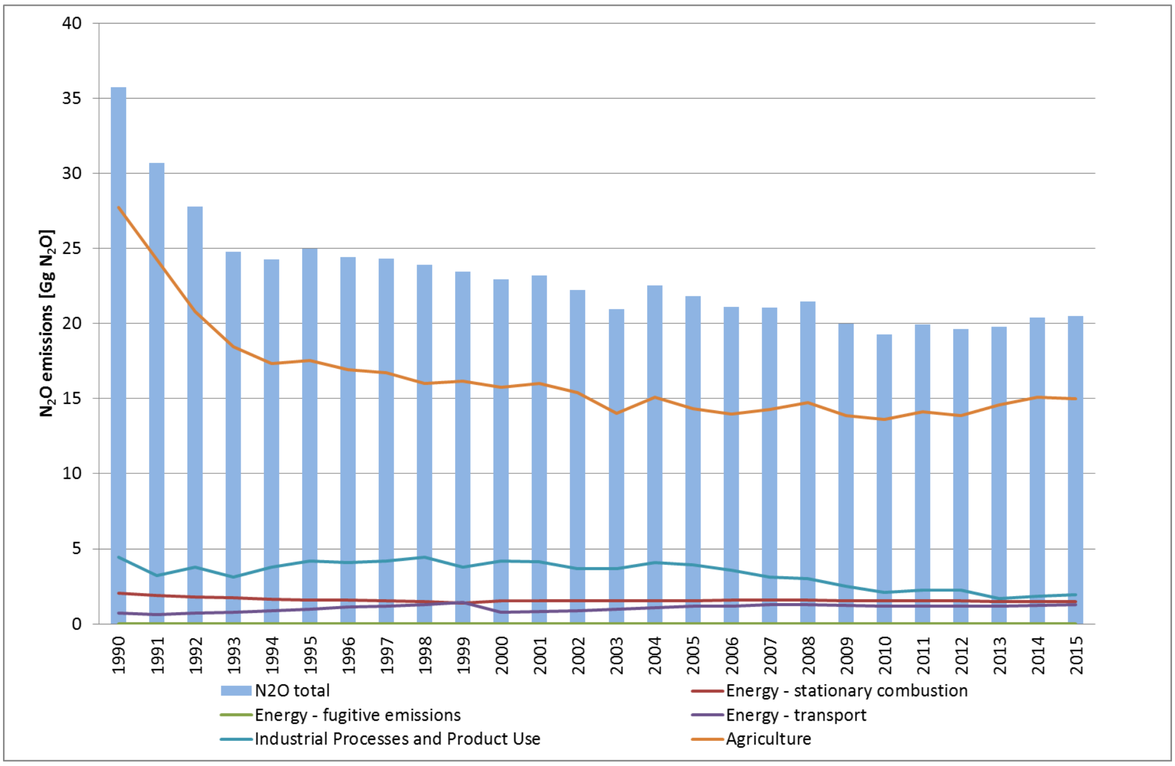
3.2.2.3 Nitrous oxide

The largest amounts of nitrous oxide (N_2O) emissions are produced in agriculture, especially by denitrification of nitrogen added to soil in the form of mineral fertiliser or organic materials. Other significant sources are production of nitric acid and Transport sector (automobiles with catalysers).

N_2O emissions strongly decreased from 1990 to 1994 by 32.11% over this period and then show slow decreasing trend with inter-annual fluctuation. N_2O emissions decreased between 1990 and 2015 from 10 642.52 to 6 112.73 kt CO_2 eq. In 2015 N_2O emissions were 42.56% below the base year level, mainly due to lower emissions from 3 Agriculture and 2.B Chemical Industry and despite increase from the 1.A.3 Transport category.

The main source of N_2O emission is category 3.D Agricultural Soils (others less important sources are 1.A Fossil Fuel Combustion and 2 Industrial Processes – 2.B Chemical Industry).

Figure 3.6: Trends of N_2O emissions and shares of individual sector in the Czech Republic in the 1990 – 2015 period (Gg N_2O)



Source: CHMI

3.2.2.4 F-gases

Emissions of fluorinated gases since 1995, which is the reference year defined by the Kyoto Protocol (KP), increased from 84.1 Gg CO_2 eq. in 1990, when emissions of SF_6 use started to be estimated, to 3549.9 Gg CO_2 eq. in 2015 and their share in total aggregated emissions increased from 0.1% in 1995 to 2.8% in 2015 (excl. LULUCF, incl. indirect emissions). These substances are not produced in the Czech Republic and the entire consumption is imported. Increase in these emissions is caused by replacing CFC and HCFC (ozone depleting substances) in cooling and by extended application of F-gases in modern technologies. This concerns especially HFCs in cooling sector, SF_6 in electronics and in other areas (for instance window insulation, plasma etching, fire extinguisher content, aerosol propulsion gases and expanding agents etc.).

HFCs

HFCs actual emissions increased remarkably between 1995 and 2015 from 0.32 to 3 455.08 kt CO_2 eq. Emissions of HFCs have been rapidly increasing since the base year 1995. In 2015, HFCs emissions were more than 10 000-times higher than in the base year 1995.

The main sources of HFCs emissions are 2.F Product Uses as ODS substitutes (Refrigeration and Air Conditioning).

PFCs

PFCs actual emissions show very similar trend as HFCs emissions but on much lower scale. They increased between 1995 and 2015 from 0.01 to 1.96 kt CO_2 eq. In 2015, PFCs emissions are over 200 times higher than in the base year 1995. HFCs and PFCs have not been imported and used before 1995.

The main sources of PFCs emissions are Semiconductor Manufacture, Refrigeration and Air Conditioning equipment.

SF_6

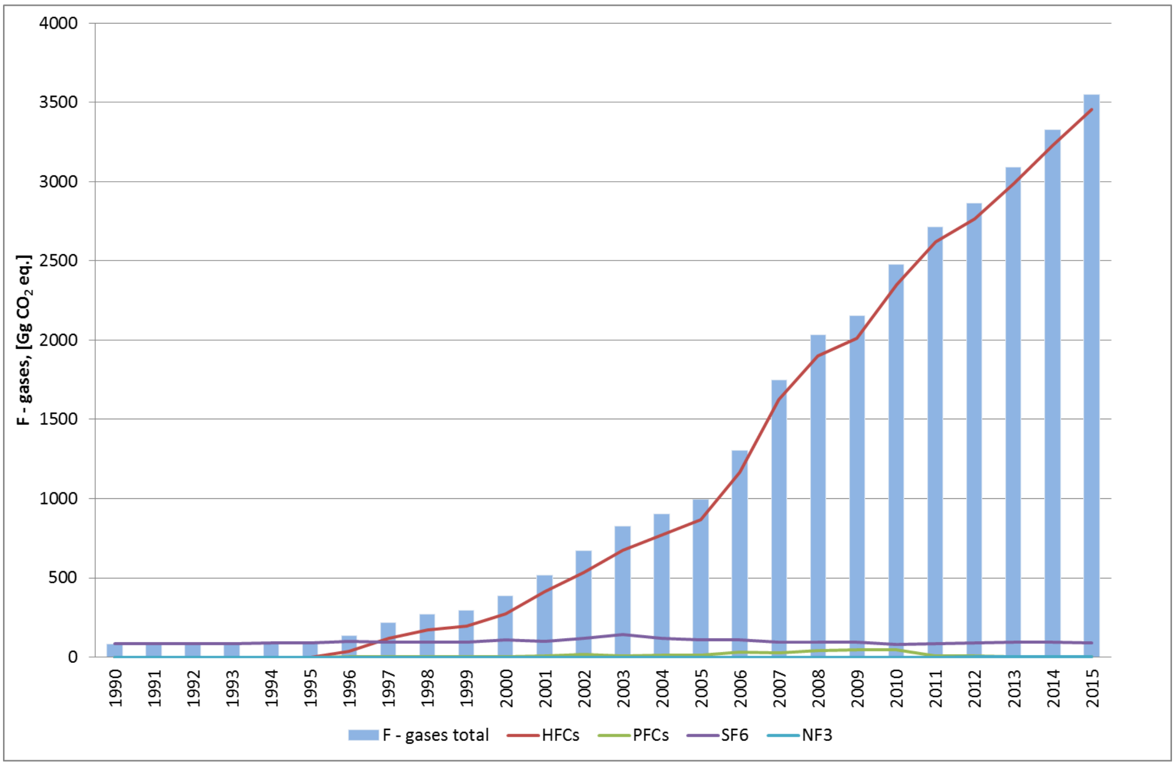
SF_6 actual emissions in 1995 accounted for 88.47 kt CO_2 eq. Between 1995 and 2015 they inter-annually fluctuated with maximum of 144.19 kt CO_2 eq. in 2003 and minimum of 80.23 kt CO_2 eq. in 2010. In 2015 SF_6 emissions reached amount of 90.55 kt, the level was 1.02% higher than the base year (1995).

The main sources of SF_6 emissions is 2.G Other product manufacture and use.

NF_3

With the technological progress a new gas was included in the emission inventory. NF_3 is a gas, used mainly for manufacturing of LCD displays, solar panels and etching semiconductors. Base year for this gas is 1995. In 2015 the emissions of NF_3 equalled to 2.29 kt CO_2 eq., which is 2.78% decrease, compared to year 2014.

Figure 3.7: F-gases inventories in the 1990 – 2015 period (Gg CO_2 eq.)



Source: CHMI

3.2.3 Description and interpretation of emission trends by category

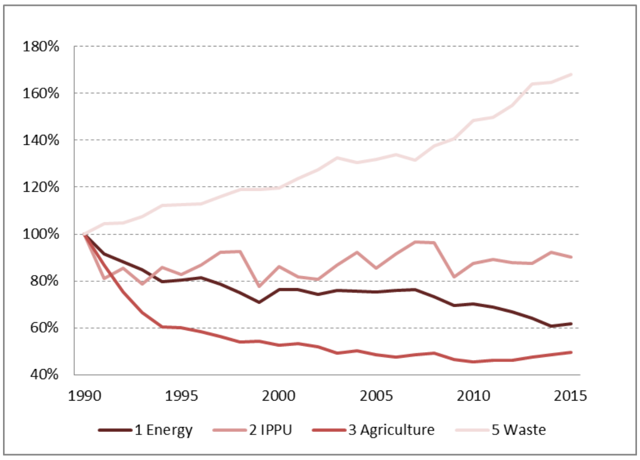
Figure 3.8 presents a summary of GHG emissions by categories for the period from 1990 to 2015:

- Category 1 Energy
- Category 2 Industrial Processes and Product Use
- Category 3 Agriculture
- Category 4 LULUCF
- Category 5 Waste

The dominant category is the 1 Energy sector, which caused 80.97% of total GHG emissions in 2015 (77.07% in 1990) excluding LULUCF, followed by the categories 2 Industrial Processes and Product Use and 3 Agriculture, which caused 12.12% and 6.67% of total GHG emissions in 2015 (8.72% and 8.71% in 1990, resp.), 5 Waste category covered 4.13% and 4 LULUCF category removed 6 640.69 kt CO_2 eq. which represents share of 5.22% of all GHG emissions.

The trend of GHG emissions by categories is presented in Figure 3.8 (indexed relative to the base year), see also the percentual share of individual sectors Figure 3.8.

Figure 3.8: Emission trends in 1990-2015 by categories in index form (base year = 100)



Source: CHMI

Table 3.2: Summary of GHG emissions by category 1990-2015 [kt CO_2 eq.]

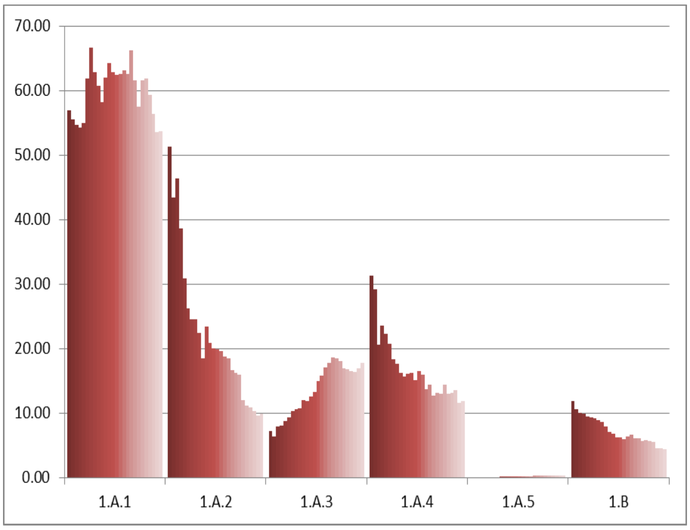
	1 Energy	2 IPPU	3 Agriculture	4 LULUCF	5 Waste
1990	158569.90	17080.37	17049.98	-6487.71	3126.83
1991	145280.83	13822.62	14776.05	-9608.86	3269.57
1992	139704.28	14587.97	12837.41	-10096.28	3279.01
1993	134456.29	13429.78	11358.39	-9692.70	3361.17
1994	126411.72	14667.86	10315.36	-7569.01	3509.75
1995	127386.59	14157.41	10245.64	-8046.44	3517.95
1996	129112.60	14834.19	9977.98	-8393.65	3528.62
1997	124793.12	15727.31	9593.14	-7476.59	3620.43
1998	119050.50	15833.77	9202.65	-7621.31	3723.39
1999	112492.12	13282.45	9271.62	-7905.05	3716.46
2000	120785.21	14720.47	8975.75	-8805.07	3743.17
2001	120948.03	13979.55	9082.41	-9133.21	3867.68
2002	117756.84	13767.46	8855.49	-8765.67	3989.00
2003	120347.94	14815.57	8388.58	-7266.25	4139.18
2004	120151.37	15745.25	8583.03	-7788.08	4074.26
2005	119563.18	14591.83	8257.49	-8134.59	4117.16
2006	120250.69	15663.66	8111.66	-5969.29	4185.89
2007	120821.36	16482.26	8265.07	-3759.54	4113.87
2008	116011.65	16438.62	8382.73	-6910.63	4302.21
2009	110539.82	13964.07	7929.92	-7932.08	4401.85
2010	111261.56	14965.30	7761.98	-7200.07	4637.01
2011	109071.35	15257.84	7904.13	-8388.97	4684.20
2012	105815.68	15012.07	7895.79	-8552.72	4837.84
2013	101510.15	14982.78	8128.87	-7920.23	5127.98
2014	96618.86	15787.85	8280.62	-7801.09	5151.31
2015	97973.60	15413.84	8482.99	-6640.69	5256.41
[1]%	**1.40%**	**-2.37%**	**2.44%**	**-14.87%**	**2.04%**
[2]%	**-38.21%**	**-9.76%**	**-50.25%**	**2.36%**	**68.11%**

¹ Difference relative to previous year
² Difference relative to base year

Source: CHMI

Energy (IPCC Category 1)

Figure 3.9: Trends in Energy by categories 1990-2015 (Tg CO_2 eq.)



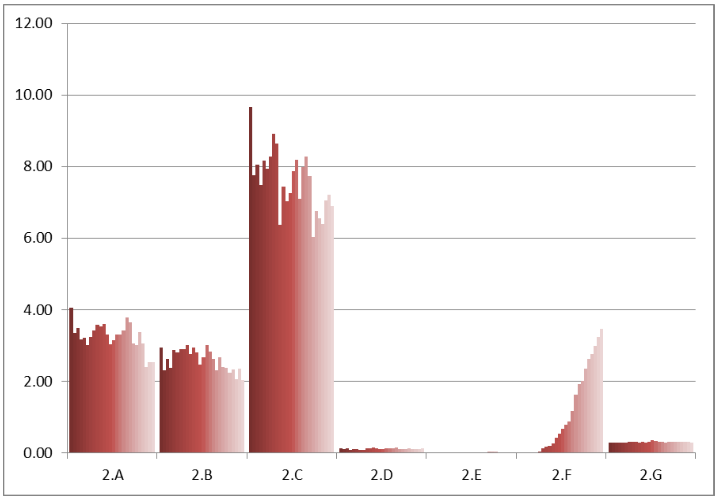
Source: CHMI

The trend for GHG emissions from 1 Energy category shows decreasing trend of emissions. They strongly decreased from 1990 to 1994 and then fluctuated by 2002. After 2002 they stayed relatively stable by 2007. In the period 2002 – 2007 emissions kept around 120 000 kt CO_2 eq. Total decrease between 1990 and 2015 is 38.21%. Between 2014 to 2015 emissions from category 1 Energy slightly increased by 1.40%.

From the total 97 973.60 kt CO_2 eq. in 2015 95.52% comes from 1.A Fuel Combustion, the rest are 1.B Fugitive Emissions from Fuels (mainly Solid Fuels). 1.B Fugitive Emissions from Fuels is the largest source for CH_4, which represented 30.62% of all CH_4 emissions in 2015. 37.22% of all CH_4 emissions in 2015 originated from Energy category.

CO_2 emissions from fossil fuels combustion (category 1.A Energy) are the main source in Czech Republic's inventory with a share of 88.52% in national CO_2 emissions (excl. LULUCF). CO_2 from category 1 Energy contributes for 73.62% to total GHG emissions, CH_4 for 6.60% and N_2O for 13.49% in 2015.

Figure 3.10: Trends in IPPU by categories 1990-2015 (Tg CO_2 eq.)



Source: CHMI

Industrial Processes and Product Use (IPCC Category 2)

GHG emissions from the 2 Industrial Processes and Product Use category fluctuated with decreasing trend during the whole period 1990 to 2015. In early 90's emissions decreased rather rapidly, then reached decade minimum in 1999 and subsequently decreased with total minimum in 2009 (global economic recession). Between 1990 and 2015 emissions from this category decreased by 9.76%. In 2015 emissions amounted for 15 413.84 kt CO_2 eq.

The main categories in the 2 Industrial Processes and Product Use category are 2.C Metal Industry (44.74%), 2.F Product Uses as ODS substitutes (22.43%), 2.A Mineral Industry (16.44%) and 2.B Chemical Industry (13.44%) of the sectoral emissions in 2015 (Figure 3.10).

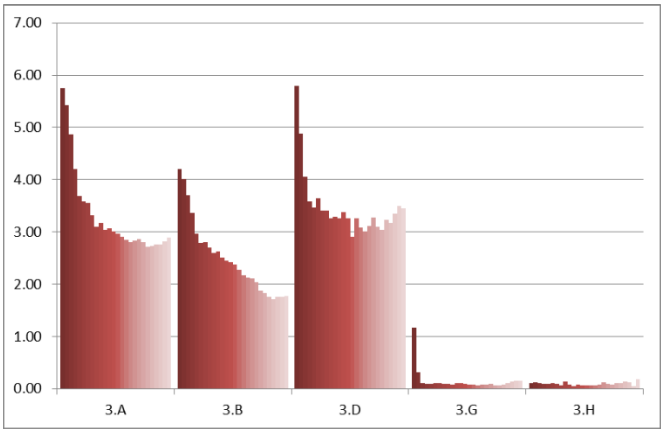
The most important GHG of the 2 Industrial Processes and Product Use category was CO_2 with 72.89% of sectoral emissions, followed by F-gases (23.04%).

Agriculture (IPCC Category 3)

GHG emissions from the category 3 Agriculture decreased relatively steadily over the period from 1990 to 2003 and then fluctuated. In 2010 emissions reached minimum level which is 54.48% below the base year level.

Agriculture amounted 8 482.99 kt CO_2 eq. in 2015 which corresponds to 6.67% of national total emissions (excluding LULUCF). The most important sub-category 3.D Agricultural Soils (N_2O emissions) contributed by 40.76% to sectoral total in 2015, followed by the 3.A Enteric Fermentation (CH_4 emissions, 34.14%).

Figure 3.11: Trends in Agriculture by categories 1990-2015 (Tg CO_2 eq.)



Source: CHMI

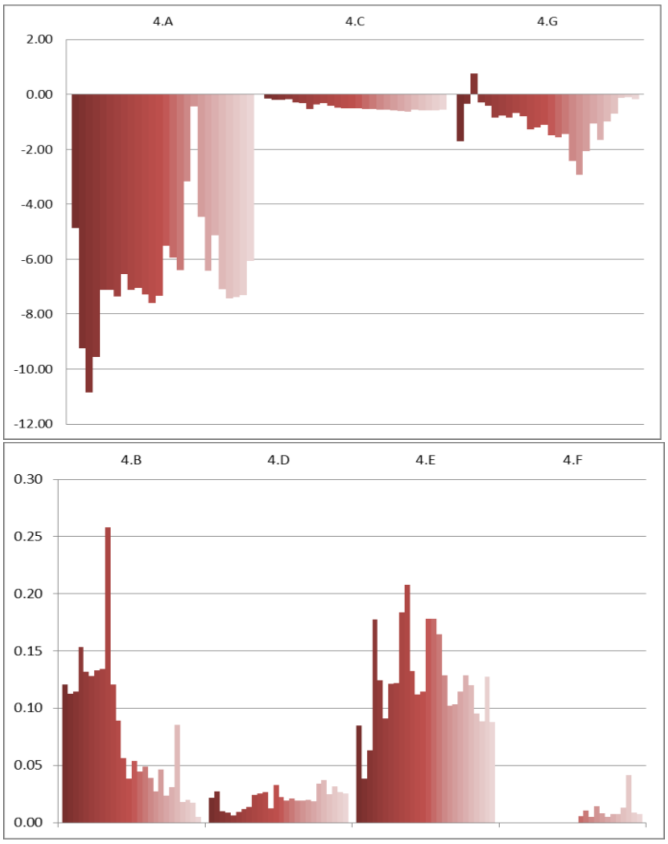
3 Agriculture is the largest source for N_2O and second largest source for CH_4 emissions (73.05% of total emissions of N_2O and 26.78% of total emissions of CH_4, excluding LULUCF). However it's emission trend steadily decreases over the whole observed period.

Land Use, Land-Use Change and Forestry (IPCC Category 4)

GHG removals from the 4 Land Use, Land-Use Change and Forestry category vary through the whole time series with minimum of -10 096.28kt CO_2 eq. in 1992 and maximum -3 759.54 kt CO_2 eq. in 2007. In 2015 removals were by 2.36% above the base year level.

Emissions and removals amounted to -6 640.69 kt CO_2 eq. in 2015, which corresponds to 5.22% of total national emissions. Emissions and removals are calculated from all categories and in line with GPG for LULUCF; IPCC 2003 and IPCC 2006 Gl.

Figure 3.12: Trends in LULUCF by separate source and sink categories 1990 – 2015 (Tg CO_2 eq.)

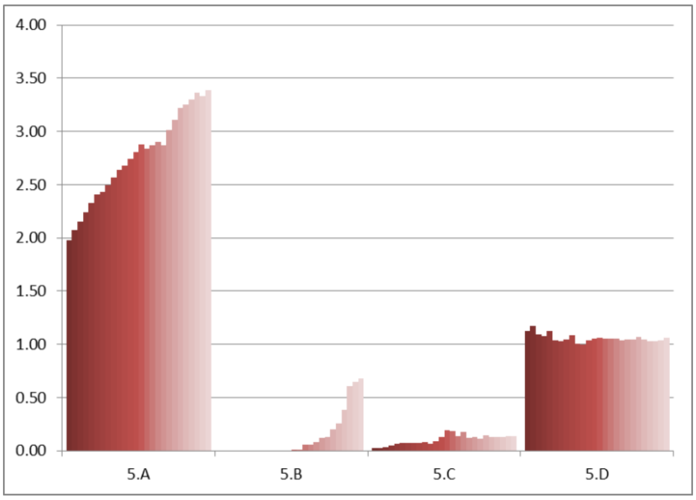


Source: CHMI

LULUCF category is the largest sink for CO_2. Net CO_2 removals from this category amounted to -6 735.41 kt CO_2 eq. in 2015. CH_4 emissions amounted to 81.91 kt CO_2 eq., N_2O to 12.81 kt CO_2 eq.

Waste (IPCC Category 5)

Figure 3.13: Trends in Waste by categories 1990-2015 (Tg CO_2 q.)



Source: CHMI

GHG emissions from category 5 Waste substantially increased during the whole period. In 2015 emissions amounted for 5 256.41 kt CO_2 eq., which is 68.11% above the base year level. The increase of emissions is mainly due to higher emissions of CH_4 from 5.A Solid Waste Disposal and due higher emissions in 5.C Incineration and open burning of waste. As a result of CH_4 recovery systems installed in 5.B Wastewater Treatment and Discharge total emissions from this category decreased by approx. 32% compared to the base year. The share of category 5 Waste in total emissions was 4.13% in 2015.

The main source is solid 5.A Solid Waste Disposal, which accounted for 69.37% of sectoral CH_4 emissions in 2015, followed by 5.D Wastewater Treatment and Discharge (17.64%) and 5.B Biological treatment of solid waste (12.99%).

92.83% of all emissions from Waste category are CH_4 emissions; CO_2 contributes by 2.52% and N_2O by 4.65%.

3.3 National greenhouse gases inventory system

3.3.1 Introduction

Article 5 of the Kyoto Protocol (KP) obliges Parties to build a fully functional national greenhouse gas inventory system (NIS) by the end of 2006, in line with rules promulgated at the 7th Conference of the Parties to the UNFCCC (Resolution 20/CP.7). The EU Member States are additionally committed by Regulation No. 280/2004/EC as replaced by Decision No. 525/2013 of 21 May 2013 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change.

The National Inventory System in the Czech Republic was launched in line with international treaties in 2005 and since then it’s been in operation without any interruption.

The objective of NIS is to ensure high-quality national inventory of GHGs so that it complies with all requirements whether imposed by relevant Decision or IPCC methodology. From practical point of view this means achieving required quality of national inventories, so that these pass regular international reviews. These reviews include especially annual UNFCCC inspection. Since 2011, the internal inspection carried out by the EC in cooperation with EEA has been growing in significance.

The main NIS functions include putting in place and operation of an institutional, legislative and procedural system that is necessary to fulfil all required activities included in the process of greenhouse gases inventory preparation. The Ministry of the Environment (national entity) is the body responsible for correct functioning of the NIS in the Czech Republic, and it administers the system via the Czech Hydrometeorological Institute (CHMI), which is the organization responsible for coordination of inventory preparation and required data and text outputs.

3.3.2 Institutional Arrangements

Person responsible for international reporting on greenhouse gases:
Mr. Pavel Zámyslický, Director of Energy and Climate Protection Dept., Ministry of the Environment
pavel.zamyslicky@mzp.cz

Person responsible for compilation of the inventory:
Ms. Eva Krtková, NIS Coordinator, Czech Hydrometeorological Institute
eva.krtkova@chmi.cz

The National Inventory System (NIS), as required by the Kyoto Protocol (Article 5.1) and by Regulation No. 525/2013/EC, has been in place since 2005. As approved by the Ministry of Environment (MoE), which is the single national entity with overall responsibility, the founder of CHMI and its superior institution.

The Czech Hydrometeorological Institute (CHMI), under the supervision of the Ministry of the Environment, is designated as the coordinating and managing organization responsible for the compilation of the national GHG inventory and reporting its results. The main tasks of CHMI consist in inventory management, general and cross-cutting issues, QA/QC, communication with the relevant UNFCCC and EU bodies.

In 2016/2017 the Czech National Inventory System has undergone some organizational changes:

- Ms. Beáta Ondrušová has been appointed as a sectoral expert to support inventory in Industrial Processes and Product Use sector;
- Mr. Martin Beck, which is no longer directly part of NIS team, is external QA experts of the NIS team.
- Denitsa Troeva Grozeva, MSc. has been hired to support national inventory team in scope of QA/QC process and Waste sector
- Jana Beranova has been hired as sectoral expert to support inventory in Agriculture sector. Zuzana Exnerova is no longer part of the inventory team, however she will serve as QA expert in future submissions.

No other significant changes occurred and the main pillars of the national inventory system declared in the Czech Republic's Initial Report under the Kyoto Protocol are operational.

Sectoral inventories are prepared by sectoral experts from sector-solving institutions, which are coordinated and controlled by CHMI:

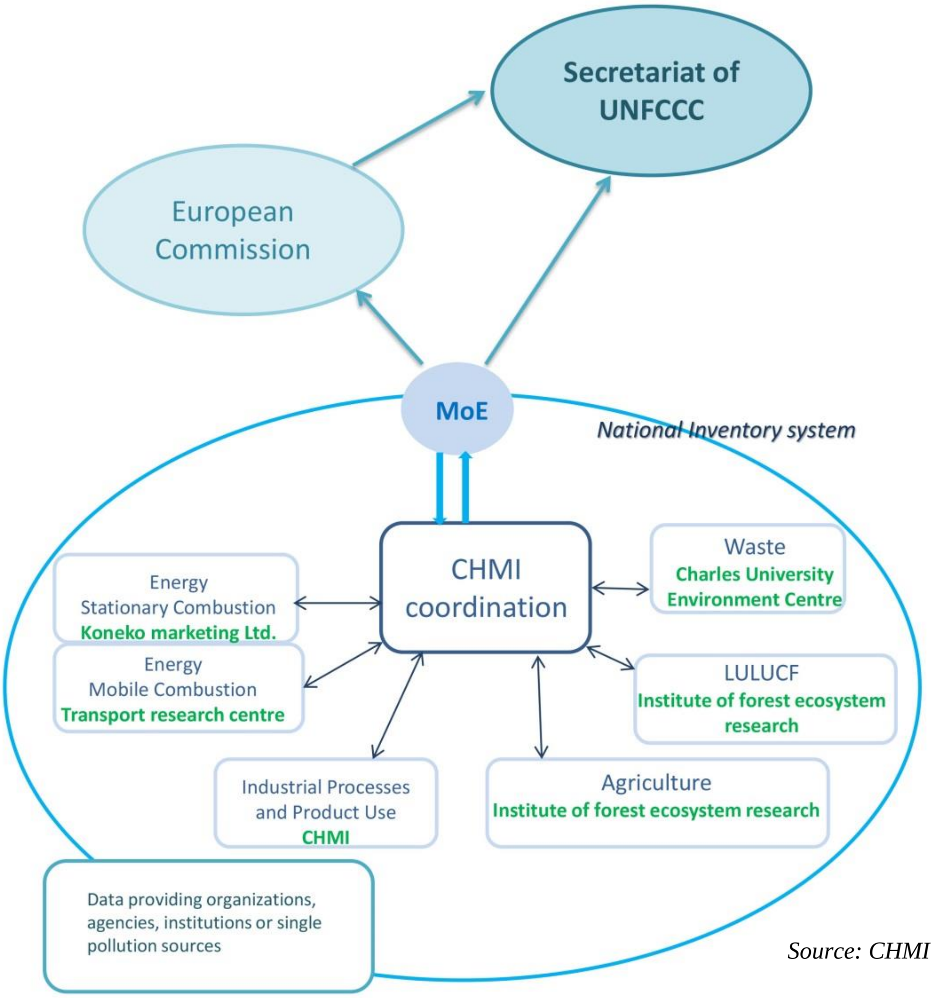
- KONEKO marketing Ltd. (KONEKO), Prague, is responsible for compilation of the inventory in sector 1. Energy, for stationary sources including fugitive emissions
- Transport Research Centre (TRC), Brno, is responsible for compilation of the inventory in sector 1. Energy, for mobile sources
- Czech Hydrometeorological Institute (CHMI), Prague, is responsible for compilation of the inventory in sector 2. Industrial Processes and Product Use

- Institute of Forest Ecosystem Research Ltd. (IFER), Jilove u Prahy, is responsible for compilation of the inventory in sectors 3. Agriculture and 4. Land Use, Land Use Change and Forestry
- Charles University Environment Centre (CUEC), Prague, is responsible for compilation of the inventory in sector 5. Waste.

One of the main pillars of NIS is allocation of responsibilities to institutions involved in inventory in individual sectors. The NIS Coordinator (CHMI) is primarily responsible for:

- Management (coordination of cooperation among individual sector agents)
- General and cross-section issues including determining the uncertainties
- QA/QC control procedures
- Data reporting in prescribed format - CRF (*Common Reporting Format*)
- Preparation of *National Inventory Report* (NIR)
- Cooperation with relevant UNFCCC and EU bodies
- Operation of complete archiving and documentation management system for the inventory.

Figure 3.14: Institutional arrangements of National Inventory System in the Czech Republic



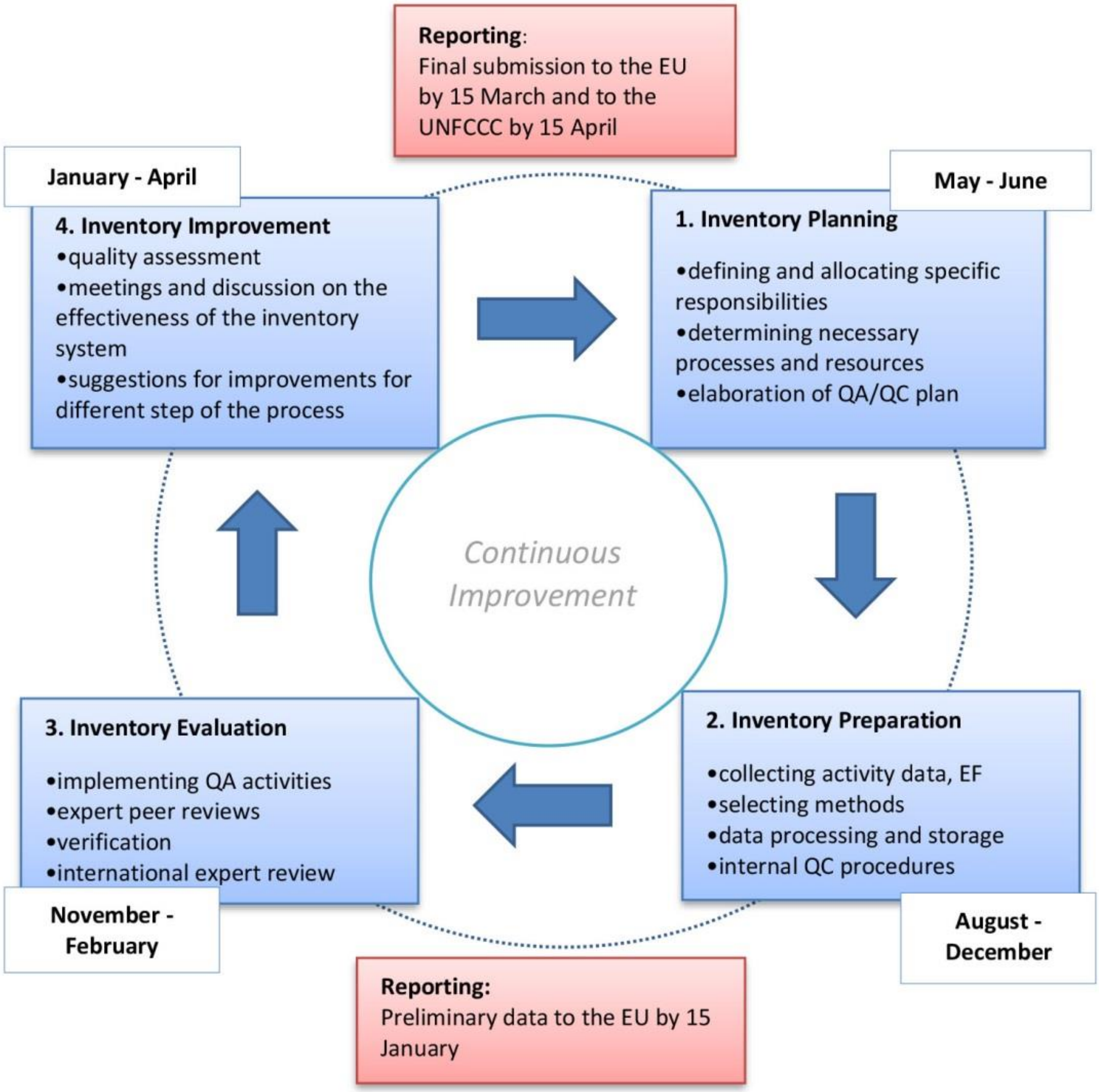
Source: CHMI

3.3.3 *Inventory process*

The annual inventory process describes at a general level how the inventory is produced by the national system. The quality of the output is ensured by the inventory experts in the course of compilation and reporting, which consist of four main stages: planning, preparation, evaluation and improvement (Figure 3.15). The quality control and quality assurance elements are integrated into the production system of the inventory; each stage of the inventory includes the relevant QA/QC procedures.

A clear set of documents is produced on the different work phases of the inventory. The documentation ensures the transparency of the inventory: it enables external evaluation of the inventory and, where necessary, its replication.

Figure 3.15: Time schedule of submissions and QA/QC procedures



Source: CHMI

3.3.4 Official inventory result approval process

The approval procedure is within the authorization of the Ministry of the Environment of the Czech Republic. The procedure involves that the report is sent by the Ministry of the Environment, well ahead via email, to the relevant ministries in the Czech Republic (e.g. Ministry of Finance, Ministry of Transport, Ministry of Foreign Affairs, Ministry of Education, Youth and Sports, etc.), organizations (e.g. Czech Environmental Inspectorate, Czech Environmental Information Agency, non-governmental organizations, etc.), as well as to the unions of different producers (e.g. Czech-Moravian Confederation of Trade Unions, Confederation of Industry of the Czech Republic, Association of Chemical Industry of the Czech Republic, Union of Czech and Moravian Production Co-operatives, Czech Cement Association, etc.) before the official submission to the UNFCCC for their comments and observations. This is the so called proceeding of external comments. Thereafter, comments and observations must be resolved by the Climate Change Department of the Ministry of the Environment in consultation with CHMI. Such procedure is in accordance with the Provision no. 11/06 of the Ministry of the Environment, regarding the procedure for preparation and hand-over of reporting information.

3.3.5 Methodical aspects

National inventory of greenhouse gases is based on the IPCC methodology and principles of good practice (IPCC 2006 Guidelines).

Inventory of greenhouse gas emissions is a multi-level process including data collection, estimating emission sources and sinks, controls and verification, determining uncertainties and reporting. The main phases of inventory are:

<u>Data collection:</u> Data collection is the most significant stage and in many cases it is the most difficult phase, directly affecting accuracy of emission determination. Methodological instructions require assessment as to the appropriateness of existing data sources, and potentially undertaking own emission measurements, or searching for new and more exact data sources.

Collection of activity data is based mainly on the official documents of the Czech Statistical Office (CzSO), which are published annually, where the Czech Statistical Yearbook is the most representative example. However for industrial processes, because of the Czech Act on Statistics, production data are not generally available when there are fewer than 4 enterprises in the whole country. In such cases, inventory compilers have to rely either on specific statistical materials edited by sectoral associations or, in some cases, inventory experts have to carry out the relevant inquiries. In a few cases, the Czech register of individual sources and emissions, called REZZO, is utilized as source of activity data.

Emission estimates from Sector 1.A Fuel Combustion Activities are based on the official Czech Energy Balance, compiled by the Czech Statistical Office. Recently data from EU ETS system are used as well. For the purposes of Energy sector these data are used more for control purposes. Furthermore, for the emission estimates in IPPU sectors EU ETS data are used in much higher extend. For some subcategories, e.g. Cement Production or Lime Production these data are used for the complete inventory; in the subcategories EU ETS data are mainly used for improving emission factors.

<u>Determining uncertainties</u>: This process provides valuable information for inventory compilers and for inventory users. Uncertainties must be defined for each separate category of sources, as well as for total emissions and their trends. Determination of uncertainties is one of the important principles of good practice as it helps inventory compilers to better focus on those

categories, which considerably contribute to larger uncertainty in emission estimates (including allocation of funding) and by that to gradual improvement of quality.

Identification of key categories: Good practice requires that key categories be identified. Key categories are important for use of development diagrams during selection of appropriate method, and the inventory coordinator seeks to apply more sophisticated higher tiers methods of inventory to these key categories.

QA/QC control procedures: Application of QA/QC processes represents an important phase in compiling NIR. QA/QC processes include planning, undertaking the controls themselves and reviewing relevant documentation, verification of data and their review by independent providers. Correct application of QA/QC processes is also one of good practice principles, allowing removal of potential mistakes and discrepancies.

Reporting inventory results: Reporting to UNFCCC bodies takes place annually on April 15. Documents submitted include:

- *National Inventory Report*
- Export of complete data inventory – in xml format
- CRF tables (*Common Reporting Format*)
- SEF tables (*Standard Electronic Format*)

Reporting to the EU takes place in two stages, first as of 15 January and final version as of 15 March, reporting for the EU matches the extent and quality of the report for UNFCCC.

IPCC 2006 Guidelines represent a set of instructions, recommendations and advice prepared by the IPCC, whose aim are to achieve the required quality of the result, and ensure that the inventory is not under- or over-estimated.

Text below specifies some other tools ensuring the required quality of reporting:

Tier approach: Depending on the complexity of the calculation and types of emission factors used (generally recommended - default, country-specific, site-specific and technology-specific), the approaches described in the IPCC methodology consist of three tiers. Tier 1 is typically characterized by simpler calculations, based on the basic statistical data and on the use of generally recommended emission factors (default) of global or continental applicability, tabulated directly in above mentioned methodical manuals.

Tier 2 is based on sophisticated calculation and usually requires more detailed and less accessible statistical data. The emission factors (country-specific or technology-specific) are usually derived using calculations based on more complex studies and better knowledge of the source. Even in these cases, it is sometimes possible to find the necessary parameters for the calculation in IPCC manuals. Procedures in Tier 3 are usually considered to consist in procedures based on the results of direct measurements carried out under local conditions.

Methods of higher tiers should be applied mainly for key categories. Key categories (key source categories) are defined as categories that cumulatively contribute 90% or more to the overall uncertainty either in level or in trend. Apparently, procedures in higher tiers should be more accurate and should better reflect reality.

Because of the above-described problems encountered in the application of the methods of higher tiers, these procedures have so far been introduced only for some key categories. For example, for combustion of fuels, country-specific factors are employed only for Brown/Hard Coal, Brown Coal + Lignite, Bituminous Coal, Coking Coal, Gas Works Gas, Refinery Gas, LPG and Natural Gas, while the default emission factors are employed for the rest of the other fuels combustion. For Bituminous Coal, Brown Coal + Lignite and Brown Coal Briquettes are used country specific oxidation factors as well. For Industrial Processes, the Tier 2 method is used for the production of iron and steel production, while for cement and lime production is used Tier 3. Higher tiers methods are used in Agriculture as well. In contrast, the methods of higher tiers and/or country-specific factors are employed far more frequently for other key categories.

Emission factors: As described above continuous development of country specific emissions factors is occurring. The choosing of emission factor and methodology for emission estimates is specific for each sector and category. For more information on emission factors and methodologies used please see Chapters 3 to 9 of National Inventory Report submitted in April 2017 to the UNFCCC.

Key categories: The key categories concept lies in identification of categories, which have significant impact on total national greenhouse gases emissions or which could contribute to uncertainties (trends) since 1990. Key categories contribute to total uncertainty of emission estimate in actual year or determining its trends. Key categories enjoy special attention in compiling the national inventory, demanding more complex methods and thorough application of QA/QC processes, and undergoing more rigorous methods in planning the inventory improvement. Prioritization of funding allocation is directly tied to the output of key categories' analyses.

Adherence to good practice principles leads to achieving all required quality criteria, which include: transparency, completeness, consistency, comparability and accuracy.

Transparency: Transparency means transparent and clear documenting of applied processes, allowing understanding how the inventory was compiled and whether all relevant principles of good practice were observed.

Completeness: National inventory must include all categories of sources and sinks of greenhouse gas emissions. Any missing categories must be clearly identified and appropriate justification provided why they could not be included in the inventory or what steps are being taken for their future inclusion.

Consistency: Ensuring consistency of time series is important for demonstrating credibility of trends. Methodological manual describes ways of ensuring this consistency. Inventory emissions in the entire period must be determined using identical methods and same or similar data sources. Time series should encompass development of emissions over time and not potential changes in methods applied during the monitored period.

Comparability: National inventory of greenhouse gases shall be complied in a manner allowing comparison with inventories taken in other countries. This may be achieved by application of unified IPCC methods, including identical classification of sources and sinks, identification of key sources, prescribed manner of reporting etc.

Accuracy: National inventory should not be over or under-estimated. It is therefore necessary to avoid systematic mistakes in estimating emissions.

Following the IPCC methodology (IPCC 2006 Guidelines) recalculations in estimating emissions and sinks are undertaken also in those cases when new and more credible data are obtained, or when there is a change in methodology leading to more accurate result. Having in mind the principle of consistency, these recalculations are undertaken for the entire time series. Most recalculations of an important nature were undertaken prior to submitting the Initial Report for the Czech Republic to the Kyoto Protocol. In recent years, recalculations in the Czech national inventory are undertaken mainly in connection with international reviews organized by the UNFCCC. These recalculations usually only slightly amend the previously estimated figures. For more detailed description of recalculations see Chapter 10 of the National Inventory Report submitted in April 2017 to the UNFCCC. For quantified effect of the recalculations see individual sectoral chapters of the NIR.

3.3.6 Key categories

The IPCC 2006 Guidelines (IPCC, 2006) provides two approaches of determining the key categories (key sources). Key categories by definition contribute to 90% percent of the overall uncertainty in a level (in emissions per year) - *Level Assessment* or in a trend - *Trend Assessment*. Approach 2 follows from this definition, and requires thorough analysis of the uncertainty and use of sophisticated statistical procedures and evaluation of sources in terms of the appropriate characteristics. The procedure of the Approach 2 is based on the results of the uncertainty analysis. The key categories were considered to be those whose cumulative contribution is less than 90%. For trend assessment, a similar procedure is used; with the difference that here the decisive quantity is defined as the product of the relative contribution to the total emissions (determined in the previous case) and the absolute value of the relative deviation of the individual trends from the total trend.

Following tables give a list of key categories, evaluated on the basis of emitted volume i.e. according to "emission level" (*Level Assessment*, LA), and in trends (*Trend Assessment*, TA) by Approach 1 and Approach 2. The lists are drawn up using 2015 data, trends account for results from 1990, which is the reference year according to the Convention.

Table 3.3: Identification of key categories by level assessment (LA) and trend assessment (TA) for 2015 evaluated with LULUCF (Approach 2)

IPCC Source Categories	GHG	Cumulative Total (LA, %)	Cumulative Total (TA, %)	KC type
1.A Stationary Combustion - Solid Fuels	CO_2	38.97	24.03	LA, TA
1.A Stationary Combustion - Liquid Fuels	CO_2	40.85	78.45	LA,TA
1.A.3.b Transport - Road Transportation	CO_2	52.46	46.10	LA, TA
1.A Stationary Combustion - Gaseous Fuels	CO_2	62.33	58.46	LA, TA
2.C.1 Iron and Steel Production	CO_2	67.41	98.67	LA
4.A.1 Forest Land remaining Forest Land	CO_2	71.93	83.84	LA, TA
5.A Solid Waste Disposal on Land	CH_4	75.27	89.16	LA, TA
2.F.1 Refrigeration and Air Conditioning Equipment (CO_2 eq.)	HFC	78.51	66.46	LA, TA
1.B.1.a Coal Mining and Handling	CH_4	81.19	83.96	LA, TA
3.D.1 Agricultural Soils, Direct N_2O emissions	N_2O	83.77	89.05	LA, TA
3.A Enteric Fermentation	CH_4	86.07	82.90	LA, TA
2.A.1 Cement Production	CO_2	87.12	94.24	LA
3.D.2 Agricultural Soils, Indirect N_2O emissions	N_2O	88.02	93.52	LA
3.B Manure Management	N_2O	88.89	89.77	LA, TA
1.B.2 Fugitive Emission from Oil, Natural Gas	CH_4	89.59	93.29	LA
3.B Manure Management	CH_4	90.25	89.77	TA
2.B.8 Petrochemical and carbon black production	CO_2	90.91	95.92	LA
4.G Harvested wood products	CO_2	98.23	81.41	TA
3.G Liming	CO_2	98.40	84.36	TA
1.A Stationary Combustion - Solid Fuels	CH_4	96.07	86.81	TA
5.B Biological treatment of solid waste	CH_4	92.84	88.79	TA
2.B.2 Nitric Acid Production	N_2O	96.51	90.50	TA

Source: CHMI

Table 3.4: Identification of key categories by level assessment (LA) and trend assessment (TA) for 2015 evaluated without LULUCF (Approach 2)

IPCC Source Categories	GHG	Cumulative Total (LA, %)	Cumulative Total (TA, %)	KC type
1.A Stationary Combustion - Solid Fuels	CO_2	41.44	23.59	LA, TA
1.A Stationary Combustion - Liquid Fuels	CO_2	43.43	72.06	LA, TA
1.A.3.b Transport - Road Transportation	CO_2	55.77	43.14	LA, TA
1.A Stationary Combustion - Gaseous Fuels	CO_2	66.27	53.94	LA, TA
2.C.1 Iron and Steel Production	CO_2	71.67	99.02	LA
5.A Solid Waste Disposal on Land	CH_4	75.23	81.77	LA, TA
2.F.1 Refrigeration and Air Conditioning Equipment (CO_2 eq.)	HFC	78.67	61.08	LA, TA
1.B.1.a Coal Mining and Handling	CH_4	81.52	77.19	LA, TA
3.D.1 Agricultural Soils, Direct N_2O emissions	N_2O	84.26	88.96	LA,TA
3.A Enteric Fermentation	CH_4	86.71	83.23	LA, TA
2.A.1 Cement Production	CO_2	87.82	94.80	LA
3.D.2 Agricultural Soils, Indirect N_2O emissions	N_2O	88.78	93.03	LA
3.B Manure Management	N_2O	89.70	85.68	LA, TA
1.B.2 Fugitive Emission from Oil, Natural Gas	CH_4	90.45	84.64	LA
3.G Liming	CO_2	98.73	84.57	TA
1.A Stationary Combustion - Solid Fuels	CH_4	96.90	86.85	TA
5.B Biological treatment of solid waste	CH_4	93.90	88.61	TA
3.B Manure Management	CH_4	91.15	89.65	TA
2.B.2 Nitric Acid Production	N_2O	97.12	90.32	TA

Source: CHMI

Table 3.5: Identification of key categories by level assessment (LA) and trend assessment (TA) for 2015 evaluated with LULUCF (Approach 1)

IPCC Source Categories	GHG	Cumulative Total (LA, %)	Cumulative Total (TA, %)	KC type
1.A Stationary Combustion - Solid Fuels	CO_2	41.92	23.09	LA,TA
1.A Stationary Combustion - Liquid Fuels	CO_2	43.93	67.53	LA, TA
1.A.3.b Transport - Road Transportation	CO_2	56.57	44.33	LA, TA
1.A Stationary Combustion - Gaseous Fuels	CO_2	67.30	56.19	LA, TA
2.C.1 Iron and Steel Production	CO_2	72.41	97.57	LA
4.A.1 Forest Land remaining Forest Land	CO_2	76.61	91.26	LA, TA
1.B.1.a Coal Mining and Handling	CH_4	79.28	72.40	LA, TA
2.F.1 Refrigeration and Air Conditioning Equipment (CO_2 eq.)	HFC	81.83	77.96	LA, TA
5.A Solid Waste Disposal on Land	CH_4	84.35	84.95	LA, TA
3.A Enteric Fermentation	CH_4	86.50	86.20	LA, TA
3.D.1 Agricultural Soils, Direct N_2O emissions	N_2O	88.41	92.07	LA, TA
2.A.1 Cement Production	CO_2	89.57	94.96	LA, TA
3.B Manure Management	N_2O	90.32	87.11	LA, TA
3.D.2 Agricultural Soils, Indirect N_2O emissions	N_2O	90.98	94.33	LA, TA
5.D Wastewater treatment and discharge	CH_4	91.62	96.20	LA
3.B Manure Management	CH_4	92.19	90.10	LA, TA
2.B.1 Ammonia Production	CO_2	92.74	99.29	LA
2.B.8 Petrochemical and carbon black production	CO_2	93.28	95.72	LA
5.B Biological treatment of solid waste	CH_4	93.75	100.00	LA
2.A.2 Lime Production	CO_2	94.20	93.09	LA, TA
1.B.2 Fugitive Emission from Oil, Natural Gas	CH_4	94.65	95.38	LA
4.G Harvested wood products	CO_2	98.73	81.50	TA
3.G Liming	CO_2	98.85	88.06	TA
1.A Stationary Combustion - Solid Fuels	CH_4	97.50	88.91	TA

2.B.2 Nitric Acid Production	N_2O	96.33	89.54	TA
1.A Stationary Combustion - Other fuels - 1A2	CO_2	95.86	91.89	TA
1.A Stationary Combustion – Biomass	CH_4	95.10	92.70	TA
2.A.2 Lime Production	CO_2	94.20	93.09	LA, TA
1.A.5.b Mobile sources in Agriculture and Forestry	CO_2	96.94	93.53	TA
1.A.3.b Transport - Road Transportation	N_2O	96.12	93.95	TA
1.A Stationary Combustion - Liquid Fuels	N_2O	95.57	94.13	TA
1.A Stationary Combustion - Other fuels - MSW	CO_2	98.18	94.66	TA
1.A.3.c Transport – Railways	CO_2	97.13	94.90	TA

Source: CHMI

Table 3.6: Identification of key categories by level assessment (LA) and trend assessment (TA) for 2015 evaluated without LULUCF (Approach 1)

IPCC Source Categories	GHG	Cumulative Total (LA, %)	Cumulative Total (TA, %)	KC type
1.A Stationary Combustion - Solid Fuels	CO_2	44.31	26.04	LA,TA
1.A Stationary Combustion - Liquid Fuels	CO_2	46.43	71.56	LA,TA
1.A.3.b Transport - Road Transportation	CO_2	59.79	47.69	LA,TA
1.A Stationary Combustion - Gaseous Fuels	CO_2	71.13	59.60	LA,TA
2.C.1 Iron and Steel Production	CO_2	76.53	99.66	LA
5.A Solid Waste Disposal on Land	CH_4	79.20	85.98	LA,TA
1.B.1.a Coal Mining and Handling	CH_4	82.01	76.77	LA,TA
3.A Enteric Fermentation	CH_4	84.29	87.38	LA,TA
2.F.1 Refrigeration and Air Conditioning Equipment (CO_2 eq.)	HFC	86.98	82.48	LA,TA
3.D.1 Agricultural Soils, Direct N_2O emissions	N_2O	89.00	91.82	LA,TA
2.A.1 Cement Production	CO_2	90.22	94.94	LA,TA
3.B Manure Management	N_2O	91.01	88.36	LA,TA
2.B.8 Petrochemical and carbon black production	CO_2	91.58	96.99	LA
3.D.2 Agricultural Soils, Indirect N_2O emissions	N_2O	92.28	94.65	LA,TA
3.B Manure Management	CH_4	92.88	90.87	LA,TA
5.D Wastewater treatment and discharge	CH_4	93.56	96.47	LA
2.B.1 Ammonia Production	CO_2	94.14	98.46	LA
1.A Stationary Combustion - Liquid Fuels	N_2O	94.25	94.83	LA,TA
2.A.2 Lime Production	CO_2	94.73	93.53	LA,TA
3.G Liming	CO_2	98.94	89.37	TA
1.A Stationary Combustion - Solid Fuels	CH_4	98.81	90.26	TA
2.B.2 Nitric Acid Production	N_2O	97.60	91.54	TA
1.A Stationary Combustion - Other fuels - 1A2	CO_2	96.96	92.46	TA
1.A Stationary Combustion – Biomass	CH_4	96.46	93.10	TA
1.A.5.b Mobile sources in Agriculture and Forestry	CO_2	97.38	93.98	TA
1.A.3.b Transport - Road Transportation	N_2O	95.98	94.41	TA

Source: CHMI

On the whole, 20 key categories were identified either by level assessment or by trend assessment. A summary of the assessed numbers concerning key categories is given in Table 3.6.

Table 3.7: Figures for key categories assessed

	Approach 1	Approach 2
Key categories (KC) with LULUCF	33	22
KC identified by LA	21	17
KC identified by TA	26	17
KC identified by LA + TA concurrently	16	11
KC identified by only LA	6	5

KC identified by only TA	11	6
Key Categories (KC) without LULUCF:	26	19
KC identified by LA	19	14
KC identified by TA	22	15
KC identified by LA + TA concurrently	15	10
KC identified by only LA	4	4
KC identified by only TA	7	5

3.3.7 Inventory uncertainties

Determination of uncertainties is one of the most important principles of good practice in the emission inventory. Analysis of uncertainties characterizes extent (i.e. possible interval) of results of the entire national inventory, as well as of its individual components. Knowledge of partial and overall uncertainties allows compilers to better understand the inventory process, which includes collecting of appropriate input data and their evaluation. Analysis of uncertainties assists in identifying those categories of emission sources and shares, which contribute the most to total uncertainties and determining priorities for further improvement of quality.

Analysis of uncertainties is based on partial uncertainties of activity data for individual categories of sources and their shares, as well as on uncertainties corresponding to emission factors and other parameters required for calculation. These partial uncertainties are expressed in the form of statistical characteristics, or on the basis of an expert assessment (if there is a lack of data for determining statistical characteristics). Resulting values are then uncertainties of total greenhouse gas emissions and their trend. To this end, one can use the method of error propagation based on mathematical-statistical relations for calculation of sum variations or product from corresponding variations of its individual terms. IPCC methodological manual (IPCC 2006) provides a solid ground for this calculation, which is also being used for the Czech national inventory of greenhouse gases. The recommended more robust method for determining uncertainties (Tier 2), which better works with partially dependent values (which is also the case in national inventory) and asymmetric interval of reliability is based on stochastic modelling using the Monte Carlo method. Preparation for use of this more sophisticated method has already been completed by the Czech team and in the coming years it will be implemented.

Uncertainty analysis of Tier 1, which is presented in the latest National Greenhouse Gas Inventory Report of the Czech Republic, employs the same source categorization as used in key categories assessment.

Results of uncertainty assessment were obtained (i) for all sectors including LULUCF and (ii) for comparison also for all sectors without LULUCF.

The estimated overall uncertainty in level assessment (case with LULUCF) reached 3.72%. The corresponding uncertainty in trend is 2.41%.

For the case without LULUCF the estimated overall uncertainty in level assessment is 3.39% and 2.29% in trend.

3.3.8 QA/QC control procedures

QA/QC processes are carried out annually pursuant to updated plan. Plan preparation reflect institutional arrangement: each institution prepares its own QA/QC procedures, including authorization of responsible QA/QC expert for each sector. Sector QA/QC plan is an integral part of the entire QA/QC plan, which is drafted by NIS coordinator. National inventory of greenhouse gases is a part of client processes at CHMI, which follow the ISO 9001 quality standard (CHMI obtained certification in 2007). Processes relating to national inventory are elaborated in the form of development diagrams and include all main principles that need to be adhered to during compilation of the inventory including QA/QC processes.

QC processes include routine technical inspections of inventory quality so as to ensure consistency, integrity, accuracy and completeness of the data and to reveal and remove any error and omissions. QC processes are applied to all fundamental processes carried out during inventory: data collection, selection of appropriate method and emission factors, and calculations of emissions and processes documentation. These QC procedures are carried out in line with *IPCC 2006 methodology*. Sector compilers undertake parts of these processes; the remainder is carried out by NIS coordinator. Sector compilers focus primarily on activity data control, emission factors and applied sector-specific methods, NIS coordinator reviews appropriateness of method selection, analyses trends and compares data from several possible sources. Sector compilers and NIS coordinator use control tools available in CRF *Reporter*.

QA processes include control activities and review by third parties not directly involved in national inventory compilation, but who are competent in the given field. CHMI cooperates on QA processes with Slovak experts from SHMI, who are involved in compilation of the Slovak national inventory. Active control role is obviously assumed by the Ministry of the Environment, which reviews all drafts at least two weeks before the official submission of national results.

Regular international inspections undertaken by the UNFCCC play a large role in increasing the quality of national inventory. Inspections identify shortcomings and provide recommendations that are thoroughly analysed by the Czech NIS team; inspection conclusions are then used in order to improve quality of the Czech national inventory.

More detailed description of the quality assurance and quality control plan and its implementation is provided in Chapter 1.5 “Information on the QA/QC Plan” of the National Inventory Report submitted in April 2017 to the UNFCCC.

3.3.9 Systematic improvement of inventory quality

Plan for improvement of inventory quality also constitutes one of the good practice tools besides being one of the fundamental provisions of the Kyoto Protocol (KP) (Art.10, para a-f). The National inventory system has drafted and annually updates improvement plan for the existing inventory system. One of the basic tools for this planning is, among other, analysis of key categories.

The improvement plan is yearly evaluated and updated. Focus on the improvement is on key categories, as well as on the development of country specific emissions factors and other necessary computational factors. Important part of the improvement plan are annual reviews held by UNFCCC and EU.

For further details please consult Chapter 1.2.3.4 and Chapter 10 of the National Inventory Report submitted in April 2017 to the UNFCCC.

3.3.10 Systematic Minimization of adverse impacts and effects under articles 3.14 and 2.3 of the Kyoto Protocol / Information on assessment of consequences of response measures

For information on Minimization of Adverse Impact see Chapter 15 of the National Inventory report submitted in April 2017 to the UNFCCC. More information on the EU-wide assessment procedures is available in section 4.4 of the EU 3rd Biennial Report.

3.4 National emission trading registry

The European Union Emissions Trading Scheme (EU ETS) has been established by Directive 2003/87/EC, as amended. The EU ETS has been a part of the Kyoto Protocol (KP) since 2008. According to the Commission Regulation (EU) No. 389/2013 of 2 May 2013 establishing a Union Registry pursuant to Directive 2003/87/EC, as amended, each Member State is obliged to use the single EU registry which functions as KP registry.

The national registry has been operated since 2005 by OTE, corp., company on the basis of authorization issued by the Ministry of the Environment. The single EU registry was fully implemented in June 2012. Only duly authorized representatives of account holders can access the registry.

The registry serves to provide accurate evidence of issuance, holding, transfers and cancellations of allowances. EU ETS allowances and Kyoto units are recorded in individual accounts of the parties, operators' accounts, aircraft operators' accounts, trading accounts or personal accounts. According to Act No. 383/2012 Coll. on conditions of trading with greenhouse gas emission allowances, as amended, all facility operators holding Ministry of the Environment permit to discharge greenhouse gases into air, have the obligation to establish an account in the registry. Since January 2012, the same obligation is imposed on aircraft operators with operating license issued in the Czech Republic or who fall under the Czech administration pursuant to the list of aircraft operators issued by the EC. Trading account or personal account may be opened by any natural or legal entity including facility of (aircraft) operators, who already have an operator's account.

OTE, corp., company as the administrator of the Registry operates an internet emission trading portal at https://www.povolenky.cz/

Contact information:
OTE, corp. (Czech electricity and gas market operator)
Sokolovská 192/79, 186 00 Prague 8 – Karlín
Telephone: +420 296 579 329
Fax: +420 296 579 180
e-mail: povolenky@ote-cr.cz

The EU Member States, which are also Parties to KP, including also Iceland, Lichtenstein and Norway have decided to operate national registry in consolidated form in line with all relevant decisions applicable to Parties' registries – namely Decision 13/CMP.1 and 24/CP.8. Consolidated platform implementing national registries (including EU registries) is called CSEUR - Consolidated System of EU Registries)

In 2012, the EU registry underwent fundamental change / development in line with new requirements laid down by Commission Regulation 920/2010 and Commission

Regulation 1193/2011 and in line with CSEUR implementation. Both regulations are now replaced by Commission Regulation (EU) No. 389/2013. Transfer to the Consolidated System of EU Registries initiated changes in security system and control systems and in minimizing of discrepancies during manipulation with individual unit types (ERU, CER, tCER, lCER, AAU, RMU).

The registry information system conforms to DES. The UNFCCC Secretariat has verified DES compatibility during initiation procedure prior to connection into EUTL and by a set of testing scenarios. The registry successfully completed all these tests and obtained required certificates on 1 June 2012, please refer to Figure 3.16.

Complete description of functionalities and technical details of consolidated registries have been provided to UNFCCC within the framework of common/specific readiness documentation of EU national registries and all consolidated national registries. The overview of security measures, list of publicly accessible information and description of disaster recovery plan is provided in Chapter 14.2 of the National Inventory Report (NIR), which was submitted to the secretariat of the UNFCCC in April 2017, and separate annexes referenced in Chapter 14.2 which were submitted together with NIR.

Figure 3.16: UNFCCC certificate

United Nations
Framework Convention on
Climate Change

Recertification Certificate

Party	***Czech Republic***
Issue Date	**01-06-2012**

This certificate confirms that the national registry of *Czech Republic* has successfully passed all recertification tests pursuant to the release of the change of the consolidation of European national registries:

Test Item	Date Passed
Common readiness documentation review	15/12/2011
Specific readiness documentation	31/05/2012
Connectivity reliability test	30/05/2012
Distinctness test	9/12/2011
Interoperability test	30/05/2012

As a result of the execution of the abovementioned tests, the following comments/remarks shall be taken into account:

Item	Comment
SEF	Support of the standard electronic format (SEF) shall be tested and implemented by September 2012

Jörg Kirschbaum

for the ITL Administrator

4 POLICIES AND MEASURES, LEGISLATION AND PROGRAMMES WITH IMPACT ON GREENHOUSE GAS EMISSIONS REDUCTION

4.1 System of climate policies and legislation

4.1.1 Climate policy development

The Ministry of the Environment is responsible for the compliance with the UNFCCC, the Kyoto Protocol and the Paris Agreement in the Czech Republic; the Ministry of the Environment is also the supreme State administration body in the area of environmental protection. The climate change agenda is addressed primarily within the Department of Energy and Climate Protection which also includes the national focal point for the Convention, Protocol and the Paris Agreement in the Czech Republic. Having in mind the cross-sectoral nature of climate change issues, which affects many other departments, the Ministry of the Environment is responsible primarily for the drafting of national policies in areas of mitigation and adaptation. Individual State departments (Ministries), such as Ministry of the Environment, Ministry of Industry and Trade, Ministry of Transport, Ministry of Agriculture, Ministry of Regional Development etc. are then responsible for drafting and implementation of sector-specific policies and measures aiming to reduce emissions of greenhouse gases and/or adapt to climate change impacts, according to the nature of measure.

4.1.2 National and regional programmes, legislative tools and administrative procedures

With regard to the size of the Czech Republic, arrangement of its State administration and division of powers between central and regional bodies pursuant to Act No. 129/2000 Coll., on Regions, as amended, the Regions do not have a direct competence in the area of protection of global climate system. Nevertheless, the Regional bodies remain responsible, pursuant to Section 1 and 14 of Act No. 129/2000 Coll., on Regions, as amended, for overall development of its territory and for addressing the needs of its population in general terms. This is the foundation of the regional role of responsible bodies in creation of Regional development concepts and plans including water management plans for river basins and flood prevention measures, principles of territorial development including use of renewable energy sources (RES). Regional bodies are also involved in implementation of the below specified energy savings programmes and use of RES, restoration of housing fund (central heating supply systems, revitalization of housing estates) and improvement of transportation infrastructure. Regions also play a large role in preparation of waste management plans and in actual waste management (operation of landfills, composting facilities, facilities involved in energy and material recovery of waste etc.).

Measures of a legislative nature play an important role in the Czech Republic, not only imposing a number of obligations on the state administration and also natural and legal persons, but also providing for the preparation and revision of important strategic documents and programmes.

Since 2000, an integrated and complex system of strategic and operational planning has gradually been created, which is further modified in line with international commitment of the Czech Republic whether assumed pursuant to post-Kyoto processes or EU policies and legislation. Legislative measures also lay down rules for institutional responsibilities for coordination and implementation of various programmes and impose obligations for their regular evaluation.

Wider strategic framework is created primarily by the following documents:

- Czech Republic 2030 (adopted by the Czech Government in 2017),
- National Strategic Reference Framework (2007 – 2013),
- National Reform Programme (updated annually, last update in 2017),
- Strategy of the Regional Development 2014 – 2020 (adopted in June 2013).

The most important strategic documents with direct or demonstrable indirect effect on greenhouse gas emissions:

- State Environmental Policy 2012-2020 – see Chapter 2.5
- National Emission Reduction Programme – see Chapter 4.3
- Climate Protection Policy of the Czech Republic – see Chapter 4.3
- Strategy on Adaptation to Climate Change in the Czech Republic – see Chapter 6.3
- National Action Plan on Adaptation to Climate Change – see Chapter 6.3
- State Energy Policy – see Chapter 4.3
- National Emission Reduction Programme – see Chapter 4.3
- National Action Plan for Clean Mobility – see Chapter 4.3
- National Action Plan for Energy Efficiency – see Chapter 4.3
- National Renewable Energy Action Plan – see Chapter 4.3
- Waste Management Plan 2015 – 2024 – see Chapter 4.3

Annex 4 gives an overview of all measures (direct and indirect) according to sectors and gases. This overview is based on the recommended methodology for preparation of the National Communication.

4.2 Legislative instruments

This chapter gives an overview of the key legislation especially in the area of emission trading system, air protection, industrial emissions, energy sector and waste.

4.2.1 Goverment Decree No. 173/2016 Coll., on determining binding award criteria of public contracts for the acquisition of road vehicles specifies, in connection with procurement of vehicles, that contracting authorities must define technical specification, including consumption, emissions of CO_2, NOx, hydrocarbons and particles.

4.2.2 Act No. 310/2013 Coll., on supported sources of energy

This Act amends Act No. 165/2012 Coll., on supported of energy sources (SES Act), as amended by Act No. 407/2012 Coll., and other laws. The amendment cancels support provided to new electricity generating facilities from renewable sources from 2014, with one-year transition, allowing completion of projects in progress. It also defines the maximum fee levied for the support of renewable sources, which will be collected from customers within the regulated price of electricity and introduces levy on electricity generated from solar radiation effective as of 1. 1. 2014 for facilities put into operation in 2010.

The Act transposes Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

This Act regulates:

a) Support provided to generation of electricity, heating and bio-methane from renewable sources of energy (RES), secondary energy sources (“secondary source“), highly efficient combined production of electricity and heat and decentralized electricity generation, exercise of state administration and related rights and obligations of persons involved,

b) Content and creation of the National Action Plan of the Czech Republic pro energy from RES (“National Action Plan”),

c) Conditions for issue, record-keeping and acknowledging guarantees of energy originating from RES,

d) Conditions for certification on origins of electricity generated from highly efficient combined production of electricity and heat or from secondary sources,

e) Financing of the support of electricity generated from supported sources, heat from RES, decentralized electricity production, bio-methane and provision of subsidy to market operator to cover these expenses,

f) Levies on electricity generated from solar radiation,

g) The purpose of this Act is to protect climate and the environment,

h) Support provided to use of RES, secondary sources, highly efficient combined generation of electricity and heat, bio-methane and decentralized of electricity production,

i) Increase of the share of RES on consumption of primary energy sources,

j) Contribute to efficient use of natural sources and permanently sustainable social development,

k) Creation of conditions for the fulfilment of binding share of energy from RES on the gross final consumption of energy in the Czech Republic while simultaneously reflecting interests of the customers on minimising the impacts on energy prices in the Czech Republic.

The main purpose of this amendment to the SES Act was to introduce measures aimed to stabilize the impact of support for energy from RES on the Czech industry competitiveness and on the citizens of the Czech Republic due to the increasing financial burden of this support.

Key changes to the SES Act included namely:

- Suspension of support for electricity from RES (excluding hydropower plants with an installed capacity of up to 10 MW) generated in plants commissioned after 1 January 2014;
- Suspension of support for production of biomethane after 31 December 2013 (due to the length of time required to finish installations under construction;
- Support for wind power plants commissioned by 31 December 2014 and hydropower plants with an installed capacity of over 10 MW commissioned by 31 December 2015 shall be maintained);
- Continued support for secondary sources, in particular waste for incinerators;

- Cessation of support for decentralized production;
- Continuation of solar levy for installations commissioned in the year 2010;
- Fixing the contribution to the supported RES in cost of electricity for end consumers.
- Separation of the price component for support of RES and other supported sources from the prices for electricity transmission and distribution and its inclusion in a special price to cover costs associated with support for electricity and heat and setting a ceiling for this price at CZK 495/MWh;
- Change in the solar levy on electricity generated after 1 January 2014.
- As of 31 July 2014, aid recipients will be required to disclose their owners (in response to passing of Act No. 134/2013 Coll., on Certain Measures to Improve Transparency of Joint Stock Companies and on Amendments to Other Laws).

4.2.3 Act No. 134/2016 Coll., on Public Procurement

The Public Procurement Act specifies, in connection with procurement of vehicles, that contracting authorities must define technical specification, including consumption, emissions of CO_2, NO_x, hydrocarbons and particles.

The new Act no. 134/2016 Coll., on public procurement (effective from October 2016) reflects public procurement of environmentally friendly. Contracting authorities may, when determining the terms and conditions take into account the impact on the environment. Environmental requirements can be evaluated in the evaluation and also in the context of the life cycle (the Contracting authority will evaluate the costs). New at national and european regulation - the inconsistency of legislation on the environment is a reason for exclusion under § 48 of the Act. Formulation of § 48 of the Act is general, Contracting authority has a wide scope.

4.2.4 Act No. 383/2012 Coll., on Conditions of Trading with Greenhouse Gas Emission Allowances

This Act transposes Directive 2003/87/EC as amended by Directive 2009/29/EC and simultaneously introduces a lot of changes to EU ETS (European Union Emissions Trading Scheme) for the third trading period 2013-2020. This Act defines the rights and obligations of the entitities which participate in this system.

Besides Directive 2009/29/EC, the functioning of the EU ETS is also regulated by other EU legislation. The Act implements this regulation, respectively adapts the directly applicable EU regulation (Regulation 1031/2010/EU on auctioning, Regulation 601/2012/EU on monitoring and reporting, Regulation 600/2012/EU on accreditation and verification, Regulation1193/2011/EU on registries, Commission Decision 278/2011/EU on benchmarks, Commission Decision 2010/2/EU on vulnerable sectors).

The EU ETS gradually moves, within the framework of third trading period, from free allocation of allowances to the system of auctions, and the share of allowances sold through auctions will gradually increase.

Directive 2009/29/EC imposes obligation on Member States to use at least 50% of revenues generated from auctions for pre-defined purposes, which primarily involve reduction of GHG emissions and adaptation to negative effects of climate change. The Act No. 383/2012 Coll. implements these obligations so that 50% of auction revenues to be used to decrease energy intensity of buildings, support innovations and clean technology in industry, compliance with the Czech Republic's international commitment in the area of climate protection and to cover administrative costs associated with ETS operation.

The Directive also lays down the principle that since 2013 onwards no more free allowances will be issued to electricity producers. The Czech Republic however used its exemption clause and will allocate a portion of its free allowances to electricity producers nevertheless in order to support investment into modernization. Power and heating plants operators generating electricity in the Czech Republic will therefore be able to obtain up to 70% of the allowances for free in 2013. The volume of free allowances will gradually decrease between 2013 and 2020 to 0% in 2020. This exemption is subject to fulfilment of several requirements.

The Ministry of the Environment submitted to the EC, in the autumn 2011, the so-called National investment plan for equipment and modernization of infrastructure and clean technologies. This plan forms the groundwork for partial free allocation of allowances to electricity producers (also for co-generation of heat and electricity) and consists of individual investments to be implemented by facility operators, whose investment must correspond at least to the total value of freely allocated allowances.

Facility operators, who will be temporarily able to obtain free allowances for purposes of electricity generation, must undertake investments equal at least to the minimum market value of free allowances into equipment and modernization of infrastructure and into clean technologies.

Other industrial sectors and heat producers will also be entitled to a certain amount of free allowances pursuant to the Directive. These sectors may be principally divided into the following two groups:

- Sectors affected by carbon leakage – 100% of free allocation for the entire term of the third trading period based on benchmarking. Beneficiaries will be cement and lime producers, iron and steel works and chemical industry (list of exposed Sectors is provided in the Annex to the Commission Decision 2010/2/EU).
- Other – these are sectors not exposed to carbon leakage and heating producers, who may obtain up to 80% of free allowances in 2013 with gradual decrease to 30% in 2020. By 2027 they should not be able to obtain any free allowances at all. This group includes heating plants and industrial sectors, which were not identified as affected by loss of competitiveness (for instance automobile producers).

The new law further regulates conditions, following onto EU regulation, for issuance of permit to emit greenhouse gases, conditions applicable to emission estimates, fundamental obligations in relation to determining, reporting and verification of reported emissions and AAUs management. These activities are modified so that they become harmonized with the EU from 2013.

Air transportation has been a part of EU ETS since 2012.

In July 2015, the European Commission presented a legislative proposal to undertake a revision of the scheme for its next phase (2021-2030), with the aim of reducing EU ETS emissions by 43% compared to 2005. The proposal includes the following key elements:

- Increase the pace of emissions cuts: the overall number of allowances to decline at an annual rate of 2.2% from 2021 onwards, compared to 1.74% currently
- Rules for carbon leakage: the aim is to improve carbon leakage classification and align free allocation more closely to production levels

- Support mechanisms: two new funds, the Innovation Fund and the Modernisation Fund, will be established for low-carbon innovation and energy sector modernisation.

4.2.5 Act No. 201/2012 Coll., on Air Protection, as amended

Act No. 201/2012 Coll., on Air Protection replaced Act No. 86/2002 Coll., and its objective is to achieve targets of air quality and further decrease of pollutants discharged into the air. The Act transposes a number of EU Directives in the area of air protection (such as Directive 2010/75/EU, 2008/50/ES, 2001/81/ES etc.); it regulates obligations of source operators, defines emission limits and other operational conditions for stationary source operators. It introduces additional mechanisms for improvement of air quality (such as compensation measures for sources located in location already suffering from polluted air), restricts emission limits for a number of sources, introduces new measures in transportation sector (by establishing the so-called low-emission zones); a significant priority is also the area of household heating – solid fuels, where it prescribes fundamental change in existing sources with perspective to 2022 aiming to lower primary particle emissions generated by combustion processes, i.e. also the "black carbon" fraction. The new act also anticipates a more flexible approach of the permitting bodies, which are able to modify conditions for sources with more regard to local condition and quality of air.

Amendment to the Air Protection Law is effective from 1st of January 2017 and includes, i.e. the possibility to control combustion stationary source located in a family house, apartment or building for family recreation. From the date, it is possible to establish low emission zones in any Czech town as they have been already fixed in the Capital of Praha. This plaque is compulsory for automobiles (both passenger and freight), buses and motorcycles. Municipal authority with extended powers can inspect the appliance in case of repeated reasoned suspicion that violation of the Air Protection Law occurs.

Among the biggest obstacles to wider introduction of low emission zones in the Czech Republic, there are these statutory duties: to lay out alternate routes, to ensure sufficient amount of parking places and available public transport.

The government regulation No. 283/2016 Coll., on assessment of priority road infrastructure was released on the 24th August 2016 to address this problem. These priorities are defined in the attachment of this regulation and they include also most needed bypasses.

4.2.6 Act No. 73/2012 Coll., on ozone depleting substances and fluorinated greenhouse gasess, as amended

This Act regulates the rights and obligations of persons and competence of administrative bodies in the field of ozone layer protection and climate system protection against negative effects of regulated substances and fluorinated greenhouse gases. The implementing regulation to Act No. 73/2012 Coll., as amended, is regulation No. 257/2012 Coll., on emission prevention of substances damaging ozone layer and fluorinated greenhouse gases.

With regard to ozone layer protection, the fundamental regulation is Regulation (EC) No.1005/2009 of the European Parliament and of the Council of 16 September 2009 on substances that deplete the ozone layer, as amended, and Regulation (EU) No. 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No. 842/2006.

4.2.7 Act No. 76/2002 Coll., on integrated pollution prevention and control, on the integrated pollution register (Integrated Prevention Act), as amended

Integrated pollution prevention and control, abbreviated as IPPC, refers to the minimising of pollution from various industrial sources throughout the EU. The Integrated Prevention Act, as amended, transposes EU legislation, at the beginning Directive 96/61/EC (later replaced by codified wording under No. 2008/1/EC) on Integrated Pollution Prevention and Control (IPPC). The current Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) have been transposed into national legislation in 2013 according to Article 80(1) of the Directive by amending the Act. The Regulation requires industrial and agricultural activities with a high pollution potential to have a permit; this permit can only be issued if certain environmental conditions are met, so that the companies themselves bear responsibility for preventing and reducing any pollution they may cause. The IPPC Directive is based on several principles, namely an integrated approach, best available techniques, flexibility and public participation. The implementing regulation to Act No. 76/2002 Coll. is regulation No. 288/2013 Coll.The main objective of integrated prevention is protection of the environment as a whole against industry and agriculture pollution by regulation of operations of selected facilities listed in Annex No. 1 of the Act. Issuance of integrated permit replaces several other administrative acts according to corresponding legislation.

Prevention of pollution by implementing the so-called BAT (best available techniques) represents a higher degree of protection of the environment.

In the area of greenhouse gas emissions, which are generated by production and use of heat and electricity, the Act allows the regulator to apply the BAT concept, which should lead to increased energy efficiency of production. BAT includes technologies used as well as the manner in which the facility is designed, built, operated, maintained and decommissioned. This Act also allows application of emission limits or equivalent technical parameters, which are based on advanced technologies used in affected industrial sectors. Nevertheless, the possibility of imposing emission limits directly with respect to greenhouse gas emissions remains limited by law on integrated prevention only in cases where it is required, in order to prevent serious pollution at the site.

The manner and scope of ensuring information exchange by BAT is defined in Act No.76/2002 Coll., on integrated prevention, as amended. The set of BAT is specified in reference documents (BREF). For permitting purposes the most important information is provided in the so-called conclusions on BAT.

4.2.8 Act No. 185/2001 Coll., on Waste, as amended, and its implementing regulation and Act No. 477/2001 Coll. on Packaging

Basic waste management rules are set forth in Act No. 185/2001 Coll., on Waste, as amended, and in its implementing regulation and by Act No. 477/2001 Coll. on Packaging, as amended. Waste management objectives and measures for their achievement are defined in Waste Management Plan of the Czech Republic for 2015 – 2024 (see Chapter 2.12).

4.2.9 Act No. 406/2000 Coll. on Energy Management, as amended

This act transposes relevant EU legislation including: Directive 2002/91/EC of the European Parliament and of the Council of 16 December 2002 on the energy performance of buildings, Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and subsequently repealing Directives 2001/77/EC and 2003/30/EC, Directive 2009/125/EC establishing a framework to set mandatory ecological requirements for energy-using and energy-related products, Regulation (EC) No 1222/2009 of the European Parliament and of the Council of 25 November 2009 on the labelling of tyres with respect to fuel efficiency and other essential parameters, Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources on energy-related products, Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings and Directive 2012/27/EU of the European Parliament and the Council of 25 October 2012 on energy efficiency.

The Act gives requirements for efficiency of energy use (construction and reconstruction of the electricity generation plant and generation plants including combined heat and power generation plants, inspections of boilers and hot water supply, including the internal distribution of thermal energy in buildings and inspection of air conditioning systems). The Act further defines the requirements for the gradual reduction of energy consumption by 2020 and introduces energy performance certificates. It also includes energy performance requirements for electrical appliances and introduces their certificates and also introduces mandatory and voluntary energy audit and energy assessment and sets professional requirements for energy specialists who can handle these instruments.

Act No. 318/2012 Coll., on energy management – the substantial amendment of Act No. 406/2000 Coll., stipulates specific measures leading to gradual reduction of energy intensity of buildings, in particular:

- Efficiency of energy use: a producer of electricity or thermal energy is obliged, in newly established installations, to provide for at least the minimum efficiency of energy use stipulated by an implementing legal regulation. This obligation also applies to installations for production of electricity or thermal energy in which a change is introduced in previously completed structures. Owners are obliged to provide regularly control of operating boilers, heat distribution and air conditioning systems.
- Energy intensity of buildings: a builder, building owner or association of owners of units must provide for compliance with the requirements on the energy intensity of buildings and compliance with comparative indicators and also compliance with the requirements stipulated by the relevant technical standards. An implementing legal regulation stipulates the requirements on the energy intensity of buildings, comparison indicators, the method of calculation of the energy intensity of buildings and other details. Buildings, which are owned by a public entity must have nearly zero energy consumption as of January 1, 2018.
- Energy Performance Certificate – in case of new building or building undergoing a renovation, or during a sale or a lease of a building, the owner: of the building is obliged to acquire energy performance certificate.
- Energy audit - the Act regulates the conditions for the obligatory energy audit.
- Energy labelling - energy-related products covered by Commission regulations are provided with a label in order to inform customers about the energy efficiency and other resources use of products, thereby encouraging them to buy more energy efficient ones. The label contains information that indicates the operating costs and the electricity consumption and is displayed on the product. It is the responsibility of supplier to provide a label and information list with the product.
- Ecodesign - specific requirements for each product group covered by Commission regulations are set in order to encourage manufacturers to design the products in

environmentally friendly way with the lowest possible negative environmental impact. It is the responsibility of manufacturer or authorized representative that the product complies with the ecodesign requirements when placed on the market or put into service.

The Act No. 406/2000 Coll. was amended also by the Act No. 310/2013 Coll. specifically in the issues concerning persons authorized to build RES-utilizing installations.

4.2.10 Act No. 458/2000 Coll., on Business Conditions and Public Administration in the Energy Sectors and on amending certain acts, as amended (Energy Act)

Act No. 458/2000 Coll. transposes Directive 2009/72/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in electricity and repealing Directive 2003/54/EC, Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC, Regulation (EC) No. 714/2009 laying down rules providing a framework for cross-border exchanges in electricity in order to alleviate these difficulties, Regulation (EC) No. 715/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No. 1775/2005 and Regulation (EC) No. 713/2009 of the European Parliament and of the Council of 13 July 2009 establishing an Agency for the Cooperation of Energy Regulators.

This Act regulates conditions for business activities, exercise of state administration and non-discriminatory regulation in energy sectors such as electro-energy sector, gas and heating, as well as the related rights and obligations of natural persons and legal entities. It concerns organization of business activities in energy sector while maintain economic competition, meeting the needs of consumers, interest of license holders and ensuring safe, secure and stable supply of electricity, gas and heating for acceptable prices.

The further amendment Act No. 131/2015 Coll. removed some administrative barriers for small photovoltaic installations (up to 10 kW), which are no longer subject to licensing and introduced support for heat from biomass installations.

4.2.11 The legislative framework concerning alternative fuels in the Czech Republic

The important regulations concerning development of alternative fuels, approved by the Czech National Council, is Act No. 16/1993 Coll., on road tax which specifies minimal tariffs of the tax according to particular categories of vehicles and further Act No. 261/2007 Coll., on stabilization of public budgets. Both acts relate to tax issues.

Act No. 261/2007 Coll., specifies besides tariffs of excise duty of natural gas and electricity used to drive vehicles. Act No. 311/2006 Coll., of fuels and fuel stations including changes of some related acts, concerning vehicles with natural gas used as fuel. In general, both CNG and LNG are subject of this law (see definition of “fuels”, § 2) except assignations which define requirements on CNG and LNG stations. On the other hand this act does not include hydrogen among fuels.

The resolution of Czech government No. 941 on National Action Plan for Clean Mobility included in a section III of the document with the ref. number 1369/15 of 20 November 2015.

4.3 Programming tools

4.3.1 National Programme to Abate the Climate Change Impacts in the Czech Republic

Objective: update of the "Strategy of Protection of the Climate System of the Earth in the Czech Republic" and adoption of new reduction targets by 2020, i.e. reduce by 2020 in comparison with 2000:

a) Emissions of CO_2 per inhabitant by 30%,
b) Aggregated emissions by 25%.

Characteristics: Cross-section and framework strategic document on national level (coordination by the Ministry of the Environment).

Implementation period: 2004 – 2016, replaced by the Climate Protection Policy of the Czech Republic.

Timeframe: 2020

Sector: Cross-sectoral.

In March 2004, the Czech Government adopted the National Programme by its Resolution No. 187 dated 3. 3. 2004. The National Programme replaced the Strategy of Protection of the Climate System of the Earth in the Czech Republic (adopted by the Government Resolution No. 480 in May 1999), whose objective was to ensure fulfilment of the Czech international commitment under the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol (KP). This document did not anticipate future membership of the Czech Republic in the EU and the necessity to harmonize its national policies and measures with the EU strategic and legislative framework.

The National Programme represented strategic Government document coordinating sectoral and cross-sectoral policies at national level and acknowledged requirements defined in the European Climate Change Programme (ECCP), which became a binding document for the Czech Republic upon its accession to the EU in 2004. Individual Ministries implemented the national Programme according to their competences.

The National Programme, drafted in line with requirements set forth by Council Decision 99/296/EC, outlined specific reduction (mitigation) measures for reduction of greenhouse gas emissions, as well as adaptation measures allowing the society and eco-systems to adapt to climate change. The National Programme emphasized that emissions reduction are in general built on respective international treaties with regard to the sustainable development in the Czech Republic.

The Government Resolution No. 395 dated 6. 4. 2005 triggered an evaluation of the National Programme from the perspective of environmental effects and economic impacts of adopted measures in 2007, i.e. comparison of the original starting position and achieved reduction of GHG emissions since the National Programme came into force.

In March 2017 the Government adopted a new Climate Protection Policy of the Czech Republic, replacing the original National Programme.

4.3.2 Climate Protection Policy of the Czech Republic

Objective: The Policy defines greenhouse gas reduction targets for 2020 and 2030. It also includes indicative trajectories and objectives for 2040 and 2050. Further the Policy defines policies and measures for specific sectors on national level. Most of the identified policies and measures will be implemented by the time of the next Policy update, which is planned for 2023.

Characteristics: Cross-cutting and framework strategic document at a national level. The mitigation effect is calculated in other PaMs.

Period of implementation: 2017 – **ongoing,** Policy evaluation expected in 2021, Policy update expected in 2023, **existing measure**

Time framework: primary objectives for 2020 and 2030, indicative objectives for 2040 and 2050

The Government (see Government Resolution No. 207/2017) adopted the Climate Protection Policy of the Czech Republic in March 2017. This Policy reflects significant recent developments at the European Union, international and national level. The long term perspective for gradual transition to low emission development until 2050 was included in such governmental document for the first time. The Strategic Impact Assessment of the Policy was carried out and completed with an affirmative statement in January 2017.

This Policy sets specific targets and measures for the particular sectors on national level in order to fulfill greenhouse gas reduction targets resulting from international agreements as well as EU legislation. This Policy should contribute to gradual transition to low emission development until 2050. The Policy further sets primary and indicative emission reduction targets, which should be reached in a cost efficient manner. Measures are proposed in the following key areas: energy, final energy consumption, industry, transport, agriculture and forestry, waste, science, research development and voluntary tools.

Primary emission reduction targets

- Greenhouse gas reduction of 32 Mt CO_2eq. compared to 2005 until 2020
- Greenhouse gas reduction of 44 Mt CO_2eq. compared to 2005 until 2030

Indicative emission reduction targets

- Indicative level towards 70 Mt CO_2eq.of emitted greenhouse gases in 2040
- Indicative level towards 39 Mt CO_2eq.of emitted greenhouse gases in 2050

The Policy also outlines some economic aspects for the greenhouse gas reductions on the national level. The European structural and investment funds represent the main source of financing in the programming period of 2014-2020. Another key financial source is represented by the auction revenues generated by the EU Emission Trading System (EU ETS).

The Policy will be evaluated in 2021 and on the basis of such evaluation the Policy will be updated by 2023.

4.3.3 National Emissions Reduction Programme

Objective: The National Emissions Reduction Programme (NERP) is the fundamental conceptual material in area of air quality and for reduction of emissions from air pollution sources. Is processed on the basis of Article 8 of the Act No. 201/2012 Coll., on Air Protection, as amended. This document was approved the 2nd December 2015 by resolution of the Czech Republic Government No. 978. It comprise analysis of the state of air and its development in the Czech Republic, causes of pollution, emissions of pollutants from particular sectors of national economy, predictions of air pollution, international commitments of the Czech Republic and their observance. NERP also define procedures and measures to remedy current substandard state of air, goals in the area of air pollution reduction and terms of their attainment. It works with different scenarios of predictions and in the part entitled suggestions defines ultimate amounts of SO_2, NOx, VOC, NH_3 and PM2.5 emissions and also emission ceilings in particular sectors of national economy. These emission values should be reached by introduction of 23 measures at national level to reduce emissions and to improve quality of air. These measures are assigned to each central authority of state administration to be accomplished and are described in detail by cards of measures in the attachment of the NERP documentation. Total of 15 measurements are dedicated to the transport sector.

Characteristics: The programme contains analysis of the state of the air quality in the Czech Republic, the causes of air pollution, emissions of pollutants from various sectors of the economy, scenarios of air pollution, the international commitments and their fulfillment.

The programme establishes procedures and measures for improvement of the unsatisfactory state of air quality, set targets in area of the air pollutants reduction and sets measures for emission reduction and schedules and responsible authorities for their realization. The programme operates with various scenarios of future development and establishes unsurpassable national emission values by the year 2020 the for pollutants of sulfur dioxide, nitrogen oxides, volatile organic compounds, ammonia and fine particulate matter $PM_{2.5}$, that goes beyond the targets of the revised Gothenburg protocol and Directive 2016/2284 for 2020. To achieve these emission levels, specific sector-dependent emission ceilings have also been set.

23 priority measures at national level have been set to reduce emissions and improve air quality and include measures for transport sector, agriculture sector and energy sector including household heating, predominantly in the form of legislative changes and economic instruments.

The National Emissions Reduction Programme set up "Unsurpassable national emission values by the year 2020 according to WaM scenario, which are lower that values set up in Gothenburg Protocol.

Table 4.1: Unsurpassable national emission values by the year 2020 according to WaM scenario

Pollutant	**SO_2**	**NO_x**	**MNVOC**	**NH_3**	**$PM_{2.5}$**
Emission (kt/year)	92	143	129	64	19

Source: MoE

The National Emissions Reduction Programme also sets emissions ceilings for 2020 for several individual groups of stationary and mobile combustion sources, such as Public Energy sector, Heating of households and Road transportation.

4.3.4 State Energy Policy

Objective: The State energy policy (SEP) is the main high level strategic document for the energy sector in the Czech Republic. The new SEP was approved by the Government on 18th of May 2015 and replace the previous SEP from the year 2004. SEP is codified in Act no. 406/2000 Coll., on Energy Management. A time horizon of SEP is 25 years, with the evaluation at minimum every five years. Moreover there is in place an annual assessment of implementation measures. According to the aforementioned legislation SEP is binding for governmante and state institutions.

The main purpose of the SEP is to ensure reliable, secure and environmentally-friendly supplies of energy to meet the needs of the populace and economy of the Czech Republic, at competitive and acceptable prices under standard conditions. It must also secure uninterrupted energy supplies in crisis situations to the extent necessary to ensure the functioning of the main components of the state and the survival of the population.

SEP (2015) has three strategic objectives, which are security of energy supply; competitiveness and sustainability. These three strategic objectives are further translated into more concrete strategic priorities of the energy sector in the Czech Republic, these are: i) balanced energy mix; ii) savings and efficiency; iii) infrastructure and international cooperation; iv) research, development and innovation; v) energy security.

The indicative indicators and targets by 2040 set by the State Energy Policy are expressed in terms of corridors for ensuring a balanced mix of sources for electricity generation and corridors for the composition of a diversified mix of primary energy sources prioritising the use of domestic primary sources and keeping import dependence at an acceptable level.

Targeted composition for electricity generation mix for the year 2040 is following:

Nuclear fuel	46 – 58 %
Renewable and secondary sources	18 – 25 %
Natural gas	5 – 15 %
Brown and black coal	11 – 21 %

Targeted structure of primary energy mix (for the year 2040):

Nuclear fuel	25 – 33 %
Solid fuels	11 – 17 %
Gas fuels	18 – 25 %
Liquid fuels	14 – 17 %
Renewable and secondary sources	17 – 22 %

SEP also includes other indicative indicators and targets. These should ensure the tracking of the progress and enable assessment of possible need for updated of the SEP. SEP also has dedicated section for implementation instruments, those are mainly: i) legislative instruments; ii) instruments in the area of state administration; iii) fiscal and tax instruments; iv) foreign policy instruments; v) instruments in education and support for science and research; vi) exercise state ownership rights in energy companies in which the Czech Republic has an ownership interest; vii) communication and media promotion.

Characteristics: Cross-sectional and framework strategic document on national level.

Implementation period: From 2004 onwards, evaluation takes place every 5 years.

The proposal for the SEP is drafted by the Ministry of Industry and Trade after which is it submitted for approval to the Government. The Ministry of Industry and Trade evaluates the implementation of the State Energy Policy at least once every 5 years and informs the Government of the results.

4.3.5 State Programme to Promote Energy Savings and the Use of Renewable Sources of Energy

Objective: Promoting energy savings, increasing energy efficiency and use renewable sources energy.

Characteristics: Programme involves State administration and local governments, private sector, households and non-profit organizations.

Implementation period: 2005 – onwards, since 2007 in place in the form of the EFEKT programme implemented only by the Ministry of Industry and Trade (MIT).

Timeframe: Annual evaluations and definitions of subject matter and budget of individual parts of the program (funded from the state budget).

The State Programme to Promote Energy Savings and the Use of Renewable Sources of Energy was adopted by Government Resolution No. 1105/2004. Its scope and funding is defined in Act No. 406/2000 Coll., on energy management (as amended by Act No. 61/2009 Coll.).

This programme represents implementation tool for the State Energy Policy and Czech commitments toward the EU in the area of energy efficiency. It is supplemental programme to energy programmes financed from the EU Structural Funds.

The State Programme to Promote Energy Savings and the Use of Renewable Sources of Energy focuses on reducing energy consumption, use of renewable and secondary energy sources in line with economic and social needs, sustainable development and protection of the environment. Besides that it focuses on education, energy planning, small-scale investment actions and pilot projects. The most significant emission reductions have been achieved in the energy sector, protection of the environment area, renewable sources energy (RES) and energy savings in industry and in housing sector.

Programme has been implemented during its initial run (since 2005) not only by MIT (which coordinates the entire programme), but also by 10 ministries, especially MoT, MRD, MoA and MoE. Since 2007, the programme has been renamed Programme EFEKT, and as such it has been fully implemented only by MIT. The Programme EFEKT has provided support for various projects during the 2007-2013 period.

In 2016, the programme has been amended for the 2017 – 2021 period and is now called *State programme to promote energy savings*. The yearly budget has been increased to 150 mil. CZK. The new so called EFEKT 2 is particularly aimed at soft measures such as promoting education and raising awareness in the area of energy savings, but also at smaller scale investment actions and pilot projects. The new programme does not support the use of renewable energy anymore and focuses solely on energy efficiency measures. One of the most important supported areas of the programme is increasing energy efficiency in public lighting systems.

4.3.6 National Renewable Energy Action Plan (NREAP)

Objective: Increasing the share of RES in final energy consumption

Characteristics: The plan implements Renewable Energy Directive 2009/28 which requires that the EU Member States will cover a specified percentage of final energy demand by renewable energy in 2020. The Czech Republic is committed to achieve 13% share of RES in 2020, while the total EU target is 20%.

The main aim of the RED Directive is to establish a common framework for the promotion of energy from renewable energy sources and the principal requirements are:

- Mandatory national overall targets and measures for the use of energy from renewable sources
- National renewable energy action plans
- Calculation of the share of energy from renewable sources
- Statistical transfers between Member States
- Joint projects between Member States
- Effects of joint projects between Member States
- Joint projects between Member States and third countries

- Effects of joint projects between Member States and third countries
- Joint support schemes, etc.

The Directive requires that each Member State submits a National Renewable Energy Action Plan describing how it plans to achieve its 2020 target. The Czech NREAP was submitted to EC in July 2010 and subsequently updated in July 2012 and in December 2015 The NREAP currently proposes for 2020 a higher share of RES in final energy consumption (15.3%) in comparison to the target of Directive 2009/28/EC (13%). The main renewable energy sources in the Czech Republic are biomass, followed by biofuels for transportation, biogas, hydropower and photovoltaic.

Period of implementation: 2010 – 2020, ongoing

Timeframe: National Renewable Energy Action Plan is evaluated every two years by Ministry of Industry and Trade. The results are reported to the Government and the European Commission.

4.3.7 National Energy Efficiency Action Plan (Directive 2012/27/EU on energy efficiency)

Objective: National Energy Efficiency Action Plan sets the national target for energy savings and describes existing and planned measures to reach this target.

Characteristics: The Directive 2012/27/EU establishes a set of binding measures to reach the EU 20% energy efficiency target by 2020. Under the Directive, all EU countries are required to use energy more efficiently at all stages of the energy chain, from production to final consumption.

National measures must ensure major energy savings for consumers and industry, for example:

- Energy distributors or retail energy sales companies have to achieve 1.5% energy savings per year through the implementation of energy efficiency measures
- EU countries can opt to achieve the same level of savings through other means, such as improving the efficiency of heating systems, installing double glazed windows or insulating roofs
- The public sector should purchase energy efficient buildings, products and services
- Every year, governments in EU countries must carry out energy efficient renovations on at least 3% (by floor area) of the buildings they own and occupy
- Energy consumers should be empowered to better manage consumption. This includes easy and free access to data on consumption through individual metering
- National incentives for SMEs to undergo energy audits
- Large companies will make audits of their energy consumption to help them identify ways to reduce it
- Monitoring efficiency levels in new energy generation capacities

National Energy Efficiency Action Plans (NEEAPs) set out estimated energy consumption, planned energy efficiency measures, and the improvements a country expect to achieve. Under the Energy Efficiency Directive, EU countries must draw up these plans every three years.

The indicative national target defined in Article 3 of Directive 2012/27/EU is a framework, non-binding target. Latest update of the NEEAP from 2017 sets the target for the Czech Republic at 51.10 PJ of new final energy savings by 2020. The slight increase of the target follows the revision of energy statistics by Eurostat.

Article 7 of the Directive establishes a binding end-use energy savings target by 2020 equivalent to achieving new annual savings of 1.5% of the annual energy sales to end customers.

Period of implementation: 2008 – 2020, ongoing

Timeframe: National Energy Efficiency Action Plan is required to be updated every three years.

4.3.8 European Structural Funds Programmes

Reductions of greenhouse gas emissions achieved thanks to the implementation of the Operational programmes remain, due to the scope of objectives of individual programmes, mostly unquantified. These programmes (2014 – 2020) seek to achieve the objectives defined in the Lisbon Strategy for economic development taking into account a state of the environment in the EU 28 (esp. in the agriculture and environment sector).

Partnership agreement for programming period 2014-2020

Partnership Agreement for programming period 2014-2020 was approved by the European Commission on 26 August 2014. Since then were added two revisions of the Partnership Agreement. The first revision was technical and related to later approval of some operational programmes. It was approved by the European Commission on 13 April 2016. The second revision of the Partnership Agreement was caused by reallocation from the Operational Programm Transport to Operational Programm Environment and it was approved by European Commission on 21 December 2016. The agreement contains a number of mitigation and adaptation measures; the most important measures are defined as follows:

<u>Support of conversion to low-carbon economy in all sectors</u>

- Increasing the share of production/consumption of renewable energy sources (RES),
- Reduced energy intensity of buildings (incl. housing sector, public and commercial buildings),
- Reduced energy intensity respectively increased energy efficiency of production and technology processes especially in industry but also in agriculture and aquaculture,
- Modernisation of energy transmission and distribution networks with emphasis on electricity network including support of smart grids development,
- Increased share of alternative energy use in transportation,
- Increased carbon sequestration in agriculture and forestry.

<u>Support of climate adaptation, prevention of and risk management</u>

- Removal and inventory of ecological burden
- Reduction of environmental risks and development of risk management measures

<u>Protection of the environment by supporting efficient use of resources</u>

- Ensuring flood protection based on increased retention capacity of the landscape and slower draining away of water from landscape in agriculture and aquaculture sectors as this issue is one of the key factors in flood occurrences, implementation of additional flood-prevention measures including technical.

- More efficient waste management in line with waste management hierarchy as set forth by the Framework Directive, with emphasis on reduced landfilling of waste,
- Increase protection of nature and landscape by strengthening of its ecological stability by strengthening biodiversity, reduction of landscape fragmentation and implementation of appropriate measures in the area of agriculture and aquaculture,
- Increase soil protection, especially cropland, against erosion and degradation.

Operational Programme Transport II (2014 – 2020)

Objective: The main objective of the Operational Programme Transport (OPT) is to ensure high-quality transport infrastructure throughout the Czech Republic, including gradual alignment of the quality of the Czech Republic's transport system with the "old" EU countries.

Characteristics: Operational Programme Transport (OPT) has a budget of **4.7 billion EUR, whic**h represents approximately **20%** of all funding allocated from the ESIF funding to the Czech Republic for 2014-2020. The Czech public sources co-finance approx. additional 2.2 billion EUR.

Differences compared with 2007–2013

Greater emphasis on strategic anchoring and concentration of support on key projects in terms of key needs of the CR, greater emphasis on support for sustainable forms of transport and reducing adverse impacts of transport on the environment, and greater emphasis on the use of integrated approaches to addressing traffic problems in cities. The main focus is on road and rail transport and road infrastructure.

Current priority is expressed as thematic objective 7 "Modernization of transport infrastructure and ecological transport. OPT is divided into **Priority Axes** forming logical sections, and these are further detailed by setting up the so-called Areas of Intervention, which defined what types of projects may be supported within the framework of corresponding Priority Axis:

1. Infrastructure for railway and other sustainable transport
2. Road infrastructure in the TEN-T network and public infrastructure for clean mobility
3. Road infrastructure outside the TEN-T network
4. Technical assistance

Subsidy programs to support development of alternative fuels within OPT

Specific objective: 2.2 Introduction of conditions supporting wider use of road vehicles using alternative fuels

Among supported activities within the specific objective 2.2 of OPT is to equip the public transport infrastructure with rechargeable and filling stations for alternative fuels, including currently used "park and ride" places and parking places for fee.

Within programming period 2014-2020, a certain share of support through so called innovative finance instruments is also planned for building necessary infrastructure related to electro-mobility. Although, it can be already stated, that this area is not suitable for use of these instruments.

It is planned that the total capacity of equipment designed to charging will increase from 1164 kWh (in default year 2013) to the target value 16300 kWh in 2023. A number of newly established or modernised units of technical infrastructure for ecological vehicles should increase, compared to the year 2011, up to 1000 of units in 2023.

All projects implemented within individual Priority Axes favour mass transportation, aim to increase flow of road transportation and support ecological alternatives to road automobile transportation (water-borne and railway transportation) and thus have indirect positive effect on CO_2, NO_x and solid particle emissions. On the second hand, they increase the volume of transit traffic between the West and Eastern Europe, which in turn increases transportation-generated emissions.

Operational Programme Environment (2014 – 2020)

Objective: The aim of the Operational Program Environment 2014 – 2020 is to protect and improve the quality of the environment in line with the principles of sustainable development. Two priority axes relevant for GHG reductions are priority axis 2 - Improvement of Air Quality and priority axis 5 – Energy Savings.

Characteristics: For the programming period 2014 – 2020 the total allocation is expected to be more than € 3 billion including about € 1 billion for activities improving air quality and energy efficiency. The priority axis 5 supports insulation and other energy efficiency measures in public sector and promotes increased use of renewable energy sources. It also supports the exemplary role of public administration by subsidizing construction of new public buildings in passive energy standard. The priority axis 2 supports mainly the replacement of boilers burning solid fuels with more efficient low-emission boilers and heat pumps.

Period of implementation: 2014 – 2020

Time framework: All supported projects must be realized by the end of 2023 at the latest. It is estimated that by that date the energy savings from Priority axis 2 should reach about 3 PJ and energy savings from Priority axis 5 about 2 PJ. The corresponding estimated reductions of GHG emissions are 320 kt CO_2eq for Priority axis 2 and about 300 kt CO_2eq for Priority axis 5.

Operational Programme Enterprise and Innovation for Competitiveness (2014 – 2020)

Characteristics: Operational Programme Enterprise and Innovations for Competitiveness (OP EIC) is focused on increasing the competitiveness of the Czech economy by supporting the business environment, promoting innovations in the production and services sectors, energy treatment and development of ICT. EU funding allocation reached 4.33 billion EUR. Direct impact on effective energy management and use of renewable sources is apparent for Priority Axis 3 'Efficient energy management, development of energy infrastructure and renewable energy sources, support for the introduction of new technologies in the management of energy and secondary raw materials'. PA 3 covers 28.1% of the allocation of the OP EIC and is directly linked to the fulfillment of selected key objectives of the Europe 2020 strategy.

Implementation period: 2014–2020

The specification of aid conditions within the OP EIC include an obligation to comply with the sustainable development. Compliance with the principles of sustainable development is required at the individual project level of interventions involving construction works, purchase of technology, equipment, appliances, i.e. interventions showing a high probability of impacts on the environment or efficient use of resources (in particular energy resources), investments in scope of such interventions have to meet the highest standards. As a general rule, no projects with adverse effects on sustainable development will be promoted under the OP EIC. The OP EIC also contains environmental indicators which are monitored for relevant specific objectives at the project level, to be further aggregated for the needs of the Partnership Agreement. Environmental indicators mainly concern the indicator ‘Reduction in final energy consumption in supported entities’, ‘Additional capacity of renewable energy production’, ‘Estimated annual decrease of GHG’, ‘Reduction in emissions of primary particles and secondary particulate precursors’ and other related indicators. In connection with the termination terms of physical realization of supported projects these indicators have not begun to be fulfilled so far. Estimated energy saving in this period is about 20 PJ.

Integrated Regional Operational Programme (IROP)

Characteristics: Integrated Regional Operational Programme (IROP) and its specific objective 2.5 "Reduction of energy consumption in the residential sector" support reduction of energy consumption through improvement of thermal and technical properties of buildings (heat insulation, window replacement), replacement of heat sources, using renewable sources of energy (heat pumps, biomass boiler). Financial allocation of the specific objective 2.5 is 622 796 485 EUR (approximately 17 billion CZK).

Implementation: 2014-2020

The Managing authority has announced two calls for submission of applications since 2015. Till March 2017 677 applications were submitted with a total allocation of 1,300 million CZK. We expect app. 8,000 applications by the end of the programming period funding app. 100,000 invididual households. Estimated energy saving in this programming period is 6.4 PJ.

Operational Programme Prague – Growth Pole of the Czech Republic

Characteristics: The support fori increasing energy efficiency of transport infrastructure and pilot projects for near zero public buildings in period 2014-2020 withinPriority axis 2: Sustainable mobility and energy savings. Estimated energy saving in this period is only about 10 TJ.

4.4 Other measures

4.4.1 Emission trading (EU ETS)

Characteristics: The EU ETS is one of the most important economic tools seeking to reduce CO_2 emissions. Administrative framework for the EU ETS is based on Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, which is transposed by Act No. 383/2012 Coll., on conditions of trading with greenhouse gas emission allowances.

Implementation period: 2005 – continues;

Timeframe: In the second trading period 2008-2012, allowances were allocated free-of-charge, similar to the first trading period 2005-2007. In the third trading period 2013-2020, allowances are being allocated on the basis of harmonized rules and a growing share of allowances is sold at auctions.

Sector: Energy sector (public and industrial), industrial technologies (refineries, chemical sector, metallurgy, coking plants, lime production, cement, glass-making, ceramics, paper and cellulose).

In the Czech Republic, the EU ETS is controlled via Act No. 383/2012 Coll., on conditions of trading with greenhouse gas emission allowances. This Act defines what facilities are subject to the system and the rights and obligations of operators. Operators monitor their emissions, report to the Ministry of the Environment and receive allowances. Part of the allowances is allocated free of charge, the remainder may be bought at the marketplace or in auctions. Allowances exist and can be transfered between allowance accounts within the registry, which is administered by OTE, a.s.

In 2015, approximately 330 facilities participated in the system. Volume of emissions covered by the trading system in the Czech Republic represented approximately 52% of total greenhouse gas emissions in the Czech Republic in 2015. Monitored greenhouse gases include CO_2 and N_2O.

Allocation plan represented the required premise before initiation of allowance trading in the first two trading periods. National allocation plan (NAP) determines the quantity of allowances, which are to be distributed during the trading period to individual facility operators. The Ministry of the Environment has prepared NAP in cooperation with the Ministry of Industry and Trade. NAP2 (2008 – 2012) – allocation plans covered the first Kyoto Protocol commitment period and directly followed NAP1 (2005 – 2007) created for the first trading period. When calculating the allocated volume of allowances, the Ministry of the Environment based its estimates on historical, only partially verifiable emissions between 2000 and 2004 (which means that the quality and availability of data for the preparation of NAP1 was limited) and on fully verified emissions for the period covering 2005 and 2006 (for NAP2). The third trading period 2013 – 2020 uses National Allocation Tables instead of NAP, and these tables determine allocation per facility for each year according to benchmarks.

In case of NAP2 (2008 – 2012), the total level of allocation in the Czech Republic was decided on 26 March 2007 by the European Commission, which allocated 86.8 million allowances annually to the Czech Republic. This allocated volume includes reserve for new entrants in the amount of 1.29 million allowances and a reserve for joint implementation (JI) projects amounting to 99 389 allowances.

The existing Czech facilities received allocation amounting to 86.8 million emission allowances in average annually between 2008 and 2012.

In 2015, facilities covered by the EU ETS emitted 66.63 million t CO_2. In comparison with 2014, there has been a reduction of emissions by 0.1%, which is 65 thousand t CO_2. Table below shows differences between allocated allowances and verified emissions in completed trading periods.

Table 4.2: Allocated allowances vs. verified emissions [10^3 t CO_2]

Sector	Information	2009	2010	2011	2012	2013	2014	2015
Combustion facilities	EUA allocated free-of-charge	66 437	66 571	69 008	69 001	35 922	30 980	26 121
	Verified emissions	58 892	62 066	60 655	56 285	54 597	53 257	53 297
	Difference	**7 545**	**4 505**	**8 353**	**12 716**	**-18 675**	**-22 277**	**-27 176**
Refineries of mineral oils	EUA allocated free-of-charge	1088	1088	1088	1088	977	901	885
	Verified emissions	980	1054	988	951	820	914	925
	Difference	**108**	**34**	**100**	**137**	**157**	**-13**	**-40**

Raw iron or steel	EUA allocated free-of-charge	10 169	10 195	8 083	8 086	8 926	8 791	8 629
	Verified emissions	7 555	6 081	5 922	5 861	5 916	5 904	5 704
	Difference	**2 614**	**4 114**	**2 161**	**2 225**	**3 010**	**2 887**	**2 925**
Cement or lime	EUA allocated free-of-charge	4 043	4 043	4 043	4 043	3 590	3 527	3 463
	Verified emissions	3 846	3 368	3 752	3 422	3 144	3 369	3 486
	Difference	**197**	**675**	**291**	**621**	**446**	**158**	**-23**
Glass	EUA allocated free-of-charge	1 043	1 041	1 041	1041	686	664	652
	Verified emissions	624	668	635	652	636	672	725
	Difference	**419**	**373**	**406**	**389**	**50**	**-8**	**-73**
Ceramic products	EUA allocated free-of-charge	816	819	806	803	452	438	433
	Verified emissions	474	409	442	418	393	389	380
	Difference			**364**	**385**	**59**	**49**	**53**
Pulp, paper, cardboard	EUA allocated free-of-charge	866	880	881	869	347	355	350
	Verified emissions	645	648	585	593	502	480	476
	Difference			**296**	**-507**	**-155**	**-125**	**-126**
Total	EUA allocated free-of-charge	85 912	86 084	86 428	86 407	52 317	47 044	41 925
	Verified emissions	73 785	75 584	74 187	69 316	67 712	66 695	66 630
	Difference	**12 127**	**10 500**	**12 241**	**17 091**	**-15 395**	**-19 651**	**-24 705**

Source: EUTL

It remains difficult to quantify the EU ETS effect on the development of emissions due to the fact that besides the EU ETS companies are influenced also by developments in fuel prices or electricity and general economic development.

Sector: Civil aviation.

New Directive 2009/29/ES of the European Parliament and of the Council of 23 April 2009 amending Directive 2008/101/EC of the European Parliament and of the Council of 19 November 2008 amending Directive 2003/87/EC included aviation activities in the scheme for greenhouse gas emission allowance trading within the Community. The new Directive, approved by decision of the Council 94/69/ES, reflecting the ultimate goal of UNFCCC i.e. to reach a stable concentration of GHG in atmosphere on the level which will prevent dangerous disruption of global climate system, should improve and extend the system of GHG´s emissions trading within Community. The new Act 257/2014 Coll., which amended Act No. 383/2012 Coll. transpose the Directive 2009/29/ES into the Czech legal system.

Originally, the EU ETS was designed to cover all the flights performed to/from and within the airports in the European Economic Area[12]. However, the Regulation (EU) No 421/2014 of the European Parliament and the Council limited the geographical scope of the EU ETS to intra European Economic Area flights only for the 2013 – 2016 period. The main reason of limiting the EU ETS scope was to progress negotiation within the framework of International Civil Aviation Organization (ICAO) on development of Global Market Based Measures to reduce

[12] European Economic Area is the area in which the Agreement on the European Economic Area provides for the free movement of persons, goods, services and capital within the .European Single Market. Covers EU Member States and Norway, Iceland and Lichtenstein.

international aviation emissions, which was finally concluded at the 39th ICAO Assembly (September 2016, Montreal).

In general, there are two trading periods for the aviation sector in EU ETS. The first period was the year 2012 only. The second trading period is already harmonized with the third trading period for stationary sources (2013 – 2020). The volume of emission allowances EUAA in the 1st trading period was determined at 97% of historic emissions (average emissions in the EU between 2004 and 2006). In the 2nd trading period this volume has been reduced to 95% of historic emissions. From this amount, 15% of allowances has been auctioned and the remaining allowances are allocated to aircrafts operator free-of-charge. Moreover, the special reserve of 3% for new and fast-growing operators has been also created within the second trading period. Allocation of emission allowances free-of-charge to individual operators is determined on the basis of multiplication of a benchmark[13] and volume of verified tonne-kilometres in 2010.

An Aircraft operator included in the EU ETS is obliged to annually monitor and report CO_2 emissions produced during the calendar year. Tonne-kilometre data are monitored and reported only for the purposes of applying for free allocation of emission allowances for trading periods or for allocation of free emission allowances from special reserve.

Each aircraft operator performing flights, which are included in the EU ETS scope is assigned under administration of one EU Member State, which is determined by the aircraft operator list published annually by the European Commission. The overview of EU ETS coverage in the Czech Republic is included in the table 4.3 below.

Table 4.3 – The EU ETS coverage in the Czech Republic in the period 2012 - 2015

Year	Czech AOs			Foreign AOs			Total CO_2 emissions	Free EUAA allocation
	# AOs administered	CO_2 emissions (tonnes)		# AOs administered	CO_2 emissions (tonnes)			
		Domestic flights	International flights		Domestic flights	International flights		
2012	4	10 421	894 227	9	117	2 883	907 648	798 821
2013	2	8 562	404 040	2	84	1 400	414 086	374 780
2014	2	9 532	382 368	2	35	1 418	393 353	374 780
2015	3	12 454	416 523	2	35	1 417	430 429	374 780

4.4.2 Green Investment Scheme (GIS)

Characteristics: Project activities based on Art. 17 of the KP coordinated by the Ministry of the Environment.

Implementation period: 2009 – 2012, for public sector buildings – 2014*

** Note: part of the State Environmental Fund's own reserves (from the total amount of 1.5 billion CZK) and additional 400 million CZK from Government budget reserve (NER surplus) has been allocated to energy savings in public sector buildings. The amount of own resources of the SEF allocated to support the public sector buildings will be based on actual implementation of the measure.*

The Czech Republic had in 2008 – 2012 (under Kyoto Protocol regime) anticipated emission surplus of about 150 million t CO_2 eq., which corresponds to identical number of AAUs (Assigned Amount Units,an equivalent of one tonne of CO_2), and from that number approximately 130 million AAU could be sold within the framework of international emission trading. The legal ground for GIS programme in the Czech Republic is Section 12a of Act

[13] Benchmark was determined by the European Commission by Decision No. 2011/638/EU

No. 695/2004 Coll., as amended by Act No. 212/2006 Coll. and Act No. 315/2008 Coll., governing AAU management.

These AAUs were the property of the Czech Republic, managed by the Ministry of the Environment. AAUs, which the Czech Republic have not used toward fulfilment of its KP commitments, can be traded by the Ministry of the Environment on international market according to Art. 17 of the KP or used to support projects within the framework of joint implementation mechanism under Art. 6 of the KP. Funds obtained from the sales of AAUs were revenues of the State Environmental Fund (SEF) of the Czech Republic. These revenues were used only to support activities and projects leading to reduction of greenhouse gas emissions.

Cumulative resource of the GIS programme reached approximately **22 billion** CZK (resources obtained by the sales of AAUs incl. interest, and additional 400 million CZK from Government budget reserve – NER surplus – and own resources of the SEF up to the amount up of 1.5 billion CZK. Support focused on family homes, residential houses and in 2013 the programme begun administering applications for public sector buildings submitted in 2010. Beneficiaries included owners of family homes, residential houses (municipalities, housing co-ops and other), public sector building owners (such as municipalities, hospitals, schools, civic associations and others).

GIS programme was focused on reduction of energy intensity and CO_2 emissions in the housing sector. In 2011, the households consumption reached 258,9 PJ (i.e. 71,9 GWh). This includes not only consumption for heating (including losses), but also hot water and general household running. Average energy intensity in 2011 reached 228 kWh/m^2 per year.

Households contributed to energy consumption by almost a quarter (23.9% in 2006) and the housing sector belongs, along with industry and transportation, among the worst emitters of GHGs. Consumption of energy for heating and hot water remains the most significant item in energy balance of households, respectively residential houses. Most of these houses do not comply with existing energy standards, which manifests itself by high energy intensity and CO_2 emissions per unit of residential area. As a consequence, use of small heaters and stoves running on solid fuels (especially brown coal containing sulphur) family houses represent a significant source of local air pollution by emitting dust particles (PM_{10}).

GIS programme was officially announced on 22. 4. 2009 (Earth Day).

GIS programme was divided into three areas of intervention:

A. Heating energy savings, via

A.1. Complex insulation aiming to achieve low-energy standard,

A.2. High-quality thermal insulation of selected parts of houses (partial insulation).

B. Support provided to new buildings complying with passive energy standards

C. Use of renewable sources of energy for heating and hot water

C.1. Replacement of sources running on solid and liquid fossil fuels or electric heating for low-emission sources running on biomass and efficient heat pumps,

C.2. Installations of low-emission sources running on biomass and efficient heat pumps in new buildings,

C.3. Installations of solar thermal collectors.

D. Subsidy bonus for select measure combinations – some combinations are favoured in the form of a bonus

Support was provided nation-wide. In August 2010, the Ministry of the Environment stopped accepting applications for panel housing estate segment and on 29 October 2010 it stopped application for family houses and non-panel residential houses.By the end of 2016 74 043 energy savings projects were supported by this programme. The annual CO_2 emission reduction from these projects is estimated at 798 kt CO_2 while the energy savings reached 1 303 GWh/year.

4.4.3 New GREEN SAVINGS Programme 2013

New Green Savings Programme opened on 13 June 2013 by the Ministry of the Environment announcing the first Call to submit applications. On 12. 8. 2013, the Ministry of the Environment opened the family houses segment. Resources provided by the State Environmental Fund, with allocation 1 billion CZK cover the Call. The objective of the programme is to lower greenhouse gas emissions by implementing measures leading to lower energy intensity of the family houses, supporting construction of family houses with low energy footprint and supporting efficient use of energy sources.

Support is being provided in the following areas:

- Support area A – Reducing energy footprint of existing housing
- Support area B – Construction of family houses with very low energy intensity
- Support area C – Efficient use of energy sources
- Support area D – Support dedicated to preparation and ensuring implementation of supported measures
- Support area E – Bonus for combinations of selected measures.

By the end of 2015 3 655 energy savings projects were supported by this programme and energy savings from realized projects reached 55.6 GWh/year.

4.4.4 New Green Savings Programme

The objective of this programme is support provided to implementation of measures leading to lower energy intensity of buildings (energy savings, reduced greenhouse gas emissions and pollutant into ambient air, improvement of culture of housing and other).

Funding of the programme in 2013 – 2020 will be covered by the EUA and EUAA revenues plus additional public and other sources. The anticipated revenue from auctioning could range, according to Act No. 383/2012 Coll. in 2013 – 2020 between 12 – 20 billion CZK.

Under the New Green Savings Programme, 70% of the funding will be directed into the housing sector, i.e. family and residential houses, public buildings will represent 30% of supported renovations (division of total allocation: family homes – 49%, residential housing - 21% and public sector buildings - 30%). The amount of support is linked to the achieved energy savings, type of implemented measure, cost, execution and other parameters.

Programme benefits – pro-growth measure with positive impact on the Czech economy (directly on State budget, enterprise development in construction sector, machinery etc.), creation and maintenance of dozens of thousands jobs.

Programme is construed so as to achieve high leverage effect by high degree of mobilization of private sector’s own sources.

4.4.5 Programme PANEL / NEW PANEL / PANEL 2013 +

Characteristic: Programme PANEL (NEW PANEL since 2009, PANEL 2013 + since 2013) supports complex renovation and upgrades of residential houses improving their value, lowering their energy intensity and fundamentally extending their lifetime.

Implementation period: since 2001, temporarily suspended in 2010, continues in 2013, will continue in the future

Timeframe: Annual evaluation and budgeting exercise.

Programme was established in 2001 by Government Resolution No. 299/2001 Coll. Support may be provided to:

- Natural persons or legal entities owning or co-owning a building;
- Natural persons or legal entities owning or co-owning flats or non-residential premises in a building;
- Flat-owners associations.

Support was provided in 2006 for specific types of repairs or upgrades in panel housing built using standardized construction systems. This support was later extended to all residential houses regardless of their construction system.

Support was provided in the form of:

- Guarantee for loan provided,
- Subsidy toward partial interest from loans.

Since 2013, this programme has been implemented pursuant to Government Resolution No. 468/2012. Support takes the form of a low-interest loan in the programme PANEL 2013 +.

The Ministry of Industry and trade evaluation of the State Programme to Promote Energy Savings and the Use of Renewable Sources of Energy in 2016 demonstrated that energy savings in all so far renovated apartments receiving PANEL or New Panel support amounted to approximately 5 852 304 GJ.

4.4.6 Organic farming

Organic farming is an integral part of agricultural policy in the Czech Republic. Its importance lies not only in production of high-quality organic products but especially in holistic approach. This approach is based especialy on closed cycles of nutrients, ban of mineral nitrogen fertilisers and pesticides, preference of farm made materials etc. Side effects and benefits of this approach are connected with lower GHG emissions and increase of long-term sequestration of carbon in the form of organic soil matter.

Organic farmers are not allowed to use industrial nitro-based fertilisers, which produce large amounts of CO_2 during its production and whose application causes NO_x emissions from the soil. Similarly, any pesticides are banned on organic farming as well as growth regulators, whose production also increased CO_2 emissions.

- Action plan for development of organic farming 2011 – 2015 (including scenarios with additional measures – WAM) adopted by the Government on 14. 12. 2010 described strategy for the development of organic farming in the Czech Republic by 2015. As of 31. 12. 2015 organic farmers farmed about 478 988 ha, which is 11.74% of the total agricultural land. In this respect, the Czech Republic is high above the EU average. More than 80% of area farmed by organic farmers is taken up by grassland, which plays an important role in sequestering carbon.

- Conditions of organic farming are set by EU Regulation No. 834/2007 and EC Regulation 889/2008. Additional national provisions are set by Act No. 242/2000 Coll., on organic farming.

4.4.7 Joint implementation projects (JI)

Characteristics: Project activities pursuant to Art. 6. KP coordinated by the Ministry of the Environment.

Implementation period: 2002 – 2012 *(last issue of emission reduction units and submission of final reports in 2013)*

Sectors: Industry, Energy sector (including RES), Waste.

Act No. 383/2012 Coll. on conditions of trading with greenhouse gas emission allowances allows use of free AAUs to support projects pursuant to joint implementation mechanism (Art. 6 of the KP).

The Czech Government approved by its Resolution No. 648 dated 30. 6. 2003 conclusion of a Framework cooperation agreement for implementation of projects aiming to reduce greenhouse gas emissions between the Czech Republic and the International Bank for Reconstruction and Development – IBRD and other investor countries.

In total 85 JI projects (Table 4.4) were implemented in the Czech Republic. From the perspective of the KP these emission reductions were applied for the 2008 – 2012 period in the form of Emission Reduction Units (ERUs).

One of the projects aimed to reduce N_2O emissions produced during manufacture of nitric acid, achieved an average annual reduction of approximately 427 thousand t CO_2eq. During the first commitment period of the KP (2008 – 2012), approximately 0.883 million ERUs have been issued (see Table 4.8). Implementation of all JI projects in 2002-2012 used up approximately 7.446 million AAUs, from that issued ERUs 4.413 million.

Table 4.4: JI projects overview

Project type	Number	ERU (thousand/year)
Small hydropower plant	17	48
Replacing fossil fuels with biomass	18	106
Nitrous oxide breakdown	1	427
Coal to gas conversion[1]	2	1
Energy recovery of landfill gas	47	301
Total	85	883

[1] coal to gas conversion project including use of heat pumps, only AAUs were issued. *Source: MoE*

4.4.8 National Action Plan for Clean Mobility (NAP CM)

The National Action Plan for Clean Mobility for the period 2015-2018 with the future outlook 2030 responds to the Directive 2014/94/EU of the European Parliament and of the Council of 22 October 2014 on the deployment of alternative fuels infrastructure which requires creation of domestic policy framework in order to support a development of the market with alternative fuels within the transport sector and the development of related infrastructure.

The NAP CM deals with electro mobility, CNG, LNG and in a limited range also with the hydrogen technology (or the technology of fuel cells). Because of direct relation to the

Directive 2014/94/EU, the main focus in this document is primarily on those alternative fuels which the directive considers as crucial for member states and need to be defined within domestic policy frameworks including national targets for development of related infrastructure of charging and filling stations or where, in case of hydrogen filling stations, it is desirable. This emphasis of the NAP CM is in accordance with an effort to strive primarily for technologies which are currently very close to their commercial use. There will be regular update of the Czech NAP CM every three years as it is required by the Directive 2014/94/EU.

By introduction of the NAP CM, the Czech Government declared its will to support the development of alternative fuels in transport and thus fulfil targets of the Czech Republic in the area of energetics, transport and environment.

Key principle of the NAP CM is the principle of technological neutrality which means preference of diversification of alternative fuels by public sector as it is required by the Directive 2014/94/EU of the European Parliament and of the Council on the deployment of alternative fuels infrastructure.

To achieve planned reduction of emissions in transport, it is necessary to increase share of alternative fuels in transport. There are predictions that the biggest impact on reduction of GHG emissions to 2020 within alternative fuels (CNG, LNG, electricity and hydrogen) will be reached by use of CNG in Czech conditions.

4.5 Measures in preparation

There are recorded only those measures for which preparation is in an advanced stage.

4.5.1 Amendment to the Government Order on the purchase of road vehicles

The Ministry for Regional Development prepares, in cooperation with the Ministry of the Environment, the Ministry of Transport and the Ministry of Industry and Trade, a draft amendment to the Government Order in which the contracting authority will add to the obligations related to the purchase of road vehicles a new obligation for the contracting authorities to purchase, vehicles of categories M1 and N1 and the mandatory share of alternative-drive vehicles.

4.5.2 Draft Decree amending Decree No. 257/2012 Coll., on the prevention of emissions of substances that deplete the ozone layer and fluorinated greenhouse gases

The Ministry of the Environment submits to the interdisciplinary comment procedure a draft decree amending Decree No. 257/2012 Coll., on the prevention of emissions of ozone depleting substances and fluorinated greenhouse gases. The aim of the amendment is to fulfill the purpose of the legal regulation of fluorinated greenhouse gases in the Czech legal order in accordance with Act No. 73/2012 Coll., On Substances that Deplete the Ozone Layer and on Fluorinated Greenhouse Gases, or in connection with European legislation.

4.5.3 Draft Decree amending Decree No. 415/2012 Coll., on the permissible level of pollution and its detection and implementing some other provisions of the Act on Air Protection, as amended

The amendments to the Decree follow the adoption of Act No. 369/2016 Coll., Amending Act No. 201/2012 Coll., on air protection, as amended.

4.5.4 Draft Government Order on Biofuels Sustainability Criteria and GHG Reduction from Fuel

The Government Regulation repeals and replaces Government Regulation No. 351/2012 Coll., on sustainability criteria for biofuels. The draft Government Decree is submitted following the amendment to Act No. 201/2012 Coll., on air protection, currently being discussed in the Chamber of Deputies of the Parliament of the Czech Republic.

4.5.5 Bill amending Act No. 201/2012 Coll., on air protection, as amended

The aim of the draft law is to implement a partial transposition of Council Directive (EU) 2015/652 laying down calculation methods and reporting requirements under Directive 98/70/EC of the European Parliament and of the Council on the quality of petrol and diesel fuels and Directive of the European Parliament and of the Council (EU) 2015/1513 amending Directive 98/70/EC on the quality of petrol and diesel fuels and Directive 2009/28/EC on the promotion of the use of energy from renewable sources.

4.5.6 Draft Act on Waste and draft Act on End-of-Life Products

The aim of these drafts is to improve and update the current waste legislation of the Czech Republic and implement the EU legislation on waste.

4.5.7 Integrated National Energy and Climate Plan

According to the Proposal for a Regulation of the European Parliament and Council on Governance of the Energy Union all Member States shall prepare an Integrated National Energy and Climate Plan. While the legislative procedure is still ongoing, the Czech Republic has already started drafting the plan since the draft should be submitted to the European Commission by 31 December 2018. In these plans the Member States shall set out their their objectives, targets and contributions relating to the five dimensions of the Energy Union (decarbonisation, energy efficiency, energy security, internal energy market, research, innovation and competitivenes). The first plan will be for the period 2021-2030. The projections will be prepared until 2040 for all dimensions of the Energy Union. Longer term perspective in line with the objectives of the Paris Agreement should be included, where relevant and possible.

4.5.8 Best Available Techniques (BAT) Reference Document for Large Combustion Plants[14]

The BAT revision for large combustion plants commenced in 2011. The BAT conclusions are part of the revised BREF large combustion plants document. Their validity will start from the date they will be issued by the European Commission decision and the four-year deadline for approved emission limits will apply from the date of approval of the BAT conclusions. In the

[14] http://eippcb.jrc.ec.europa.eu/reference/BREF/LCP/JRC107769_LCP_bref2017.pdf

Czech Republic, the approved emission limits will cover approximately 120 installations with integrated permit issued.

5 GREENHOUSE GAS EMISSIONS PROJECTIONS

5.1 Emission projection scenarios

The following projections have been prepared in line with methodological guidelines for projection compilation[15] and in line with Regulation (EU) No 525/2013:

- With existing measures, i.e. with measures implemented and effective as of the date when preparation of projections began (June, 2016);
- With additional measures, i.e. with existing measures and with measures, which are to be implemented in near future or which are planned. Additional measures included in projections preparation include, for instance:
    - Support of voluntary commitments to energy savings in industry,
    - Economic and tax tools,
    - Nitrate Directive – 4th Action Plan.

Table below provides overview of projection results. All specific PaMs included in WEM and WAM scenarios are presented in Chapter 4.

***Table 5.1:** Overview of projection results - emissions [Mt CO_2 eq., % reduction in comparison with 1990 and 2005, without LULUCF]*

Scenario	1990	2005	2010	2015	2020	2025	2030	2035	1990 - 2020	2005 - 2020	1990 - 2030	2005 - 2030
WEM	195.8	146.5	138.6	127.1	122.5	113.6	108.8	101.6	-38%	-16%	-44%	-26%
WAM	195.8	146.5	138.6	127.1	122.1	113.2	107.8	100.0	-37%	-16%	-45%	-26%

Source: CHMI

5.2 Sectoral projections

During preparation of projections for greenhouse gases the greenhouse gas emissions were divided, in line with IPCC Guidelines, according to their origin into the following groups:

1. Greenhouse gas emissions from combustion processes and fugitive emissions (Sector 1A and 1B)
2. Greenhouse gas emissions from industrial processes (Sector 2)
3. Emissions from agriculture (Sector 3)
4. Emissions from LULUCF (Sector 4)
5. Waste (Sector 5)

Projections were then calculated according to the above groups (CO_2, N_2O and CH_4, HFC, PCF and SF_6). Methodological operations and modelling tools are described in the text below.

[15] UNFCCC *Reporting Guidelines on National Communication*, FCCC/CP/1999/7, part II

5.3 Greenhouse gas emissions from combustion processes and fugitive emissions (Sector 1A and 1B)

For projection of CO_2, CH_4 and N_2O emissions from combustion processes – use of fuels, we have used the MESSAGE model. Activity data used for estimation of fugitive emissions are based on production and distribution of respective fuels. Calculation includes the following processes for individual gases:

CO_2 emissions

- fuel combustion in fuel conversion processes (public and industrial energy sector),
- fuel combustion in final consumption (industrial processes, transportation, households, agriculture and sector of public and commercial services),
- fuel refinement processes (refineries, coal treatment and coking),
- desulfurization processes using lime.

CH_4 emissions

- mining and post-mining treatment of coal,
- mining, storage, transit and distribution of natural gas,
- mining, storage, transportation and refining of oil.

N_2O emissions

- fuel combustion (in stationary or mobile sources).

Parameters of energy sector development are the result of calculations using the MESSAGE model. Balance is valid for scenario with measures.

Table 5.2: Domestic consumption of primary energy sources – WEM scenario

(PJ)	2010	2015	2020	2025	2030	2035
Brown coal	555	471	449	330	307	253
Black coal and coke	203	209	164	163	144	143
Oil	335	375	374	367	349	326
Gas	266	271	345	349	358	361
Electricity	-54	-45	-59	-22	-12	-30
Nuclear	296	291	332	332	332	449
RES	176	179	210	241	268	294
Total	**1 777**	**1 751**	**1 815**	**1 760**	**1 746**	**1 796**

Source: CzSO, MoI

Table 5.3: Structure of electricity production – scenario WEM

(TWh)	2010	2015	2020	2025	2030	2035
Brown coal	40.9	36.3	37.0	29.2	28.0	23.4
Black coal	5.7	4.3	4.2	4.1	2.8	2.8
Oil	0.4	0.8	0.9	1.3	1.5	1.5
Gas	4.2	2.0	5.1	5.1	5.2	5.3
Nuclear	28.0	30.3	31.5	30.4	31.5	41.2

(TWh)	2010	2015	2020	2025	2030	2035
RES	6.6	10.1	11.6	13.7	15.1	17.6
Total	**85.9**	**83.9**	**90.2**	**83.8**	**84.0**	**91.7**

Source: CzSO, CHMI

Table 5.4: Final consumption of fuel and energy – scenario WEM

(PJ)	2010	2015	2020	2025	2030	2035
Brown coal	63.3	56.0	44.7	29.6	26.2	20.3
Black coal	23.7	31.8	30.9	26.8	27.1	26.6
Oil	286.3	281.0	154.9	154.8	153.0	147.1
Gas	293.9	272.9	247.0	247.7	255.4	258.6
Electricity	200.1	207.1	217.7	234.1	246.8	256.8
Heat	146.1	116.8	102.4	102.7	99.2	100.8
RES	105.3	122.7	143.1	149.1	155.7	163.9
Total	**1 118.7**	**1 088.3**	**940.7**	**944.8**	**963.4**	**974.1**

Source: CzSO, CHMI

Table 5.5: Final consumption of electricity – scenario WEM

(TWh)	2010	2015	2020	2025	2030	2035
Households	15.0	14.3	14.3	14.6	14.7	14.5
Transport	2.2	2.4	2.7	3.4	4.3	5.7
Industry	22.5	24.1	25.2	27.1	28.3	29.1
Services	15.8	16.8	18.6	20.5	21.8	22.7
Total	**55.6**	**57.5**	**60.8**	**65.6**	**69.1**	**71.9**

Source: CzSO, MoI

For heating we have used the average value according to EUROSTAT of 3 571 day-degrees. For building cooling there has been no uniform methodology for calculation or day-degree unit yet. Scenarios with additional measures, respectively excl. measures were calculated by adding, respectively subtracting emissions from partial measures.

Table 5.6 provides projections of total greenhouse gas emissions from the Energy sector for scenarios with existing measures and with additional measures.

Table 5.6: Projections of total greenhouse gas emissions from the Energy sector [Mt CO_2 eq., respectively % reduction in comparison with 1990 and 2005]

Scenario	1990	2005	2010	2015	2020	2025	2030	2035	1990 - 2020	2005 - 2020	1990 - 2030	2005 - 2030
WEM	158.6	119.6	111.3	98.0	94.2	85.6	81.9	75.9	-40.6%	-48.3%	-21.2%	-31.5%
WAM	158.6	119.6	111.3	98.0	93.9	85.3	81.6	75.5	-40.8%	-48.6%	-21.5%	-31.8%

Source: CHMI

Table 5.7 shows projections of greenhouse gas emissions related to fuel sold to aircraft in international transport. The Czech Republic doesn´t have emission related to fuel sold to ships for international transport. These emissions are not included in totals. Emission from international aviation strongly increased in 2005 in comparison to 1990. However, after 2015 a gradual decline is expected.

Table 5.7: Projections of greenhouse gas emissions related to fuel sold to aircraft [kt CO_2 eq.; only WEM scenario]

Scenario	1990	2005	2010	2015	2020	2025	2030	2035
WEM	528.2	978.9	965.4	895.1	893.2	901.5	910.0	918.5

Source: CHMI

5.3.1 Transport

Emissions in transportation sector are calculated using the COPERT 4 model. Calculation is based on the following projection of transportation performances in the transportation sector (Table 5.8).

Table 5.8: Expected transport performances for personal and freight transportation

	2010	2015	2020	2025	2030	2035
Personal transportation (million person-km)	107.03	115.67	122.13	128.59	135.05	136.35
Freight transportation (million t-km)	68.50	74.31	76.83	79.34	81.86	82.37

Source: MoT, TRC, CDV

The following projections of final consumption of energy in transportation sector for the WEM scenario are expected (Table 5.9).

Table 5.9: Projections of final fuel and energy consumption in transportation – scenario WEM (PJ)

	2010	2015	2020	2025	2030	2035
Bio fuels	9.7	14.3	28.1	28.1	28.1	28.1
Electricity	7.8	6.6	9.7	12.1	15.6	20.4
Liquid fuels	239.3	212.2	202.2	195.9	180.0	164.4
Natural gas	2.9	3.3	26.8	35.1	44.1	48.1
Total	**259.6**	**236.4**	**266.8**	**271.2**	**267.8**	**261.0**

Source: CzSO and CHMI

5.3.2 Buildings

Emission projections for residential houses are based on the final energy consumption in residential sector (Table 5.10).

Table 5.10: Projections of final energy consumption in residential sector

Final energy consumption in residential sector (PJ)	2010	2015	2020	2025	2030	2035
Brown coal	18.9	15.8	9.2	2.6	1.8	1.8
Hard coal	3.3	3.6	3.6	3.6	3.6	3.6
Liquid fuels	0.2	0.1	0.0	0.0	0.0	0.0
Natural gas	100.5	65.5	60.1	55.4	55.0	54.4
Electricity	54.1	50.5	50.4	50.4	50.8	50.1
Heat	50.3	45.2	43.3	41.7	39.0	38.1
Other (renewables and waste)	59.0	55.3	68.4	75.8	75.7	79.5
Total	**286.4**	**236.0**	**235.0**	**229.5**	**225.9**	**227.5**

Source: CzSO, MoI and CHMI

For the commercial sector, the final energy consumption is shown in Table 5.11.

Table 5.11: Projections of final energy consumption of commercial sector and other

Final energy consumption in commercial sector (PJ)	2010	2015	2020	2025	2030	2035
Brown coal	0.9	1.4	1.1	0.7	0.6	0.5
Hard coal	0.1	0.5	0.5	0.5	0.4	0.4
Liquid fuel	1.6	14.4	13.9	13.6	12.9	12.0
Natural gas	60.5	48.6	65.8	69.1	71.2	72.7
Electricity	53.5	62.4	67.0	73.9	78.4	81.6
Heat	11.4	22.5	24.0	26.1	26.4	28.4
Other (renewables and waste)	3.0	9.5	15.4	13.7	14.2	12.9
Total	**131.0**	**159.3**	**187.7**	**197.6**	**204.1**	**208.5**

Source: CzSO, MoI and CHMI

5.3.3 Sensitivity analysis of conbustion processes on GDP and coal price

Economic development remains the dominant factor affecting the results of projections.

With regard to the dominant share of combustion processes on total greenhouse gas emission levels in the Czech Republic, the sensitivity analyses focused on this decisive portion of projections.

The sensitivity analysis was conducted for CO_2 emissions from fuel combustion in energy sector (1.A.). Dependency on economic development was tested (+/- 5% GDP difference) with the MESSAGE model. The following table shows the results.

Table 5.12: Sensitivity analysis of combustion processes (1.A.) on GDP (WEM scenario)

	CO_2 (Mt)	CO_2 in Mt (GDP +5%)	CO_2 in Mt (GDP -5%)	Emission difference in % (GDP +5%)	Emission difference in % (GDP -5%)
2020	88.5	93.2	81.7	+ 5.3	-7.7
2025	80.5	85.8	75.7	+ 6.6	- 6.0
2030	76.9	79.8	73.4	+3.8	-4.6
2035	71.5	73.5	69.0	+ 2.9	-3.5

Differences between high (GDP +5%) and basic scenarios are mostly lower than variations between basic and low scenario (GDP -5%). That means that higher growth of emissions with high scenario, that is contingent of fast economic growth, is partially compensated by improved energy efficiency. Improved energy efficiency in the high scenario may be explained by growth in investment in more favourable economic conditions.

In the analysis of combustion processes on the coal price the price was changed (+/- 30%). The model MESSAGE shows no differences due to a higher price of natural gas and to a lower price of biomass (governmental support and no payment for allowances included). Even when the price of coal was changed by +/- 30%, the price of natural gas remained higher and the price of biomass stayed lower than the price of coal.

5.4 Greenhouse gas emissions from industrial processes (Sector 2)

For projections of greenhouse gases from industrial processes was used the MESSAGE model. Projections of emissions were calculated on the basis of GDP and production development in industrial sectors.

Emissions from combustion processes in industry were calculated using the MESSAGE model, based on demand deduced from sectoral GDP projections. Table 5.13 gives final fuel consumption in industry for the WEM scenario.

Table 5.13: Final consumption of fuel and energy in industrial sector – WEM scenario

(PJ)	2010	2015	2020	2025	2030	2035
Brown coal	39.2	27.8	29.9	27.3	21.6	19.7
Hard coal	31.5	25.7	27.7	26.8	22.7	23.1
Liquid fuels	16.0	12.4	12.8	16.8	17.7	17.3
Natural gas	101.2	85.0	90.6	94.3	88.1	85.1
Electricity	82.4	82.8	84.6	90.6	97.7	102.0
Heat	32.0	26.2	30.2	35.1	34.9	33.8
Other (renewables and waste)	30.6	26.0	30.6	31.2	31.5	37.7
Total	**332.9**	**285.9**	**306.4**	**322.1**	**314.2**	**318.7**

Source: CzSO, CHMI

Emissions from industrial processes were determined from projections of energy intensive materials and products, on the basis of information obtained from industry associations. Overview of projections on industrial production and use of produced material is given in Table 5.14. Table 5.15 provides emission projections for WEM and WAM scenarios.

Table 5.14: Projections of activity data for industrial processes (kt)

Activity data [kt]	2010	2015	2020	2025	2030	2035
A. Mineral industry						
1. Cement production	2 748	2 800	2 900	3 000	3 100	3 200
2. Lime production	915	820	800	780	761	742
3. Glass production	1 023	1 100	1 200	1 200	1 200	1 200
4. Other process uses of carbonates						
a. Ceramics	1 117	1 550	1 550	1 550	1 550	1 550
b. Other uses of soda ash	2.6	2.6	2.6	2.6	2.6	2.6
c. Non-metallurgical magnesium production						
d. Other	C	C	C	C	C	C
B. Chemical industry						
1. Ammonia production(5)	257	235	235	235	235	235
2. Nitric acid production	442	550	550	550	550	550
3. Adipic acid production	NO	NO	NO	NO	NO	NO
4. Caprolactam, glyoxal and glyoxylic acid production						
a. Caprolactam	C	C	C	C	C	C
b. Glyoxal	NO	NO	NO	NO	NO	NO
c. Glyoxylic acid	NO	NO	NO	NO	NO	NO
5. Carbide production						
a. Silicon carbide	NO	NO	NO	NO	NO	NO
b. Calcium carbide	NO	NO	NO	NO	NO	NO
6. Titanium dioxide production	45	45	45	45	45	45
7. Soda ash production	NO	NO	NO	NO	NO	NO
8. Petrochemical and carbon black production						
a. Methanol	NO	NO	NO	NO	NO	NO
b. Ethylene	455	490	483	476	468	461

Activity data [kt]	2010	2015	2020	2025	2030	2035
c. Ethylene dichloride and vinyl chloride monomer	136	120	120	120	120	120
d. Ethylene oxide	NO	NO	NO	NO	NO	NO
e. Acrylonitrile	NO	NO	NO	NO	NO	NO
f. Carbon black	25.5	25.5	25.5	25.5	25.5	25.5
g. Other(6)						
Styrene	170	165	165	165	165	165
10. Other (please specify)						
Non selective catalytic reduction	5.0	5.2	5.2	5.2	5.2	5.2
Other non energy use in chemical industry	76.4	75.6	75.6	75.6	75.6	75.6
C. Metal industry						
1. Iron and steel production						
a. Steel	5 274	5 400	5 319	5 240	5 162	5 085
b. Pig iron	3 978	4 100	4 039	3 979	3 919	3 861
c. Direct reduced iron	NO	NO	NO	NO	NO	NO
d. Sinter	4 628	5 747	5 661	5 577	5 494	5 412
e. Pellet	NO	NO	NO	NO	NO	NO
f. Other (please specify)						
Metallurgical coke	2 548	2 537	2 500	2 462	2 426	2 389
Use of limestone and dolomite	2 642	2 339	2 028	1 756	1 661	1 457
2. Ferroalloys production	C	C	C	C	C	C
3. Aluminium production	NO	NO	NO	NO	NO	NO
4. Magnesium production	NO	NO	NO	NO	NO	NO
5. Lead production	C	C	C	C	C	C
6. Zinc production	C	C	C	C	C	C
7. Other (please specify)						
D. Non-energy products from fuels and solvent use						
1. Lubricant use	177	156	156	156	156	156
2. Paraffin wax use	13	12	12	12	12	12
3. Other (please specify)(5)(6)						
Road paving with asphalt	4 800	4 800	4 800	4 800	4 800	4 800
Solvent use	509	400	390	380	371	362
Other (please specify)						
Urea used as catalyst	66.4	70.7	70.7	70.7	70.7	70.7
G. Other product manufacture and use						
3. N_2O from product uses						
a. Medical applications	0.6	0.6	0.6	0.6	0.6	0.6
b. Other(7)						
Propellant for pressure and aerosol products	0.15	0.15	0.15	0.15	0.15	0.15
4. Other						
Laboratory (Experimental) use	NO	NO	NO	NO	NO	NO
H. Other (please specify)(8)						
2.H.3 Other (please specify)						

Source: CRF tables, CzSO, ENVIROS, Ltd.

Table 5.15: Projections of total greenhouse gas emissions from Industrial Processes [Mt CO_2 eq., respectively % reduction in comparison with 1990 and 2005; only WEM scenario]

Scenario	1990	2005	2010	2015	2020	2025	2030	2035	1990 - 2020	2005 - 2020	1990 - 2030	2005 - 2030
WEM	17.1	14.2	14.4	14.4	14.7	15.3	15.3	14.7	-14.2%	13.1%	-12.5%	14.1%

Source: CHMI

5.4.1 HFC, PCF and SF_6 emissions

Emissions of fluorinated gases have origin only in their use. There is no production of fluorinated gases in the Czech Republic. The assumptions on future use of fluorinated gases changed crucially due to adoption of the Regulation (EU) No 517/2014 of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006 in comparison with the previous projections. The regulation will significantly influence use of coolants, mainly in refrigerators and freezers in households.
Table 5.16 gives projections of emissions for use of fluorinated gases.

Table 5.16: Projection of emission of the use of fluorinated gases [kt CO_2 eq.]

Usage	Gas	2005	2010	2015	2020	2025	2030	2035	2040
Industrial and domestic refrigeration	C_2F_6	0.203	0.401	0.082	0.000	0.000	0.000	0.000	0.000
	C_3F_8	6.767	8.377	4.004	0.221	0.000	0.000	0.000	0.000
	C_6F_{14}	0.233	0.317	0.140	0.000	0.000	0.000	0.000	0.000
	HFC-125	123.04	708.691	1 193.03	1 104.84	787.248	111.91	0.000	0.000
	HFC-134a	191.67	284.406	322.732	203.418	180.689	240.47	76.725	0.000
	HFC-143a	143.69	297.928	371.192	187.356	161.052	73.554	8.149	0.000
	HFC-152a	0.262	0.155	0.114	0.063	0.057	0.072	0.068	0.068
	HFC-227ea	0.020	0.264	0.686	0.855	0.424	0.225	0.000	0.000
	HFC-23	3.571	5.088	2.567	0.824	0.366	0.106	0.003	0.000
	HFC-245fa	0.000	0.075	0.504	0.223	0.112	0.000	0.000	0.000
	HFC-32	3.025	94.420	217.417	128.112	11.645	0.000	0.000	0.000
Mobile refrigeration	HFC-134a	185.87	507.631	769.861	685.765	704.993	401.89	221.07	87.178
Fire extinguishers	C_3F_8	0.015	0.024	0.040	0.000	0.000	0.000	0.000	0.000
	HFC-227ea	0.303	2.052	4.499	9.917	13.636	16.779	21.712	21.712
	HFC-236fa	5.818	12.596	9.374	10.375	11.524	12.014	11.289	9.605
Metered Dose Inhalers	HFC-134a	36.733	30.302	4.365	0.000	0.000	0.000	0.000	0.000
Foam blowing	HFC-134a	3.630	3.047	2.421	1.923	1.527	1.213	0.964	0.766
	HFC-227ea	0.015	0.108	0.086	0.068	0.054	0.043	0.034	0.027
	HFC-245fa	0.052	0.017	0.014	0.011	0.009	0.007	0.005	0.004
Electrical equipment	SF_6	85.601	77.897	79.718	81.983	84.066	85.980	87.740	89.358
Sound proof windows	SF_6	15.721	3.390	3.253	17.829	5.887	12.587	0.000	0.000
Semiconductor manufacture	HFC-23	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	CF_4	0.927	6.754	3.547	3.547	3.547	3.547	3.547	3.547
	C_2F_6	4.590	33.449	0.000	0.000	0.000	0.000	0.000	0.000
	SF_6	1.126	0.000	5.700	5.700	5.700	5.700	5.700	5.700
	NF_3	0.000	0.000	2.580	2.580	2.580	2.580	2.580	2.580
Total		**812.89**	**2 077.38**	**2 997.92**	**2 445.61**	**1 975.11**	**968.68**	**439.59**	**220.54**

Source: CRF tables 2005 – 2015 ENVIROS, Ltd.

5.5 Emissions from agricultural production (Sector 3)

Projections of greenhouse gases emissions includes the following activities:

CH_4 emissions

- enteric fermentation,
- manure management.

N_2O emissions

- manure management,
- agricultural soils.

CO_2 emissions

- liming,
- urea application

The projections of greenhouse gas emissions in Agriculture are based on trends in the activity data used in the emission inventory calculation. The most important sources of data are: animal population (particularly cattle and swine population), amount of fertilizers applied to agricultural soils, and the annual harvest production.

The trend series are consistent for both methane and nitrous oxide. For methane, the decrease in emissions for enteric fermentation and manure management since 1990 is connected with the decrease in the numbers of animals (especially cattle and swine). Since 1994, it seems that agrarian conditions have, at least in part, settled down to the current level. The reduction in the dairy cow population is partly counterbalanced by an increase in dairy cow efficiency (increasing gross energy intake and milk production).

Expert judgments of Ministry of Agriculture and IFER were employed to forecast activity data and the emission factors employed in sector of Agriculture under the conditions in the Czech Republic. The activity data is supplied by the Czech Statistical Office. The approach using a spreadsheet processor, based on the projection of trends in the individual activities for these emissions and processes, was employed to prepare the projection of greenhouse gases from agricultural production.

The documents ”Strategy for growth - Czech agriculture and food related to CAP after 2013” and ”Strategy of the Ministry of Agriculture with a view to the 2030” formulate the common and specific goals and trends based on the broad discussion of the *Group for strategic questions in agriculture*, formed the baseline of status and trend analysis for Czech agriculture.

Methane emissions

The methane emissions consist of emissions from enteric fermentation and manure management. Due to planned subsidies for dairy and pig farmers an increasing trend of cattle and pig population is expected. Also moderate increase in goat, sheep and horse breeding is expected. The following table gives the reported and forecast activity data. The emission coefficients used to estimate methane emissions are taken from the Czech National Inventory Report 2017. The methodology of emission estimation is linked to the IPCC 2006 Guidelines.

Table 5.17: Historic and projected activity data for animal population (thousands of heads)

	1990	2015	2020	2025	2030	2035
Cattle	3 532	1 407	1 485	1 560	1 605	1 630
Swine	4 790	1 560	1 800	2 100	2 400	2 500
Sheep	430	232	235	240	250	260
Goats	41	27	30	35	40	42
Horses	27	34	35	35	40	40
Poultry	31 971	22 508	22 500	23 000	25 000	25 500

Source: 1990, 2014 and 2015 – CzSO data; 2020, 2025, 2030 and 2035 – MoA

Nitrous oxide emissions

The current level of fertilizer application can be expected to remain unchanged in the near future, while an additional decline of up to 5-10% is anticipated under the WAM scenario. For example, the implementation of ecological and organic farming would bring a positive effect in GHG emission reduction.

A prognosis of total agricultural plant production is very uncertain. A harvesting of crops is dependent on many other indicators. A slight increase of harvests of other than crops is expected, despite of consistent decline in agricultural areas (conversion to settlements, afforestation) and cropland areas (conversion to grassland).

The emission coefficients used to estimate the nitrous oxide emissions were taken from the National Inventory Report 2017. The methodology of emission estimation corresponds to the IPCC 2006 Guidelines.

Table 5.18: Historic and projected activity data for application of mineral fertilizers and annual harvests (kt)

Input data	1990	2015	2020	2025	2030	2035
Mineral fertiliser	418	270	275	280	280	285
Crops (cereals)	8 947	8 184	8 470	8 100	7 930	8 060
Pulses	152	96	91	104	113	117
Potatoes	1 755	505	612	629	683	700
Sugar beet	4 026	3 421	3 720	3 844	4 030	4 347
Fodder	7 444	2 708	3 250	3 551	3 850	4 163
Soya	2	20	25	30	36	48

Source: IFER, Ltd.

WEM and WAM scenario

The WEM and WAM scenarios include corresponding policies and measures. WEM (with existing measures) scenario takes into account the policies and measures adopted and implemented until June 2016 presented in the Chapter 4.

WAM scenario takes into account the policies and measures implemented after June 2016 within The Fourth Action Plan of Nitrate Directives.

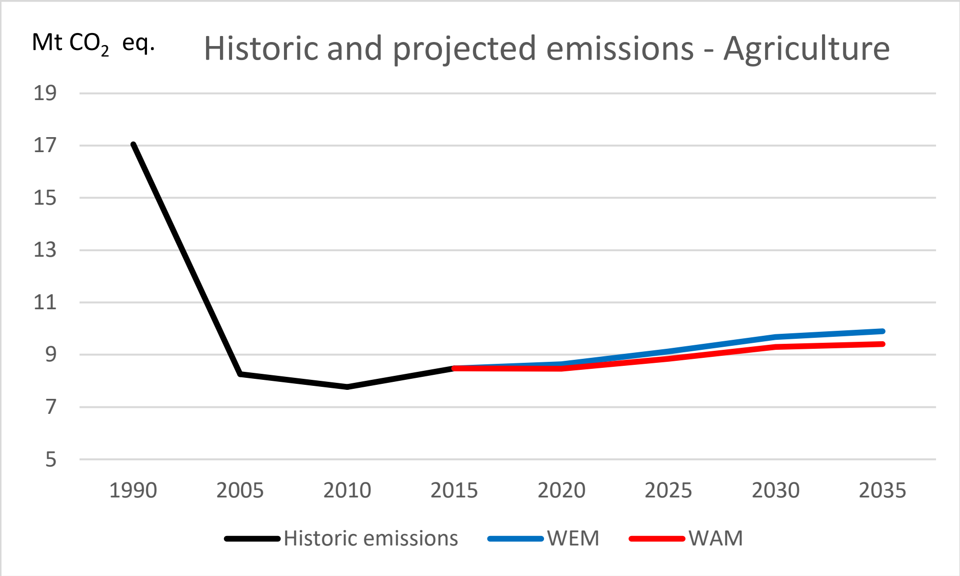
A strong increasing trend in the production of greenhouse gases in Agriculture is expected, according to WEM scenario and the emissions should be approximately 17% above the 2015 level in 2035. The emissions should slightly rise also under WAM scenario, this means that the implemented and additional measures are not sufficient to eliminate the increase in emissions. The previous rapid decline of emissions during 1990-2015 by 50% is sufficient to cover increase of emissions by 17% in the period 2015-2035. The resulting effect of WEM scenario for period 1990-2035 presents a decrease of emissions about 42% in agriculture sector.

Table 5.19: Historic and projected emissions from agriculture (in Gg CO_2 eq.)

Scenario	1990	2005	2010	2015	2020	2025	2030	2035	1990 - 2020	2005 - 2020	1990-2030	2005-2030
WEM	17050.0	8257.5	7762.0	8483.0	8638.9	9124.0	9682.3	9899.5	-49.3%	4.6%	-43.2%	17.3%
WAM	17050.0	8257.5	7762.0	8483.0	8466.2	8850.3	9295.0	9404.5	-50.3%	2.5%	-45.5%	12.6%

Source: Source: IFER, Ltd.

Figure 5.1: Historic and projected greenhouse gas emissions (Mt CO_2 eq.) in Agriculture according to scenario with existing measures (WEM) and scenario with additional measures (WAM)



Source: CHMI

5.6 Land Use, Land-Use Change and Forestry (Sector 4)

Projections for LULUCF include the following activities:

CO_2 emissions

- Cropland,
- Wetlands,
- Settlements,
- Other land.

CO_2 removals

- Forest land,
- Grassland,
- Harvested wood products.

CH_4 emissions

- Forest land.

N_2O emissions

- Forest land.

Land use, land-use change and forestry (LULUCF) is a specific sector within the emission inventory framework, as it is the only one able to directly offset CO_2 emissions due to photosynthetic fixation of carbon in plants and increasing individual ecosystem carbon pools.

The emission estimates in the LULUCF sector are to a large degree determined by development of land areas categorized by their use. Therefore, the LULUCF emission estimates and their projections must primarily methodologically solve the issue of land areas. The data on areas used in the LULUCF emission inventory of the Czech Republic are exclusively based on the cadastral land use information of the Czech Office for Surveying, Mapping and Cadastre (COSMC; www.cuzk.cz). The observed development of the six major IPCC land use categories is reported in the latest Czech National Inventory Report (NIR 2017) for the period 1990 to 2015. The projections beyond 2015 are based on the observed trends and anticipation of gradually diminishing land use changes until 2035. The historical and projected land use areas are shown in table below. No dramatic changes are foreseen. There is a slight increase of forest, grassland and wetland land use categories, while the areas of cropland and other land are expected to further decrease. The changes in cropland land use category is in both relative and absolute numbers the most significant shift in land use expected in the country for the period since 2015 until 2035, the end year of the projection period. In general, the solely assumption implied for the land use change is that the rate of the observed changes in land use would tend to decrease for the projected period until year 2035 by a half relative to the rates observed for the previous two decades.

Table 5.20: Historic and projected areas of land use

Land use categories (thousand ha)	**1990**	**2015**	**2020**	**2025**	**2030**	**2035**
Forest land	2629	2668	2676	2681	2683	2685
Cropland	3455	3195	3168	3150	3138	3131
Grassland	832	1014	1027	1037	1045	1052
Wetlands	158	164	166	167	169	168
Settlements	705	740	746	747	747	747
Other land	107	106	105	105	104	104

Source: IFER, Ltd.

WEM and WAM scenario

Secondarily, following the setup of land use areas, the projections of emission estimates are prepared. The specific attention is given to forest land, which always represents the key emission category of the LULUCF sector as well as within the entire Czech National Inventory. For this reason, the projections related to forestry are elaborated on the basis of the scenario modelling using EFISCEN – the European Forest Information Scenario Model.

The projections of greenhouse gas emissions related to other land use categories besides Forest Land are based on simple correlations of the estimated emissions for the reference year linked exclusively to the corresponding land areas for the predicted years. The exception is the emission contribution of harvested wood products (HWP), which are newly reported under UNFCCC and Kyoto Protocol since 2015 annual inventory submission. The EFISCEN projections of greenhouse gas balance of Forest Land are based on the study performed within the project CzechForScen (Contribution of forestry to the emission balance of the Czech Republic and model prediction of forest management scenarios in the conditions of the Czech Republic), funded by the Czech Ministry of Education, Youth and Sports.

The WEM (With Existing Measures) scenario includes the development of land areas of individual land use. That development of land areas and land use changes drives the emissions of the reference year in response to the projected are change for the individual land use categories with exception of CO_2 emissions from Forest Land and HWP emission contribution. For Forest Land, the EFISCEN model scenario is used that includes the currently implemented forest management recommendations of the Czech Forestry Act and actual species composition as of the reference year.

The WAM (With Additional Measures) scenario is similar to WEM. However, it differs in the applied EFISCEN model scenario for Forest Land and CO_2 emissions, the key category of the LULUCF emission inventory. Specifically, it includes the proposed change of dominantly spruce even-aged forests stand to more diverse stands with higher share of broadleaved tree species such as beech and oak, applicable to period beyond 2016.

The historical data and projections using the WEM and WAM scenarios are shown in Figure 5.2. It can be observed that for the nearest decades, the LULUCF sector continues to act as a sink of emissions under the current harvest demand remaining for both WEM and WAM scenario. The difference between the WEM and WAM scenarios is notable, but quantitatively insignificant in relation to both the overall trend and annual fluctuations of emissions in this sector. The WAM scenario includes the proposed change of dominantly spruce even-aged forests stand to more diverse stands with higher share of broadleaved tree species such as beech and oak, applicable to period beyond 2016. The proposed species change is driven by the actual management groups and by altitude of their locations.

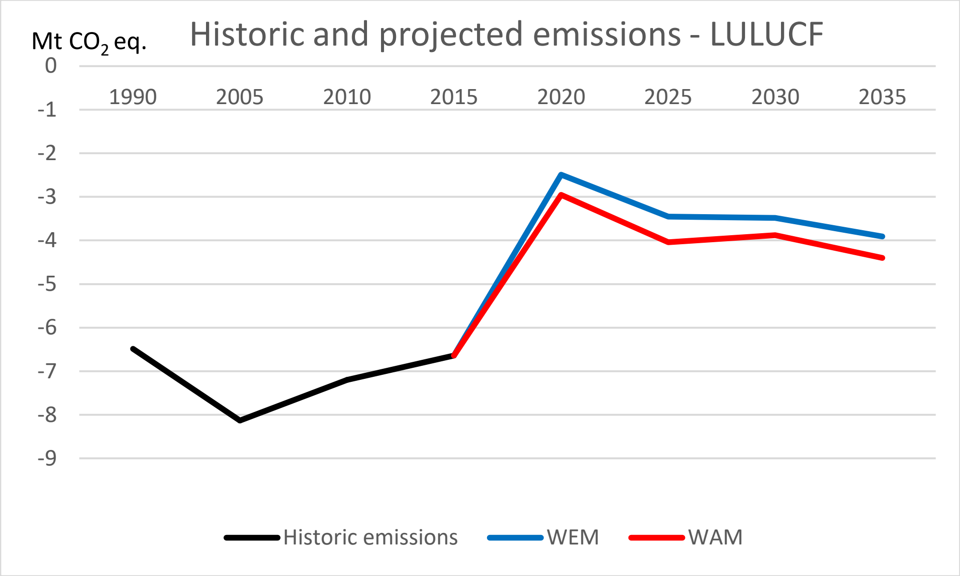
The numeric values for the trends by WEM and WAM scenarios are shown in Table 5.21. It can be seen that the sink of CO_2 observed in LULUCF for the previous decades to a notable extent diminishes. In relation to the base year 2015, the sink of emissions would decrease by about 41% and 34% in 2035 of that observed in 2015 for the WEM and WAM scenarios, respectively.

Table 5.21: Historic and projected emissions from LULUCF (in Gg CO_2 eq.)

Scenario	1990	2005	2010	2015	2020	2025	2030	2035	1990 - 2020	2005 - 2020	1990-2030	2005-2030
WEM	-6487.7	-8134.6	-7200.1	-6640.7	-2494.3	-3452.9	-3483.2	-3911.7	61.6%	69.3%	46.3%	57.2%
WAM	-6487.7	-8134.6	-7200.1	-6640.7	-2952.9	-4037.7	-3877.9	-4399.6	54.5%	63.7%	40.2%	52.3%

Source: IFER, Ltd.

Figure 5.2: Historic and projected greenhouse gas emissions (Mt CO_2 eq.) in LULUCF according to scenario with existing measures (WEM) and scenario with additional measures (WAM)



Source: CHMI

5.7 Emissions generated from waste (Sector 5)

Projections include the following activities:

CO_2 emissions

- waste incineration.

CH_4 emissions

- solid waste disposal,
- biological treatment of solid waste,
- incineration and open burning of waste,
- waste water treatment and discharged.

N_2O emissions

- biological treatment of solid waste,
- incineration and open burning of waste,
- waste water treatment and discharged.

Overall development of the waste sector in past decades is dominated by landfilling of waste. Landfilling is still dominant type of waste management nowadays, but its importance is decreasing due to rise of waste recycling (collection of separated waste parts) composting and incineration. In not so far future landfilling (mainly landfilling of municipal/organic waste) might disappear as the landfills capacity is decreasing and other options are preferred by national legislation.

Main activity data comes from WMP (Waste Management Plan) of the Czech Republic. Key assumptions in WMP for the future GHG emissions (mainly for municipal waste) development are following: "The developed forecasts of municipal waste (MW) production imply that MW production between 2013 and 2024 will decline slightly." It can be seen that on the basis of these assumptions, due to the diversion of materially recoverable components of MMW, in the years 2013-2024 a decrease in landfilling occurs, compensated by a significant increase in material recovery of MW, by the development of composting and anaerobic digestion, and last but not least, by energy recovery.

The capacity forecast of facilities for power recovery[16] from waste was made on the basis of the status quo (3 facilities in Prague, Brno and Liberec with an aggregate capacity of 630000 tons/year), and information about upcoming projects in various stages of completion.

By calculating waste management types to fit into the total production of MW, we acquire approximately linearly decreasing volume of landfilled MW, in a way ensuring compliance with specified requirements to restrict landfilling of biodegradable municipal waste stipulated by the Landfill Directive and material recovery of MW stipulated in the Framework Directive. The trend of reduced landfilling thus corresponds to the expected ban or one of the variants of a significant reduction in landfilling of untreated waste.

To have prolonged timelines we have used outlined scenarios and build upon them up to 2040. Assumptions source category 5D – wastewater management are based purely on population development and current technology mix and industrial water are coupled with domestic.

Table 5.22: Forecast of total MMW production by all subjects in the Czech Republic (Mt)

Year	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Total	3.12	3.12	3.1	3.09	3.07	3.06	3.04	3.02	3.01	2.99	2.97	2.96
Municipalities	2.22	2.22	2.21	2.19	2.17	2.16	2.14	2.12	2.11	2.1	2.08	2.06
Nonmunicipal entities	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9

Source: WMP 2014

Table 5.23: Forecast of municipal waste management (Mt)

Year	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**
Material recovery	1.84	1.89	1.91	1.94	1.96	1.99	2.03	2.07	2.12	2.17	2.23	2.31
Composting	0.25	0.31	0.37	0.43	0.49	0.54	0.60	0.65	0.70	0.75	0.80	0.85
Energy recovery	0.63	0.63	0.68	0.72	0.72	0.72	0.80	0.95	1.15	1.15	1.37	1.47
Landfilling	2.69	2.61	2.46	2.32	2.21	2.10	1.91	1.65	1.34	1.12	0.87	0.65
Incineration	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02

Source: WMP 2015

WEM and WAM scenario

Emissions estimated up to year 2035 are based on assumptions and forecasted scenario in the Waste Management Plan 2015 - 2024 (WMP). Forecasted scenario in WMP does not work with variants. Scenario in WMP 2014 fulfils description of WEM, however the document is taking

[16] Please note that waste to energy processes are part of energy, not waste sector.

into account all measures that are already in power, though some measures will be implemented in the future, based on the proposed roadmap. The only difference between WEM and WAM scenario are landfill gas (LFG) recovery coefficients, which are for the WAM scenario are stricter beyond 2025, hence emissions from landfilling in the WAM scenario falls more rapidly. Overall results for the waste sector are shown in Table 5.24.

Development of the WEM scenario is based on several mechanics that are embedded into quantifications and activity data assumptions. Landfilling is gradually declining and composting and incineration is taking place instead. The shift from landfilling to composting and anaerobic digestion decreases emissions because composting and anaerobic digestion produce lower emissions. Shift from landfilling to waste incineration is not visible here either, as waste to energy is reported under energy sector, where it does not leave a significant (compared to size of energy sector) footprint. Compared to the last projection GHG trend of the sector is completely reversed. The reason for this abrupt change is that previous activity data estimates were based on WMP from 2004 (valid to 2014). New WMP overhauls waste management of the country significantly and new measures should have much higher impact on GHGs.

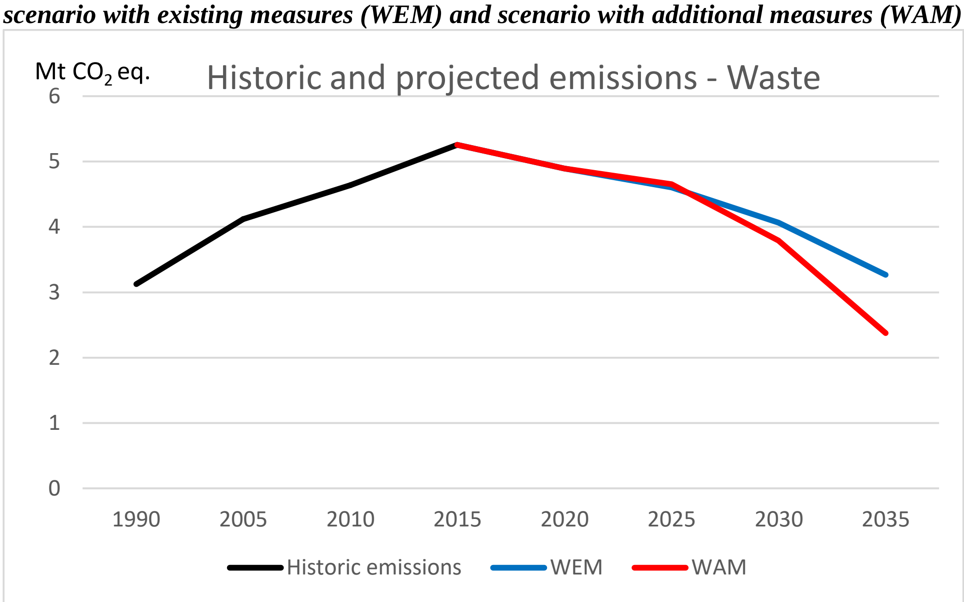
WAM scenario is almost identical to WEM scenario. The reason is that WMP 2014 is relatively new and all planned changes in waste management practice are implemented by this document. The only difference between WEM and WAM scenario is increased recovery of landfill gas, which is increasing more sharply in WAM scenario due to increased pressure from renewables market.

Table 5.24: Historic and projected emissions from Waste (in Gg CO_2 eq.)

Scenario	1990	2005	2010	2015	2020	2025	2030	2035	1990 - 2020	2005 - 2020	1990-2030	2005-2030
WEM	3126.8	4117.2	4637.0	5256.4	4894.7	4606.2	4064.3	3265.6	56.5%	18.9%	30.0%	-1.3%
WAM	3126.8	4117.2	4637.0	5256.4	4894.7	4655.0	3788.8	2373.8	56.5%	18.9%	21.2%	-8.0%

Source: CHMI

Figure 5.3: Historic and projected greenhouse gas emissions (Mt CO_2 eq.) in Waste sector according to scenario with existing measures (WEM) and scenario with additional measures (WAM)



Source: CHMI

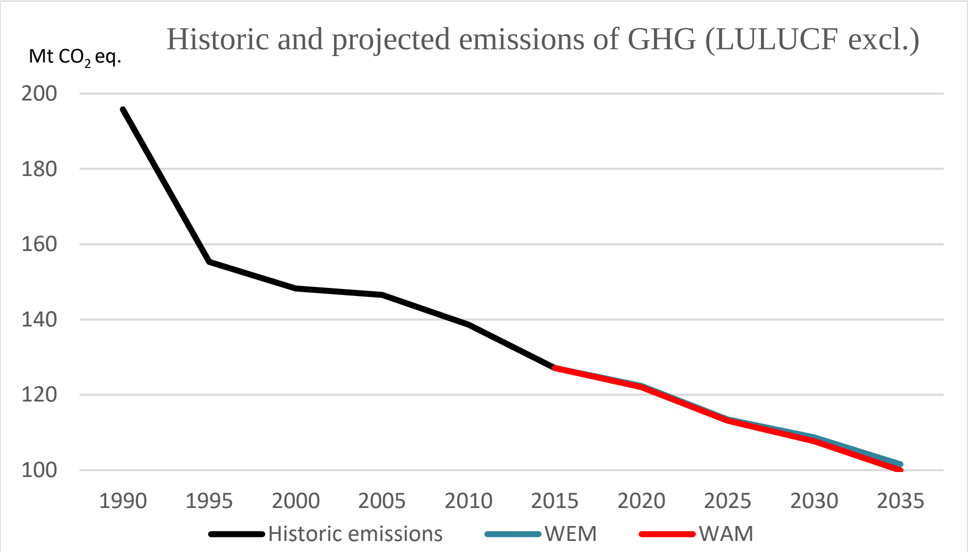
5.8 Total projections

Figure 5.4 indicates development of greenhouse gas emissions in 1990 – 2035. For period covering years 1990 – 2015 we have used values from national greenhouse gas inventories and for 2020 – 2035 our own projections:

1. Projections for WEM (with existing measures),
2. Projections for WAM (with additional measures).

These projections differ in a number of measures seeking reduction of greenhouse gas emissions and degree of their implementation.

Figure 5.4: Historic emissions and projections of greenhouse gas emissions in CO_2 eq. for WEM and WAM scenarios (excl. LULUCF)



Source: CHMI

Tables 5.25 and 5.26 show more detailed results for calculations of the two different projection scenarios.

Table 5.25: Calculation of projections of greenhouse gas emissions (excl. sector LULUCF) – projections with existing measures

Gas (Mt CO_2 eq.)	1990	2005	2010	2015	2020	2025	2030	2035
CO_2	161.6	124.6	116.2	103.8	100.3	92.2	88.5	83.1
CH_4	23.5	14.5	14.2	13.7	13.3	12.7	12.3	11.1
N_2O	10.6	6.5	5.7	6.1	6.5	6.8	7.1	7.0
HFCs	0.0	0.9	2.3	3.5	2.3	1.9	0.9	0.3
PFCs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SF_6	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
NF_3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (CO_2 eq.)	**195.8**	**146.5**	**138.6**	**127.1**	**122.5**	**113.6**	**108.8**	**101.6**

Source: CHMI

Table 5.26: Calculation of projections of greenhouse gas emissions (excl. sector LULUCF) – projections with additional measures

Gas (Mt CO_2 eq.)	1990	2005	2010	2015	2020	2025	2030	2035
CO_2	161.6	124.6	116.2	103.8	99.9	91.8	88.2	82.7
CH_4	23.5	14.5	14.2	13.7	13.3	12.7	12.0	10.2
N_2O	10.6	6.5	5.7	6.1	6.5	6.7	6.7	6.7
HFCs	0.0	0.9	2.3	3.5	2.3	1.9	0.9	0.3
PFCs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SF_6	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
NF_3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total (CO_2 eq.)	**195.8**	**146.5**	**138.6**	**127.1**	**122.1**	**113.2**	**107,8**	**100,0**

Source: CHMI

Total effects of policies and measures for the WEM and WAM scenarios, aggregated and for each sector, are given in table 5.27.

Table 5.27: Total effect of policies and measures in 2020 and 2030

Total Effect of Policies and Measures	Expected benefit in reducing greenhouse gas emissions (in kt CO_2 eq./year)	
	2020	2030
WEM Scenario		
Energy supply	7774	9135
Transport	2675	4380
Industrial Processes	3152	4775
Agriculture	825	912
Waste	466	1304
Cross-cutting	793	665
Total Effect WEM	**15685**	**21171**
WAM Scenario		
Energy supply	621	495
Transport	160	176
Industrial Processes	0	0
Agriculture	0	0
Waste	0	0
Cross-cutting	0	0
Total Effect WAM	**781**	**671**
Total Aggregate Effect (WEM+ WAM)	**16466**	**21842**

Source: CHMI, ENVIROS, Ltd.

5.9 Used methodology

Methodology used in preparation of emission projections is in line with methodology used for compilation of the Third, Fourth, Fifth and the Sixth National Communication, which enables their mutual comparability. Methodology includes a set of the following actions:

1. Inventory of greenhouse gases,
2. Selection of the starting and the end year and cross-sectional years for projection,
3. Selection of own methodology and modelling tools for projections,
4. Collection and analysis of input data,
5. Determination of initial assumptions,
6. Definition of scenarios,
7. Calculation of scenarios and results presentation,
8. Sensitivity analysis of selected assumptions.

Results of these actions are described below.

5.9.1 Inventory of greenhouse gas emissions

The Czech Hydrometeorological Institute compiled the inventory; the last available summary inventory used in preparation of projections is dated 2015. Summary data from this inventory are given in Chapter 3 here above.

5.9.2 Starting year and cross-section periods

2015 is the starting year; for projections purposes, the following data were available for this year: macro-economic development, energy balance, sources balance and energy consumption, national emission inventory. End year for projection of greenhouse gas emissions was 2035, which is in line with the required methodology for compilation of this document. Years 2015, 2020, 2025, 2030 and 2035 were selected to be the cross-section years.

5.9.3 Modelling tools and methods

For projections of CO_2, CH_4 and N_2O emissions from fuel combustion processes was used the MESSAGE model. The strength of the model is its flexibility regarding all input data and the possibility to calculate not only activity data and emissions, but also to estimate the influence of various PaMs. The weakness of the model is the complicated inserting of input data, which is time intensive.

Following activities were included in projections for individual gases:

- **Carbon dioxide (CO_2)** - fuel combustion in fuel conversion processes (public and industrial energy sector), fuel combustion in final consumption (industrial processes, transportation, households, agriculture and public and commercial services sector), fuel refining processes (refineries, coal treatment and coking) and SO_2 removal from flue gases using lime;
- **Methane (CH_4)** - coal mining and post-mining treatment of coal; mining, storage, transit and distribution of natural gas and mining, storage, transportation and refining of oil;
- **Nitrous oxide (N_2O) -** fuel combustion in stationary and mobile sources.

For projections of greenhouse gases development from industrial processes, was also used the the MESSAGE model. Projections of emissions were calculated on the basis of GDP and production development in industrial sectors.

5.9.4 *Collection and analysis of input data*

The basic sources of data for compilation of greenhouse gases projections were the following documents:

Statistical data:

1. Greenhouse gas emissions inventory of the Czech Republic 2017, CHMI, Prague, April 2015
2. Energy Balance of the Czech Republic 2010- 2015, CzSO, Prague, 2017
3. National Action Plan for Energy Efficiency for the Czech Republic (NEEAP IV), Ministry of Industry and Trade, February 2016.
4. Annual Report on the Operational Program Enterprise and Innovation 2013, CzechInvest, Prague, July 2014 (http://www.mpo-oppi.cz/media/273-vyrocni-zpravy-oppi-za-roky-07-08-09-10-1112-13.html)
5. Documents provided by the Ministry of Industry and Trade, Ministry of the Environment, Ministry of Transport, Ministry of Agriculture, Ministry of Education Youth and Sports, Ministry of Culture, Czech Energy Agency, State Environmental Fund, Czech Statistical Office and CzechInvest.

Prognostic data:

1. Ministry of Industry and Trade, 2015. State Energy Policy of the Czech Republic
2. Ministry of Agriculture (2016). Ministry of Agriculture strategy with a view until 2030, no. 66699/2015-MZE-10051, 136 pp. (in Czech)
3. National Renewable Energy Action Plan of the Czech Republic. Ministry of Industry and Trade, December 2015
4. Documents provided by Ministry of Industry and Trade, Ministry of the Environment, Ministry of Transport, Ministry of Agriculture, Ministry of Education Youth and Sports, Ministry of Culture, Czech Energy Agency, State Environmental Fund.
5. Documents provided by EGÚ Brno, a. s., VUPEK-ECONOMY, spol. s. r. o.

The above-mentioned sources were used in creating databases for prognoses input data.

5.10 Initial assumptions and scenarios

5.10.1 *Political and legal environment*

From political and legal perspective these following conditions have been taken into consideration with regard to the development of energy sector and industrial processes emitting GHGs:

- By acceding to the EU, the Czech Republic committed itself in terms of protection of the environment and climate, which form a part of the Acquis communautaire, such as Directive No. 80/2001/EC, Directive No. 96/61/EC (to be replaced by Directive 2010/75/EU in 2014), Directive No. 81/2001/EC (replaced by Directive 2016/2284/EU), Directive No. 96/2003/EC (replaced by Directive 2003/27/EC and Regulation (EC) No 1882/2003) and Directive No. 2003/30/EC (replaced by Directive 2009/28/EC).

- The ETS system is in operation in the Czech Republic as a part of the EU ETS. This system is developing especially in terms of allowance allocations, when the so-called grandfathering is being gradually abandoned and auctions are the main source of allowances (since 2013).
- The Czech Republic is bound by a number of international climate and environmental protection treaties (Kyoto Protocol, Second Sulphur Protocol, Gothenburg Protocol).
- Energy market is open to all comers pursuant to Act No. 458/2000 Coll. amended by Act No. 670/2004 Coll. (electricity from 1. 1. 2006, gas 1. 1. 2007) and coal, gas and electricity prices are converging with European market prices.

5.10.2 Technological development

In the period between 2015 and 2035 there are anticipated significant developments in technologies for acquisition, conversion, transportation and use of energy sources. In the area of solid fuels used in electricity generation, the use will lead to sources with supercritical steam parameters and fluid technologies, which will considerably increase efficiency; in the area of combined electricity and heat production the improvement of technologies will allow construction of sources as close as possible to its consumers. Later on, we anticipate possible coming of small sources based on micro turbine and fuel cell technologies.

In the nuclear sector is anticipated the construction of two new nuclear blocks around 2035.

In terms of motor fuel is anticipated, besides further decreasing consumption, a higher use of alternative fuels, which will be possible also by use of renewable energy sources (biofuel). Main trend will be not only further decreased in measurable investment costs, but also criteria affecting protection of soil and biodiversity, respectively demonstrable contribution to reducing greenhouse gas emissions.

5.10.3 Demographic development scenario

Population growth prognosis is based on the Czech Statistical Office (CzSO) data[17]; numbers of households, which are also necessary to calculate energy-related demand, were estimated. CzSO prepared three separate population projections; we have used the middle projection.

Table 5.28: Demographic prognosis (thousand)

	2010	2015	2020	2025	2030	2035
Population	10 517	10 511	10 502	10 478	10 428	10 351
Households	4 614	4 491	4 585	4 648	4 687	4 702

Source: CzSO, ENVIROS, Ltd.

5.10.4 Economic development scenario

An official projection of long-term trends in GDP is not available for the outlook to the year 2030. In addition, under the conditions in the current economic crisis, it is very difficult to predict the trends in the national economy and its individual sectors. The scenarios of trends in the GDP used in this projection are based on predictions made by company EGÚ Brno, a. s., for the Electricity Market Operator (OTE). These projections are made every year and approved by a group of experts organized by the OTE.

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[17] Population prognosis up to 2050, CzSO, Prague 2017 (https://www.czso.cz/csu/czso/populacni-prognoza-cr-do-r2050-n-g9kah2fe2x)

Table 5.29: Gross added value development prognosis (2010 constant prices[18]) in billion EUR

Sector	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
Industry	42.4	46.2	53.8	61.5	68.1	73.8
Construction sector	9.7	9.4	10.7	12.0	13.3	14.6
Agriculture	2.4	2.7	3.0	3.3	3.6	3.8
Transport	8.7	7.8	9.1	10.5	11.9	13.3
Services	78.4	85.7	100.1	117.1	135.0	153.8
Total	**141.7**	**151.9**	**176.6**	**204.4**	**231.9**	**259.3**

Source: ENVIROS, Ltd.

5.10.5 Development of global fuel and energy prices

Petroleum, natural gas and black coal are commonly traded energy commodities on the global market. Price trend scenarios are also regularly prepared for these three basic energy commodities. Recently, electrical energy has been increasingly traded; however, because of the regional character of trade, no scenarios have been published for price trends.

The prices of fuels on the global market were taken from EU documents[19] dated 14. 6. 2016.

Table 5.30: Global prices of fuels (€/GJ, constant prices of 2013)

€ (2013)/GJ	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
Oil	9.3	11.9	11.6	13.2	14.5	15.1
Natural gas	5.9	7.7	7.5	8.1	8.8	9.4
Coal	2.5	2.3	2.2	2.6	3.2	3.4

Source: Recommended parameters for reporting on GHG projections in 2017, Final, 14/06/2016

The main assumptions used in outlining the scenarios include:

- There has been a jump in oil / gas prices and long-term prognoses for its development vary considerably;
- With regard to ever-growing demand (especially in the developing world) natural gas prices will continue to be tied to oil prices (extent and speed in price change will be lower than for oil);
- Price on import for black coal is based on the optimistic assumption of its surplus on European market;
- There exists a certain risk of black coal prices rising due to growing demand in fast-growing Asian countries;
- Domestic price of black coal will be burdened with additional transportation costs at state border (estimate 10 CZK/GJ);
- New energy sources will need to comply with strict ecologic limits and electricity prices will need to cover variable and constant costs, and therefore the price will be considerably higher than current prices;
- After 2010 the increases in electricity price is derived from increase of natural gas prices, as a new decisive source of fuel for generation of electricity in Europe.

[18] Exchange rate 25.29 CZK/€ – average for 2010, 25.974 CZK/€ – average for 2013
[19] Recommended parameters for reporting on GHG projections in 2017, Final, 14/06/2016

5.10.6 Development of domestic prices and fuel and energy availability

Prices of imported primary energy sources are based on the above-listed average import prices into the EU. The prices of domestic energy sources are based on the costs of their acquisition and will also be affected by the position of the given fuel in the market compared to competitive energy sources. Solid fuels, especially brown coal, will continue to be a decisive domestic primary energy source by 2020.

Purchase prices of electricity from renewable energy sources and from sources with combined heat and electricity production were stipulated by a Decree of the Energy Regulation Authority. The legislation guaranteed favourable purchase prices for a period of 15 years from bringing the source into operation. The Energy Regulatory Office could reduce these prices by up to 5% annually compared to the previous year. The projections assumed maintenance of current purchase prices for the entire period.

During 2010 investment costs of photovoltaic pannels decreased dramatically and extreme boom of new solar installations occurred. The installed capacity of photovoltaic power plants tripled and reached 1800 MW by the end of 2010. Because this sharp increase would have led to a substantial increase of electricity prices, a new law was adopted which enabled to decrease the feed-in tariff by 50 % and a new tax of 26 %, applicable for 3 years for solar power plants built in 2009 and 2010, was introduced. Since 2015, the operational RES support for new installations is only granted to the CHP plants and partially biogas and hydro installations.

5.10.7 Availability of domestic coal

Solid fuels, especially brown coal, will continue to be a decisive domestic primary energy source in the near future. These sources will depend on the binding nature of administrative territorial environmental limits on brown coal mining. Tab. 5.31 shows the updated trends in the capacities of mining. The update respects the Governmental decision 827/2015, which partially releases territorial environmental limits at the Bílina mine and keeps them at the ČSA mine. As regards brown coal prices, they are moving from the costs-based price to a price derived from hard coal prices. It is expected that the brown coal price will reach about 75 % of hard coal price.

Quite dramatic development is observed in hard coal mining. Hard coal mining becomes cost ineffective and the mining company OKD shortened economically exploitable reserves. Moreover, in 2016 the OKD Company filed bankruptcy. The insolvency proceedings were kept off after all but the future of domestic hard coal mining is not very clear.

Table 5.31: Projections of domestic coal mining

Categories coal	Maximum mining capacity (units)	2015	2020	2025	2030	2035
Hard coking coal	PJ	116.6	35.1	0.0	0.0	0.0
	thousand t	4,400	1,300	0	0	0
Hard steam coal	PJ	79.5	24.3	0.0	0.0	0.0
	thousand t	3,000	900	0	0	0
Brown steam coal (SD – Libouš)	PJ	166.8	115.0	115.0	109.2	69.0
	thousand t	14,500	10,000	10,000	9,500	6,000
Brown steam coal (SD – Bílina)	PJ	134.0	134.0	121.4	111.5	90.3
	thousand t	9,500	9,500	8,600	7,900	6,400
	PJ	62.4	67.6	67.6	67.6	62.4

Categories coal	Maximum mining capacity (units)	2015	2020	2025	2030	2035
Brown steam coal (CC - Vršanská uhelná)	thousand t	6,000	6,500	6,500	6,500	6,000
Brown steam coal (Severní energetická)	PJ	59.0	45.0	0.0	0.0	0.0
	thousand t	3,280	2,500	0	0	0
Brown steam coal (SU – total)	PJ	69.4	53.8	50.2	50.2	50.2
	thousand t	5.600	4.500	4.200	4.200	4.200

Source: VUPEK-ECONOMY, Ltd.

5.10.8 Energy scenarios

Model calculation of greenhouse gas emissions from energy processes is based on the following assumptions:

1. Temelín nuclear power plant will operate over the entire monitored period (2000 – 2035);
2. The operation license for the Dukovany nuclear power plant will be prolonged and the power plant decommissioned gradually in the period 2035 – 2037;
3. The tender for new nuclear units in the nuclear power plant Temelin was cancelled and possible introduction of new nuclear units was postponed to and after the year 2030;
4. The territorial environmental limits on mining of brown coal will be retained at the ČSA mine and partly relaxed at the Bílina mine;
5. There will be no limits in place for oil, gas and black coal imports;
6. Import and export of electricity will be limited by technical capacity of the transmission network.

6 ESTIMATED VULNERABILITIES, CLIMATE CHANGE IMPACTS AND ADAPTATION MEASURES

6.1 Anticipated climate change impacts

The below described approach for scenarios application and generating estimations of climate development in the Czech Republic is adopted from the previous 6th National Communication. No new dedicated scenario for the territory of the Czech Republic has been developed, and newly available analyses of regional scenarios (EURO-CORDEX) for the Czech Republic[20] are in accordance with climate development estimations established in 6th National Communication.

6.1.1 Construction of scenarios

Integration of the regional climate model (RCM) ALADIN–CLIMATE/CZ[21] with emission scenario A1B for the 1961 – 2050 period, with horizontal resolution of 25 km, was completed in 2008. The outputs of the ALADIN – CLIMATE/CZ model in the form of series for the 1961 – 1990 period with a time resolution of 6 hours were first converted to daily data. The average daily and also maximum and minimum air temperatures and total daily precipitation were calculated. Subsequently, the obtained fields were validated by comparison with the set of measured values.

During the construction of the scenario of changes in the air temperature and atmospheric precipitation, emphasis was placed on three thirty-year time intervals: 2010 – 2039, 2040 –2069 and 2070 – 2099 and SRES scenario A1B. The basis for the scenario consists in RCM ALADIN – CLIMATE/CZ outputs with a resolution of 25 km, corrected for errors in the model, which were identified when comparing the model simulation for the reference period.

The global climate model (GCM) was used for uncertainty analyses for the 2010 – 2039 and 2040 – 2069 periods. The range of changes in thirty-year average temperatures and total precipitation in the country is characterized by the upper and lower quartiles of the set of changes, calculated by a group of selected GCM; the average change is the multi-model median. In addition to RCM ALADIN – CLIMATE/CZ outputs, the scenario will also include additional time series, which will reflect the "average" change that can be expected in the region of the Czech Republic on the basis of GCM outputs and the interval within which the results of 50% of the monitored GCM lie. A simple additive (for temperatures) and multiplicative (for precipitation) procedure recommended by the IPCC[22] was used to obtain these time series. In addition to GCM, the estimate of the uncertainty for the 2070 – 2100 period will also be based on inclusion of the outputs of the ALADIN – CLIMATE/CZ model in the context of further RCM, primarily in the models of the PRUDENCE [23] project.

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[20] For example, Belda, Pišoft, Žák (2015): Outcomes of regional climate models in the area of the Czech Republic for the period 2015 – 2060 (availiable in czech language only)

[21] Farad, A., Skalák, P., Štěpánek, P. (2008): High resolution experiments with the regional climate model ALADIN-Climate/CZ, Geophysical Research Abstracts, Vol. 10, EGU2008-A-08210

[22] IPCC-TGICA (2007): General Guidelines on the Use of Scenario Data for Climate Impact and Adaptation Assessment. Version 2. Prepared by T.R. Carter on behalf of the Intergovernmental Panel on Climate Change, Task Group on Data and Scenario Support for Impact and Climate Assessment, 66 pp.

[23] http://prudence.dmi.dk/

6.1.2 *Climate development estimates for the Czech Republic until the mid 21st century*

The basis for climate change scenario in the Czech Republic comprises of ALADIN-CLIMATE/CZ regional climate model output with 25 km resolution for the 1961–2100 period according to emission scenario SRES A1B, corrected for errors in the model, which were identified when comparing the model simulation for reference period 1961–1990 with actually measured values. Scenario has been prepared for the basic set of climatological elements: average daily temperature, daily precipitation amount, daily sum of global radiation, average daily wind speed, average daily humidity, daily minimum and maximum temperature. Selection of these climatological elements is based on the requirements of individual sectors involved in estimates of climate change impacts. Changes of climatological elements calculated by the ALADIN-CLIMATE/CZ model for 2010–2100 period in accordance with emission scenario SRES A1B are only one of the possible variants of the future climate development. These changes must be included into the context of uncertainties arising from use of various RCMs, governing GCMs and emission scenarios. For the purposes of estimating climate change development in the Czech Republic, we have used, from the set of compiled scenarios, the short-term (2010–2039) and medium-term timeframe (2040–69). The resulting scenario is a result of an R&D project completed in 2011[24]. A more recent analyses[25] of outputs or regional climate models (EURO-CORDEX) does not indicate any need for a substantial correction of the estimation of the future climate change development in the Czech Republic as prepared for the 6th National Communication.

Estimation of the short-term climate change development in the Czech Republic (2010–2039)

The short-term estimation (midpoint in 2030) shows that the average annual air temperature in the Czech Republic will increase, according to the ALADIN-CLIMATE/CZ model, approximately by 1 °C; warming up in the summer and winter is only slightly less than in the spring and autumn (Table 6.1). There is an apparent systematic increase of temperature with relatively little fluctuation over the area (Fig. 6.1).

Table 6.1: Changes in average seasonal temperature and precipitation in the short-term horizon in comparison with reference period 1961–1990 according to simulation by ALADIN-CLIMATE/CZ RCM model for A1B scenario

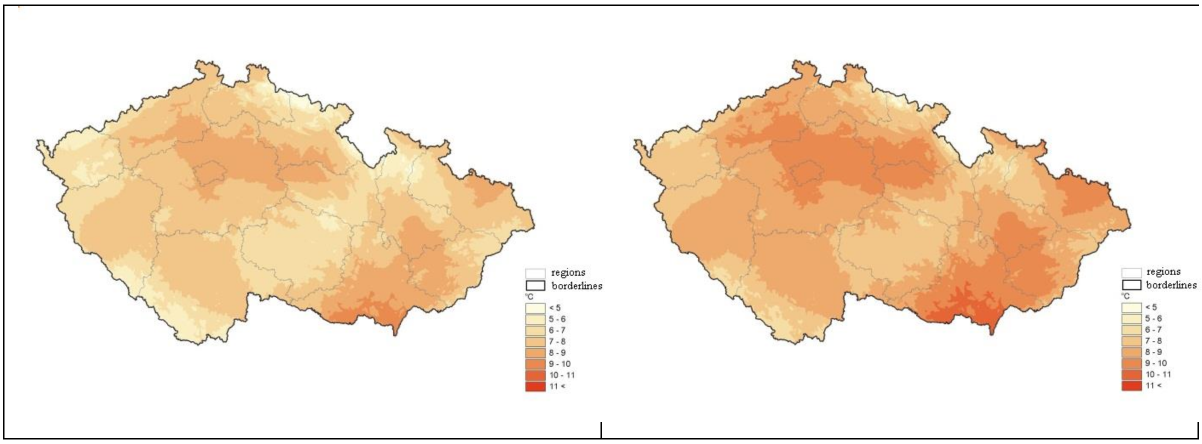
	Spring	Summer	Autumn	Winter	Year
Temperature [°C]	1.2	1.1	1.2	1.1	1.1
Precipitation [mean share]	1.10	1.03	1.07	0.91	1.03
Precipitation [%]	10	3	7	-9	3

Source: CHMI

[24] Pretel, J. a kol., 2011: Specification of existing estimates of climate change impacts in water management, agriculture and forestry sectors and proposal for adaptation measures. Technical summary of results of the R&D project (Ministry of the Environment, SP/1a6/108/07, 2007–2011). Prague: CHMI, p 67

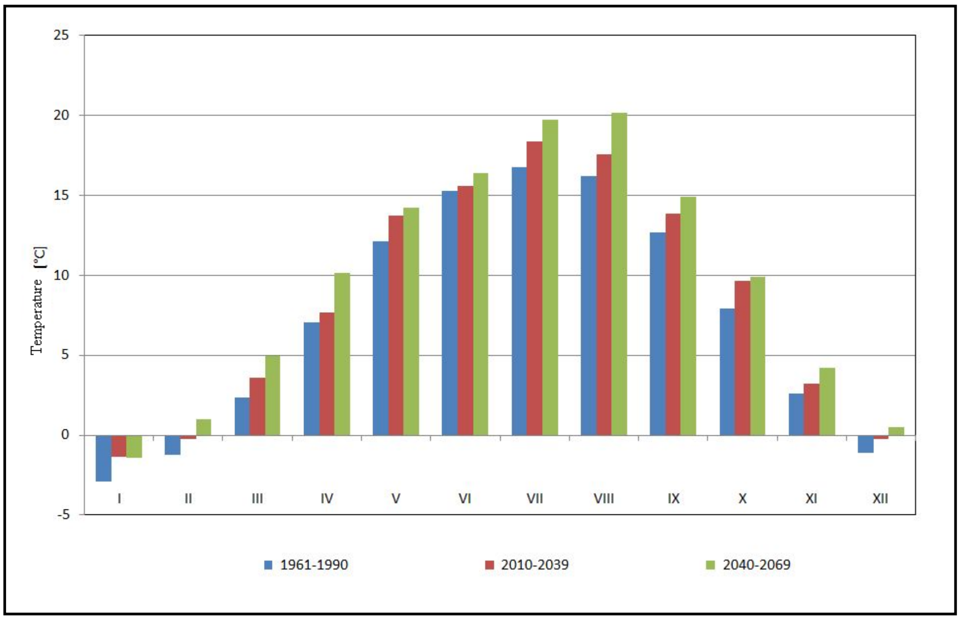
[25] For example, Belda, Pišoft, Žák (2015): Outcomes of regional climate models in the area of the Czech Republic for the period 2015 – 2060 (availiable in czech language only)

Figure 6.1: Average temperature in the Czech Republic in 1961-1990 (left) and estimated average annual temperature in 2010-2039 (right)



Source: CHMI

Figure 6.2: Average monthly temperature in the Czech Republic in reference periods 1961-1990, 2010-2039 and 2040-2069 (scenarios)



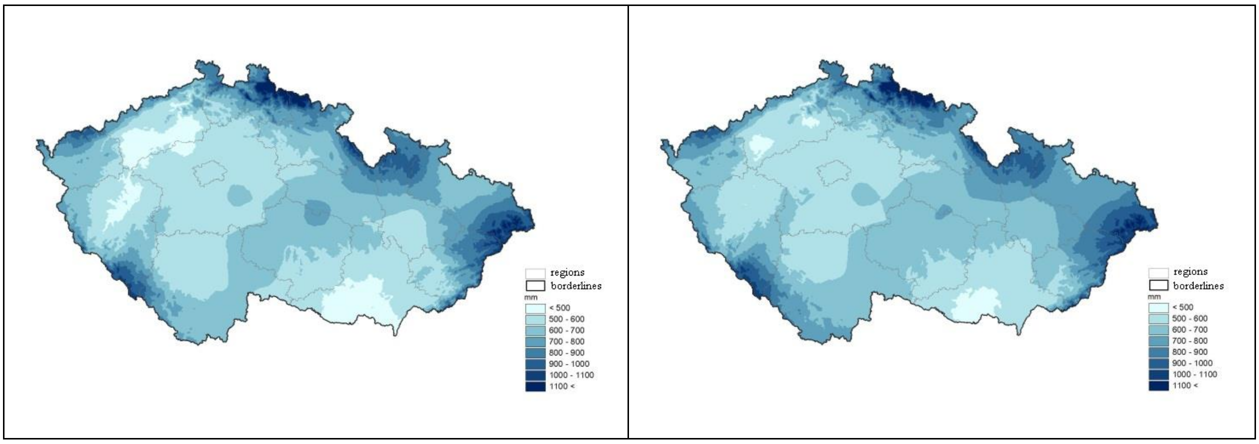
Source: CHMI

Fig. 6.2 above shows change in monthly temperature shown for the scenario periods, for both short- and medium-term horizon with reference to 1961-1990 period. Simulations also indicate that change in temperature is linked to certain related temperature characteristics. In the summer, we may anticipate slight increase in the number of summer and tropical days and nights, in the winter a decrease in the number of frost, ice or arctic days.

Total precipitation changes are more complex. Most nodal points in winter show in simulation decrease of precipitation (depending on specific location by up to 20%), while in the spring the same show increase (by 2 to approximately 16%); in the summer and especially in the autumn the situation varies place to place (some locations show slight decrease by several per cent in the autumn, while elsewhere an increase by up to 20–26%, in the summer slight decrease prevails, but in some locations (for instance in Western Bohemia) there is an increase by up to 10%). At the same time, there is an apparent spatial variability of these changes, so it is possible that eventual climate signal may be, in this short timeframe, drowned out by natural (year-on-year) fluctuation of precipitation totals.

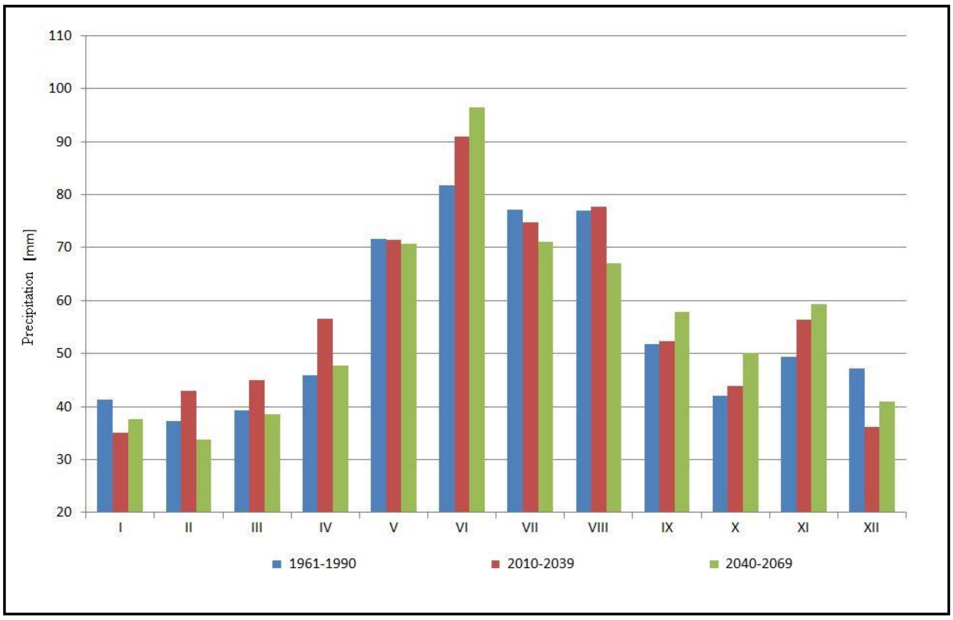
Between the beginning of autumn until the beginning of the summer the anticipated increase of precipitation is accompanied by identical increase in territorial evapotranspiration caused by increased temperature. In the summer, there is a decrease in precipitation and due to a drop in water reserves in the soil, this will probably not lead to a significant increase in territorial evapotranspiration. An important factor is a shift in snow cover melt in higher altitudes due to higher temperature, roughly from April to January/February.

Figure 6.3: Average annual precipitation in the Czech Republic in 1961-1990 (left) and estimated average annual precipitation in 2010-2039 (right)



Source: CHMI

Figure 6.4: Average monthly precipitation in the Czech Republic in reference period 1961-1990 and in scenario period 2010-2039 and 2040-2069



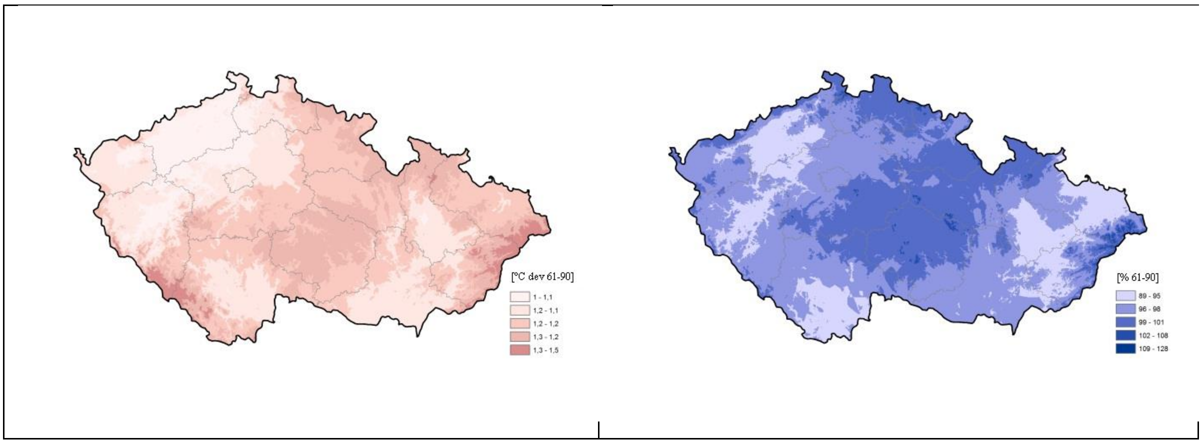
Source: CHMI

Changes in monthly precipitation in scenario periods in comparison with reference period 1961-1990 are shown in Fig. 6.4.

Model simulations for this period do not provide unequivocal results for subsequent change in terms of precipitation regime (number of floods or droughts occurrence). The acquired signals are ambiguous and present themselves in evaluated profiles both increases and decreases in the size of modelled flooding. This ambiguity is caused by the opposing influence of less frequent but more extreme precipitation and lower average initial saturation of the soil (due to potential higher evapotranspiration and longer period of dry episodes during the summer half of the year). Change in runoff in January-May is determined mainly by different snow cover dynamics, change in the summer period by decrease in precipitation.

Considering the weak signal of anticipated change in relative humidity and with regard to the fact that measured relative humidity values have not changed between 1961 and 2000, we use the measured value from the reference period to estimate these impacts. Simulated changes in seasonal daily averages of global radiation are most apparent in the winter (exceeding 10%), in other seasons they range in most locations below 4%, however in comparison with model errors the change in global radiation is small. Same recommendation remains therefore in place for application of these sets as for relative humidity.

Figure 6.5: Deviation of average temperature (left) and share of long-term average precipitation (right) in the Czech Republic in 2010-2039 in comparison with reference period 1961-1990



Source: CHMI

Medium-term (2040–2069) climate development estimation in the Czech Republic

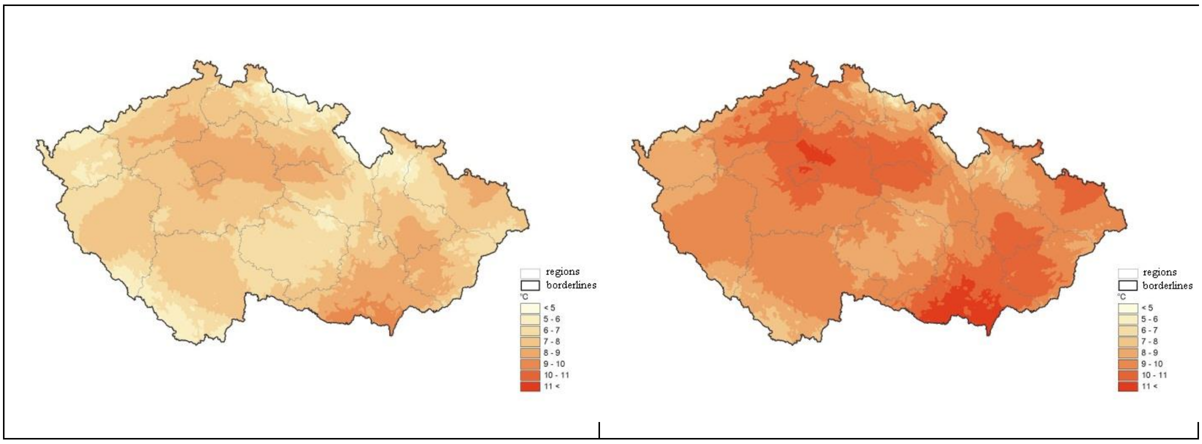
In medium-term timeframe (midpoint in 2050), the simulated warming becomes more significant (Table 6.2); temperature will rise the most in the summer (by 2.7 °C), least in the winter (by 1.8 °C). Temperature increase in August reaching almost 3.9 °C should be especially noted. Changes in temperature at individual grid points may range, in the spring and summer between 2.3 °C up to 3.2 °C, in the autumn between 1.7 °C and 2.1 °C and in the winter between 1.5 °C and 2.0 °C.

Table 6.2: Changes in average seasonal temperature and precipitation in medium-term compared to reference period 1961–1990 according to simulation of ALADIN-CLIMATE/CZ RCM model for A1B scenario

	Spring	Summer	Autumn	Winter	Year
Temperature [°C]	2.6	2.7	1.9	1.8	2.2
Precipitation [mean share]	1.00	0.99	1.17	0.89	1.01
Precipitation [%]	0	-1	17	-11	1

Source: CHMI

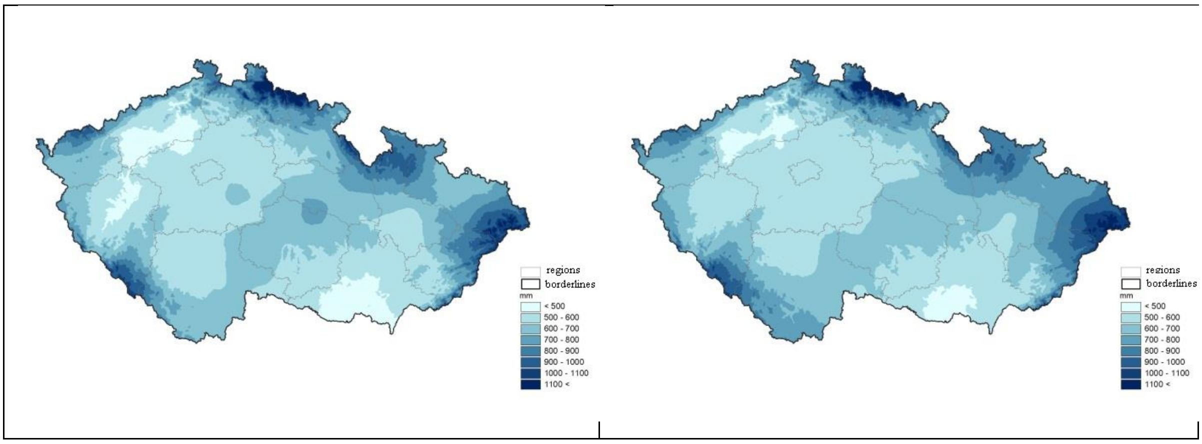
***Figure 6.6:** Average temperature in the Czech Republic in 1961-1990 (left) and estimated average annual temperature in 2040-2069 (right)*



Source: CHMI

The medium-term perspective makes winter decrease in precipitation more apparent (for instance in Krkonoše, Českomoravská Vysočina, Beskydy by up to 20%) and their increase in the autumn. During the summer, the decrease in precipitation becomes dominant factor, which will be even more significant in long-term horizon, while decrease of winter precipitation will be lower in comparison with the preceding period.

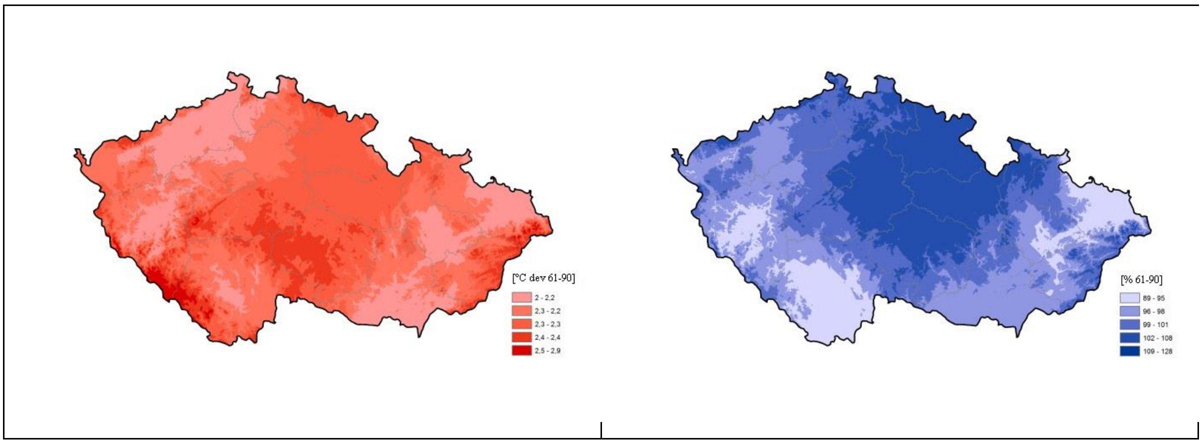
***Figure 6.7:** Average annual precipitation in the Czech Republic in 1961-1990 (left) and estimated average annual precipitation in 2040-2069 (right)*



Source: CHMI

Changes in relative humidity are small, but the model signals decrease for all seasons and time horizons – in the winter below 5%, summer 5–10% and at the end of the 21st century this may become up to 15% (in parts Central Bohemia, Vysočina). This finding is in line with the anticipated increase of air temperature and decrease in precipitation amount.

Figure 6.8: Deviation of average temperature (left) and share of long-term precipitation (right) in the Czech Republic for 2040-2069 in comparison with 1961 – 1990



Source: CHMI

6.2 Vulnerability estimates

Development trends in meteorological characteristics and more frequent occurrence of extreme meteorological events are already being reflected in changes of the water regime, agriculture and forestry and partially it also affects the state of health of the population. In the medium term (around 2030, see the scenario for the 2010 – 2039 period), it can be expected that there will be a further increase, especially harmful impacts are expected on the individual components of the natural environment, and it has been relatively newly pointed out that impacts are aslo anticipated in the energy sector, potential for recreation and tourism and overall wellbeing of the population, especially in larger residential agglomerations.

In response to tackling with negative impacts of climate change the European Commission adopted an EU strategy on adaptation to climate change in April 2013[26] (EU Adaptation Strategy). It represents a long-term strategy (by 2020) to increase resilience of the EU against climate change negative impacts at all levels and in line with Europe 2020 Strategy. It lays down framework and mechanisms, which should improve EU preparedness and enhance coordination of adaptation activities. The EU Adaptation Strategy also supports the EU Climate-ADAPT platform[27] as an European-wide information system for climate change impacts and adaptation. It contains data, maps, information on adaptation projects, measures and other relevant information. The EU Adaptation Strategy is being evaluated, thus it examines the actual implementation and the achievements of EU Adaptation Strategy compared to what was expected. The evaluation is planned to be completed by mid-2018.

The Czech Republic has prepared and approved its national Strategy on adaptation to climate change in the Czech Republic (2015) identifying vulnerabilities and defining general adaptation measures for relevant sectors. Most recently, the National Action Plan on Adaptation to Climate Change (2017) has been approved and it contains analysis identifying priority adaptation measures addressing the key climate change risks in an integrated cross-sectoral manner (for more details refer to Chapter 6.3).

[26] http://mzp.cz/cz/adaptacni_strategie_eu

[27] http://climate-adapt.eea.europa.eu/

6.2.1 *Water regime in the landscape and water management*

Water supply in the Czech Republic depends almost entirely on atmospheric precipitation and its transformation in nature.

The frequency of dry months has reached the maximum over the entire observed period in the last two to three decades. According to CHMI data, the number of below-normal precipitation months grew by approximately 50%, and the number of strongly below-normal precipitation months fell by approximately 1%. These are overall data for the Czech Republic since 1961.

In general terms there has been a decrease in usable water sources entirely as well as sporadically on local level. Supply of both surface and groundwater and refilling depends also on the retention capacity of the landscape, which has not yet reached a satisfactory level despite certain positive change since 1989.

The Czech territory has been hit several times by large-scale flooding in recent years. After the relatively quiet 20th century, in terms of floods, the last 20 years were affected by higher frequency of flooding.

In the medium term, it can be expected that the average flow rates will decrease in many river basins by 15 – 20% ("optimistic" scenario) to 25 – 40% ("pessimistic" scenario), which will lead to fundamental changes in the overall hydrological regime. Similar relative decreases can be expected for the minimum flow rates and minimum outflow of groundwaters. As a consequence of higher winter temperatures, the annual outflows will also change due to a reduction in stocks of water from snow (in some places very substantial) and an increase in territorial evaporation. The increased spring flow rates and subsequent additions to groundwater stocks will be gradually shifted to the end of winter and stocks of water will generally decrease. In the spring to autumn period, when a large part of the precipitation will be converted to territorial evaporation as a consequence of increased temperatures, outflows will generally decrease and this reduction can be prolonged by one or two months compared to current conditions.

Analyses of the climate change impacts on the water sources indicate an increasing evaporation that will be compensated by dry seasons because of limited water humidity in the soil. The consequence will be a higher potential for fires and 'heat waves'. While the overall average precipitation is expected to increase up to 10% for the period 2070-90, it will be mainly during winter seasons. Opposite to that, summer seasons will be dryer. The above-mentioned changes will lead to a significant decrease of the ground water reservoirs as well as water flow in rivers and streams. It is also bound to decreasing water quality. Expected changes in the hydrological regime and water quality will negatively affect water management and water infrastructure. Increasing demand for irrigation in agriculture in a combination with trends will probably end up by conflict of interests. Therefore, an international cooperation of river basin managements is necessary (Elbe, Donau, Oder).

The degree of expected reduction of the storage function of reservoirs is substantially affected according to the scenario of further development and can vary in a wide range from several percent to as much as half of current values. Water courses characterized by substantial accumulation volume in the form of groundwater stocks or artificial reservoirs are generally more resistant to the climate change impacts. The effect of changes on the hydrodynamics and selected water quality parameters in reservoirs will be demonstrated in increased lowering of water levels in the summer and autumn, shortening of the winter stratification period and of the interval of coverage of the reservoir by ice and increased summer surface temperatures. Decrease in flow rates will be demonstrated in changes in the quality of surface waters through an increase in the water temperature and its subsequent eutrophication. This will extend the water deficits in the summer and autumn months, even in relatively wetter regions. Increased winter run-off and the risk of increased occurrence of spring floods and inundation situations can be expected in parallel with reduced creation of stocks of water from snow cover.

In terms of flooding costs the experiences of the last 20 years may represent a strong indicator. Damage caused by floods between 1990 and 2010 reached 170 billion CZK, which is approximately 8.5 billion CZK annually only in terms of flood damage compensation. Most of these costs are covered by the public budget.

Cost of drought-related adaptation measures is even more difficult to estimate, as these climate change aspects have not yet been sufficiently explored in the Czech Republic. Cost of inaction will need to include compensation of damage caused by lack of water supply due to lower quality of water (for instance in connection with drinking water production), sanctions due to failure of compliance with EU commitments under the Directive 2000/60/EC etc. In comparison with the anticipated gross cost estimates for measures in the water management sector, amounting to 4.2 billion CZK annually, these costs will be considerably higher.

In terms of droughts, the state compensates and provides extraordinary subsidies, now on an almost annual basis, primarily to the agriculture sector (for instance in 2003, which was an extraordinarily dry year, the Government provided compensation in the amount of 1.4 billion CZK, in 2012 farmers required compensation up to 750 million CZK, and for 2015 the compensations for drought reached total of 1,2 billion CZK).

6.2.2 Agriculture

Adaptation of the agriculture sector to climate change relates not only to ensuring food supply and general food security, but also to maintaining sustainability of ecosystem services provided by the agriculture.

Climate change will affect plant and fodder production as well as production of other raw materials, it will also affect genetic diversity in agriculture, soil fertility and erosion, quality and availability of water and recreational potential of the landscape.

Future climate development scenarios indicate extension of vegetation period. In the medium-term horizon, the crops may profit from the extended vegetation (10 -15%) period, but on the other hand, less moisture may lower production yields by 5 up to 10%.

A number of the Czech most productive farming areas, suffering from falling moisture indexes, will be endangered by droughts in the future, if the current precipitation amount continues to fall and evapotranspiration increases. Changes in current precipitation regime and more frequent occurrence of storm rainfall may increase soil water erosion risks, which affect more than half of the area of the national farming land. Extension of periods without freezing temperatures by 20-30 days may be a potentially positive consequence of climate change, due to a shift in the main vegetation period in the warmest regions to the beginning of March until the end of October. Higher air temperatures will allow earlier seeding and influence growth and development of crops. In comparison with current situation, the harvesting period around 2050 may come sooner in lower altitudes (below 400 above sea) by 10 – 14 days and in higher altitudes by 15 – 20 days.

Anticipated temperature increase may create favourable conditions for growing of thermophilic crops even in cooler regions. This will make it possible to cultivate more thermophilic species (such as red grapes) in the warmest regions of Southern Moravia and Elbe River valley. A serious threat eliminating positive effect of an earlier onset of the main vegetation period constitutes spring frost, which is the probable and most significant (current and future) meteorological extreme of early spring weather.

Increase of photosynthesis intensity and increased concentrations of carbon dioxide constitute favourable climate change effect. According to an experimental research, type C3 plants (most of the temperate zone plants) react to increase of each 100 ppm by increased biomass production in terms of percentage, while for C4 plants (tropical fast-growing plants such as corn) the biomass increase is minimal. A positive, physiological effect demonstrated by plants vegetating in higher carbon dioxide concentration environment, is increased water efficiency in plants.

The anticipated warming and small decrease in atmospheric precipitation between April and September will likely trigger increase in evaporation in the most productive farming regions in the Czech Republic and cause their subsequent exposure to drought, which already negatively influences farm yields today. In some regions, it may be expected that the number of locations, which will not be suitable for farming, will grow. On the other hand, some locations at higher altitudes may prove to become more attractive in terms of farming, due to climate change, and their production potential may grow. It must be noted however, that the soil fertility in these regions is often lower, soil shallower and more prone to erosion and nutrient runoffs.

Warming in the spring months (April-June) may trigger stronger convection streams and resulting change in precipitation distribution, in terms of decrease in precipitation-days or days with lower precipitation than normal in this key period for crops. At the same time, there is a risk of increased probability of daily precipitation amount exceeding 10 mm, which trigger erosion risks. Area of the land exposed to erosion will rise by at least 10%. Erosion causes both financial losses and increased cost of crop farming.

Climate change will also influence changes in environment in terms of extending territory for diseases and pests, which were so far typical only for warmer regions. Warmer climate may increase number of pest populations and contagious pressure of certain crop diseases. On the other hand, temperate winters could expose the wintering pest populations to predators or other positive development in local shifts in of pest and host phenology, which may lead to disharmony and alleviation of damage caused by at least some pest populations.

It may also be anticipated that rising temperatures and longer vegetation period, will extend natural proliferation of plants growing in the wild and feral animals habitats tied to agro-ecosystems. Besides that, there will be a gradual introduction of crops and species from warmer climate areas to locations in the Czech Republic. This will change the crop and animal production composition and resulting impact in soil management and composition of associated vegetation.

Agriculture will continue to have, besides simple productive function, a significant landscaping role. The proposed adaptation measures are therefore based on existing knowledge and analyses of regional and local natural conditions. In this respect, and in connection with the anticipated climate change, it will be necessary to strengthen measures aiming to protect soil against erosion and measures to promote water retention in the agricultural landscape.

6.2.3 Forest management

Plants and tree species respond to climate change mainly through migration, while genetic adaptation is negligible. Thus, the anticipated increase in average temperatures will be manifested in a shift in the occurrence of many tree species to higher altitudes. For example, an increase in the average annual temperature by 1 – 2 °C can lead to a shift in the tree line by 100 to 200 meters.

The effect of dangerous stress by drought will be reflected on forest vegetation. Further habitat factors, such as light, air temperature, availability of nutrients or environmental pollution will act synergically with soil moisture and could reduce tolerance to drought. From climate change perspective drought remains the most pronounced risk factor, increasing the risk of forest fire, and having a negative effect on forest ecosystem production and services they provide.

Climate change effects will play a significant role in terms of worsened health and stability of regulated area felling tree stands which are mostly spruce monocultures, in lower and medium altitude locations, which are key locations for logging in the Czech Republic.

The current less-than-satisfactory state of tree stands, caused in the past particularly by burdening by high air pollutant concentrations, could become even worse with changes in climate conditions.

Many pest species are being activated, acting as initiation and mortality stressors affecting forest growth of all ages and simultaneously increasing frequency of calamities caused by abiotic effects during sudden climatic events (destructive gusty winds, wet snow, landslides after extreme rainfall, forest fires etc.). Monoculture forests are at most risks from these negative events. We must anticipate more frequent pest occurrences. Species that have not yet been recorded in this country could spread. The stress burden will probably lead to an increased proportion of dry wood and thus greater occurrence of fungal diseases.

The increased concentration of carbon dioxide in the atmosphere is demonstrated in promotion of the plants growth and production of biomass; nonetheless, the long-term effect can lead, especially for spruce, to the occurrence of acclimation depression of photosynthetic activity. The resulting effect of increasing concentrations can thus vary between zero effect on accretion, through increased growth of roots and new shoots, to changes in the growth of new shoots and roots in favour of one or the other.

Stabilization of forestry sector will be the main task. This will require close linkage between adaptation and mitigation measures, as measures to prevent areal collapses of forest ecosystems due to climate change represent simultaneously measures that stabilize carbon stock in forests and thus decelerate climate change. The optimum model, from the perspective of climate change, respecting principles of due care, appears to be cultivation of structurally rich forest, avoiding regulated area felling, with preference given to suitable tree stands with high and stable wood mass production, managed by methods that are close-to-natural processes with minimum energy contributions.

6.2.4 Biodiversity and ecosystem services

Despite the fact that decreases in biodiversity and degradation of ecosystem services are caused by varying environmental and socio-economic factors (regional transitions due to other economic factors, fragmentation of environment, unsustainable use of ecosystems or environment pollution), climate change has even larger effect. The most vulnerable ecosystems in the Czech Republic include alpine ecosystems and ecosystems consisting of residues of the original grasslands. Changes are observed mostly in ecosystems above the shifting upper boundary of forests, where their relatively small area exacerbates the vulnerability. Approximately one tenth of monitored plant species will be in danger of extinction by the end of the century, while one fifth of plant species can rapidly and effectively adapt to a changing climate. Climate change will enable the spreading of invasive non-indigenous species, i.e. species whose intentional planting or inadvertent introduction and subsequent spreading endangers biological diversity, biotopes or even entire ecosystems.

Potential negative impacts on biological diversity also include new interventions of humans into nature and the landscape. A typical example is the construction of dams, which on the one hand intends to prevent potential lack of water but, on the other hand, sometimes constitutes a substantial danger for biodiversity due to the water regime change in the particular area, its migratory permeability for water and water-related animal life, chemical and biological characteristics etc. Subsidized cultivation of crops processed to first-generation biofuels and extensive afforestation (especially in farmed landscape) can destroy valuable residues of the original environment or can promote the spreading of invasive non-indigenous plants species, including tree species.

Climate change impacts have been recorded for many animal and plant species. In the Czech Republic, there has been a decrease in the number of northerly species of birds with corresponding increase in southerly bird populations. Northerly bird populations fell over the last 30 years by approximately 40%, which is approximately 1,3% decrease annually. It was caused mainly by the increase of spring temperatures. Between 1951–1980 and 1995–2001, there has been a significant shift in habitats of 12 species of butterflies to higher altitude locations. Climate change also contributes to proliferation of alien plant species, which migrate in higher numbers into mountain areas.

Biological systems are very closely tied to natural climatic conditions. Migrating species are especially sensitive to climate change. EUROMOVE model anticipates that by 2050 the Czech Republic will host dozens and hundreds of entirely new plant species, while dozens will become extinct. These changes will result in overall decrease of the original biological diversity and its homogenization. Extinction will jeopardize especially the rare species with specific environmental requirements, and which also act as indicators of the environment quality.

Climate change influences ecosystem dynamics. Changes in species and population biodiversity will trigger emergence of new ecosystem types, which may affect the ability to provide certain ecosystem services. Climate change will have effect primarily on ecosystems that are key for carbon accumulation, such as forests (especially the fragile even-aged monoculture tree stands consisting of inappropriate tree species), grassland ecosystems and wetlands and moorland. Shift in vegetation zones and change in quality and extent of individual biotopes will affect ecosystem productivity and their ability to accumulate carbon, probably in both directions (favourably by, for instance, fertility-increasing effect of CO_2 or larger distribution of more productive ecosystems, unfavourably by droughts and fire). Changes in land use may also have effect on albedo and contribute to regional climate change. Last but definitely not least, it is also estimated, that climate change will lead to an increased risk of natural disasters, such as floods, droughts and biological invasions.

6.2.5 Urban landscape

Urbanized landscape represents a highly specific environment which is very sensitive to change in climatic conditions and simultaneously having low ecological stability and low inherent adaptation potential to such changes. Large share of paved surfaces affects microclimate of territories and causes overheating of surfaces, higher air temperature, higher evaporation, fast runoff of precipitation water, dustiness etc. Prognoses of gradual climate change in the Czech Republic generally indicate changes in weather throughout the year. Also, prognoses indicate significantly more frequent (extreme) changes in high temperatures connected with low precipitation inculding periods with high precipitation over a short period of time (in the summer).

These changes (in the direction of extreme fluctuations) will have significant impacts in urban areas (and especially in large cities) on the quality of life and on availability and quality of water. Another climate change effect having a detrimental impact on quality of life in urban areas is more frequent periods with high (tropical) temperatures and low or zero precipitation between April and September. Climate change will affect housing, technological constructions and construction sector as such. The fluctuations between temperature minima and maxima will be dramatic, affecting exposed materials and buildings. More intensive precipitation events and strong winds, among other, will increase the danger of building constructions being damaged, lowering their value and lifetime, thus increasing the costs for their repairing and maintenance.

6.2.6 Health and hygiene

Climate change may affect the population health by an entire complex of direct and indirect impacts. Direct impact is a consequence of changes in physical climate value (temperature change, consequences of more frequent and intensive extreme weather events, increase UV radiation etc.). Indirect impacts are a combination of environment with other living conditions underlined and modified by climate change, for instance air pollution, depleted ozone layer, pollen, which may trigger increase in seasonal occurrence and duration of allergies and changes in occurrences of contagious diseases.

Climate change will probably increase frequency of extreme weather events, especially floods, which will be accompanied by a wide variety of direct and indirect effects, including diseases, and risk carried by mosquitoes and diseases they may transmit. Increasing numbers of day with temperatures exceeding 30 °C may lead to increased risk of overheating of organism, heat-strokes, dehydration and health problems generally (along with increased mortality rates) especially for high risk population segments with lowered thermoregulation abilities (children, seniors and sick people) as well as cardiovascular, renal, respiration and metabolic disorders. It may also be anticipated, that increase in average air temperature between spring and autumn will also unfavourably influence occurrence of infections borne in food.

Population migrations related to climate change will represent health risk both for the migrants and for the receiving population. Worsened conditions due to climate change may lead to a higher population mobility. There may be increased demand for humanitarian aid and healthcare for the migrant groups, demanding more healthcare capacity and pharmaceuticals.

As a result of climate change, there has been a significant rise in diseases transmitted between animals and humankind, affecting both animal host and the agent. In Europe, there have been cases involving agents transmitting subtropical diseases, previously unknown in these regions, and which are transmitted further due to favourable climatic conditions. There are infections being transmitted by originally domestic arthropods into higher altitudes. Keeping in mind that approximately 70% of infections originate in animal agent, we may expect that new infections will be identified in the future.

The hygiene and health sector is closely related to spatial development, architecture and construction sectors. Suitable architecture, spatial planning and suburban vegetation helps in alleviating the effects of the so-called heat islands in cities and in reducing thermal stress. Health risks triggered by extreme meteorological events (heat waves, extreme precipitation, wind storms) will need to be reduced by preventive measures in the construction sector and infrastructure as well as by appropriate risk management and flood prevention plans.

6.2.7 Emergency events and protection of the population and the environment

Climate change increases the likelihood of crisis situations arising from such changes. It is anticipated that the intensity and frequency of extreme meteorological events will rise (extreme heat, precipitation, wind storms) as well as long-term droughts, large-scale flooding, landslides, rock formation collapses and large-scale forest fires. Protection of the population and of the environment will have a significant importnace as well as preventing large-scale property damage.

Population protection should be understood as minimizing the negative impacts of extraordinary situations and crises on health and lives of people and their living conditions. We can expect more extreme meteorological events in the future, triggered by climate change, thus there will be a higher need and demand on civil protection, higher demand on resources, crisis and risk and rescue management.

Climate change also fundamentally affects environmental security, which is understood as a state in which the probability of a crisis situation arising as a result of disruption of the environment remains acceptable. Activities in this area will focus on measures alleviating effects of natural disasters triggered by climate change on the health of the population, on the environment and the property.

Critical infrastructure, such as energy and water supplies, transport, telecommunications and information technology, securing basic needs of the population, is especially jeopardized in this respect. High vulnerability of critical infrastructure results from its mutual interconnectedness. For instance, a breakdown in energy supply or IT services will lead to breakdown or outage in all other critical infrastructure sectors.

On the international level, we may expect increased migration pressure from those regions, which will be affected by climate change more severely than the Central European region. This applies to regions suffering from insufficient water supply, drought, failing harvests or from other climatic extremes. We must also anticipate the possibility of increase in local and cross-border conflicts related to lack of access to basic natural resources, which could trigger migration waves into EU and to a certain degree to the Czech Republic.

Crisis situations are closely related to health and the environment, but also to other sectors such as energy, urbanized landscape, forests or agricultural ecosystems. In terms of water management, the most relevant measures are measures coping with flood risks, alleviating effects of droughts, rainfall water management, ensuring stability of slopes etc.

6.2.8 Tourism and recreation

Changes in the distribution of precipitation, increased variability and extremes of temperature and humidity and other changes in meteorological factors, together with their feed-back, will influence the landscape and its natural units. A number of tourist and recreational activities are directly dependent on the weather. There has been a trend in shortening of the winter skiing season in recent years, and this can be expected to continue in the future. Artificial snow and its production on ski slopes and cross-country ski tracks, which could prolong the season, will be increasingly complicated by lack of water sources and energy barriers (especially increasing prices).

The expected increase in summer temperatures could increase interest in summer recreation around natural and artificial water reservoirs, but prolonged high temperatures will cause substantial heating of water volumes with subsequent reduction in water quality, accompanied by the growth of blue-green algae. This is a high-risk factor that could even make the use of water resources impossible. Therefore, it can be expected that the recreation season will tend to shift to the spring or autumn months, which will have more acceptable temperatures.

Even optimistic scenarios anticipate that the main affected areas will be the areas of concentrated tourism. This is already apparent from the developments in the last decade. For instance, the area known as České Švýcarsko, which has not had a proper touristic season since 2002, without having been significantly affected by natural disasters – in this location specifically the floods, which have caused an estimated 500 mil CZK damage as a result of climate change. Based on these estimates in this one location, we may estimate that the climate change impacts in this sector in the entire Czech Republic will reach tens of billions CZK annually.

6.2.9 Transportation

Extreme weather fluctuations such as sudden intensive rain or snow fall, flooding, heat waves or low river water levels may significantly affect road, railways, river-born and also air transport. More frequent and more intensive precipitation affects especially the road transport (lower visibility, slippery surface etc.).

More frequent occurrences of extreme weather events will cause impassability of transport infrastructure due to flooding, physical damage or destruction, fallen trees etc. Landslides falling on roads and railways may also considerably disrupt traffic. This will reflected in higher demand for capacity and alternative routes, organization of transport generally, as well as affecting the ability of infrastructure operators to react, with sufficient speed, to these extraordinary events. Preventive measures and maintenance of vegetation and pylon, which may disrupt use of infrastructure, will be also necessary. The threat of complete disruption is especially serious in locations where alternative routes do not exist.

Rise in temperatures and more frequent fluctuations of high and low temperatures increase the demand for air-conditioning in public, personal and even freight transport. Besides heating by engine redundancy, it will probably be necessary to provide additional heating inside the vehicles as well as provide sufficient cooling in the summer months, which are both energy intensive activities. Due to these reasons, we may expect increase energy consumption in the transport sector by up to 1 to 10% (estimation provided by Ministry of Transport).

Heat waves in the summer may result in an increased accident rate due to lowered concentration of drivers and cause damage to road infrastructure (for instance thermal disruption of asphalt). On the other hand, sudden frost or snowdrifts in winter will also have effect on accident rate, infrastructure quality and general functioning of transport.

6.2.10 Industry and energy sector

Energy infrastructure forms a part of the critical infrastructure and comprises of production and non-production systems and services, whose lack of functionality might have an adverse and serious impact on the protected interests of the state (security, lives and health of the population, economy and public administration). Energy infrastructure includes electricity, heat gas and oil supply.

As a result of climate change, the energy sector in Europe will most probably suffer from differences between available energy supply and demand for energy. Climate change will also affect volume and distribution of precipitation during the course of the year and that will have an effect on hydropower electricity generation. Northern Europe may expect more than 5% increase in electricity production from this energy source, while southern Europe anticipates more than 27% decrease. Lower precipitation amount during the summer as well as more frequent extremely hot periods may have an adverse effect on the cooling process in thermal power plants. Climate change may also affect transmission and distribution networks, which may find it difficult to cope with demand for cooling during summer peaks, but also with damage caused by high winds and flooding.

Long-term occurrences of extremely high temperatures have an adverse effect on the cooling processes within power plants (whether nuclear, gas or coal-fired) and along with higher electricity consumption dedicated to cooling in addition to planned maintenance of power sources and network may even lead to network overload and in extreme cases to breakdowns.

On the other hand, long-term occurrences of extremely low temperatures may lead to complications in the energy supply areas, where icing may jeopardize dull functionality of the transmission and distribution network.

Longer periods without precipitation will affect accumulation reservoirs of hydropower plants and that will reduce availability of this source. In the medium-term outlook, we may expect that the average flow in many basins will decrease by 15 – 20% (in "optimistic scenarios") up to 25 – 40% (in "pessimistic" scenarios), which will lead to reduced electricity generation capacity in hydropower plants if adequate measure will not be taken. Lack of precipitation may lead to reduced production of biomass used in production of electricity and heat, and limit production in sectors which are water intensive (such as paper mills, chemical plants).

Conversely, heavy precipitation (flooding) may disrupt electricity supply networks and product pipelines as well as limit or shutdown supply by road or railway, disable production in industrial plants, disrupt hydropower plants functionality and cause hazardous materials leakages; similarly, it may limit production of biomass that is used for energy generation.

Extreme weather events (windstorms, tornadoes) may disrupt transmission networks leading up to total disintegration of the electricity supply network, shutdowns of certain power plants, limit production of biomass that is used for energy generation, in cases when industrial plants are affected, also to limited production and distribution.

More frequent extreme climatic events may represent increased risk for security of the industry and business activities in general, deteriorate of working conditions for employees, operation of manufacturing and operational facilities, but also have a negative impact on the environment (such as in cases of hazardous materials leaks).

6.3 Adaptation measures

The Czech Republic is already implementing a number of adaptation measures, especially in connection with water regime in the landscape and water management, forestry, agriculture and ecosystems.

The Strategy on Adaptation to Climate Change in the Czech Republic (hereinafter referred to as "Strategy") was adopted by the Czech Government in October 2015 and is implemented by the National Action Plan on Adaptation to Climate Change (hereinafter referred to as "Action Plan") since January 2017. Preparations of both the Strategy and Action Plan were coordinated by the Ministry of the Environment in cooperation with a number of Ministries and relevant scientific institutions.

The Strategy, which is based on the relevant EU documentation, has been adjusted to specific conditions of the Czech Republic. The Strategy objective is to reduce anticipated climate change impacts, adapt to these impacts, maintain good living conditions and to develop economic potential for the future generations. The Strategy presents observed climate change and defines the adaptation measures including their mutual linkages in connection to anticipated impacts of these changes. Adaptation measures are proposed in the following areas:

- Forest management
- Agriculture
- Water regime in the landscape and water management
- Urban landscape
- Biodiversity and ecosystem services
- Health and hygiene

- Tourism and recreation
- Transportation
- Industry and energy sector
- Emergency events and protection of the population and environment

The Action Plan focuses on all major impacts of climate change in the Czech Republic: Long-term droughts, Floods and flash floods, Extreme meteorological events (Heavy rainfall, Extremely high temperatures, Extreme wind), and Wild fires. The Action Plan elaborates further the measures outlined in the Strategy into specific tasks, which assign responsibilities, implementation deadlines, relevance of measures to individual climate change impacts and sources of financing. The document contains 33 specific objectives and 1 cross-cutting objective on Education, Training and Awareness raising. The individual specific objectives are fulfilled by 52 priority measures with 160 priority tasks. The number of measures and associated tasks reflect the broad intersectoral overlap between impacts of climate change and adaptation needs and the fact that the vast majority of measures (over 80%) are already (in some sense) included in other strategic materials of national significance.

6.3.1 Forest management

Timely adaptation measures in forest management sector are required to reduce the risk of calamities and disruption of ecosystem services as well as functionality related to biological diversity of the forest life. Diversity in growth conditions makes it impossible to entirely generalize the potential impact of climate change on forests and to adopt sweeping overall measures. On general level, forest management potential in terms of adaptation to climate change include preference of close-to-nature, environment-friendly forms of management along with changes in the species and spatial composition of forest cover. Application of these management methods will bring an increase in biological diversity of forests together with increase of their ecological stability and resilience, respectively their ability to adapt to climate change. The importance of adaptation is evident from the inclusion of these issues among the crucial actions in the National Forestry Programme II, which is the key document for forestry-related policies (approved by Government Resolution No. 1221/2008).

Forest ecosystems play an important role as storage in the carbon cycle by their ability to bind carbon dioxide out of the atmosphere and reduce greenhouse gas emissions. The significance of forests for carbon balance is determined by the extent of forests and therefore the amount of carbon deposited (both in forest stands and forest soils) and at the same time by their longevity. Their potential to positively influence the carbon balance, which can be further enhanced by appropriate forest management and prudent afforestation of non-forest land, is an important tool in meeting international commitments on carbon dioxide emission limits.

Adaptation measures in this sector are financially supported mainly by the Rural Development Programme, the Operational Programme Environment (Priority Axis 4 - Protection and care for the nature and landscape), and additionally by the programme Support Restoration of the Natural Landscape Functions.

<u>Utilization of natural processes and cultivation of spatially varied and species-rich forest stands</u>

The long-term objective of this measure is a species-rich, age and spatially varied forest consisting of economically interesting and locally suitable trees that are able to resist a wide range of possible climate change scenarios without causing a large-scale disruption of forest stands. The measure consists in cultivation of spatially and species-rich stands with the greatest possible use of natural processes, varied tree species and cultivation practices, in strengthening the proportion of improving and stabilizing trees, in the use of pioneer and preparatory woody plants, and in favor of natural forest regeneration. Additionally, it is important to promote appropriate changes to the water regime of forests, to revise the forest ameliorations and torrent control, and to minimize the technical drainage of forest land by favoring natural processes or nature-friendly practices. To allow natural regeneration of a wide range of trees, it is crucial to achieve such game populations which are endurable for the forest ecosystem. When logging and regenerating the forests, it is necessary to apply procedures and measures to prevent or slow down the accelerated surface runoff and to take measures against soil erosion.

Changing the preference of species and ecotypes of forest tree species

The measure is to maximize the species composition with a predominance of domestic species and ecotypes of trees with wide ecological valence, which is suitably complemented by introduced species (in accordance with nature conservation interests). When reforesting, it is especially necessary to use preparatory and pioneer woody species on calamity clearing areas. It is also necessary to protect the native gene pool of forest tree species which are endangered by climate change and to promote species and ecotypes of forest tree species that are more tolerant of climate change and more resistant to biotic pests.

Stabilization of carbon volumes bound in forest ecosystems

Carbon stabilization in forest ecosystems is supported by forestry techniques that provide permanent soil protection with long or continuous regeneration times to minimize the fluctuations in the highest humus layers and by the use of trees with high primary productivity and beneficial effects on the pedosphere. It is also necessary to stabilize the size of forest type groups which are affected by water and to protect wetlands in forests. Maintaining the existing high-quality ecosystems will contribute to preserving or enhancing the higher sequestration potential of forest soils and binding in forest biomass.

Determination of priorities for support of adaptation measures in forest ecosystems

In order to apply adaptation measures effectively, it is necessary to identify risk areas in the Czech Republic for priority implementation in forest ecosystems and to reflect these results in the Regional Forest Development Plans. Based on the formulated set of adaptation measures, responsible bodies have to develop *best management practices* (BMP) for forest owners and forest managers in these risk areas. In terms of financing these measures, both national and EU financial contributions to implementation of adaptation measures should be more tied to compliance with these BMP's.

Genetic resources of forest tree species

In accordance with the National Program for the Protection and Reproduction of Forest Trees (2014), there is a need to create the prerequisites for effective and sustainable use of forest tree genetic resources, to monitor the genetic resources, to ensure the evidence of genetic resources, to create the conditions for preservation *in situ* and *ex situ*, and to increase the availability of genetic resources for users' needs.

6.3.2 Agriculture

The risks and potential benefits of climate change in agriculture are closely related, meaning that in order to take advantage of potential benefits caused by climate change, one must be actively implementing adaptation measures. Essential prerequisites for successful adaptation include flexible and environment-friendly land-use, introduction of new technologies as well as diversification in farming. In terms of landscape, this involves adaptation and preventive measures with combined effects especially on soil quality, water (with emphasis on retention), and agro-biodiversity.

Due to high importance of the soil, its sustainable use (e.g. protection against erosion and degradation, restoration of its water retention capacity, and preservation of soil fertility) is a key condition for climate change adaptation. The solutions should be based on the following principles of sustainable farming:

- Suitable spatial arrangement of agricultural land,
- Soil-protecting and anti-erosion measures,
- Improvement of soil structure,
- Increasing the proportion of organic matter in the soil.

All these measures are very complex in their nature and linked to a number of factors. One factor is the relationship of owners to the land, which predetermines the possibilities that the above mentioned measures are actually implemented.

Issues related to agriculture are closely linked with other sectors, mainly water management, biodiversity and provision of ecosystem services. Agriculture depends on sufficient supply of water and the water demand may increase due to droughts. Farming co-determines the quality of surface and ground water. Agriculture contributes to preserving of indigenous agro-biodiversity. There exists a strong link to forest management and LULUCF (Land Use, Land-Use Change and Forestry) sector, especially in connection with mitigation measures involving possible afforestation and planting of energy crops on farming land.

Agricultural ecosystems have the potential to mitigate climate change, especially in terms of accumulating carbon in soil and in reducing greenhouse gas emissions released within the sector, especially N_2O released from the soil and CH_4 generated by livestock. In this respect, it is especially important to increase content of organic matter in the soil to use the soil protecting technology, and to sustainably manage the farmland. Agriculture is a real or potential source of raw material for energy use. This involves energy crops grown on farmland, biodegradable waste and by-products. Their use reduces consumption of fossil fuels as well as limits releases of CH_4 from non-decomposed biomass.

Adaptation measures in this sector are financially supported mainly by the Rural Development Programme, the Operational Programme Fisheries 2014–2020, the Operational Programme Environment (Priority Axis 4 - Protection and care for the nature and landscape), and additionally by the programme Support Restoration of the Natural Landscape Functions.

Land consolidation

Land consolidation creates conditions for rational management by the property owners. Properties are thus classified in terms of space and function and provision is made for access to them. An integral part of all land-use planning also consists in a plan for joint facilities, encompassing, amongst other things, water management and anti-erosion measures (to protect the land fund and to improve the water regime in the landscape), measures to protect and restore the environment, and measures to increase the ecological stability of the territory (TSES and other green areas). Thus, land consolidation substantially reduces the impacts of extreme meteorological situations, prevents erosion of the soil and helps prevent floods. This implies the need to organize and financially support the implementation of land consolidation so as to contribute to adaptation and mitigation of climate change.

Genetic resources, research, breeding and agricultural biotechnology

Research focuses especially on cultivation of agricultural crops and on selection of suitable species and plants that are resistant to climate change and on cultivation of new and revitalization of original species and cultivars of arable crops and livestock that are aimed at producing good yield while being pest-resistant and coping well with droughts, heat waves, high air temperatures, soil erosion etc.

Standards of Good Agricultural and Environmental Condition (GAEC)

GAEC standards have significant potential, notably in increasing the demand for more nature-friendly and sustainable farming. GAEC-compatible farming activities have favorable influence on the content of organic matter in the soil, protection of soil structure; it also helps in protecting landscape elements and permanent grasslands; they also partially limit the spreading of invasive plant species etc. Compliance with these measures, such as the use of soil protecting technology in cultivating crops, bans on cultivation of crops that are dangerous for soil erosion, and compliance with post-harvest soil cover in location that are prone to erosion, is being rigorously monitored. In order to adapt to climate change, it is necessary to effectively set the GAEC standards to contribute to the increase of the water retention capacity of the soil and landscape.

Afforestation and grassing

Changing arable land to forest with good species composition or to permanent grassland operates as a measure combating wind and (in case of forests, partially) water erosion and reduces soil moisture loss. This measure also has a mitigation effect as forests and grassland accumulate more carbon than arable land and even non-aerated soil reduces oxidation processes leading to nitrous oxide and carbon dioxide emissions. Similar significance should be placed upon groves, balks and free standing trees. The measure consists mainly in targeting the grassing, afforestation, and establishing the elements of non-forest vegetation to the most vulnerable areas, and in promoting the restoration, establishment and development of floodplain forests using geographically indigenous species.

Organic farming

Principles applied in organic farming create prerequisites for achieving higher average carbon content and humus in soil, better conditions for the soil organisms etc. They also support biodiversity of organisms that are directly or indirectly linked to farming land, which reduces the speed of genetic erosion. Organic farming may contribute to adaptation of agriculture to climate change by maintaining genetic sources of indigenous species and plants, maintaining traditional knowledge, methods and pest control processes, methods limiting water consumption and soil erosion or methods of biological protection of plants (which is the preferred method of protection due to ban on chemical protection and GMO use in organic farming). All this may contribute to climate change adaptation of agriculture. The measure is based on stable support of organic farming and activities with emphasis on non-farming functionality with adaptation effects.

Reducing soil erosion

Due to the expected increase in erosion pressure, the anti-erosion measures must become a normal part of farming, land consolidation process, and one of the main instruments of adaptation measures. The aim is to support measures to reduce the erosion of agricultural land, such as conservation tillage, crop rotation practices aimed at soil protection, grassing, and establishment of anti-erosion barriers.

Measures combating agricultural drought

Keeping in mind the anticipated more frequent occurrences of agricultural dry periods, it will be necessary to support the measures contributing to increased water retention capacity of the landscape and to optimization of irrigation systems as well as to minimize the negative effects of drainage systems on accelerated runoff of water from the landscape. These measures relate to application of technologies and research results contributing to reduced water consumption and reduced losses of soil moisture. Operability condition of irrigation systems is the availability of good quality irrigation water. Specifically, these measures include construction and upgrade of irrigation systems which use water more efficiently and make crop production possible even during prolonged droughts. Irrigation systems should only complement moisture deficits without destroying the soil structure and adversely affecting other production conditions. It is also important to apply technologies and methods reducing the unproductive evaporation and promoting more efficient use of soil moisture by crops.

Protection of biodiversity in agriculture

Genetically diverse populations and species-rich ecosystems have a greater potential to adapt to climate change. Agrobiodiversity includes breeds, plants, micro-organisms, and ecosystems affected by agricultural activity. In order to preserve biodiversity, it is important to support appropriate farming systems and landscape structure, mitigating the decline in biodiversity associated with agricultural land, agri-environment measures, and nature-friendly farming practices. In order to protect agrobiodiversity, the conservation of genetic resources relevant to agriculture, whether *in situ*, *on farm* or *ex situ*, is essential.

Diversification of agriculture

Diversification of agricultural activities is one of the key adaptation measures since the system, where the farm has multiple sources of income (including non-productive), reduces the risk of dependence on agricultural production itself. Therefore, it is necessary to support for example the production for non-food purposes and for unconventional agricultural production (e.g. bio-production) as well as the non-agricultural activities (agro-tourism, etc.). A convenient production can play an important role for energy purposes according to the principles of sustainability and without negative impact on the environment or food prices.

Monitoring, risk analysis, and early warning systems

Risk analysis concerning harmful plant organisms are being implemented by the State Phytosanitary Administration of the Czech Republic in the form of the so-called express analyses, which assess the degree of risk represented by newly imported and transmitted harmful organisms in the Czech Republic, and the availability of phytosanitary measures combating such imports and transmission. Detection surveys carried out by SPA partially focus on alien thermophilic harmful plant organisms invading the Czech Republic. The measure includes improvement of the national system of risk analysis related to harmful organisms in the sense of its focus also on the risks associated with changes in the harmfulness of these organisms in the context of climate change, early detection of new pests or changes in the harmfulness of native species together with timely publication of this information, development of more environment-friendly methods of plant protection.

Addressing the impact of extreme meteorological phenomena on farming

There are effective technical measures that are in place against some of the extreme meteorological events (such as hailstorms in orchards). Their implementation is mostly driven by support provided at national level. On the other hand, there is no effective protection against some other types of events. More frequent occurrence of extreme meteorological events reduces the availability of insurance cover and increases its cost. In these cases, implementation of preventive and adaptation measures is the priority, with the insurance playing a smaller part of a complex risk management and prevention solutions against climate change impacts. The objective is to elaborate the principles of comprehensive risk management and preparedness against the negative impacts of climate change and to continue with motivation of the farmers to use agricultural insurance and the insurance companies to provide it.

Greening of the European Common Agricultural Policy

The measure is a mandatory eco-directed component of direct payments designed to support the implementation of climate-friendly and environment-friendly farming practices. These procedures go beyond the cross-compliance in the form of three components: crop diversification, conservation of permanent grassland, and establishment of the ecological focus areas (EFA). As an EFA, landscape elements and fallow land used in ecological interest, field margin, areas with short rotation coppice, some wooded areas, areas with catch crops or nitrogen-binding crops can be selected.

6.3.3 Water regime in the landscape and water management

The aim of adaptation measures in water management is to stabilize the water regime in the landscape, to strengthen water resources and protect them, to use water resources efficiently, and to manage extreme hydrological phenomena - floods and long-lasting droughts. Water retention in the landscape, achieved by optimizing its structure and by utilization of effective and close-to-nature technical preventive measures, forms a fundamental basis for protection against extreme hydrological events. In order to meet these conditions, it is necessary to involve responsible regional bodies and local governments in preparation of long-term estimates regarding the required volume of water and prepare appropriate legislative measures. Climate change (change in precipitation patterns) will result in increased pressure on surface and groundwater resources, especially in connection with expected increase of water consumption in agriculture.

A balance needs to be struck between the use of the energy potential of water that is a significant source of renewable energy and other requirements for the use of a watercourse or tank as a water resource. The construction of new hydroelectric power plants as a renewable energy source should be the subject of thorough scrutiny and further research, in particular with regard to the total emissions generated by the construction of dams and weirs.

Adaptation measures in this sector are financially supported mainly by the Operational Programme Environment (Priority Axis 1 - Improving water quality and reducing flood risks, Priority Axis 4 - Protection and care for the nature and landscape), the Flood Prevention Programme III and additionally by the programme Support Restoration of the Natural Landscape Functions, the Green Savings Programme, and the National Programme Environment.

Measures to ensure the stability of water regime in the landscape

The aim is to reduce and slow down the surface water drainage, to increase water retention in the landscape, and to ensure groundwater replenishment. This can be achieved in particular by proper management of agricultural and forest land, appropriate landscape arrangement, and minimization of the negative impacts of drainage facilities. The system of small water reservoirs and wetlands also plays an important role.

Systems of rainwater management and water reuse

For sustainable management of rainwaters in urbanized areas, it is necessary not to connect clean rainwaters from impervious surfaces to the drainage (sewerage) systems and to reduce the amount of impervious surfaces that are already connected. The basis of this measure is a system of decentralized rainwater management that promotes the infiltration, retention or use of rainwater directly on the site. At the same time, it is advisable to introduce systems of close-to-nature drainage even on the traffic roads and areas and to introduce the infiltration technologies on the storm drainige. The expected decline in water resources can be prevented by introduction of water re-use systems and water recycling systems, in particular the re-use of less polluted or partially cleaned waste waters.

River Basin Management Plans and Flood Risk Management Plans

River Basin Management Plans and Flood Risk Management Plans are an essential tool for introducing adaptation measures in the EU's water management, as it addresses both the achievement of good water status and the negative impacts of floods and droughts. Increased attention needs to be paid to the flood protection and the development of effective early warning systems for communities especially for flash floods. Furthermore, there is a need to develop a concept for drought and water scarcity and to prevent extraordinary events caused by long-term water scarcity.

Plans for the Development of Water Supply and Sewerage

The measure uses development plans of water supply and sewerage systems of regions and municipalities to ensure and maintain sufficient back-up water resources for drinking water supply during the long-term droughts and to increase the reliability of water supply systems by their interconnection, which will be required with decrease of reliability of existing water resources. In doing so, it is necessary to consider extending the water supply network to localities which are dependent on poorly reliable water resources. In addition, it is necessary to emphasize the infiltration and retention of rainwater in planning the drainage of urbanized areas and to reduce the amount of rainwater discharged by a combined sewer system.

Measures at water supply systems

The measure consists in introducing risk management methods in the drinking water production and distribution process, ensuring the safety of distributed water through preventive measures and interconnecting the water supply systems.

Measures at wastewater treatment plants and sewerage systems

The measure includes support for decentralized wastewater treatment solutions to minimize the production of wastewater discharged or transported away from the site of origin and tightening and streamlining the control of the operation of existing plants. Furthermore, the security of wastewater treatment plants and sewage systems should be addressed against the adverse effects of floods and flash floods.

Optimizing the function of existing water reservoirs and system of water management structures

The measure leads to better preparedness for both hydrological extremes - floods and droughts - and consists of re-evaluating the existing use of water reservoirs and water management systems and optimizing their management to best meet the new defined requirements for their function even with a view to the future. For this purpose, simulation modeling and mathematical optimization should be carried out and the results should be taken into account in the modifications of the rules of operation and service of the water management structures.

Restoration of small water reservoirs and enhancing their reliability

The measure consists in restoring the water management function of small water reservoirs which have lost this function due to poor technical condition or subordination of their function for secondary use for fish-farming; it is necessary to take into account the occurrence of developed and stable wetland habitats. With respect to expected higher incidence of heavy rainfalls, it is appropriate to identify small water reservoirs that do not meet the stability requirements of the dam according to valid standards, and to support their reconstruction.

Modifications of watercourses and floodplains

Former modifications of the watercourses have been implemented with the aim of diverting water from the area as quickly as possible - this has negative impacts on the speed and the course of the flood wave; further, the rapid drainage of the water from the landscape is drying the area and deteriorating the situation downstream. Appropriate remedial measures include comprehensive revitalization of watercourses and floodplains, and the facilitation of natural or controlled flooding in the floodplains. Of the technical flood control measures, it is necessary to prefer the solutions with no or minimal negative impact on the ecological status of waters, nature and landscape. In settlements, the modifications of watercourses must be able to safely transfer the water through built-up areas of municipalities, but it is also appropriate to use, in addition to technical measures, close-to-nature measures.

Rationalization of the licensing system for water abstraction and discharges

In order to ensure sustainable use of water resources, a water balance assessment system should be used within the six-year cycles of river basin management plans to allow spatial and time variability of water balance to be assessed in the context of ongoing climate change. It is also necessary to avoid excessive requirements for the reserve in the permission for water use, except for the drinking water treatment.

Protection of existing and prospective water resources

Measures include, in particular, the preventive protection of water resources (protected zones of water resources, protected areas of natural water accumulation and areas protected for the accumulation of surface water) and revision of those areas and activities that could adversely affect water quality and quantity. Water resources need to be used in a sustainable way (the amount of water taken must not exceed the amount naturally replenished).

Infiltration of surface water into groundwaters

The measure consists of promotion artificial infiltration of surface water into groundwaters and in formation of wetlands in infiltration zones for water supply purposes, replenishment of groundwater resources in intensively used collectors, and in accumulation of water at the time of its surplus to overcome period of deficiency.

Water transfers

Realization of water transfer from an area with surplus of water resources can be a suitable measure to strengthen existing water resources in areas where hydrological and hydrogeological conditions do not allow other measures to ensure greater resistance to drought and water scarcity.

Water reservoirs in the areas protected for accumulation of surface water

A key role for adaptation to climate change has the implementation of landscape measures that support its natural water retention capacity and contribute to increasing resilience to climate change. Only when there is an imbalance between the available water resources and the requirements imposed on them, will it be necessary to examine the implementation of new water resource. This measure defines basic criteria for such examination, including the implementation of comprehensive analyzes of adaptation measures, sufficient use of the potential of nature-friendly measures and adaptation measures that do not disturb the good status of water bodies, delimitation of floodplains and areas designated for flooding, application of legislative and organizational measures for adaptation, reassessment of water requirements, use of groundwater resources for drinking purposes and demonstration of the link between water scarcity and the climate change.

Hydric utilization of mines and quarries

This measure establishes the need to examine the possibility of hydric utilization of abandoned mines and quarries to the accumulation of water at their disposal and recultivation, and if necessary justified in ensuring a source of drinking water or water for crisis situations. Accumulation or retention of water should be preferred if this public interest significantly outweighs the approved reclamation plan.

6.3.4 Urban landscape

The basic aim of adaptation measures in an urban landscape is to increase the resilience of settlements and their ability to adapt to the effects of climate change, which can be achieved by their sustainable development while preserving the necessary population quality of life. In order to achieve this goal, it is necessary to ensure sustainable water management and functional interconnection of areas with the predominant natural components forming the system of urban greenery. At the same time, it is necessary to support the overall variability of urbanized areas. An important role is played by water and vegetation areas and elements, as they can significantly affect settlement microclimate and reduce the air temperature in cities.

Adaptation measures in this sector are financially supported mainly by the Operational Programme Environment (Priority Axis 1 - Improving water quality and reducing flood risks, Priority Axis 4 - Protection and care for the nature and landscape, Priority Axis 5 – Energy Efficiency), the Integrated Regional Operational Programme, the Operational Programme Enterprise and Innovation for Competitiveness, and additionally by the Green Savings Programme and the National Programme Environment.

Measures to minimize surface runoff

Measures include the conservation and restoration of close-to-nature water bodies, the protection of valuable aquatic and wetland ecosystems, the realization of diverse natural areas and areas with vegetation elements, increasing the proportion of surfaces with water permeable surfaces, the implementation of water retention structures and infiltration systems, the use of vegetation on roofs and walls, and accumulation of rainwater with the possibility of using it.

Measures to reduce pollution of surface runoff

The measure consists mainly in minimizing the contact of the surface runoff with a potential source of pollution, cleaning the streets and areas of public green, realizing activities to reduce soil erosion, minimizing the salting of roads and the use of herbicides and pesticides in the river basins, restricting the use of artificial fertilizers in gardens and parks, minimizing the water pollution during heavy rains as a result of mixing the rainfall and sewage in the combined sewer overflows.

Ensuring variability of the urbanized area

The objective of the measure is to improve the quality and efficiency of existing green and water areas and to ensure the development of systems of urban greenery, optimally involving areas of the Territorial Environmental Stability System (TSES), significant landscape elements (SLE) and small-scale specially protected areas (SPA).

Measures to ensure a functional and ecologically stable system of urban greenery

The aim is to increase the ecological stability, functionality and quality of the environment in settlements. In order to do this, it is necessary to increase the share and functional quality of available green and water areas in relation to the number and density of the population, to revitalize the existing and to realize new functional interconnections of existing green areas, to increase the green areas and elements on horizontal and vertical structures. It is necessary to ensure adequate management of the system of the urban greenery, including the efficient maintenance and use of management tools.

Measures in the field of urban development, construction and architecture

A significant effect can be achieved by consistent utilizing the synergy of mitigation and adaptation measures consisting of high-quality construction and energy-efficient renovation of buildings. Support for research and development of new materials and technologies, adaptation of building standards and certifications to the anticipated effects of climate change, and promotion of air-conditioning of buildings using renewable energy sources and modern technology is needed. Further to implement public sector programs favoring low energy and passive standards and technologies in public buildings at least according to the 3rd scenario of the Strategy for Renovation of the National Action Plan for Energy Efficiency of the Czech Republic. The master plans should prefer utilization of brownfields.

Mitigation of flood impacts in urbanized areas

Buildings and projects planned in urbanized areas, which are potentially at risk from floods, should be based on assessment of the possible impacts of these events. The long-term objective of flood protection is to reduce the number of people living permanently in the flood plains. Valuable, strategic assets as well as potentially hazardous substances should be preventively shifted and secured so that they are not within reach of possible flooding. Buildings should be resistant to soil moisture or flooding, new buildings should include elements to reduce surface runoff.

Measures to reduce the risks associated with air temperature and quality

Due to the expected more frequent occurrence of extreme meteorological phenomena, urbanized areas are sensitive, especially from the point of view of the population health and potential disturbance of infrastructure or transport systems. The measure includes such building solutions that lead to shading of buildings and windows, installation of outdoor shutters and blinds, introduction of "green" and light surfaces (at roofs and pavements). It is also appropriate to create plans for prevention of heat islands in large agglomerations, to set urban planning requirements for protection against urban heat islands, and to create air-conditioned spaces for vulnerable persons and children with chronic respiratory diseases in the hospitals and social centers.

Responsible management and reducing the footprint of urbanized areas

In terms of climate change adaptation and mitigation it is desirable to reduce the environmental footprint of settlements arising from the growing demand for built-up areas (urban sprawl), transport (especially passenger road transport), food, water or heating. Adaptation measures in urbanized areas (water management, environmentally friendly buildings, clean mobility, etc.)

should be related to the reduction of ecological footprint and improvement of the quality of life of the inhabitants as a manifestation of responsible management of settlements.

6.3.5 Biodiversity and ecosystem services

Measures protecting biodiversity, which have so far been supported from national and EU programmes, focus on ecosystem protection and restoration, protection and support of biodiversity *in situ*, restoration of natural water regime in the landscape, adaptation to climate change, adaptive capacity of ecosystems and species to increasing fragmentation of the landscape, and care for handicapped animals.

Measures are mostly being implemented over long time with financial support from the Operational Programme Environment (Priority Axis 4 - Protection and care for the nature and landscape) and from national subsidy programmes (the programme Support Restoration of Natural Landscape Functions, the Landscape Management Programme, and the programme Administration of Vested State Property in Special Protected Areas). Some adaptation measures are also supported by the Rural Development Programme and the Operational Programme Fisheries.

Analyses of climate change impacts on biodiversity

Analyses of future climate change impacts on individual species, biotopes, ecosystems and special protected areas in order to define priorities for management and protection of the most potentially endangered phenomena (especially mountain and alpine species, ecosystems involving remnants of primal grasslands, biotopes with specific microclimatic conditions, such as iced scree fields, upland moors, and sand dunes) and securing periodical monitoring of sensitive organism reactions to climate change and efficiency of implemented measures.

Measures to protect, restore, and improve ecosystems and natural or close-to-natural areas and elements contributing to adaptation to the impacts of climate change

These measures aim to support establishment and management of vegetation in urban areas, such as parks, vegetation isolation zones, water features etc. Further measures are designed to ensure protection and restoration of ecosystems and natural elements in landscape that increase ecological-stabilization of functionality of the landscape and permeability for migrating animal species (e.g. water courses, floodplains, small water reservoirs, fishponds, springs, wetlands, copses, alleys, naturally structured forests and grasslands etc.).

Measures to increase the capacity of ecosystems to provide key services

Objective of these measures is to ensure protection, maintenance and potential restoration of ecosystems which are significantly sequestrating carbon from the atmosphere and stocking it in its biomass for long term, such as indigenous or close-to-nature forest ecosystems, wetlands and moorlands; further support measures eliminating irreversible appropriation of arable land due to urbanization. The objective is to include integration of ecosystem services with measures implemented in agricultural, forest and water ecosystems. From the perspective of adaptation in urban areas, it will be necessary to promote consideration of ecosystem services in these locations.

Measures to protect and restore the connectivity and permeability of the landscape

Various biotope areas within landscape matrix need to be reconnected using tools available in zoning procedures, especially those which function as source areas for various species, as well as implement TSES (Territorial System of Ecological Stability) in order to ensure maintenance and reproduction of natural abundance of species, and to act favorably on the surrounding less stable landscape fragments while increasing adaptation potential of the landscape as a whole. Climate change adaptation will be best served by protection and restoration of the corresponding types of environment allowing spreading of individual elements of biodiversity threatened by climate change and especially by ensuring sufficient general protection of nature and landscape, especially its interconnectedness and permeability for organisms.

Measures to prevent and limit the spread of invasive species

These measures aim to slow down the spread of invasive alien species of plants and animals and their eradication, if possible, and to ensure active approach of nature protection authorities if a situation would require solution on a larger scale; further to limit the effect of other factors which may favor invasive species and negatively influence biodiversity, such as environmental pollution by heterogeneous substances or accumulation of nutrients in the environment.

Measures to protect and improve the status of populations of rare and endangered species in key biotopes

These measures should extend, building on the existing instruments and systems ensuring territorial and population protection (Natura 2000, special protected areas, endangered species, general protection of nature), the concept of nature protection from the perspective of climate change, especially in those areas, which are important for their biological diversity, such as flower meadows, orchid meadows or primal forest ecosystems.

Ensuring concurrency of adaptation measures and nature protection tools

The objective is to limit potential adverse impacts of adaptation and mitigation measures on biodiversity and ecosystem services in arable and forest land, for instance as a consequence of afforestation, planting of energy tree stands or introduction of anti-erosion zones. The aim is to strengthen populations of endangered species of wild plants or animals within the framework of Rescue Programmes. It is important to implement anti-erosion and soil protection measures and measures supporting soil biodiversity by using suitable agro-technical solutions and principles of good farming practice.

6.3.6 Health and hygiene

Adaptation in healthcare and hygiene sector primarily involves measures combating contagious and other diseases (such as cardiovascular disorders and allergies) and in prevention of harmful effects on human health caused by extreme weather events. In certain European countries there are persistent diseases that can be transmitted between humans and animals (zoonosis), and which have already been eradicated in the Czech Republic. Their repeated dissemination cannot be ruled out due to the unrestricted international movement of goods and foodstuffs. Migration of people, whether for business, work or recreation, can contribute to the spread of other contagious diseases, which have not been present in local conditions.

Adaptation measures in this sector are financially supported mainly from the Integrated Regional Operational Programme and the state budget.

Measures for infectious and non-infectious disease reduction or even elimination

The main objective is to ensure that clinicians and laboratory experts are fully informed of the possible risks associated with the changing epidemiological situation related to the impact of climate change on occurrences of infections. The existing monitoring system must be reviewed to ensure that it covers climate-sensitive pathogens and their animal vectors and reservoirs.

Since June 2007, there has been a forecasting system in place, issuing warnings regarding tick-related activity levels and in connection with recent floods, there is monitoring of mosquitos in place.

Awareness and healthcare

The healthcare sector needs to be involved in information capacity to support decision-making processes during exceptional situations, which may potentially endanger the health of the population. Healthcare information and education system needs to implement an early warning system eliminating potential harmful health consequences (such as during heat waves, landslides etc.). At the same time, general public needs to be educated regarding dangers associated with climate change in order to preventively influence their behavior and reduce subsequent health risks.

6.3.7 Tourism and recreation

Tourism, as a consequence and expression of increasing mobility, suffers the effects of climate change but at the same time it contributes to its intensity. Climate conditions are a key factor in the development of tourism and its spatial and time distribution. Climate change is therefore a major threat to tourism, which, like other sectors, must respond appropriately to the economy. At the same time, climate change is a challenge for tourism to reduce its contribution to increasing its intensity. Climate change (e.g. temperature changes, flood threats) also affects the state of the monuments.

Adaptation measures in this sector are financially supported mainly from the Integrated Regional Operational Programme, the Rural Development Programme, and from the state budget.

Measures in public administration

The purpose of the measure is to promote cross-sectoral cooperation and the exchange of information necessary for the sustainable development of tourism, to set up land-use planning regulations and incentives for tourism in order to maintain the value of attractive areas. It is desirable to introduce education and awareness rising programs for tourism stakeholders and to address the possibilities for monuments protection from negative climate change effects.

Tourism sectors and destinations

The aim is to integrate tourism into strategies and plans to mitigate the impact of climate change and into strategies for the sustainable development of tourism. For the development of tourism, it is important to protect the landscape, biodiversity and ecosystems, and to ensure sustainable use of natural resources, to increase climate change related awareness of clients and employees, and to engage in processes which lead to mitigating the impacts on tourism and climate change mitigation.

Consumer measures in tourism

The measure consists in promoting environmentally friendly forms of tourism and in stimulating the visitors to consider climatic, economic, social and environmental impacts of consumer behavior, and to prioritize environmentally friendly tourist activities and facilities.

Research and communication in tourism

Measures include stimulation of interdisciplinary research into the climate change impacts on tourism, thematic integration of the climate change impacts and possible adaptation and mitigation measures into education programs, and ongoing risk assessment of infectious diseases. It is also important to promote responsible tourism in terms of climate, environmental, economic and social aspects, and to raise awareness of the positive impacts of environmentally friendly forms of tourism on the economy, employment, nature and landscape conservation and the cultural identity of local people.

6.3.8 Transportation

Adaptation measures in the transport sector require inclusion of climate change impacts both in the long-term investments such as road and infrastructure construction and acquisition of transport assets and in the sectoral concepts and strategies. In addition, the measures must be specifically targeted to the type of transport and transport infrastructure, therefore the research in this area and appropriate tools for climate change impact assessment, such as risk and vulnerability analyzes and cost-benefit analyzes, needs to be fostered.

Adaptation measures in this sector are financially supported mainly from the Operational Programme Transport, the Integrated Regional Operational Programme, and from the state budget.

Ensuring flexibility and reliability of the transport sector, ensuring operation after extreme weather conditions

It is necessary to assess the planned measures to ensure the reliability of the waterways in terms of the climate change impacts, in particular long-term water scarcity, and to consider their economic and environmental suitability in this context. Furthermore, it is desirable to increase the reliability of the transport sector by removing the “*bottlenecks*” and to connect spatial planning and risk management in creation of the transport infrastructure conceptions, in prevention of possible damage, and in elimination of the consequences of extreme weather effects. It includes the implementation of engineering measures to protect transport infrastructure, ensuring good connections to European maritime ports by rail transport with sea container transport and supporting the operation of public logistics centers on the railways.

Identifying and monitoring the unsatisfactory technologies in transport infrastructure, promoting research and development of new materials

The measure consists of taking into account the consequences of climate change, effects of extreme temperature fluctuations, heavy rains, fire safety, etc. in designing buildings and transport structures. In addition, it is desirable to support the research and development of new materials and technologies that reduce the risk of negative technical, economic and health impacts, increase the life of transport infrastructure, adapt laws and standards relating to building structures in the context of the climate change.

Optimizing temperatures in the means of transport

The principle of action is to require the carriers to use air-conditioned vehicles at least for anticipated longer driving time, to choose air conditioning and vehicle heating with a view to high efficiency and economy, and to exploit the potential of modern technology and innovation in the development and production.

Measures to shade the roads

Woody plants along roads, dampen extreme stress on the structure and protect the vehicles from the sun, wind and snow. For this reason, it is desirable to systematically plant the trees at a suitable distance along roads and railways and to determine procedure for selecting the suitable trees.

6.3.9 *Industry and energy sector*

Adaptation measures in the industry and energy sector focus in particular on ensuring the functioning of critical infrastructure whose failure might have impacts not only for the end consumers, but which might also have a serious impact on the protected state interests, and therefore, the following section is divided according to individual energy sectors (electricity generation and distribution, gas, oil heating, renewable energy sources). Important is also to ensure security of industrial facilities.

Adaptation measures in this sector are financially supported mainly from the Rural Development Programme, the Operational Programme Enterprise and Innovation for Competitiveness, the Oparational Programme Environment, and from the state budget.

Measures of industrial facilities and their safety

The measure consists in ensuring the safety of industrial installations with regard to the expected impacts of climate change and the adaptation of current security measures, in particular crisis and emergency plans and risk management systems in industrial facilities, in the case of accidents due to, for example, extreme winds and floods. Furthermore, it is important to increase efficiency of the water use resources in production processes through the economic management and water recycling, the use of appropriate technologies and the rainwater use in the plant.

Measures in the electricity sector

The measure includes support for solutions to prevent network congestion and the risk of outages due to significantly increased consumption or significant surplus production (especially from renewable sources), i.e. the development of smart grids, decentralization of electricity production and cyber security of the key elements of the power system. Furthermore, it is important to ensure the capacity of the Czech Republic's transmission system to operate on a long-term basis in the island regime, to ensure high resistance to the Czech Republic's transmission network against the import and spread of failures, and to ensure the ability to quickly restore the electrical network as a whole.

Measures in the gas industry

The aim of the measure is to maintain sufficient capacity of domestic gas storage facilities, to ensure the availability of gas reserves in the Czech Republic for the needs of crisis management, to ensure the ability of gas systems to change the transit and supply routes in a coordinated way, and to further diversify the transport routes and source territories for gas supplies.

Measures in the oil industry

The measure consists of maintaining oil and oil emergency stocks in line with EU and IEA requirements, increasing self-sufficiency in the production of petroleum products necessary for state emergency and population supply, and supporting further diversification of shipping routes and source territories for oil supplies.

Measures in the heating sector

Measures include the setting of emergency regimes to switch to emergency supply in the event of a reduction in the supply of primary fuels for heat supply systems with a capacity exceeding

10 MW, effective support for the ability of new gas to pass on alternative fuels in the event of a crisis regime, support for cogeneration of electricity and heat; Support for the use of renewable and secondary energy sources.

Measures in the field of renewable energy sources

Ensuring the availability of biomass as an energy source is essential for heat generation, combined heat and power systems in biogas plants, etc. - wet and dry biomass, waste, or liquid biofuels are used for this purpose. The measure consists in supporting those types of energy sources whose production is environmentally friendly and economically advantageous - for example crop cultivation that does not contribute to worsening the soil and water regime and does not require high inputs of additional energy, industrial fertilizers or biocides, growing these crops on less fertile soils in the less favorable areas (LFA).

6.3.10 Emergency events and protection of the population and the environment

Due to the anticipated more frequent occurrences of extraordinary situations triggered by climate change, it will be necessary to support development of population protection and environmental security measures, especially of integrated forecasting systems for natural disasters, early warning systems and systems ensuring protection of critical infrastructure. Adaptation measures must be efficient and economical.

Adaptation measures in this sector are financially supported mainly by the Operational Programme Enterprise and Innovation for Competitiveness, the Integrated Regional Operational Programme, the Operational Programme Employment, and from the state budget.

Protection of the population, early warning systems in emergency

Existence of early warning systems and forecasting systems predicting natural disasters form an important part of population and environmental protection against consequences of crisis situations triggered by natural disasters. In this area, responsible authorities need to designate those settlements that may be affected by various types of risk triggered according to specific local conditions by climate change and to draft appropriate adaptation measures for local households. Most of the preventive measures should focus on areas and populations living in places, which are already critical (for instance in terms of regular or repeated flooding risks, erosion etc.).

Development and strengthening of the Integrated Rescue System

Integrated rescue system needs further development and strengthening of its capacities so as to ensure that it is capable of coordinating actions comprising of all its units (Fire Rescue and Fire Protection Units, Police, and emergency services etc.) in preparation for extraordinary situations or during these situations and in providing rescue and liquidation services.

Measures protecting critical infrastructure

Adaptation measures for critical infrastructure are closely linked to specific measures in the industry and energy sectors. Additional measures include:

- Displacement of housing built in flood-prone areas by exchanging affected land parcels between the house owners and the municipality for suitable land outside the critical zone;
- Creation of local early warning system using text messaging (warnings sent by mobile operators upon instruction of the municipality emergency committee, contractual arrangement on regional level),

- Creation of a methodological assistance for households facing frequent climatic extremes, which may be uninsured due to unavailability of commercial insurance policies.

Environmental security

The main task for achieving environmental security is completion of a system with specific legislative, technical, institutional and information measures, including:

- Drafting a proposal for a system of indicators and measures addressing droughts and protection of ecosystems against its consequences,
- Drafting a proposal for a template plan for crisis situation for "long-term dry periods",
- Analyze existing template plans for solution of crisis situations with respect to environmental security and provide appropriate adaptation measures,
- Analyze and propose corresponding change to legislation preventing forest (vegetation) fires,
- Improve forecasting, warning and alarm services and monitoring systems and harmonize them with similar systems in the EU and global systems,
- Draft legal regulation ensuring meteorological and hydrometeorological services,
- Support research, development and innovations in environmental security sector.

Precipitation is one of the most important triggers of landslides, therefore monitoring of risk slopes and water regime, documentation and analysis of data for the purposes of creating preventive measures forms the basis for effective protection against this type of risk and thus such measures are necessary. Alleviation of climate change impacts in this area must also involve active development of stabilizing elements not only in locations that are already in emergency conditions but also in those areas which may enter such state in the near future.

Enhancing security research and development

With regard to anticipated climate change, it will be necessary to strengthen security research and development focusing on areas, which may be critically endangered by climate change. The measure includes:

- Formulating new priorities of the Czech Security Research Programme focusing on the fundamental aspects of climate change mitigation,
- Defining procedures for the use of data for purposes of risk evaluation related to climate change,
- Defining criteria for determining investment priorities in connection with various risks and describe corresponding risk scenarios;
- Elaborating methods reducing vulnerabilities of the society and increasing resilience in connection to extreme climatic events and natural risks.

7 FINANCIAL RESOURCES AND TECHNOLOGY TRANSFER

The Czech Republic is not a party to Annex II to the Convention and as such is not obliged to adopt measures, in line with Article 12.3 of the Convention and fulfil obligations pursuant to Articles 4.3, 4.4 and 4.5 of the Convention and provide additional financial sources. Nevertheless, the Czech Republic as the EU member state, along with other developed countries committed itself at the 15th session of the Conference of Parties to the Convention in December 2009 in Copenhagen, to a goal of mobilizing jointly USD 100 billion annually by 2020 to address the needs of developing countries in the context of meaningful mitigation and adaptation actions and transparency on its implementation. Therefore the Czech Republic is pleased to provide on voluntary basis available information on the support provided to developing countries for activities related to climate change.

The Czech Republic has been providing climate specific support to developing countries since 2010. The Development Cooperation of the Czech Republic (DC) is the main mean through which the climate financing and the technology transfer support have been delivered to developing countries. For the reporting purposes the climate specific funding has been identified in accordance with the OECD-DAC methodology. Only projects with adaptation or mitigation RIO Markers (significant or principal objective) are accounted towards the climate specific funding. The DC has two main delivery channels a) The Bilateral Development Cooperation (BDC) and b) The Multilateral Development Cooperation (MDC). Key strategic documents include **Development Cooperation Strategy of the Czech Republic 2010-2017** and **Multilateral Development Cooperation Strategy of the Czech Republic 2013 – 2017**, which define territorial and sectoral priorities of foreign development cooperation of the Czech Republic and reflect international commitments and actual challenges in development cooperation area.

7.1 Bilateral Development Cooperation

The Ministry of Foreign Affairs is the main administrator of activities related to BDC. However, the coordination and coherence of the BDC are also the responsibility of the inter-ministerial Council on Development Cooperation, where all Ministries take part and contribute to the formulation of Czech policies in their specific areas of expertise. The implementation body of the BDC is the Czech Development Agency, established in January 2008, which is responsible for the provision of development cooperation including the identification of suitable projects, their wording, the advertising of competitions (in the form of public contracts and grants), the signing of contracts and monitoring of projects. According to the Development Cooperation Strategy of the Czech Republic 2010-2017 the geographic priorities are focused on countries with cooperation programmes: Afghanistan, Bosnia and Herzegovina, Ethiopia, Moldavia, Mongolia; and the so-called project countries - Georgia, Cambodia, Kosovo, Palestine and Serbia. Detailed overview of climate specific bilateral projects supported by the Czech Republic is included in CTF table 7b) of the Biennial Reports of the Czech Republic.

7.2 Multilateral Development Cooperation

The Czech Republic is also involved in a number of multilateral activities overseen by a number of international organizations, which aim to achieve global development objectives and other international commitments. The Czech Republic participates in and contributes to funding of development activities of the UN, EU, OECD, international financial institutions and other organizations. For the purposes of the Strategy the Czech Republic considers only those organizations whose activities are in line with OECD-DAC definition of development cooperation and contributions provided are fully or partially creditable towards official development assistance (ODA). Organizations were divided into four groups: 1) EU, 2) development banks and financial institutions, 3) programs and funds of the UN, and 4) other organizations. The Czech Republic is a member of Development Assistance Committee OECD (DAC) since 14 May 2013.

Detailed overview of our multilateral funding is included in CTF table 7a) of the Biennial reports of the Czech Republic. The climate specific funding of MDC has been channelled to the three main international funds i.e. The Green Climate Fund, the Global Environmental Fund and the Multilateral Fund for the Implementation of the Montreal Protocol. Furthermore, in relation to the Green Climate Fund activities, the Czech Republic also contributed approx. EUR 1,500,000 in 2014 to the German Climate Finance Readiness Programme, which has been implemented by the GIZ[28]. The Climate Finance Readiness Programme is working with an initial group of countries (Bangladesh, Cambodia, Grenada, Jamaica, Morocco, Namibia, Peru, South Africa, St. Kitts and Nevis, St. Lucia, Tajikistan, Tanzania, Uganda, Viet Nam, Georgia and Zambia). The main programme’s activities are as follows: i.) Institutional support, e.g. support for regional and national climate finance institutions including development banks in gaining accreditation for direct access, promotion and support for the work of National Designated Authorities (NDA) and Country Focal Points, ii.) Strategic and conceptual advice in advancing and implementing national climate strategies and policy packages for ambitious, climate-resilient low-carbon development paths as basis for funding decisions, iii.) National Green Climate Fund investment plans and corresponding project pipeline, iv.) Global sharing of experiences in climate finance and refinement of approaches and methodologies.

[28] Deutsche Gesellschaft für Internationale Zusammenarbeit - https://www.giz.de/expertise/html/19694.html

Tab. 7.1 - The overall 2013 – 2016 climate specific funding from Bilateral and Multilateral Development Cooperation of the Czech Republic (in Euros)

Allocation channels	2013			2014			2015			2016		
	Mitigation	**Adaptation**	**Cross-cutting**	**Mitigation**	**Adaptation**	**Cross-cutting**	**Mitigation**	**Adaptation**	**Cross-cutting**	**Mitigation**	**Adaptation**	**Cross-cutting**
Multilateral climate change funds			1 236 000			2 161 826			2 181 636			2 201 823
Multilateral financial institutions, including regional development banks									572 662			577 958
Specialized United Nations bodies												
Total contributions through multilateral channels			1 236 000			2 161 826			2 754 298			2 779 781
Total contributions through bilateral, regional and other channels	1 345 227	2 462 971		1 149 083	2 799 552	98 064	2 952 882	2 483 836		1 598 135	2 767 150	404 090
Total climate specific by funding type (total for mitigation, adaptation, crosscutting, other)	1 345 227	2 462 971	1 236 000	1 149 083	2 799 552	2 259 890	2 952 882	2 483 836	2 754 298	1 598 135	2 767 150	3 183 871
Total climate specific finance	**5 044 198**			**6 208 524**			**8 191 016**			**7 549 156**		

Source: MoE, MFA, CDA

7.3 Information according to Article 10 of the Kyoto Protocol

Information provided according to Article 10 of the Kyoto Protocol to be provided within the framework of the 7th National Communication is provided in Annex 3.

8 RESEARCH AND SYSTEMATIC OBSERVATION

This chapter summarizes information on the structure of research in the area of climate change and its main results in the period since the Sixth National Communication of the Czech Republic to UNFCCC[29]. It also provides basic information on the ongoing systematic observation and archiving of climatological data.

This research is intended particularly to improve knowledge of the causes, effects, magnitudes and temporal factors of climate change and their sectoral, economic or social consequences.Attention is also devoted to international cooperation and exchange of scientific, technical and also socio-economic information.

8.1 General organization of research and systematic observation

Research on aspects connected with the current state and development of the climate system is concentrated particularly in the following institutions:

- The Committee on the Environment of the Academy of Sciences of the Czech Republic
- The National Forestry Committee
- Institutes of the Academy of Sciences of the Czech Republic (Global Change Research Institute AS CR, public research institution – CzechGlobe; Institute of Atmospheric Physics AS CR, public research institution; Geophysical Institute AS CR, public research institution; The Institute of Hydrodynamics of the AS CR, public research institution; Institute of Systems Biology and Ecology, public research institution; Institute of Geology AS CR, public research institution)
- University departments (Faculty of Mathematics and Physics, Charles University in Prague; Faculty of Science, Masaryk University; Faculty of Science, Charles University in Prague; University of South Bohemia in České Budějovice; the Mendel University in Brno)
- Sectoral institutes (Czech Hydrometeorological Institute; National Institute of Public Health; the T.G. Masaryk Water Research Institute, public research institution; Czech Geological Survey) and other research institutes (Crop Research Institute, public research institution; Research Institute of Agricultural Engineering, public research institution; Research Institute of Ameliorations and Soil Conservation public research institution; etc.).

Some of these institutes are members of or are represented in the National Climate Programme of the Czech Republic, which is an association of legal persons entrusted, amongst other things, with performance at a national level of the tasks of the World Climate Research Programme of the World Meteorological Organization (WMO), creation of research teams of scientists in the area of climate change in the Czech Republic and publication of the results obtained.

The research, which is part of the basic tasks of the individual institutions, is financed both from their budgets and also through the Czech grant agencies and the Academy of Sciences of the Czech Republic or grant projects announced by the Ministry of the Environment and Ministry of Agriculture. Some projects are carried out in the framework of international cooperation and co-financed by foreign partners.

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[29] http://unfccc.int/files/national_reports/annex_i_natcom/submitted_natcom/application/pdf/cze_nc6_resubmission.pdf

Systematic observation of the climate system is carried out mostly by the Czech Hydrometeorological Institute (CHMI) which performs the function of a State institute for the area of air quality protection, hydrology, water quality, climatology and meteorology, with a competence to establish and operate State monitoring and observation networks, including international data exchange pursuant to the WMO principles. Other institutions carry out monitoring for their own needs, usually for a limited period of a certain project.

Exchange of scientific and technical information between Czech and foreign institutions is not regulated in any way and occurs quite freely; CHMI provides basic data, usually for a fee according to the valid tariff.

The Global Change Research Institute of the Czech Academy of Sciences (CzechGlobe) provides trainings to Ph.D. students and experts (researchers, technicians, public service) from various developing countries. Currently 9 Ph.D. students from Vietnam, Panama, Ghana, India, Nepal, Peru are trained and do research in CzechGlobe. Thanks to established long-term collaboration (agreements, joint projects, research mobilities, visiting professorships…) with national partners (universities, research centres, governments, NGOs…) are prepared joint projects leading to creation of research sites of greenhouse gases cycles research in tropical ecosystems + related global change research in Vietnam, Panama and Ghana. Within project of the EU programme Horizon 2020 of SEACRIFOG (2017-2019) is provided by CzechGlobe trainings and knowledge transfer in climate change adaptations and climate services related to food security to African experts from public service and academia (mainly from Ghana, Sudan, Kenya, Cape Verde, Ethiopia, South Africa, Namibia). Within the Czech-UNDP Trust Fund project Sharing of Czech Experience: Piloting SEEA-EEA were provided in 2016, among others, trainings to the experts of the National Statistical Committee and The State Agency for Environment Protection and Forestry. The CzechGlobe provides also regular visiting lectures and trainings at universities in Bolivia and Columbia dedicated to biodiversity research and protection in the context of climate and global change.

In addition to participation in the activities of the WMO and UN Environmental Programme (UNEP), the Czech Republic cooperates on a number of international projects concerned with the climate. The most important in this respect is participation in the RC LACE project (the ARPEGE-CLIMAT model). Recently, participation of the Czech Republic in international projects concerned with modelling the climate system and estimation of the impacts of climate change has expanded substantially. The Czech Republic for example participates in the Intergovernmental panel on Climate Change (IPCC), the World Climate Programme (WCP WMO), the International Geosphere-Biosphere Programme (IGBP) and the Global Climate Observing System (GCOS WMO). The cooperation is mainly based on data delivery to relevant databases and international exchanges.

The Czech Republic regularly provides assistance to developing countries in the area of training courses, and assistance in installation and calibration of instruments (e.g. monitoring of the ozone layer, etc.).

8.2 Research projects, experimental development and innovations 2013 - 2017

For the period covered by this 7th National Communication, 75 research, development and innovations projects related to climate change were identified by qualified selection. This includes projects initiated and completed within this period, projects commenced prior and completed within this period and projects initiated in this period and continuing beyond this period. Some of these projects were commenced during the 6th National Communication. The

Research and Development and Innovations Information System of the Czech Republic (R&D IS) is the source of information on these projects.

The total volume of funding provided to R&D projects reached 597.7 million CZK. The funding structure in individual years is given in the table below.

Table 8.1: Actual funding provided toward R&D (climate change) projects in 2013 - 2017

Year	**million CZK**
2013	45.0
2014	50,8
2015	223,9
2016[30]	278,0
Total	**597,7**

Source: R&D IS

Table 8.2: Actual funding provided toward R&D (climate change) projects from the state budget in 2013 – 2017 according to provider (millions of CZK)

Provider / Source	**2013**	**2014**	**2015**	**2016**	**2017***	**TOTAL**
Academy of Sciences (AS CR)	5.6	14.7	26.6	38.5	35.4	**120.8**
Czech Science Foundation	0.7					**0.7**
Ministry of Education, Youth and Sports (MEYS)	2.8	1.2	2.6	2.1	2.2	**10.9**
Ministry of Agriculture (MoA)	8.5	8.2	10.0	11.2	11.1	**49**
Technology Agency (TA CR)	9.3	11.6	8.8	7.8	18.4	**55.9**
Total	**26.9**	**35.7**	**48.0**	**59.6**	**67.1**	**237.3**

* *allocated funds* *Source: www.rvvi.cz*

8.2.1 Chief beneficiaries

R&D projects focused on climate change were implemented between 2013 and 2017 mainly by the following organizations (number of projects given in brackets):

Global Change Research Institute AS CR, public research institution – CzechGlobe (10), The T. G. Masaryk Water Research Institute, public research institution (9), Institute of Atmospheric Physics AS CR, public research institution (7), Masaryk University (7), Czech University of Life Sciences in Prague (CZU) (6), Biology Centre AS CR, public research institution (6), Charles University (5), the Mendel University in Brno (MU) (3), University of South Bohemia in České Budějovice (USB) (3), Institute of Botany, public research institution (3), Czech Hydrometeorological Institute (CHMI) (2), Institute of Animal Physiology and Genetics AS CR, public research institution (2), Czech Technical University in Prague (CTU) (2), Crop Research Institute, public research institution (2), Czech Geological Survey (1), CENIA, Czech Environmental Information Agency (1), Czech Metrology Institut (1), Geophysical Institute AS CR, public research institution (1), IFER – Institute of Forest Ecosystems Research Ltd. (1), Brno University of Technology (1), Research Institute of Ameliorations and Soil Conservation (1) and The Silva Tarouca Research Institute for Landscape and Ornamental Gardening, public research institution (1), Institute of Microbiology AS CR, public research institution (1), Institute of Vertebrate Biology AS CR, public research institution (1), Institute of Hydrodynamics AS CR, public research institution (1).

[30] Allocation disbursed in 2016

8.3 Information on selected important national research projects

A number of important national research projects focusing on climate change have been supported since 2013; these include:

- CzechGlobe - Global Change Research Institute of the Czech Academy of Sciences (provider MEYS, beneficiary Global Change Research Institute of the Czech Academy of Sciences)
- CzechGlobe 2020 - Development of the Global Change Research Institute of the Czech Academy of Sciences (provider MEYS, beneficiary Global Change Research Institute of the Czech Academy of Sciences)
- CzeCOS (provider MEYS, beneficiary Global Change Research Institute of the Czech Academy of Sciences)
- Biodiversity change during the Pleistocene-Holocene transition: modern analogues in relict ecosystems of Siberia (provider GA CZ, beneficiary Masaryk University)
- Assessment of expected changes in growth and mortality of forest stands, impacts on forest production in the Czech Republic, and proposal of adaptation strategy (provider MoA, beneficiary CZU)
- Plant diversity changes under climate warming: from regional flora to microhabitat adaptation and diversity patterns (provider GA CZ, beneficiary Institute of Botany)
- Economical aspect of Phytophthora alni invasion in the context of climatic Change (provider MoA, beneficiary The Silva Tarouca Research Institute for Landscape and Ornamental Gardening)
- Compensation of negative climate change impacts on water supply and ecosystems using the localities for potential accumulation of surface water (provider TA CZ, beneficiary The T. G. Masaryk Water Research Institute)
- Sustainable water resources management under climate change conditions (provider TA CZ, beneficiary The T. G. Masaryk Water Research Institute)
- Adaptive genomic divergence to climatic refugia (provider GA CZ, beneficiary Institute of Animal Physiology and Genetics)

The above projects are described in more detail in Annex 5.

8.4 Information on selected major projects involving international cooperation

International projects include:

- ***ACTRIS***

The Ministry of Education, Youth and Sports is provider of funding required for the MSMT-1000/2016 project. The chief beneficiary is CHMI. RECETOX of Masaryk University in Brno, Institute of Chemical Process Fundamentals AS CZ and CzechGlobe cooperate on the project. Project runs from 2016 to 2017.

The ACTRIS Czech Republic (ACTRIS-CZ) research infrastructure forms a unique platform for the long-term background air quality monitoring and research closely related to climate, environmental and health issues qualified as society challenges. The RI represents a national node of the existing European ACTRIS RI (Aerosol, Clouds and Trace gases Research Infrastructure) established with support of the EU 7th Framework Programme INFRA-2010-1-1.1.16 (EU FP7). Currently, ACTRIS RI activities are supported by the ACTRIS-2 project of EU Horizon 2020 (H2020-INFRAIA-2014-2015: Integrating and Opening Existing National and Regional Research Infrastructures of European Interest). In December 2015 ACTRIS was adopted on the ESFRI roadmap 2016 for Research Infrastructures. In addition, the ACTRIS PPP (Project Preparatory Phase) project, that is crucial for implementing ACTRIS RI into a fully operational pan-European Research Infrastructure, started in the beginning of 2017. The national ACTRIS-CZ RI is based on the long-term collaboration of 4 research partners: Czech Hydrometeorological Institute (CHMI), The Institute of Chemical Process Fundamentals of the CAS, v. v. i. (ICPF), The Global Change Research Institute of the CAS, v. v. i. (GCRI) and Masaryk University (MU) at the research facility of the Košetice Observatory (OBK) operated by the CHMI. The core part of the RI is a background station, established in 1988 and continuously operating since then. Essential is the coordination with the ICOS (Integrated Carbon Observation System) activities. Actually, the Czech Republic is one of the first European countries where the ACTRIS and ICOS activities are coordinated at the same site. The RI is closely connected to capacities of the accredited laboratories of two partners (CHMI and RECETOX). The RI provides an access to the RI equipment. The user community is also entitled to an access to various data sets and products including standard operation procedures, calibration results, data protocols, and support to environmental policies. ACTRIS-CZ users include the individual researchers or students, organizations and institutions as well as general public. The development of ACTRIS-CZ RI is planned both in line with the long-term goals of the European ACTRIS and the national partners. The strategic aim of ACTRIS is to secure long-term coordinated aerosol, cloud and trace gas observations and ACTRIS services in Europe and to guarantee sustainable resources and feasible governance for ACTRIS operations both at national and European level through an internationally competitive European ACTRIS RI.

- ***CzeCOS***

The Ministry of Education, Youth and Sports is provider of funding required for the MSMT-1000/2016 project. The beneficiary is Global Change Research Institute of the Czech Academy of Sciences. Project runs from 2016 to 2017.

The research infrastructure CzeCOS is a unique platform for undertaking comprehensive international interdisciplinary research on Global Change (GC) and its impacts on ecosystems. It substantially contributes to the fulfillment of international commitments of the Czech Republic in the field of research, adaptation and mitigation of Global Change impacts. As for the Czech Republic, CzeCOS is the only national component of the following European Research Infrastructures ICOS – Integrated Carbon Observation System- infrastructure for the research on the fluxes of greenhouse gases (founding member), AnaEE – analytical and experimental infrastructure for ecosystems (founding member), EUFAR – European Facility for Airborne Research - infrastructure for remote sensing within environmental monitoring. At the national and international levels, CzeCOS offers a unique interconnection between experimental devices for the manipulation of major environmental factors – MANIPULATION EXPERIMENTS, devices measuring physiological changes in ecosystems - PHYSILOGICAL FIELD TOOLS, analytical platform for studying metabolic processes - BIOCHEMICAL LABORATORY, ecosystem stations monitoring greenhouse fluxes emissions - OBSERVATORY FACILITIES and the advanced platform for remote sensing of ecosystems - FLYING LABORATORY. The research infrastructure CzeCOS represents a unique set of both stationary and mobile devices, instruments and other supporting facilities for the research on the GC impacts on ecosystems, the study of adaptation mechanisms in plants and microorganisms and the subsequent development of procedures for mitigation measures. Interdisciplinary and synergetic interconnection of the specific analytical devices, equipment for ecophysiological measuring, equipment for laboratory and field manipulation experiments, bioreactors for the research and development of photosynthetic microorganisms, ecosystem stations for the study of the matter and energy fluxes, as well as high-end sensors for remote sensing of ecosystems allow us to perform comprehensive research on the GC at an international level.

8.5 Systematic observation

Systematic observation, which is directly connected to the subject of climate change, is provided mainly through the Czech Hydrometeorological Institute which, in connection with Act No. 219/2000 Coll., on the property of the Czech Republic (as amended) and acts thereof in legal relations, and according to the founding document of the Ministry of the Environment of 2004, acts as the central State institute for the areas of air quality, hydrology, water quality, climatology and meteorology.

Its activities also encompass establishment of a state monitoring and observation network for monitoring the quantitative and qualitative condition of the atmosphere and hydrosphere and the causes leading to their pollution and damaging, processing of the results of the observations, measurements and monitoring while complying with the principles of the legislation of the European Union, creation and administration of databases for the field and provision of up-to-date information on the state of the atmosphere and hydrosphere, including forecasts and warnings related to dangerous hydrometeorological phenomena.

In the sense of its authorization and in connection with climate change, CHMI acts as the national communication centre in the World Weather Watch system coordinated by WMO, as the national reference centre for Hydrological Operational Multipurpose System of WMO (HOMS), as the authorized professional entity for determining and evaluating the state of surface and groundwaters, the authorized professional entity for drawing up the hydrological balance, the meteorological calibration laboratory and the workplace of the flood forecast service.

A good database and its administration form the fundamental basis for all activities connected with protection of the climate of the Earth. The developed countries, including the Czech Republic, are working on development and improvement of modern databases, permitting integration of the available methods of observation and their coordination with similar activities on an international scale.

The programme database of the CLIDATA[31] system was created through cooperation between CHMI and ATACO s.r.o. in Ostrava and has been highly praised by WMO. The Czech CLIDATA programme system is based on the modern Oracle database environment. It enables users easy transition from older database systems, especially the internationally used CLICOM system. Work with the CLIDATA system is lucid and comprehensible, but is protected against unauthorized access to the application. One of the main objectives in creating this system was maximum safeguarding of information contained in the database. It allows connection of the database with the Geographic Information System and this connection can also be used to control data for other applications. The CLIDATA programme system was developed so as to

[31] http://www.clidata.cz

enable simple creation of language mutations. CHMI uses CLIDATA for the following activities:

a. Metadata administration pertaining to meteorological, climatological and precipitation (including foreign) networks used by CHMI. This includes information on geographical location of stations, including their history, defining linkages between individual stations and previously used systems of station record-keeping, administrative classification of individual measurement points, definitions of the content of measurements in individual stations (measured elements, instruments used and time schemes from a single minute to monthly records) and description of measurement points and their graphical documentation (historical plans, photographs).

b. Administration of descriptive metadata (calculation methods, control mechanisms, importing methods, historical units, element tables and meteorological events, river basins, districts and other).

c. Acquisition and control of data, definitions of acquisition forms in line with current and historically used reports, definitions of control procedures in line with national requirements. Data verification during acquisition and imports, user control based on element and time consistence of data, spatial data control in Geographic Information System.

d. Archiving of climatologic records of the Czech Republic since 1775.

e. Calculation of derived climatologic data and characteristics (interval data, daily, decade, monthly and annual values, long-term averages and extremes, normal values).

f. Calculation and preparation of special climatologic products (wind rose, precipitation intensity, typical days, numbers of event days and more).

g. Preparation of data sets for forecasting and warning services (SIVS) and for evaluations in meteorology and climate sector (dealing with the regular and ad hoc agenda and requests for the meteorological and climatological information).

h. Preparation of CHMI web-based products (monthly and spatial reports, graphs of element development in regions, maps).

i. Application includes a section that is designated for work with phenological data (FENODATA), probe data (ADATA) and a section that cooperates with hydrological forecasting models (SOMDATA).

In connection with the increasing weather extremes and their manifestations in recent years, the warning system has been further improved on the basis of the innovated Integrated Warning Service System in the Czech Republic. This system includes forecast warning information on 26 dangerous phenomena and for each phenomenon is considered a danger level (low, medium, extreme). Information on the occurrence of dangerous phenomena is issued for five phenomena with extreme levels of danger[32]. A large number of stations with operative presentation of measured data and forecasts have been placed on the web site of the reporting and forecasting flood service [33]; the new version of data presentation is more suitable for the needs and requirements of users.

In the framework of the Global Climate Observing System (GCOS), the Czech Republic participates only in meteorological atmospheric observations GCOS: in the network of GSN

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[32] http://portal.chmi.cz/files/portal/docs/meteo/om/sivs/sivs.html

[33] http://hydro.chmi.cz

round-level stations at the Milešovka observatory, in the GAW network at the Hradec Králové CHMI Solar and Ozone Laboratory and at the CHMI observatory for monitoring the quality of the natural environment on a regional level, located in Košetice[34]. All three observatories adhere to the principles of climate monitoring introduced in GCOS/GOOS/GTOS. It has also been increasing international activities in the last few years. For example, the 15th congress of WMO supported the Intergovernmental GEO – *Group on Earth Observations*, of which the Czech Republic became a member in 2006. The programme of GEO encompasses the GEOSS programme – *Global Earth Observations System of Systems*. The Czech Republic is actively involved in the EU Copernicus, which represents the EU contribution to the global GEO program. The main objective of Copernicus is to ensure a continuous, independent and reliable access to data and information from the Earth observations for the EU. The Czech Republic is also actively participating in IBCS - *Intergovernmental Board for Climate Services* established following onto the 16th WMO congress.

The Czech Republic became the full member of the EUMETSAT on 14. 4. 2010 after ratification of the Accession Agreement between EUMETSAT and the Czech Republic which was signed on 22. 6. 2009. Information from meteorological satellites are in the Czech Republic considered as a one of the fundamental source of forecasting and warning system. CHMI also operates, in cooperation with the Czech military hydrometeorological services, the Integrated Warning Services System where the satellites data are crucial.

The CHMI observatory in Hradec Králové acts as the European Dobson spectrophotometry calibration centre and, together with the Slovak Hydrometeorological Institute, is also active in the area of measuring ozone and solar radiation levels. In 2007, the Czech Republic became a co-working member of the METEOALARM project of the EUMETNET (Network of European Meteorological Services organization. The project, which is available at the website [35], provides a rapid survey of warnings against dangerous meteorological phenomena in Europe.

The WMO always appreciates the Czech foreign assistance provided to developing countries in meteorology and hydrology as this assistance is being requested more and more in connection with building up climate-related databases[36,37], where the CLIDATA system is currently at the cutting edge of available technology worldwide. By virtue of the system flexibility, easy administration and multi-language support, the system is capable of set up in any foreign country and for any meteorological service. In 2016, national meteorological services in 35 countries all over the world (e.g. Guyana, Georgia, Ethiopia, Nigeria, Jamaica, Latvia, Lithuania, Serbia, Montenegro, etc.) used the CLIDATA system.

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[34] CHMI Annual Report 2015, CHMI, Prague 2016

[35] http://www.meteoalarm.eu

[36] http://www.clidata.cz

[37] www.wmo.int

9 ENVIRONMENTAL EDUCATION AND PUBLIC AWARENESS

9.1 General policy

The obligation to promote environmental education and public awareness (EE&A) arises from valid legislation, the fundamental statute being Act No. 123/1998 Coll., on the right to information on the environment awareness and Act No. 561/2004 Coll. on School Education.

The key strategic and cross-sectional document for elaboration of detailed environmental programmes, including climate change, is the State Environmental Policy 2012 – 2020 (SEP). SEP defines EE&A as a "*long-term preventive instrument in the environment, aimed at limiting future damage to the environment caused by insufficient knowledge and awareness, and resulting from incompetent decision-making processes"*. The SEP formulates the following measures in this respect:

- Use all levels of education system (including pre-school and extra-curricular), training and adult education to increase environmental awareness / literacy.
- Increase environmental awareness of the general public by provision of systematic information, edification and eco-counselling.
- Provide quality information, support information exchange, awareness and enlightenment.
- Ensure efficient application of the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention).

The most important body regarding education for sustainable development is The Government Council for Sustainable Development of the Czech Republic (Council). It was established by Government Resolution No. 778/2003 as a permanent consulting, initiative and coordinating body of the Government of the Czech Republic for the area of sustainable development and strategic management. In order to foster partnership and inform all stakeholders about the latest developments in the field of sustainable development, the Office of the Government has revived the tradition of the national Sustainable Development Forum, which is held annually since 2014. The Forum in 2015 was one of the first opportunities to discuss the implementation of the SDGs on the national level after their adoption. The Council established the Working Group for education for sustainable development.

The framework for the SDGs implementation in the Czech Republic has been established by the adoption of the Government Resolution on January 25, 2016, which tasked the Prime Minister in cooperation with the Minister of Environment to put forward a proposal for implementation of the SDGs on the governmental level. The resolution has been adopted after a series of consultations between the Government Office, the Ministry of Foreign Affairs and the Czech Statistical Office.

The main implementation platform of the Agenda 2030 in the Czech Republic is the strategic framework *Czech Republic 2030* (prepared by the Sustainable Development Unit of the Government Office) and was approved by the Governemnt in 2017.

The document sets out goals and targets to be accomplished by the 2030 and consists of a detailed development analysis and strategy for sustainable development that should be reflected in all sectoral and regional strategies. It outlines six national priority areas (people and society;

economic model; resilient ecosystems; municipalities; global development; and good governance). Another segment of the document consists of an impact analysis of global megatrends on national development.

To ensure successful implementation, the SDGs must be perceived in wider context than development cooperation or climate change and new actors must be involved in the process. The Czech Republic considers as key principle for success building strong global partnership based on participation all relevant actors and mobilization of all required financial and nonfinancial resources.

The government of the Czech Republic ratified the National priorities of oriented research, experimental development and innovations with its resolution of 19 July 2012 No. 552. R&D priorities are valid for the period up to 2030. There are 6 defined priority areas and 24 subareas with a total of 170 specific objectives. The Climate Protection Policy states that the priority area "Sustainability of energy and material resources" and priority area "Environment for quality life" is particularly relevant for climate protection. The other financial instrument mentioned in the Policy is the progamme of European Commission LIFE. It allows to finance information, innovation, demonstration projects or best practice projects within three priority areas with specific objectives: climate change mitigation, adaptation to climate change, climate governance and information.

The above documents that are broader in their scope are complemented by specific EE&A strategies, which include:

- The State Programme of Environmental Education and Eco-counselling of the Czech Republic for 2016- 2025 (last novelization by Government Resolution No. 652/2016).
- Strategy of Education for Sustainable Development in the Czech Republic 2008-2015 (Government Resolution No. 851/2008).

Key documents in terms of school environmental education and awareness include:

- Individual framework education programmes, which should introduce environmental education as a compulsory cross-cutting subject for all types and levels of schools.

The regions have become important actors in EE&A in recent years, where each region formulates their own EE&A concepts and funding mechanisms.

9.2 The State Programme of Environmental Education and Eco-counselling of the Czech Republic for 2016- 2025

The State Programme of Environmental Education and Eco-counselling for 2016–2025 (SP EE and EC)[38] is a key national strategy of the Czech Republic for the field of environmental education and eco-counselling (EE and EC), defining a structured vision, strategic areas, objectives and measures, the implementation of which includes not only state administrative authorities, but also regions, municipalities, schools, including universities, specialised facilities such as ecological education centres and eco-counselling organisations, and other entities established by the public administration, as well as private non-profit organisations, educational and research institutions, museums, zoos, botanical gardens, forestry institutions, libraries, church facilities, etc. SP EE and EC constitutes methodological support for drawing

[38] https://www.mzp.cz/cz/statni_program_evvo_ep_2016_2025

up regional and municipal environmental education and eco-counselling concepts and evaluating the impact of all forms of such activities at all levels.

The obligation of the Ministry of the Environment is to draw up and coordinate the State Programme and submit it to the government for approval stems from the Act No. 123/1998 Coll., because information about the environment available in this resort. Implementation is primarily supported by the state budget (in particular the Environment and Education Ministries), national fund calls for applications (in particular the State Environment Fund) and EU cohesion funds.

The state programme stems from and builds on a broad spectrum of legislative and programming documents, from international, governmental and local level. From an international perspective, this includes primarily the following documents:

- the Paris Agreement (adopted in Paris in December 2015 at COP21) became the most important milestone of international climate policy, referring to education, training, public awareness, public participation and access to information under Article 12
- the Sustainable Development Goals (SDGs), approved by the UN member states in September 2015, which includes Goal 4 "Quality Education", which includes target 7 – by 2030 ensuring that all learners acquire the knowledge and skills needed to promote sustainable development, including, among others, through education for sustainable development and sustainable lifestyles
- the Global Action Programme on Education for Sustainable Development, adopted at the 37th UNESCO General Conference (2013), which includes both sustainable development and environmental education (see point 5g)
- the UNECE Strategy on Education for Sustainable Development (2005)
- Directive 2003/4/EC of the European Parliament and of the Council of 28 January 2003 on public access to environmental information, which emphasises the role of public authorities in public awareness and environmental issues
- the European Landscape Convention (adopted by the Council of Europe in 2000 – CETS No. 176), as one of the few documents emphasising a holistic view of the environment
- the Aarhus Convention on access to information, public participation in decision-making and access to justice in environmental issues (1998), which enshrines the commitment to support environmental awareness and public education.

One of the key topics of the SP EE and EC is “Climate in context”. Climate change is a relatively new topic from the perspective of the long-term development of environmental education (in the Czech Republic and elsewhere). To date it has not become an integral component of the understanding of natural, social and economic conditions for life on Earth and in the contemporary world, nor has it been sufficiently incorporated into the educational system (in contrast to the older and more socially accepted "environmental protection"). For this reason it is necessary to focus on incorporaton of this topic to the EE and EC system, with a quality and urgency corresponding to the fact that climate change is considered as one from the greatest contemporary global threats, by making appropriate didactic use of scientific findings and drawing up methodologies and programmes aimed at all important target groups.

The main goal is to address all important targeted groups to understand the causes of climate change and their negative effects and impacts on the Czech Republic, Europe and the world and the ability to learn and implement measures for both mitigation (reducing greenhouse gas emissions and especially moving away from fossil fuels) and adaptation (adapting to the negative impacts and consequences of climate change, especially reacting to extreme weather events).

9.3 Education system

EE&A is a part of the National Programme for the Development of Education in the Czech Republic – the so-called White Paper (2001)[39]. One of the main provisions of the programme consists of education on environmental protection in the sense of providing for sustainable development in society. The Act on Schools of 2004 stipulates acquiring knowledges on the environment and its protection based on the principles of sustainable development as one of the components of a general education. The Strategy of Lifelong Learning, adopted in 2007 by Government Resolution No. 761, mentions, in the main strategic directions, social partnership, intended to promote harmonization of educational opportunities with the needs of economic, environmental and social development and also contains proposals for measures that emphasize sustainable development. The long-term plan for education and development of the educational system in the Czech Republic contains proposals for measures emphasizing sustainable development and describes the reasons for the reform steps in education, based, amongst other things, on the role of education as a guarantee of sustainable development.

Environmental education is a cross-subject theme in national curricula for primary and secondary schools. This means that all schools must incorporate, in one way or another, EE to their work with children. Advice on how to develop EE at schools is elaborated in more detail in the Recommended Learning Outcomes for Environmental Education which covers the areas of environmental sensitivity, principles, problems and issues, inquiry skills and action strategies.[40]

As for preschools, a national network called the Mrkvička (Little Carrot)[41] which has been in place since 2007 for kindergartens that are interested in EE&A (approximately 829 kindergartens in all regions of the Czech Republic). The objective of the project is to implement modern environmental education in kindergartens and provision of up-to-date information and guidelines for kindergarten teachers. A wide range of environmental educational programmes of environmental education centers is available for kindergartens.

The reasonable progress has been made with forest kindergartens in the Czech Republic recently. This type of preschool education with close contact with the nature is currently very popular, there are more than 120 forest kindergartens, founded in the last 6 years. Some of them become even enrolled in the register of the Ministry of Education, in the beginning of the 2017. In March 2016 the Czech Parliament agreed on a forest kindergarten definition: "The status of forest kindergarten can be used by those kindergartens, which organize their educational process mainly in an outdoor area, outside the shelter of a kindergarten. The kindergarten's shelter is used only for an occasional stay. The shelter of a forest kindergarten mustn't be a building".

9.3.1 Elementary education

Several hundred elementary schools interested in EE&A are associated in the M.R.K.E.V. network or the Environmental Education Club and in a number of school environmental projects. The best known include the Eco-school project (Tereza Association) and the School

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[39] http://info.edu.cz/en/node/415

[40] http://www.nuv.cz/vystupy/doporucene-ocekavane-vystupy-1

[41] http://www.pavucina-sev.cz/rubrika/71-PROGRAMY-MRKVICKA/index.htm

for sustainable life (Partnership Foundation and SEVER – Centre of Environmental Education and Ethics). A wide range of aids, publications and also environmental educational programmes provided by lecturers from environmental education centres are available for elementary schools. These are either short programmes for several teaching hours or several days long with accommodation in the centres.

9.3.2 Secondary education

The Ministry of Education, Youth and Sports issues so called 'Framework Educational Programmes' for 2 secondary academic education levels (gymnasia) and 283 high schools in three stages. Gymnasia curriculums include in their SEPs cross-cutting topic "Environmental Education" and all secondary vocational levels include "Man and the environment". There are 26 secondary schools that even have professionally focused curricula focused on the protection of the environment. These include topics such as "Ecology and the environment," or "Industrial ecology."

9.3.3 University education

Over 100 fields of study at universities are available at bachelor, masters and post-gradual levels which are focused on EE&A. EE&A as a part of mandatory-optional, or purely optional or selective courses in university departments involved mostly in public administration, civic sector, regional policies, agriculture or architecture. EE&A courses are being taught at almost all public universities (expect art schools) and at several private universities.

An electronic web encyclopaedia "Enviwiki" (http://www.enviwiki.cz) has been created to support education of all students not just for the benefit of future pedagogues. The Centre of environmental studies has been publishing its own electronic magazine for environmental education "Envigogika" since 2006.

The Environment Center at Charles University initiated establishment of a "Forum of University Teachers: Education for sustainable future". The objective of the Forum is to contribute to clarification and generation of content, scope and methods of education for sustainable development and to ensure mutual awareness, promote cooperation in preparation of courses, lectures and teaching materials, research and project work.

EE&A is also a part of objectives stipulated by the Strategy for Education for Sustainable Development in the Czech Republic (2008-2015), approved by the Government on 9 July 2008 and in Action plan to the Strategy (specific measures for 2011 and 2012), approved on 23 February 2011, in university education sector.

9.3.4 Further education of pedagogical workers

Further education of pedagogical workers is also an important area. The Ministry of Education, Youth and Sports is responsible for integration of the elements of environmental education and awareness into the post-graduate education of pedagogues. A number of NGOs and educational facilities offer certified EE&A seminars and courses for pedagogues lasting from several hours to several dozen hours.

Environmental Educator has recently become one of the professions in the National Register of Qualifications. It enables people to prove their competences and receive an official qualification degree. However, there is no experience with the process so far.

https://www.narodnikvalifikace.cz/en-us/qualification-1009-Environmental_education_officer

There are various forms of further education for teaching staff. Teachers training focuses on methodological assistance for teachers in planning, implementing and evaluating environmental education at schools, as well as providing practical guides and teaching methods for classes, expertise on ecology, the environment and environmental protection and a forum for teachers to swap experiences with environmental education.

The new standard for studying specialised activities in the field of environmental education was issued by the Ministry of Education, Youth and Sport in 2015. The standard stipulates that specialized studies must include at least 250 hours of instruction. Of the total number of teaching hours, no more than 20% can be used for distance learning, i.e. e-learning.

9.3.5 Informal education

The education system (and thus also EE&A) encompasses both activities taking place at schools and educational facilities (formal education) and also in employers' facilities of, private educational institutions, NGOs, school facilities and other organizations (non-formal education), as well as unorganized, every-day experience and activities at work, in the family, during free time, interactions with society and nature and through the influence of the media (informal learning).

E-learning program for state administration employees and officers focusing on environmental education prepared by the Ministry of the Environment in 2011 has been transferred to the Institute for Public Administration (under the Ministry of Interior of the Czech Republic). Some of the training sessions are implemented by NGOs such as by the National Network of Healthy Cities or Czech Ecological Management Centre (CEMC). Training sessions focus on legislation, EMAS, ISO standards, cleaner production, voluntary agreements, waste economy, packaging, chemicals and hazardous substances, monitoring, modern technologies, international and national experience, etc.

A wide range of extracurricular education for children and young people is available, with participation of numerous of school institutions and NGOs.

NGOs also play an important role. Greenpeace, the DUHA Movement, Centre for transport and energy, the CZ Biom Association and others are systematically involved in climate change-related public debates, workshops or seminars.

Specific support for EE&A related to climate change is also provided by some important foundations, such as the Partnership Foundation, the Foundation for the Development of a Civic Society, the Via Foundation and the Open Society Fund, Heinrich-Böll-Stiftung and also regional foundations – for example, the Foundation for the Jizera Mountains and the Community Foundation of Ústí nad Labem.

Governmental institutions in the area of the environment participate in environmental education of the general public – in addition to the Ministry of the Environment (see below), also the Regional Authorities, Administrations of Protected Landscape Areas and National Parks, the Czech Environmental Information Agency (CENIA), the Nature Conservation Agency of the Czech Republic as well as other institutions.

Each year, the Ministry of the Environment opens a tender for projects formulated by civic associations and NGOs. Detailed results of all supported projects in this area since 1997 are available at www.projektymzp.cz. Between 2014 and 2016 the Ministry of the Environment supported a total 12 projects in EE&A sector focusing on climate change and the total funding amounted to 1,9 million CZK.

9.3.6 Summary of supported projects in individual years

2014

Project	Author
Green roofs – healthy environment to the cities	The union of the creation and maintenance of green, r. s.
Water school	Ekocentrum Koniklec, p. b.o.

2015

Project	Author
Water school	Ekocentrum Koniklec, p.b.o.
Support the accumulation of water in the landscape in the form of self-help interventions	River coalition, r. s.
How to improve the house	Ekocentrum Paleta, p.b.o.
Wetlands for life - to experience and understand	Čmelák - the Society of friends of nature, r.s.
The celebrations of water	Arnika, r.s.

2016

Project	Author
Green roofs - a hope for the future II.	The union of the creation and maintenance of green, r. s.
Pilot verification of the use of a model extensive green roof	Czech Otter Foundation Fund
Floodplain in Mařīž – solution, and an example of the sustainability of the valuable habitat in the village	Mařížský park, r. s.
Adaptation of cities to climate change - the selection of measures and public participation	CI2, p.b.o.
Renewal of land management as a means for the restoration and conservation of biologically valuable wetland habitats in the floodplain of the upper Luznice	Juniperia, r.s.

Some examples of individual projects implemented by NGOs between 2014 and 2016 are given in Annex 6.

9.3.7 Ecological Consultancy

The goal of consultancy is to provide citizens, municipalities or companies with reliable and comprehensive information on the environment, on ecological problems and how to solve them, and on human activities and products and their influence on the environment.

Ecological counselling centres respond to individual inquiries, organise educational events, implement specific projects and issue publications. They provide the public, municipalities and other target groups with professional support and thanks to their actions in various regions they are able to cover questions on environmental protection throughout the country. The advantage of eco-counselling services is an individual approach, the connection to the local environment and assessment of the issue in the broader context. The spectrum of topics is very broad: from consumer information to protection of local nature or addressing complex and long-term cases of damage to the environment or public health. The projects of „urban“ counselling centres very often deal with waste prevention, savings water and energy, and consumer counselling, while „rural“ counselling centres devote attention to supporting sustainable use of the countryside and supporting ecological agriculture. One place you can find organisations that provide ecological consultancy is on the website of the STEP Eco-Counselling Network www.ekoporadna.cz. The STEP Eco-Counselling Network connects ecological counselling centres from around the Czech Republic.

Since 2011, STEP has been working for example with Opava city hall to introduce environmentally friendly operations and green purchasing. They drew up an initial analysis of operations and consquently an Action Plan was created. What was achieved? Aside from thorough recycling of waste, the city hall also focused on preventing it from being created. It now purchases supplies in bulk economic packages, uses reusable toner cartridges and prints on both sides. Instead of plastic bottles, water is provided in tasteful glass pitchers. The heating is set up to maintain an optimal temperature. The cleaning staff was trained in ecological cleaning and cleans without using unnecessary chemicals, which has contributed to a healthier working environment. The old flushing systems in the toilets were replaced by modern efficient ones. Wasteful and inappropriate lighting was replaced with efficient LED lights and fluorescent bulbs. An integral part of the change was informing employees and visitors.

9.4 Financing

In the Czech Republic EE&A is financed from various sources, the most important sources are the state budget and funds, local government funds (municipality budgets), EU funds, foundations, private funding and own funding of various NGOs.

In terms of funding, important support from EU funds was secured in the past as part of the Operational Programme Environment and the Operational Programme Education for Competitiveness. For example, the OP Environment helped dozens of entities in the Czech Republic to build or renovate eco-centres in 2007–2014 with a total contribution of around CZK 800 million.

The key sources of funding are currently:

- The National Environment Programme coordinated by the Ministry of the Environment and the State Environment Fund, from which CEPA and EC support is estimated at around CZK 50 million a year.
- Subsidy programme of the Environment Ministry for supporting NGO projects from which projects focused on CEPA and EC are also supported annually at a rate of around CZK 5–10 million.
- The subsidy levels for CEPA and EC from regional budgets vary by region, but range from around CZK 0.5 million to around CZK 10 million.
- Several foundations and endowment funds support CEPA and EC projects, the most significant being the Environmental Partnership Foundation. Corporate support as part of corporate social responsibility is a welcome source of funding for some CEPA programmes.

In 2010 (and in 2017 it is under preparation again), a new programme was established to support curative stays of children from regions suffering from bad air quality. These stays of 10 to 15 days focus on EE&A and take place in recreational facilities, EE&A centres etc.

9.4.1 The Technology Agency of the Czech Republic

Several interesting projects connected with climate education and public awareness has been supported by the Technology Agency of the Czech Republic recently, where the Ministry of the Environment is the main user of the outputs.

One of them is “The Nutritional footprint methodology for the assessment of environmental and health aspects of food consumption in the Czech Republic”, with duration 2016-2017. The main objective of the project is to develop the concept of Nutritional footprint integrating health and environmental aspects of food consumption in the Czech Republic and to build up a practical online tool for the use of the concept in practice. Nutritional Footprint (NF) is a concept integrating a set of environmental and nutritional indicators for various foods. It is an innovative interdisciplinary approach that aims to help consumers to make informed choices among the available foods and meals with regard to their environmental and health impacts. The main objective of the project is to further develop the concept in the Czech Republic and to assess its potential for use in practice. The project will include the following main steps: revision of the NF indicators, creation of a database with environmental and nutritional aspects of food groups in the Czech Republic (using the Life Cycle Assessment methodology – LCA), development of a methodological document and computing software (online calculator of Nutritional Footprint of meals).

Other important project "The Impact Evaluation Measures for Campaigns Focusing on Reducing Individual Greenhouse Gas Emissions", with duration 2016-2017, has aim to develop and empirically test tools (methodology and software - carbon footprint calculator) for evaluation of campaigns that aim at promotion of individual mitigation behavior and that seek to change attitude to climate change. The methodology and the carbon footprint calculator will be tested in demonstration studies using examples of existing campaigns and interventions. Assessment of campaign effects is carried out by using experimental and quasi-experimental approaches that allow for isolation of the true causal effects of campaigns.

9.5 International activities

Organizations in the Czech Republic participate in a number of international projects concerned with environmental communication, education, and public awareness. Some of these activities are supported methodically and financially directly by the Ministry of the Environment and Ministry of Education, Youth and Sports.

Below we describe some of the most important:

Model Climate Conference

Model Climate Conference, based on the United Nations Framework Convention on Climate Change, Conferences of the Parties (COP). The model conferences should enthuse and challenge students to think about the national and international implications of climate change.

Environmental center SEVER is actually the coordinator of this project in the Czech Republic.

Euronet 50/50 max

Euronet 50/50 max project aims at mobilizing energy savings in public buildings through the implementation of the 50/50 methodology in 500 schools and nearly 50 other public buildings from 13 EU countries. The 9-step methodology increases energy awareness of the building users and actively involves them in energy–saving actions. Achieved financial savings are shared equally between the building users and the local authority which covers the energy bills. Based on this project actually Czech and German Ministries of the Environment prepare the international project for schools from 4 other European countries.

The School for Sustainable Development

The School for Sustainable Development programme was conceived and created in 2004 as a joint project of several non-profit organizations, including Groundwork (UK), Partnerstwo dla Srodowiska (Poland), and Nadace Partnerství (Environmental Partnership Foundation) and

Středisko ekologické výchovy SEVER (SEVER Centre of Environmental Education) (Czech Republic). The programme is based on the principles of locally anchored and community learning, its joint vision is to support schools as initiation centres of local sustainable development and, at the same time, to use the schools' involvement as an effective tool of education for sustainable development. Practical projects initiated by students and teachers were supposed to trigger systematic improvements of the quality of the environment, as well as other changes toward sustainable development in the life of local communities, and to provide meaningful learning experiences to students. The programme has gradually expanded into other Czech regions, supporting many projects improving the surroundings of schools and public places, mapping or informing about local places of interest or local heritage, or presenting or making use of renewable energy sources, environment-friendly and safe mobility, better waste disposal practices etc.

Eco-Schools

Students work with teachers, school staff and the local public to change and ecologise their schools and improve the environment around them. The basis of the programme is a seven-step methodology that is a simple but effective tool to turn the involved schools into real Eco-Schools. An eco-team is created at the school, which goes through the school literally from the basement to the attic. They conduct an analysis and search for what specifically should be done for the school to become more environmentally friendly. The eco-team members elaborate on their ideas and bring them to their classrooms, where they implement them along with their classmates and adults. They do not neglect to evaluate the implementation.

The GLOBE programme

The *GLOBE* programme is a global programme for schools, which the Czech Republic joined together with other countries in 1995. For the *GLOBE* programme, scientists prepared a system of demonstration measurements that makes easy for students to monitor trends of different global environmental issues. In the *GLOBE* programme, students perform measurements and observations of the quality of the environment in the areas such as meteorology, hydrology, biometry, phenology, pedology and remote sensing of the Earth. They send their observations through the Internet to the NASA center in the USA. The project also includes monitoring the carbon cycle, with participation almost 400 students and 14 schools.

ANNEXES

ANNEX 1 Biennial Report

THIRD BIENNIAL REPORT
OF THE
CZECH REPUBLIC

Accompanying the document:
Seventh National Communication
of the Czech Republic
under the United Nations Framework Convention on
Climate Change

CONTENT

1. Introduction

The third Biennial Report of the Czech Republic (BR3) was prepared under Decision 2/CP.17 of the Conference of the Parties to the UNFCCC and was submitted as an Annex to the 7th National Communication of the Czech Republic under the UNFCCC (NC7).

This document is structured according to an outline defined in Annex 1 of the Decision 2/CP.17. Provisions of many chapters are reflecting information already provided in the 7th National Communication of the Czech Republic in its corresponding chapters. Some required provisions were merely referenced pointing to corresponding chapters in the 7th National Communication of the Czech Republic. Although the outlines of Biennial report and National Communication are not completely identical we believe the structural and informational integrity has been retained in both documents.

Tabular information as defined and required by the UNFCCC Biennial report guidelines has been enclosed in the CTF annex at the end of the Czech third Biennial report and also submitted electronically through UNFCCC Application and Network Access Portal.

Abbreviations

To avoid confusion please check abbreviations in the List of Abbreviation of the 7th National Communication of the Czech Republic.

2. Information on GHG emissions and trends

2.1 Introduction and summary information from the Czech national GHG inventory

Annual monitoring of greenhouse gas emissions and removals is one of the obligations following from the *UN Framework Convention on Climate Change* and its *Kyoto Protocol*. In addition, as a result of membership in the European Union, the Czech Republic must also fulfil its reporting obligations concerning GHG emissions and removals following from Regulation of the European Parliament and Council No. 525/2013/EC. The GHG emission data presented in this Biennial Report are consistent with the GHG emissions and removals reported by the Czech Repulic in the National Inventory Report (NIR), which was submitted to UNFCCC in April 2017 and officially resubmitted in May 2017.

The inventory covers anthropogenic emissions of direct greenhouse gases CO_2, CH_4, N_2O, HFC, PFC, SF_6 and indirect greenhouse gases NO_X, CO, NMVOC and SO_2. Indirect means that they do not contribute directly to the greenhouse effect, but that their presence in the atmosphere may influence the climate in various ways. As mentioned above, ozone (O_3) is also a greenhouse gas that is formed by the chemical reactions of its precursors: nitrogen oxides, hydrocarbons and/or carbon monoxide.

Total greenhouse gas emissions including sinks from LULUCF and indirect emissions, expressed in CO_2 eq., indicate decrease in the Czech Republic from 191.5 million tons to 121.3 million tons in 2015. Emissions (excl. LULUCF, incl. indirect emissions) decreased from 197.9 million tons in 1990 to 127.9 million tons, i.e. in comparison with reference year 1990 the emissions including LULUCF and indirect emissions decreased by 36.7% and excluding LULUCF with indirect emissions decreased by 35.4%. The inventory also includes emissions HFC, PFC, SF_6, NF_3 (substances containing Fluor, the so-called F-gases), which are also covered by the Kyoto Protocol. Their present share on total GHGs (excl. LULUCF, incl. indirect emissions) amounted in 2015 to 2.8%. CO_2 net emissions amounted to 81.6% of the total emissions (excl. LULUCF, incl. indirect emissions) in 2015; CH_4 share amounted to 10.7% and N_2O to 4.8%.

More detailed information about the trends of the greenhouse gas emissions are described in the chapter 3.1 of the 7th National Communication of the Czech Republic and more information about greenhouse gas inventory and about each greenhouse gases is provided in the chapter 3.2. of the 7th National Communication of the Czech Republic. Summary tables of greenhouse gas emissions of the Czech Republic for emission trends by gas and by sector in the common tabular format are presented in the CTF Table 1.

2.2 National Inventory Arrangements

The *Czech Hydrometeorological Institute* (CHMI) was appointed in 1995 by the *Ministry of the Environment* (MoE), which is the founder and supervisor of CHMI, to be the institution responsible for compiling GHG inventories. Thereafter, CHMI has been the official provider of the Czech greenhouse gas emission data. The role of CHMI was improved following implementation of the establishment of the National Inventory System (NIS) in 2005, when CHMI was designated by MoE as the coordinating institution of the official national GHG inventory. Further information on the institutional arrangement of the Czech National Inventory System is provided in chapter 3.3.2 of the 7th National Communication of the Czech Republic.

There were no significant changes of the inventory system since the last National Communication and Biennial Report except of personal changes:

- Ms. Beáta Ondrušová has been appointed as a sectoral expert to support inventory in Industrial Processes and Product Use sector;
- Martin Beck is not official part of the inventory team any more, however he is supporting the team on QA procedures for IPPU.
- Denitsa Troeva Grozeva, MSc. has been hired to support national inventory team in scope of QA/QC process and Waste sector
- Jana Beranova has been hired as sectoral expert to support inventory in Agriculture sector. Zuzana Exnerova is no longer part of the inventory team, however she will serve as QA expert in future submissions.

More detailed information on inventory data and inventory arrangements can be found in the Czech National Inventory Reports.[42]

3. Quantified economy-wide emission reduction target

In 2010, the EU submitted a pledge to reduce its GHG emissions by 2020 by 20% compared to 1990 levels. Since this target under the UNFCCC has only been submitted by EU-28 and not by each of its Member States (MS), there are no specified targets for single MS. Therefore, the Czech Republic as part of the EU-28, takes on a quantified economy-wide emission reduction target jointly with all Member States.

The definition of the EU target under the UNFCCC for 2020 is documented in the revised note provided by the UNFCCC Secretariat on the "Compilation of economy-wide emission reduction targets to be implemented by Parties included in Annex I to the Convention"[43]. In addition, the EU provided additional information relating to its quantified economy-wide emission reduction target in a submission as part of the process of clarifying the developed country Parties' targets in 2012[44].

The EU clarified that the accounting rules for the target under the UNFCCC are more ambitious than the current rules under the KP, for example, including international aviation, adding an annual compliance cycle for emissions under the Effort Sharing Decision (ESD) or higher Clean Development Mechanism (CDM) quality standards under the EU Emissions Trading System (EU ETS)[45]. Accordingly, the following assumptions and conditions apply to the EU's 20% target under the UNFCCC:

- The EU pledge under the UNFCCC does not include emissions/removals from Land Use, Land-Use Change and Forestry, but it is estimated to be a net sink over the relevant period. EU inventories also include information on emissions and removals from LULUCF in accordance with relevant reporting commitments under the UNFCCC. Accounting for LULUCF activities only takes place under the Kyoto Protocol.
- The target refers to 1990 as a single base year for all gases and all MS.
- Emissions from international aviation to the extent it is included in the EU ETS are included in the target[46].
- A limited number of CERs, ERUs and units from new market-based mechanisms may be used to achieve the target: in the ETS, the use of international credits is capped (up to 50% of the reduction required from EU ETS sectors by 2020). Quality standards also apply to the use of international credits in the EU ETS, including a ban on credits from LULUCF projects and certain industrial gas projects. In the ESD sectors, the annual

[42] http://portal.chmi.cz/files/portal/docs/uoco/oez/nis/nis_do_aj.html

[43] FCCC/SB/2011/INF.1/Rev.1 of 7 June 2011

[44] FCCC/AWGLCA/2012/MISC.1

[45] FCCC/TP/2013/7

[46] In the EU, emissions covered by category 'international aviation' go beyond the scope of the EU target, as emissions from international aviation are included in the EU Climate and Energy Package and the EU target under the UNFCCC to the extent to which aviation is part of the EU ETS. As such emissions cannot be separated in the EU inventory nor in the projections for the entire time series, emissions from international aviation have been considered in their entirety throughout the report.

use of international credits is limited to up to 3% of each MS's ESD emissions in 2005, with a limited number of MS being permitted to use an additional 1% from projects in Least Developed Countries (LDCs) or Small Island Developing States (SIDS), subject to conditions.

- The Global Warming Potentials (GWPs) used to aggregate GHG emissions up to 2020 under EU legislation were those based on the Second Assessment Report of the IPCC when the target was submitted. In accordance with the CMP Decision to revise the GWPs to those from the IPCC Fourth Assessment Report (AR4) revised GWPs from AR4 were adopted for the EU ETS. The revised GWPs were taken into account for the revision of the ESD target. For the implementation until 2020, GWPs from AR4 will be used consistently with the UNFCCC reporting guidelines for GHG inventories.

- The target covers the gases CO_2, CH_4, N_2O, HFCs, PFCs and SF_6.

Tab. 3-1 Key facts of the UNFCCC target of the EU-28

Parameters	**Target**
Base Year	1990
Target Year	2020
Emission Reduction target	-20% in 2020 compared to 1990
Gases covered	CO_2, CH_4, N_2O, HFCs, PFCs, SF_6
Global Warming Potential	AR4
Sectors Covered	All IPCC sources and sectors, as measured by the full annual inventory and international aviation to the extent it is included in the EU ETS.
Land Use, Land-Use Change, and Forests (LULUCF)	Accounted under KP, reported in EU inventories under the UNFCCC. Assumed to produce net removals
Use of international credits (JI and CDM)	Possible subject to quantitative and qualitative limits.
Other	Conditional offer to move to a 30% reduction by 2020 compared to 1990 levels as part of a global and comprehensive agreement for the period beyond 2012, provided that other developed countries commit themselves to comparable emission reductions and that developing countries contribute adequately according to their responsibilities and respective capabilities.

Source: European Commission

With the 2020 climate and energy package the EU has set internal rules which underpin the implementation of the target under the UNFCCC. The 2020 climate and energy package introduced a clear approach to achieving the 20% reduction of total GHG emissions from 1990 levels, which is equivalent to a 14% reduction compared to 2005 levels. This 14% reduction objective is divided between two sub-targets, equivalent to a split of the reduction effort between ETS and non-ETS sectors of two thirds vs one third (EU, 2009[47]).

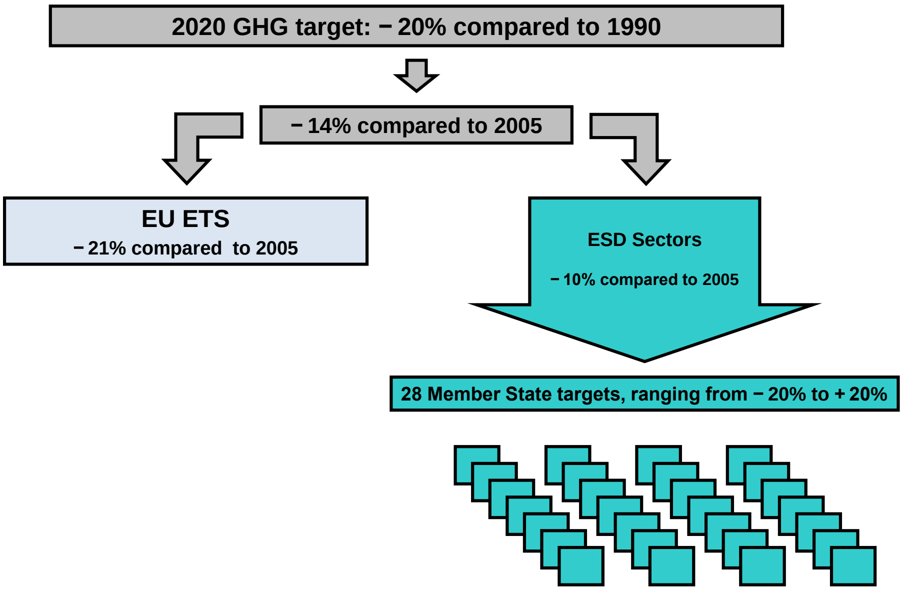
These two sub-targets are:

[47] Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community (OJ L 140, 05.06.2009, p. 63) (http://eur-lex.europa.eu/ LexUriServ/LexUriServ.do?uri=OJ:L:2009:140:00 63:0087:en:PDF)

- a 21 % reduction target compared to 2005 for emissions covered by the ETS (including domestic and international aviation);
- a 10 % reduction target compared to 2005 for ESD sectors, shared between the 28 MS through individual national GHG targets.

The distribution of the total target across the ETS and ESD is shown in Fig. 3-1.

Fig. 3-1 GHG targets under the 2020 climate and energy package



Source: European Commission

Under the revised EU ETS Directive[48], one single EU ETS cap covers the EU Member States and the three participating non-EU Member States (Norway, Iceland and Liechtenstein), i.e. there are no further differentiated caps by country. For allowances allocated to the EU ETS sectors, annual caps have been set for the period from 2013 to 2020; these decrease by 1.74% annually, starting from the average level of allowances issued by MS for the second trading period (2008–2012). The annual caps imply interim targets for emission reductions in sectors covered by the EU ETS for each year until 2020. For further information on the EU ETS and for information on the use of flexible mechanisms in the EU ETS see 3rd Biennial Report of the European Union (EU-BR3), Chapter 3.2.2.1.

Non-ETS emissions are addressed under the Effort Sharing Decision (ESD)[49]. The ESD covers emissions from all sources outside the EU ETS, except for emissions from international maritime, domestic and international aviation (which were included in the EU ETS from 1 January 2012) and emissions and removals from land use, land-use change and forestry (LULUCF). It thus includes a diverse range of small-scale emitters in a wide range of sectors: transport (cars, trucks), buildings (in particular heating), services, small industrial installations, fugitive emissions from the energy sector, emissions of fluorinated gases from appliances and other sources, agriculture and waste. Such sources currently account for about 55% of total GHG emissions in the EU.

[48] Directive 2009/29/EC of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading scheme of the Community

[49] Decision No 406/2009/EC

While the EU ETS target is to be achieved by the EU as a whole, the ESD target was divided into national targets to be achieved individually by each MS. In the Effort Sharing Decision national emission targets for 2020 are set, expressed as percentage changes from 2005 levels. The Czech Republic is allowed to increase its emissions in the ESD sectors by 9% against 2005. These changes have been transferred into binding quantified annual reduction targets for the period from 2013 to 2020 (EC 2013)[50+51], expressed in Annual Emission Allocations (AEAs). The quantified annual reduction targets 2013-2020 of the Czech Republic start from 62.5 million AEAs in 2013 and increase to 67.2[52] million AEAs in 2020. In the year 2015 verified emissions of stationary installations covered under the EU-ETS in the Czech Republic summed up to 66.6 Mt CO_2 eq. With total GHG emissions of 127.9 Mt CO_2 eq. (without LULUCF) the share of ETS emissions was 52%.

The monitoring process is harmonized for all European MS, especially laid down in the Monitoring Mechanism Regulation[53]. The use of flexible mechanisms is possible under the EU ETS and the ESD. For the use of CER and ERU under the ETS, please refer to the EU-BR3.

The ESD allows Member States to make use of flexibility provisions for meeting their annual targets, with certain limitations. There is an annual limit of 3% for the use of project-based credits for each MS. If these are not used in any specific year, the unused part for that year can be transferred to other MS or be banked for own use until 2020.

For more detailed explanation how the EU climate and energy package, EU target under the UNFCCC and KP are set up and related, please also refer to the EU-BR3.

4. Progress in achievement of quantified economy-wide emission reduction targets and relevant information

4.1 Introduction and Summary on Mitigation Actions and Their Effects

The Czech Republic committed itself to reduce its greenhouse gas emissions between 2008 and 2012 by 8% in comparison with 1990. Between 1990 and 2015 the total greenhouse gas emissions in the Czech Republic excl. LULUCF, fell by 35.4%.The Czech Republic therefore does not use flexible mechanisms to meet its commitment in the first KP commitment period. On the contrary, the Czech Republic sold, on international emission trading markets, more than 100 million AAUs, which represented the majority of the anticipated surplus in the period 2008-2012. The revenues were used to finance the so-called Green Investment Savings Programme seeking to achieve further energy savings in housing sector.

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50 Commission decision of 26 March 2013 on determining Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/EC of the European Parliament and of the Council (2013/162/EU)

51 Commission Implementing Decision of 31 October 2013 on the adjustments to Member States' annual emission allocations for the period from 2013 to 2020 pursuant to Decision No 406/2009/ EC of the European Parliament and of the Council (2013/634/EU)

52 The revision of AEAs allocation for the years 2017 to 2020 was carried out according to the Commission Decision (EU) 2017/1471 of 10 August 2017 amending Decision 2013/162/EU to revise Member States' annual emission allocations for the period from 2017 to 2020.

53 Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change and repealing Decision No 280/2004/EC

In the second commitment period, the Czech Republic will fulfil its quantified objective jointly with other EU Member States. The latest available GHG projections from March 2015 show that the EU-28 will collectively overachieve its 2020 reduction target. Under the "With Existing Measures" (WEM) scenario, total GHG emissions (excluding international aviation) are projected to be 27.9 % lower in 2020 than in 1990 and 32.2 % lower in 2030 compared to 1990. Under the "With Additional Measures" (WAM) scenario, as reported by Member States, the projected GHG emissions compared to 1990 would decrease by 28.5 % in 2020, and 34.3 % in 2030.More detailed information on progress monitoring and meeting the objectives are available in the European Commission report to the European Parliament and the Council of the European Union on Implementing the Paris Agreement - Progress of the EU towards the at least -40% target COM(2016) 707 final.

For further information on relevant mitigation policies and measures please see chapter 4 of the 7th National Communication of the Czech Republic. Summary overview of all quantified implemented or prepared measures on national level in the Czech Republic is given in Annex 4 of the 7th National Communication of the Czech Republic.

In the BR3 brief overview of the most significant climate related policies and measures is reported. The development of GHG emissions is reported in CTF Table 4. Emissions in the LULUCF sector are not included under the UNFCCC target, therefore they are not included in CTF Tables 4 and 4(a).

For information on Minimization of Adverse Impact see Chapter 15 of the National Inventory report submitted in April 2017 to the UNFCCC. More information on the EU-wide assessment procedures is available in section 4.4 of the EU 3rd Biennial Report.

4.2 Domestic institutional arrangement

There were no significant changes in domestic institutional arrangements, including legal, administrative and procedural arrangements since the last National Communication and Biennial Report.

4.3 Cross-Cutting Policies and Measures

EU level

Emission trading (EU ETS)

The EU ETS is one of the most important economic tools seeking to reduce CO_2 emissions. Administrative framework for the EU ETS is based on Directive 2003/87/EC establishing a scheme for greenhouse gas emission allowance trading within the Community, which is transposed by Act No. 383/2012 Coll., on conditions of trading with greenhouse gas emission allowances.

More information on EU ETS is descripted in 7th National Communication of the Czech Republic in chapter 4.4.1.

Implementation period: 2005 – continues;

Timeframe: In the second trading period 2008-2012, allowances were allocated free-of-charge, similar to the first trading period 2005-2007. In the third trading period 2013-2020, allowances are being allocated on the basis of harmonized rules and a growing share of allowances is sold at auctions.

Sector: Energy sector (public and industrial), industrial technologies (refineries, chemical sector, metallurgy, coking plants, lime production, cement, glass-making, ceramics, paper and cellulose).

Greenhouse gas coverage: CO_2, N_2O, PFCs

Effort Sharing Decision (ESD)

The Effort Sharing Decision (ESD[54]) establishes annual targets for GHG emissions of Member States between 2013 and 2020 which are legally binding and only refer to GHG emissions that are not included within the scope of the EU ETS, i.e. transport (except aviation), buildings, agriculture (excluding LULUCF) and waste. The emission limit for the Czech Republic is +9% by 2020 compared to 2005 levels.

In accordance with Article 14 of the Decision, the European Commission prepared an evaluation of the implementation of the Effort Sharing Decision up to 2015. The evaluation concluded that the commitments under the Decision have contributed to stimulating new national policies and measures promoting effective reductions of greenhouse gas emissions. It also found that the Decision has resulted in Member States becoming more active in considering new measures to reduce emissions in those sectors within the Decision's scope, as well as in improved coordination between national, regional and local governments.

The results of the evaluation were used by the Commission when preparing its legislative proposal, the "Effort Sharing Regulation", setting out binding annual greenhouse gas emission targets for Member States for the period 2021–2030. The proposal was presented on 20 July 2016. The proposed Regulation maintains the main elements of the ESD architecture, including the binding annual greenhouse gas emission targets for each Member State. The main changes in the proposed regulation from the current decision are as follows:

- Existing flexibilities under the Effort Sharing Decision (e.g. banking, borrowing, buying and selling) are retained, and two new flexibilities are added to allow for a fair and cost-efficient achievement of the targets. These are:
  - a one-off flexibility to transfer a limited amount of allowances from the EU ETS: This allows eligible Member States to achieve their national targets by covering some emissions in the non-ETS sectors with EU ETS allowances which would normally have been auctioned
  - a new flexibility to transfer a limited amount of credits from the land use sector (LULUCF): In order to stimulate additional action in the land use sector, the proposal permits Member States to use up to 280 million credits over the entire period 2021-2030 from certain land use categories to comply with their national targets
- Emission limits will be set for each year in the 10 year period up to 2030. The limit for each year is set according to a decreasing linear trajectory. This ensures year on year

[54] Decision No 406/2009/EC

reductions and adds integrity to the 2030 target because it is the culmination of reductions over 10 years rather than a stand-alone point.

The total amount of ESD emissions is 56,62 mil. t CO_2 eq. in 2015.

Greenhouse gas coverage:: CO_2, CH_4, N_2O and PFCs

National level

- ***Act No. 201/2012 Coll., on Air Protection***

Act No. 201/2012 Coll., on Air Protection replaced Act No. 86/2002 Coll., and its objective is to achieve targets of air quality and further decrease of pollutants discharged into the air. The Act transposes a number of EU Directives in the area of air protection (such as Directive 2010/75/EU, 2008/50/ES, 2001/81/ES etc.); it regulates obligations of source operators, defines emission limits and other operational conditions for stationary source operators. It introduces additional mechanisms for improvement of air quality (such as compensation measures for sources placed in local areas already suffering from polluted air), restricts emission limits for a number of sources, introduces new measures in transport sector (by establishing the so-called low-emission zones), prescribes fundamental change in existing sources regarding household heating and solid fuels, aiming at lower primary particle matter emissions (PM 2,5 and PM 10) generated by combustion processes by 2022, i.e. the “black carbon” fraction. The Act sets stricter limits for air pollution from boilers and minimal energy efficiency requirements for domestic boilers. The new law also anticipates a more flexible approach of the permitting bodies, which are able to modify conditions for sources with respect to local quality of air. The Act also sets emissions ceilings for stationary combustion sources. The revision of the National Emissions Ceiling Directive 2001/81/EC is currently being discussed at the EU level which should set national emission reduction commitments for each MS for 2030 (with interim targets also set for 2025) for six specific pollutants: NO_x, SO_2, NMVOC, NH_3, $PM_{2.5}$ and CH_4.

Sectors: Energy, Industrial Processes, Agriculture, Waste
Greenhouse gas coverage: CO_2, N_2O, CH_4

- ***Climate Protection Policy of the Czech Republic***

The Policy defines greenhouse gas reduction targets for 2020 and 2030. It also includes indicative trajectories and objectives for 2040 and 2050. Further the Policy defines policies and measures for specific sectors on national level. Most of the identified policies and measures will be implemented by the time of the next Policy update, which is planned for 2023.

The Government adopted the Climate Protection Policy of the Czech Republic in March 2017. This Policy reflects significant recent developments at the European Union, international and national level. The long term perspective for gradual transition to low emission development until 2050 was included in such governmental document for the first time. The Strategic Impact Assessment of the Policy was carried out and completed with an affirmative statement in January 2017.

This Policy sets specific targets and measures for the particular sectors on national level in order to fulfill greenhouse gas reduction targets resulting from international agreements as well as EU legislation. This Policy should contribute to gradual transition to low emission development until 2050. The Policy further sets primary and indicative emission reduction targets, which should be reached in a cost efficient manner. Measures are proposed in the following key areas: energy, final energy consumption, industry, transport, agriculture and forestry, waste, science, research development and voluntary tools.

Period of implementation: 2017 – ongoing
Time framework: primary objectives for 2020 and 2030, indicative objectives for 2040 and 2050
Sectors: Enegy, Transport, Industrial Processes, Agriculture, Waste, Cross-cutting
Greenhouse gas coverage: CH_4, CO_2, HFCs, N_2O, PFCs, SF_6

4.4 Sectoral Policies and Measures

Energy

- ***Act No. 318/2012 Coll., on energy management, which amends Act No. 406/2000 Coll.***

The Act No. 318/2012 Coll. stipulates specific measures leading to energy savings and thus also to a reduction in CO_2 emissions, in particular:

Efficiency of energy use
A producer of electricity or thermal energy is obliged, in newly established installations, to provide for at least the minimum efficiency of energy use stipulated by an implementing legal regulation. This obligation also applies to installations for production of electricity or thermal energy in which a change is introduced in previously completed structures. Owners are obliged to provide regularly control of operating boilers, heat distribution and air conditioning systems.

Energy intensity of buildings
A builder, building owner or association of owners of units must provide for compliance with the requirements on the energy intensity of buildings and compliance with comparative indicators and also compliance with the requirements stipulated by the relevant technical standards. An implementing legal regulation stipulates the requirements on the energy intensity of buildings, comparison indicators, the method of calculation of the energy intensity of buildings and other details. Buildings, which are owned by public sector have to have almost zero energy consumption from 1 January 2018.

Building energy performance certificate
Owner of the building is obliged to provide energy performance certificate when the building is new or is refurbished. The building must have certificate also during its sale or lease. All collective houses must have building energy certificate from 1 January 2019.

Energy labels
Domestic producers or importers of mass-produced energy-consuming appliances, a list of which is stipulated by a Decree, are obliged to place energy labels on these appliances prior to placing them on the market. The information on the label must be accurate and in the Czech language.

Energy audit
The Act regulates conditions for the performance of the obligatory energy audit of energy management and of buildings and for the use of the results of the energy audit.

Eco-design
A producer or importer of energy-consuming appliances stipulated by a regulation for implementation is obliged, prior to placing it on the market or into use, to issue a declaration of conformity, declaring compliance with the requirements on eco-design of the energy consuming appliance stipulated in an implementing legal regulation.

Sectors: Energy

Greenhouse gas coverage: CO_2

- ***State Energy Policy***

State Energy Policy (SEP), adopted by the government in May 2015, defines political, legislative and administrative framework for reliable, affordable and long-term sustainable energy supply for the population and national economy. It is anchored in Act no. 406/2000 Coll., on energy management. Within the meaning of this act, it is the strategic document expressing objectives in the energy management of the state in accordance with the needs and requirements of economic and social development, including environmental protection, for the period until 2040.

Sectors: Energy, Transport, Industrial Processes (in general all combustion processes)
Greenhouse gas coverage: CO_2

- ***Act No. 310/2013 Coll., on supported sources of energy***

This Act amends Act No. 165/2012 Coll., on supported of energy sources (SES Act), as amended by Act No. 407/2012 Coll., and other laws. The amendment cancels support provided to new electricity generating facilities from renewable sources from 2014, with one-year transition, allowing completion of projects in progress. It also defines the maximum fee levied for the support of renewable sources, which will be collected from customers within the regulated price of electricity and introduces levy on electricity generated from solar radiation effective as of 1. 1. 2014 for facilities put into operation in 2010.

The Act transposes Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

Sectors: Energy
Greenhouse gas coverage: CO_2, CH_4

- ***New Green Savings Program 2014 – 2020***

This program is a follow-up of previously implemented Green Savings Program and New Green Savings Program 2013. It aims to improve energy efficiency and utilization of renewable sources in both residential and public sector buildings and supports construction of family houses with very high energy performance. The Program is financed from EU ETS auction revenues and the expected allocation until 2021 is 27 billion CZK.

Sectors: Energy
Greenhouse gas coverage: CO_2

- ***Program PANEL/NEW PANEL/PANEL 2013+***

Program PANEL (NEW PANEL since 2009, PANEL 2013+ since 2013) supports complex refurbishments and modernizations of panel houses leading to improve utility value and substantially prolong their lifetime. The program is managed by the State Housing Development Fund.

Sectors: Energy
Greenhouse gas coverage: CO_2

- ***State Program to Support Energy Savings and Use of Renewable Energy Sources***

This Program promotes measures to increase energy efficiency and to incentivize use of renewable and secondary energy sources in accordance with the approved State Energy Policy and sustainable development principles. The Ministry of Industry and Trade prepares the Program for a period of one year and submits it to the Government for approval.

Sectors: Energy
Greenhouse gas coverage: CO_2

- ***New Green Savings Programme***

The objective of this programme is support provided to implementation of measures leading to lower energy intensity of buildings (energy savings, reduced greenhouse gas emissions and pollutant into ambient air, improvement of culture of housing and other).

Funding of the programme in 2013 – 2020 will be covered by the EUA and EUAA revenues plus additional public and other sources. The anticipated revenue from auctioning could range, according to Act No. 383/2012 Coll. in 2013 – 2020 between 12 – 20 billion CZK.

Under the New Green Savings Programme, 70% of the funding will be directed into the housing sector, i.e. family and residential houses, public buildings will represent 30% of supported renovations (division of total allocation: family homes – 49%, residential housing - 21% and public sector buildings - 30%). The amount of support is linked to the achieved energy savings, type of implemented measure, cost, execution and other parameters.

Programme benefits – pro-growth measure with positive impact on the Czech economy (directly on State budget, enterprise development in construction sector, machinery etc.), creation and maintenance of dozens of thousands jobs.

Programme is construed so as to achieve high leverage effect by high degree of mobilization of private sector's own sources.

Sectors: Energy
Greenhouse gas coverage: CO_2

- ***Operational Program Environment 2014 – 2020***

The aim of the Operational Program Environment 2014 – 2020 is to protect and improve the quality of the environment in line with the principles of sustainable development. Two priority axes relevant for GHG emissions reduction are priority axis 2 - Improvement of Air Quality and priority axis 5 – Energy Savings. For the programming period 2014 – 2020 the total allocation is more than € 3 billion including about € 1 billion for activities improving air quality and energy efficiency. The priority axis 5 supports insulation and other energy efficiency measures in public sector and promotes increased use of renewable energy sources. It also supports the exemplary role of public administration by subsidizing construction of new public buildings in passive energy standard.

Sectors: Energy
Greenhouse gas coverage: CO_2

More policies and measures in energy sector is descripted in CTF Table 4 and chapter 4 of the 7th National Communication of the Czech Republic.

Transport

- ***Promotion of biofuels and fuel quality***

The Fuel Quality Directive 2009/30/EC has been implemented into the Czech legislation (as regards GHG emissions) via the amendment to the act on air protection No. 201/2012 Coll., which sets the minimal shares of biofuels in gasoline and diesel in accordance with EU directive 2009/28/EC. Government Decree 351/2012 Coll. sets sustainability criteria for biofuels.

Sectors: Energy, Transport
Greenhouse gas coverage: CO_2

- ***Operational Program Transport***

The Operation Program Transport supports mainly investments into transport infrastructure. Side effect of better transport infrastructure is decreased energy consumption and thus lower GHG emissions.

Sectors: Transport
Greenhouse gas coverage: CO_2

- ***National Strategy of Cycling Transport Development***

The measure introduces support to the construction of cycling infrastructure in the period 2014 - 2020. It is financed mainly from the State Transport Infrastructure Fund, which provides funding for the following measures:

  - construction and maintenance of cycling infrastructure;
  - connection of cyclists with public transport;
  - use of existing roads also for the needs of cyclists;
  - construction and reconstruction of new cycling lanes, paths, walkways and underpasses.

Sectors: Transport
Greenhouse gas coverage: CO_2

More policies and measures in transport is descripted in CTF Table 4 and chapter 4 of the 7th National Communication of the Czech Republic.

Industrial Processes

- ***Regulation (EU) No 517/2014 of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006***

New F-Gas Regulation (EU) No 517/2014 retains many important and successful features of the previous F-Gas Regulation related to leak prevention, F-gas recovery and technical training. As its main measure is to reduce the use of HFCs, the new Regulation prescribes a cap and subsequent reduction of HFCs that can be placed on the EU market ("phase-down"). The new F-Gas Regulation also includes a number of bans. F-gases with high GWPs are restricted from use in new equipment in refrigeration, small air conditioners, fire protection, foams and technical aerosols. In addition, a "service ban" requires operators of existing equipment to start using more climate-friendly alternatives from 2020 onwards.

Sectors: Industrial Processes
Greenhouse gas coverage: HFCs, PFCs, SF_6

- ***Act No. 73/2012 Coll., on ozone depleting substances and fluorinated greenhouse gasess, as amended***

This Act regulates the rights and obligations of persons and competence of administrative bodies in the field of ozone layer protection and climate system protection against negative effects of regulated substances and fluorinated greenhouse gases. The implementing regulation to Act No. 73/2012 Coll., as amended, is regulation No. 257/2012 Coll., on emission prevention of substances damaging ozone layer and fluorinated greenhouse gases.

With regard to ozone layer protection, the fundamental regulation is Regulation (EC) No.1005/2009 of the European Parliament and of the Council of 16 September 2009 on substances that deplete the ozone layer, as amended, and Regulation (EU) No. 517/2014 of the European Parliament and of the Council of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No. 842/2006.

Sectors: Industrial Processes
Greenhouse gas coverage: HFCs, PFCs, SF_6

- ***Operational Programme Enterprise and Innovation***

The main programme which provides subsidies for enterprises and industries. It comprises promotion of energy efficiency and use of RES in enterprises. It replaces the Operational programme Industry and enterprise.

Sectors: Industrial Processes
Greenhouse gas coverage: CO_2

More policies and measures in IPPU is descripted in CTF Table 4 and chapter 4 of the 7^{th} National Communication of the Czech Republic.

Agriculture

The implemented agricultural policies and measures should undoubtedly increase CO_2 fixation in the agriculture sector. The policies and measures in agriculture leading to GHG mitigation are based on prudent application of fertilizers, cultivation of cover crops, adoption of ecological and organic farming, implementation of modern and innovative technologies, monitoring fermentation of crop residues, etc. Recent agricultural policy has declared the goal of reducing nitrogen leaching and run-off.

Important measures to reduce GHG emissions in agriculture are optimal timing of fertilization, the exact amount of fertilizer application to crop use and optimal (covered) storage of manure.

- ***Czech Rural Development Program (2014-2020)***

The Rural Development Program for the Czech Republic was formally adopted by the European Commission on 26 May 2015, outlining the Czech priorities for using the nearly € 3.1 billion of public money that is available for the 7-year period 2014-2020. The Rural Development Program for the Czech Republic focuses mainly on ensuring the sustainable management of natural resources and encouraging climate friendly farming practices, with around 25% of agricultural land under contract to protect biodiversity, 11% to improve water management and 12% to protect soil. The second focus is to increase the competitiveness of agriculture and forestry as well as that of the food industry. The Program also supports organic farming, increased utilization of renewables (especially biogas), measures focused on increasing energy efficiency in the agriculture sector and afforestation of agricultural land.

Sectors: Agriculture, Energy

Greenhouse gas coverage: CO_2, CH_4, N_2O

- ***Biomass Action Plan for the Czech Republic (2012-2020)***

The main aim of the Biomass Action Plan (2012-2020) is to define appropriate measures and principles that will help to the effective and efficient use of the energy potential of biomass in the Czech Republic. The main objectives include a determination of energy potential of agricultural and forest woody biomass and quantifying the amount of energy that can be produced by biomass in the Czech Republic by 2020.

Sectors: Agriculture, Energy, Waste
Greenhouse gas coverage: CO_2, CH_4, N_2O

- ***Action Plan for Development of Organic farming***

Organic farming is an integral part of the agricultural policy of the Czech Republic. Its importance lies not only in the production of good-quality bio-foodstuffs but also in the farming methods that, through their environmentally friendly influence on nature, contribute substantially to the preservation of the rural character of the countryside An important benefit lies in reduction of nitrate leaching, retention of N in biomass before the onset of winter, increased biodiversity, creating a suitable environment for beneficial organisms and effects on plant health. The state administers support for organic farmers through subsidies.

Sectors: Agriculture
Greenhouse gas coverage: CH_4, N_2O

More policies and measures in agriculture is descripted in CTF Table 4 and chapter 4 of the 7th National Communication of the Czech Republic.

Waste

Greenhouse gas emissions generated by the waste sector in Czech Republic have been growing due to organic carbon that is accumulated in landfills, increasing amount of produced municipal solid waste (MSW) and unfavorable mix of MSW treatment options. Recently this trend starts to change and partial stagnation of emission levels from landfills (a key source of this sector in the Czech Republic) can be observed. Policies and measures in the waste sector aim to reduce the amount of produced waste, minimizing the delivery of the biodegradable waste in landfills, promote the incineration and digestion of non-recyclable waste, increase the landfill gas recovery and improve the waste water treatment in sparsely populated areas.

- ***Waste Management Plan of the Czech Republic the period 2015 - 2024***

The most important instrument on the national level is the waste management plan (WMP). New WMP for the period 2015 – 2024 was adopted by the Government in December 2014.

WMP of the Czech Republic establishes in accordance with the principles of sustainable development the objectives, policies, and measures of waste management in the Czech Republic. WMP is the reference document for the development of Regional waste management plans. The binding part of WMP constitutes the mandatory basis for decision-making and other activities of the relevant administrative authorities, regions, and municipalities in area of waste management. WMP has been prepared for the period of 10 years, and will be changed immediately following any fundamental change in the conditions under which it has been developed (e.g. new legislation on waste management, which will fundamentally affect the waste management strategy, including establishment of new objectives or redefinition of existing objectives, policies, and measures).

From 2024 certain waste categories will be prohibited from being deposited in landfills. For those categories landfilling fee will be gradually increased so that a gradual decrease in the quantity of this waste deposited at landfills is achieved.

Other important objectives include:

- Introduce separate collection at least for waste consisting of paper, plastic, glass and metals by 2015;
- Increase to at least 50% by weight the rate of preparing for re-use and recycling from at least such materials such as paper, metal, plastic and glass coming from the household waste by 2020;
- Use mixed municipal waste (after sorting of materially recoverable components, hazardous substances and biodegradable waste) especially for energy recovery in facilities designed for this purpose in accordance with effective legislation;
- Reduce the maximum quantity of biodegradable municipal waste deposited at landfills in such a way, so that the share of this component in 2020 would account for maximum 35% by weight of the total quantity of biodegradable municipal waste produced in 1995;
- Increase to at least 70% by weight the rate of preparing for re-use and the rate of recycling of construction and demolition waste by 2020;
- Objectives are also set for packaging recycling, separate collection of waste electric and electronic equipment, batteries and accumulators and processing of car wrecks and tyres.

Sectors: Waste, Energy
Greenhouse gas coverage: CO_2, CH_4

5. Projections

The projections of greenhouse gas emissions of the Czech Republic have been prepared in accordance with the methodological guidelines for projection compilation and in line with Regulation (EU) No 525/2013, i.e.

Projections are divided by sectors, by gases and into two scenarios:

- with existing measures WEM (implemented and effective as of the date when preparation of projections began (June, 2016);
- with additional measures WAM, i.e. with existing measures and with measures, which are to be implemented in the near future (or which are planned).

The gases covered are: CO_2, N_2O and CH_4, HFC, PCF and SF_6

Projections for greenhouse gas emissions were divided, in line with the IPCC Guidelines, according to their origin into the following sectors:

I. Greenhouse gas emissions from combustion processes and fugitive emissions (Sector 1A and 1B)
II. Greenhouse gas emissions from industrial processes (Sector 2)
III. Emissions from agriculture (Sector 3)
IV. Emissions from LULUCF (Sector 4)
V. Waste (Sector 5)

Greenhouse gas emissions from energy sector

Table 5-1 provides projections of total greenhouse gas emissions from the Energy sector for scenarios with existing measures and with additional measures.

Table 5.1: Projections of total greenhouse gas emissions from the Energy sector [Mt CO_2 eq., respectively % reduction in comparison with 1990 and 2005]

Scenario	1990	2005	2010	2015	2020	2025	2030	2035	1990 - 2020	2005 - 2020	1990 - 2030	2005 - 2030
WEM	158.6	119.6	111.3	98.0	94.2	85.6	81.9	75.9	-40.6%	-48.3%	-21.2%	-31.5%
WAM	158.6	119.6	111.3	98.0	93.9	85.3	81.6	75.5	-40.8%	-48.6%	-21.5%	-31.8%

Source: CHMI

Table 5-2 shows projections of greenhouse gas emissions related to fuel sold to aircraft in international transport. The Czech Republic doesn´t have emission related to fuel sold to ships for international transport. These emissions are not included in totals. Emission from international aviation strongly increased in 2005 in comparison to 1990. However, after 2015 a gradual decline is expected.

Table 5-2: Projections of greenhouse gas emissions related to fuel sold to aircraft [kt CO_2 eq.; only WEM scenario]

Scenario	1990	2005	2010	2015	2020	2025	2030	2035
WEM	528.2	978.9	965.4	895.1	893.2	901.5	910.0	918.5

Source: CHMI

Greenhouse gas emissions from industrial processes

Table 5-3 shows projections of total grenhouse gas emissions from IPPU

Table 5-3: Projections of total greenhouse gas emissions from Industrial Processes [Mt CO_2 eq., respectively % reduction in comparison with 1990 and 2005; only WEM scenario]

Scenario	1990	2005	2010	2015	2020	2025	2030	2035	1990 - 2020	2005 - 2020	1990 - 2030	2005 - 2030
WEM	17.1	14.2	14.4	14.4	14.7	15.3	15.3	14.7	-14.2%	13.1%	-12.5%	14.1%

Source: CHMI

Emissions from agricultural production

A strong increasing trend in the production of greenhouse gases in Agriculture is expected, according to WEM scenario and the emissions should be approximately 17% above the 2015 level in 2035. The emissions should slightly rise also under WAM scenario, this means that the implemented and additional measures are not sufficient to eliminate the increase in emissions. The previous rapid decline of emissions during 1990-2015 by 50% is sufficient to cover increase of emissions by 17% in the period 2015-2035. The resulting effect of WEM scenario for period 1990-2035 presents a decrease of emissions about 42% in agriculture sector.

Table 5-4: Historic and projected emissions from agriculture (in Gg CO_2 eq.)

Scenario	1990	2005	2010	2015	2020	2025	2030	2035	1990 - 2020	2005 - 2020	1990- 2030	2005- 2030
WEM	17050.0	8257.5	7762.0	8483.0	8638.9	9124.0	9682.3	9899.5	-49.3%	4.6%	-43.2%	17.3%
WAM	17050.0	8257.5	7762.0	8483.0	8466.2	8850.3	9295.0	9404.5	-50.3%	2.5%	-45.5%	12.6%

Source: Source: IFER, Ltd.

Emissions from Land Use, Land-Use Change and Forestry

The numeric values for the trends by WEM and WAM scenarios are shown in Table 5-5. It can be seen that the sink of CO_2 observed in LULUCF for the previous decades to a notable extent diminishes. In relation to the base year 2015, the sink of emissions would decrease by about 41% and 34% in 2035 of that observed in 2015 for the WEM and WAM scenarios, respectively.

Table 5-5: Historic and projected emissions from LULUCF (in Gg CO_2 eq.)

Scenario	1990	2005	2010	2015	2020	2025	2030	2035	1990 - 2020	2005 - 2020	1990- 2030	2005- 2030
WEM	-6487.7	-8134.6	-7200.1	-6640.7	-2494.3	-3452.9	-3483.2	-3911.7	61.6%	69.3%	46.3%	57.2%
WAM	-6487.7	-8134.6	-7200.1	-6640.7	-2952.9	-4037.7	-3877.9	-4399.6	54.5%	63.7%	40.2%	52.3%

Source: IFER, Ltd.

Emissions from waste

WAM scenario is almost identical to WEM scenario. The reason is that WMP 2014 is relatively new and all planned changes in waste management practice are to be implemented by this document. The only difference between WEM and WAM scenario is increased recovery of landfill gas, which is increasing more sharply in WAM scenario due to increased pressure from renewables market.

Table 5-6: Historic and projected emissions from Waste (in Gg CO_2 eq.)

Scenario	1990	2005	2010	2015	2020	2025	2030	2035	1990 - 2020	2005 - 2020	1990- 2030	2005- 2030

WEM	3126.8	4117.2	4637.0	5256.4	4894.7	4606.2	4064.3	3265.6	56.5%	18.9%	30.0%	-1.3%
WAM	3126.8	4117.2	4637.0	5256.4	4894.7	4655.0	3788.8	2373.8	56.5%	18.9%	21.2%	-8.0%

Source: CHMI

Total projections

Tables 5-7, 5-8 and Figure 5-1 below show expected development of greenhouse gas emissions in 1990 – 2035. For the period 1990 – 2015 values from National greenhouse gas inventories are taken over and for the period 2020 – 2035 WEM and WAM projections scenarios have been used:

Tab. 5-7 Calculation of projections of greenhouse gas emissions (excl. sector LULUCF) – projections with existing measures

Gas (Mt CO_2 eq.)	**1990**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
CO_2	161.6	124.6	116.2	103.8	100.3	92.2	88.5	83.1
CH_4	23.5	14.5	14.2	13.7	13.3	12.7	12.3	11.1
N_2O	10.6	6.5	5.7	6.1	6.5	6.8	7.1	7.0
HFCs	0.0	0.9	2.3	3.5	2.3	1.9	0.9	0.3
PFCs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SF_6	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total (CO_2 eq.)	**195.8**	**146.5**	**138.6**	**127.1**	**122.5**	**113.6**	**108.8**	**101.6**

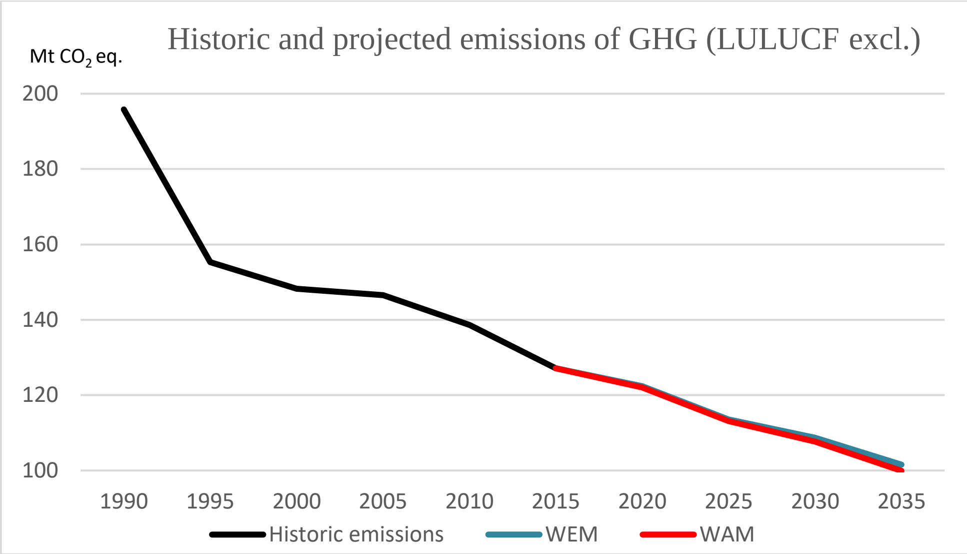
Source: CHMI

Tab. 5-8 Calculation of projections of greenhouse gas emissions (excl. sector LULUCF) – projections with additional measures

Gas (Mt CO_2 eq.)	**1990**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**
CO_2	161.6	124.6	116.2	103.8	99.9	91.8	88.2	82.7
CH_4	23.5	14.5	14.2	13.7	13.3	12.7	12.0	10.2
N_2O	10.6	6.5	5.7	6.1	6.5	6.7	6.7	6.7
HFCs	0.0	0.9	2.3	3.5	2.3	1.9	0.9	0.3
PFCs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SF_6	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total (CO_2 eq.)	**195.8**	**146.5**	**138.6**	**127.1**	**122.1**	**113.2**	**107,8**	**100,0**

Source: CHMI

Fig. 5-1 Historic emissions and projections of greenhouse gas emissions in CO2eq. for WEM and WAM scenarios (excl. LULUCF)



Source: CHMI

Total effects of policies and measures for the WEM and WAM scenarios, aggregated and for each sector, are given in table 5-9.

Table 5-9: Total effect of policies and measures in 2020 and 2030

Total Effect of Policies and Measures	**Expected benefit in reducing greenhouse gas emissions (in kt CO_2 eq./year)**	
	2020	**2030**
WEM Scenario		
Energy supply	7774	9135
Transport	2675	4380
Industrial Processes	3152	4775
Agriculture	825	912
Waste	466	1304
Cross-cutting	793	665
Total Effect WEM	**15685**	**21171**
WAM Scenario		
Energy supply	621	495
Transport	160	176
Industrial Processes	0	0
Agriculture	0	0
Waste	0	0
Cross-cutting	0	0
Total Effect WAM	**781**	**671**
Total Aggregate Effect (WEM+ WAM)	**16466**	**21842**

Source: CHMI, ENVIROS, Ltd.

Tables 5-10 and 5-11 provide the projected split between EU ETS and ESD sectors in WEM and WAM scenarios.

Table 5-10: Split of projected ETS and ESD emissions in the WEM scenario

[Mt CO2eq]	2005	2020	2030	2005 – 2020	2005 – 2030
EU-ETS	82.46	60.54	54.30	-26.58%	-34.15%
ESD	63.51	61.86	54.42	-2.60%	-14.31%

Table 5-11: Split of projected ETS and ESD emissions in the WAM scenario

[Mt CO2eq]	2005	2020	2030	2005 – 2020	2005 – 2030
EU-ETS	82.46	60.49	54.23	-26.64%	-34.23%
ESD	63.51	61.55	53.47	-3.09%	-15.81%

More detailed information on projections of greenhouse gases emissions is given in detail in chapter 5 - Greenhouse Gas Emissions Projections in the 7^{th} National Communication. For broad summary of projections please see CTF Table 5 and 6.

5.1 Changes in Projection system, Methodology

Methodology used in preparation of emission projections is in line with methodology used for compilation of the Third, Fourth, Fifth and the Sixth National Communication, which enables their mutual comparability. Methodology includes a set of the following actions:

(i) Inventory of greenhouse gases,

(ii) Selection of the starting and the end year and cross-sectional years for projection,

(iii) Selection of own methodology and modelling tools for projections,

(iv) Collection and analysis of input data,

(v) Determination of initial assumptions,

(vi) Definition of scenarios,

(vii) Calculation of scenarios and results presentation,

(viii) Sensitivity analysis of selected assumptions.

Information on provisions of individual steps is given in detail in its appropriate sub-chapters in the 7^{th} National Communication.

6. Provisions of financial, technological and capacity-building support to developing country Parties

The Czech Republic is not a party to Annex II to the Convention and as such is not obliged to adopt measures, in line with Article 12.3 of the Convention and fulfil obligations pursuant to Articles 4.3, 4.4 and 4.5 of the Convention and provide additional financial sources. Nevertheless, the Czech Republic is pleased to provide on voluntary basis available information on the financial support provided to developing countries for activities related to climate change in the years 2015 and 2016.

The climate specific support provided to developing countries through the Czech bilateral or multilateral cooperation is partially or fully credible for Official Development Assistance in accordance. More detailed information about our sectoral or territorial priorities are included in chapter 7 of the 7th National Communication of the Czech Republic.

All the information are reported in Czech crowns (CZK) / USD / EUR. The methodology used for calculating currency exchange is the Annual Average Exchange Rates announced by the Czech National Bank. The used exchange rates are as follows: 2015: 1 USD = 24,600 CZK, 1 EUR = 27,283 CZK, 2016: 1 USD = 24,432 CZK, 1 EUR = 27,033 CZK.

The climate specific funding provided through the bilateral or multilateral channels has been identified in accordance with the OECD-DAC methodology. Only projects with adaptation or mitigation RIO Markers (significant or principal objective) have been included the climate specific funding. Other financial support provided to developing countries, which is also accountable for Official Development Assistance, but where the climate related component could not be identified, has been reported as the core/general funding in the BR3 CTF tables.

For the reason that the Czech Republic has not contributed to any specific programme aimed at capacity building or technology transfer in developing countries, the CTF Table 8 and Table 9 remain blank. However, many Czech bilateral projects also have the capacity building or the technology transfer element and these projects are reported among the other projects in CTF Table 7(b).

7. Other reporting matters

No other reporting matters supplied in this submission.

CTF Annex: Common Tabular Format workbook for the 3rd Biennial Report of the Czech Republic

Overview of CTF tables provided with the third Biennial Report:

CTF Table 1: Emission trends

CTF Table 2: Description of quantified economy-wide emission reduction target

CTF Table 3: Progress in achievement of the quantified economy-wide emission reduction target: information on mitigation actions and their effects

CTF Table 4: Reporting on progress

CTF Table 4(a)I: Progress in achieving the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the contribution of the land use, land-use change and forestry sector

CTF Table 4(a)II: Progress in achievement of the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the counting of emissions and removals from the land use, land-use change and forestry sector in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol

CTF Table 4(b): Reporting on progress

CTF Table 5: Summary of key variables and assumptions used in the projections analysis

CTF Table 6(a)/(c): Information on updated greenhouse gas projections under a ‘with measures’ scenario and under a ‘with additional measures’ scenario

CTF Table 7: Provision of public financial support: summary information

CTF Table 7a Provision of public financial support: contribution through multilateral channels

CTF Table 7(b): Provision of public financial support: contribution through bilateral, regional and other channels

CTF Table 1 Emission trends: summary

(Sheet 1 of 3)

GREENHOUSE GAS EMISSIONS	Base year[a]	1990	1991	1992	1993	1994	1995	1996	1997
	kt CO_2 eq								
CO_2 emissions without net CO_2 from LULUCF	161,649.59	161,649.59	146,035.42	141,549.39	135,570.11	129,159.53	129,736.95	132,201.92	128,839.99
CO_2 emissions with net CO_2 from LULUCF	155,024.01	155,024.01	136,321.31	131,343.63	125,753.14	121,463.57	121,571.62	123,655.83	121,200.58
CH_4 emissions without CH_4 from LULUCF	23,450.87	23,450.87	21,886.29	20,493.53	19,571.96	18,432.48	18,032.44	17,842.48	17,425.87
CH_4 emissions with CH_4 from LULUCF	23,568.21	23,568.21	21,973.73	20,585.38	19,677.99	18,541.72	18,135.00	17,977.30	17,571.27
N_2O emissions without N_2O from LULUCF	10,642.52	10,642.52	9,143.41	8,280.52	7,377.15	7,225.20	7,449.40	7,272.25	7,250.62
N_2O emissions with N_2O from LULUCF	10,663.05	10,663.05	9,161.23	8,298.15	7,395.39	7,242.92	7,465.74	7,289.86	7,268.04
HFCs	NO	NO	NO	NO	NO	NO	0.32	38.02	119.96
PFCs	NO	NO	NO	NO	NO	NO	0.01	0.68	1.73
Unspecified mix of HFCs and PFCs	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
SF_6	84.10	84.10	83.94	85.23	86.40	87.48	88.47	98.06	95.83
NF3	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (without LULUCF)	195,827.08	195,827.08	177,149.06	170,408.66	162,605.63	154,904.70	155,307.59	157,453.40	153,734.00
Total (with LULUCF)	189,339.37	189,339.37	167,540.21	160,312.38	152,912.92	147,335.69	147,261.15	149,059.75	146,257.41
Total (without LULUCF, with indirect)	197,948.82	197,948.82	179,160.22	172,382.80	164,528.86	156,649.89	157,052.78	159,170.91	155,435.55
Total (with LULUCF, with indirect)	191,461.11	191,461.11	169,551.36	162,286.52	154,836.15	149,080.89	149,006.34	150,777.26	147,958.95

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[a]	1990	1991	1992	1993	1994	1995	1996	1997
	kt CO_2 eq								
1. Energy	158,569.90	158,569.90	145,280.83	139,704.28	134,456.29	126,411.72	127,386.59	129,112.60	124,793.12
2. Industrial processes and product use	17,080.37	17,080.37	13,822.62	14,587.97	13,429.78	14,667.86	14,157.41	14,834.19	15,727.31
3. Agriculture	17,049.98	17,049.98	14,776.05	12,837.41	11,358.39	10,315.36	10,245.64	9,977.98	9,593.14
4. Land Use, Land-Use Change and Forestry[b]	-6,487.71	-6,487.71	-9,608.86	-10,096.28	-9,692.70	-7,569.01	-8,046.44	-8,393.65	-7,476.59
5. Waste	3,126.83	3,126.83	3,269.57	3,279.01	3,361.17	3,509.75	3,517.95	3,528.62	3,620.43
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (including LULUCF)	189,339.37	189,339.37	167,540.21	160,312.38	152,912.92	147,335.69	147,261.15	149,059.75	146,257.41

Note: All footnotes for this table are given on sheet 3.

[1] The common tabular format will be revised, in accordance with relevant decisions of the Conference of the Parties and, where
applicable, with decisions of the Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol."

(Sheet 2 of 3)

GREENHOUSE GAS EMISSIONS	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
CO_2 emissions without net CO_2 from LULUCF	123,647.03	115,416.47	125,788.18	125,486.45	122,537.80	126,092.53	126,838.97	124,558.95	125,889.26	127,402.86
CO_2 emissions with net CO_2 from LULUCF	115,881.19	107,377.76	116,859.87	116,225.57	113,635.41	118,656.72	118,895.15	116,275.45	119,736.92	123,407.11
CH_4 emissions without CH_4 from LULUCF	16,773.62	16,067.05	15,221.02	14,960.34	14,536.68	14,523.41	14,101.36	14,481.46	14,728.31	14,259.74
CH_4 emissions with CH_4 from LULUCF	16,900.65	16,184.56	15,328.91	15,072.59	14,657.49	14,674.61	14,239.85	14,613.64	14,892.02	14,472.58
N_2O emissions without N_2O from LULUCF	7,119.89	6,985.75	6,829.79	6,911.72	6,622.86	6,250.79	6,709.75	6,495.44	6,288.47	6,273.13
N_2O emissions with N_2O from LULUCF	7,137.39	7,001.90	6,845.16	6,927.14	6,638.76	6,269.15	6,726.99	6,512.18	6,307.82	6,296.50
HFCs	173.54	196.78	272.92	411.01	534.27	671.81	771.03	867.74	1,166.49	1,624.43
PFCs	1.66	1.10	4.69	9.75	16.39	8.55	12.81	14.89	31.09	29.00
Unspecified mix of HFCs and PFCs	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
SF_6	94.56	95.53	107.99	98.41	120.80	144.19	120.00	111.18	108.28	93.41
NF3	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (without LULUCF)	147,810.31	138,762.66	148,224.60	147,877.67	144,368.78	147,691.28	148,553.92	146,529.67	148,211.90	149,682.56
Total (with LULUCF)	140,189.00	130,857.61	139,419.53	138,744.46	135,603.11	140,425.04	140,765.83	138,395.08	142,242.61	145,923.02
Total (without LULUCF, with indirect)	149,360.65	140,163.10	149,380.15	148,992.74	145,430.10	148,737.65	149,560.41	147,612.88	149,308.88	150,731.49
Total (with LULUCF, with indirect)	141,739.34	132,258.04	140,575.08	139,859.53	136,664.43	141,471.41	141,772.32	139,478.29	143,339.59	146,971.94

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	*1998*	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy	119,050.50	112,492.12	120,785.21	120,948.03	117,756.84	120,347.94	120,151.37	119,563.18	120,250.69	120,821.36
2. Industrial processes and product use	15,833.77	13,282.45	14,720.47	13,979.55	13,767.46	14,815.57	15,745.25	14,591.83	15,663.66	16,482.26
3. Agriculture	9,202.65	9,271.62	8,975.75	9,082.41	8,855.49	8,388.58	8,583.03	8,257.49	8,111.66	8,265.07
4. Land Use, Land-Use Change and Forestry[b]	-7,621.31	-7,905.05	-8,805.07	-9,133.21	-8,765.67	-7,266.25	-7,788.08	-8,134.59	-5,969.29	-3,759.54
5. Waste	3,723.39	3,716.46	3,743.17	3,867.68	3,989.00	4,139.18	4,074.26	4,117.16	4,185.89	4,113.87
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (including LULUCF)	140,189.00	130,857.61	139,419.53	138,744.46	135,603.11	140,425.04	140,765.83	138,395.08	142,242.61	145,923.02

Note: All footnotes for this table are given on sheet 3.

GREENHOUSE GAS EMISSIONS	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
									(%)
CO_2 emissions without net CO_2 from LULUCF	122,315.94	114,684.10	116,159.34	114,037.62	110,621.25	107,102.93	102,799.18	103,769.75	-35.81
CO_2 emissions with net CO_2 from LULUCF	115,217.42	106,592.38	108,790.99	105,570.68	101,985.16	99,105.08	94,912.47	97,034.34	-37.41
CH_4 emissions without CH_4 from LULUCF	14,395.03	14,041.66	14,242.64	14,229.55	14,227.09	13,665.65	13,628.21	13,694.48	-41.60
CH_4 emissions with CH_4 from LULUCF	14,563.20	14,183.66	14,392.54	14,295.87	14,298.29	13,731.61	13,701.64	13,776.39	-41.55
N_2O emissions without N_2O from LULUCF	6,389.06	5,957.57	5,746.66	5,936.66	5,849.26	5,891.47	6,081.60	6,112.73	-42.56
N_2O emissions with N_2O from LULUCF	6,408.78	5,975.22	5,765.04	5,948.31	5,861.44	5,903.14	6,093.78	6,125.54	-42.55
HFCs	1,902.14	2,010.82	2,348.97	2,620.17	2,765.99	2,989.02	3,229.53	3,455.08	100.00
PFCs	39.76	45.44	48.01	8.13	6.36	4.55	3.02	1.96	100.00
Unspecified mix of HFCs and PFCs	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	0.00
SF_6	93.29	96.06	80.23	85.39	89.63	92.35	94.73	90.55	7.67
NF3	NO	NO	NO	NO	1.80	3.82	2.35	2.29	100.00
Total (without LULUCF)	145,135.22	136,835.65	138,625.85	136,917.51	133,561.38	129,749.79	125,838.63	127,126.83	-35.08
Total (with LULUCF)	138,224.59	128,903.57	131,425.78	128,528.55	125,008.67	121,829.55	118,037.53	120,486.14	-36.36
Total (without LULUCF, with indirect)	146,162.00	137,795.64	139,593.28	137,863.57	134,465.77	130,561.18	126,616.31	127,925.53	-35.37
Total (with LULUCF, with indirect)	139,251.38	129,863.57	132,393.21	129,474.60	125,913.06	122,640.95	118,815.22	121,284.84	-36.65

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	*2008*	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
									(%)
1. Energy	116,011.65	110,539.82	111,261.56	109,071.35	105,815.68	101,510.15	96,618.86	97,973.60	-38.21
2. Industrial processes and product use	16,438.62	13,964.07	14,965.30	15,257.84	15,012.07	14,982.78	15,787.85	15,413.84	-9.76
3. Agriculture	8,382.73	7,929.92	7,761.98	7,904.13	7,895.79	8,128.87	8,280.62	8,482.99	-50.25
4. Land Use, Land-Use Change and Forestry[b]	-6,910.63	-7,932.08	-7,200.07	-8,388.97	-8,552.72	-7,920.23	-7,801.09	-6,640.69	2.36
5. Waste	4,302.21	4,401.85	4,637.01	4,684.20	4,837.84	5,127.98	5,151.31	5,256.41	68.11
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total (including LULUCF)	138,224.59	128,903.57	131,425.78	128,528.55	125,008.67	121,829.55	118,037.53	120,486.14	-36.36

Notes:

(1) Further detailed information could be found in the common reporting format tables of the Party's greenhouse gas inventory, namely "Emission trends (CO_2)", "Emission trends (CH_4)", "Emission trends (N_2O)" and "Emission trends (HFCs, PFCs and SF_6)", which is included in an annex to this biennial report.

(2) 2015 is the latest reported inventory year.

(3) 1 kt CO_2 eq equals 1 Gg CO_2 eq.

Abbreviation: LULUCF = land use, land-use change and forestry.

[a] The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[b] Includes net CO_2, CH_4 and N_2O from LULUCF.

CTF Table 1a - Emission trends (CO_2)
(Sheet 1 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	*Base year[a]*	1990	1991	1992	1993	1994	1995	1996	1997
	kt								
1. Energy	144,726.02	144,726.02	132,819.52	127,969.86	122,949.92	115,488.46	116,679.37	118,482.15	114,388.88
A. Fuel combustion (sectoral approach)	144,267.58	144,267.58	132,421.47	127,573.56	122,571.83	115,120.53	116,317.10	118,132.18	114,044.33
1. Energy industries	56,654.44	56,654.44	55,285.12	54,453.45	54,068.98	54,713.08	61,560.63	66,272.46	62,577.92
2. Manufacturing industries and construction	50,930.37	50,930.37	43,222.51	46,079.31	38,356.19	30,666.73	26,029.52	24,483.33	24,466.59
3. Transport	7,031.87	7,031.87	6,163.34	7,709.20	7,809.38	8,509.81	9,022.43	9,981.62	10,201.87
4. Other sectors	29,650.90	29,650.90	27,750.49	19,331.61	22,337.28	21,230.92	19,704.52	17,394.78	16,797.95
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	458.44	458.44	398.05	396.30	378.09	367.93	362.27	349.97	344.55
1. Solid fuels	456.24	456.24	395.10	392.83	373.45	362.60	356.21	343.65	337.79
2. Oil and natural gas and other emissions from energy production	2.20	2.20	2.95	3.47	4.64	5.33	6.06	6.32	6.76
C. CO2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial processes	15,614.07	15,614.07	12,742.86	13,330.16	12,379.72	13,413.81	12,767.27	13,435.79	14,216.73
A. Mineral industry	4,058.64	4,058.64	3,345.87	3,486.32	3,175.82	3,228.46	3,002.08	3,228.73	3,414.50
B. Chemical industry	1,783.27	1,783.27	1,533.29	1,664.92	1,626.13	1,923.09	1,725.67	1,854.99	1,814.00
C. Metal industry	9,646.60	9,646.60	7,754.06	8,052.77	7,484.64	8,148.49	7,935.77	8,261.88	8,911.60
D. Non-energy products from fuels and solvent use	125.56	125.56	109.65	126.15	93.14	113.77	103.75	90.19	76.63
E. Electronic industry									
F. Product uses as ODS substitutes									
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	1,286.35	1,286.35	445.32	216.84	196.06	194.30	219.61	212.90	159.89
A. Enteric fermentation									
B. Manure management									
C. Rice cultivation									
D. Agricultural soils									
E. Prescribed burning of savannas									
F. Field burning of agricultural residues									
G. Liming	1,177.82	1,177.82	313.32	108.31	102.92	103.36	110.34	112.43	92.42
H. Urea application	108.53	108.53	132.00	108.53	93.13	90.93	109.27	100.47	67.47
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	-6,625.59	-6,625.59	-9,714.11	-10,205.76	-9,816.97	-7,695.97	-8,165.34	-8,546.08	-7,639.41
A. Forest land	-4,985.61	-4,985.61	-9,346.26	-10,956.97	-9,678.99	-7,232.71	-7,227.54	-7,490.87	-6,690.44
B. Cropland	111.71	111.71	103.77	106.50	145.50	124.48	121.43	127.73	129.58
C. Grassland	-145.34	-145.34	-196.84	-187.45	-183.46	-292.96	-325.56	-543.67	-373.86
D. Wetlands	21.51	21.51	27.51	9.74	8.86	6.17	9.11	11.51	13.91
E. Settlements	85.09	85.09	38.17	63.41	177.38	124.10	90.72	121.02	122.13
F. Other land	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
G. Harvested wood products	-1,712.95	-1,712.95	-340.45	759.02	-286.26	-425.05	-833.50	-771.80	-840.74
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	23.15	23.15	27.71	32.52	44.41	62.97	70.70	71.07	74.49
A. Solid waste disposal	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO

B. Biological treatment of solid waste									
C. Incineration and open burning of waste	23.15	23.15	27.71	32.52	44.41	62.97	70.70	71.07	74.49
D. Waste water treatment and discharge									
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	523.72	523.72	430.45	498.13	414.11	515.34	558.03	419.43	483.25
Aviation	523.72	523.72	430.45	498.13	414.11	515.34	558.03	419.43	483.25
Navigation	NO	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 emissions from biomass	6,445.39	6,445.39	6,547.99	7,285.88	7,039.07	6,708.53	5,787.22	5,822.06	6,447.72
CO2 captured	NO	NO	NO	NO	NO	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	15,558.16	15,558.16	16,328.16	17,129.12	17,949.10	18,774.88	19,620.02	20,498.62	21,410.13
Indirect N2O									
Indirect CO2 (3)	2,121.74	2,121.74	2,011.15	1,974.13	1,923.23	1,745.20	1,745.19	1,717.51	1,701.54
Total CO2 equivalent emissions with land use, land-use change and forestry	155,024.01	155,024.01	136,321.31	131,343.63	125,753.14	121,463.57	121,571.62	123,655.83	121,200.58
Total CO2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	157,145.75	157,145.75	138,332.47	133,317.76	127,676.37	123,208.76	123,316.81	125,373.35	122,902.12
Note: All footnotes for this table are given at the end of the table on sheet 6.									

Note: All footnotes for this table are given on sheet 3.

(Sheet 2 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy	109,145.19	103,357.15	112,532.22	113,050.60	110,312.72	112,923.84	112,958.57	111,919.83	112,335.17	113,330.04
A. Fuel combustion (sectoral approach)	108,805.25	103,043.19	112,209.78	112,718.96	109,978.75	112,601.10	112,644.08	111,606.07	111,999.37	113,026.71
1. Energy industries	60,442.79	57,952.82	61,773.04	63,944.85	62,506.50	62,149.16	62,262.55	62,870.75	62,320.70	65,948.98
2. Manufacturing industries and construction	22,383.09	18,400.32	23,292.99	20,761.55	19,874.70	19,822.34	19,453.42	18,715.26	18,412.64	16,537.28
3. Transport	10,323.62	11,512.11	11,650.42	12,367.84	12,937.97	14,675.90	15,415.94	16,721.58	17,369.69	18,276.31
4. Other sectors	15,485.92	15,013.94	15,316.68	15,486.62	14,425.11	15,715.92	15,246.73	13,033.38	13,644.78	11,928.26
5. Other	169.82	163.99	176.66	158.10	234.48	237.78	265.44	265.10	251.57	335.89
B. Fugitive emissions from fuels	339.95	313.96	322.44	331.64	333.97	322.74	314.48	313.77	335.79	303.33
1. Solid fuels	332.53	306.33	315.13	324.03	322.98	309.65	301.87	300.85	324.80	293.09
2. Oil and natural gas and other emissions from energy production	7.41	7.63	7.30	7.62	10.99	13.09	12.61	12.92	10.99	10.24
C. CO2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial processes	14,193.94	11,808.04	13,033.04	12,167.69	11,938.19	12,836.95	13,553.76	12,365.78	13,223.39	13,750.69
A. Mineral industry	3,575.48	3,531.36	3,607.56	3,297.37	3,038.65	3,138.73	3,299.84	3,314.59	3,416.68	3,794.50
B. Chemical industry	1,861.45	1,802.28	1,852.80	1,726.91	1,536.03	1,731.30	1,941.46	1,823.60	1,705.77	1,537.29
C. Metal industry	8,630.87	6,352.27	7,424.08	7,023.21	7,257.25	7,852.32	8,181.93	7,091.36	7,961.08	8,266.35
D. Non-energy products from fuels and solvent use	126.15	122.13	148.60	120.21	106.26	114.61	130.52	136.23	139.86	152.54
E. Electronic industry										
F. Product uses as ODS substitutes										
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	233.05	174.82	159.89	182.03	162.84	139.66	146.19	138.15	160.38	201.84
A. Enteric fermentation										
B. Manure management										
C. Rice cultivation										
D. Agricultural soils										
E. Prescribed burning of savannas										
F. Field burning of agricultural residues										
G. Liming	90.05	86.82	112.28	104.56	98.88	78.53	76.10	63.98	77.74	79.80
H. Urea application	143.00	88.00	47.61	77.47	63.96	61.13	70.09	74.17	82.64	122.03
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	-7,765.83	-8,038.71	-8,928.31	-9,260.88	-8,902.38	-7,435.81	-7,943.82	-8,283.50	-6,152.34	-3,995.75
A. Forest land	-7,249.40	-7,175.63	-7,396.28	-7,725.78	-7,461.62	-5,676.31	-6,095.44	-6,550.46	-3,354.16	-658.35
B. Cropland	252.39	115.40	83.95	51.34	33.20	49.15	39.81	44.20	34.28	22.69
C. Grassland	-309.15	-408.09	-496.90	-500.09	-513.06	-514.27	-531.61	-526.97	-554.56	-558.59
D. Wetlands	24.34	25.18	26.46	12.60	32.51	22.55	19.11	21.24	18.93	19.25
E. Settlements	183.88	207.80	132.24	112.30	114.74	178.02	178.23	164.42	128.98	101.90
F. Other land	0.00	0.00	0.00	0.00	0.00	0.00	5.88	10.27	4.95	14.39
G. Harvested wood products	-667.90	-803.37	-1,277.79	-1,211.24	-1,108.15	-1,494.95	-1,559.80	-1,446.21	-2,430.75	-2,937.05
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	74.84	76.46	63.04	86.13	124.05	192.08	180.46	135.18	170.32	120.30
A. Solid waste disposal	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
B. Biological treatment of solid waste										
C. Incineration and open burning of waste	74.84	76.46	63.04	86.13	124.05	192.08	180.46	135.18	170.32	120.30
D. Waste water treatment and discharge										
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	571.33	537.68	588.73	625.64	540.28	726.64	933.92	970.50	1,006.00	1,055.54
Aviation	571.33	537.68	588.73	625.64	540.28	726.64	933.92	970.50	1,006.00	1,055.54
Navigation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 emissions from biomass	6,716.19	7,009.03	6,652.88	7,148.51	7,951.67	7,790.02	8,433.92	8,667.39	9,133.76	9,739.74
CO2 captured	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	22,359.06	23,265.54	24,248.75	25,259.20	26,298.05	27,342.64	28,398.27	29,472.04	30,578.44	31,755.07
Indirect N2O										
Indirect CO2 (3)	1,550.34	1,400.44	1,155.54	1,115.07	1,061.31	1,046.37	1,006.49	1,083.21	1,096.98	1,048.92
Total CO2 equivalent emissions with land use, land-use change and forestry	115,881.19	107,377.76	116,859.87	116,225.57	113,635.41	118,656.72	118,895.15	116,275.45	119,736.92	123,407.11
Total CO2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	117,431.53	108,778.19	118,015.42	117,340.65	114,696.73	119,703.09	119,901.64	117,358.66	120,833.90	124,456.03
Note: All footnotes for this table are given at the end of the table on sheet 6.										

Note: All footnotes for this table are given on sheet 3.

(Sheet 3 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
									%
1. Energy	108,553.38	103,416.52	104,043.33	101,900.82	98,833.49	95,387.93	90,622.29	92,051.70	-36.40
A. Fuel combustion (sectoral approach)	108,255.34	103,157.07	103,776.61	101,638.42	98,567.52	95,186.59	90,419.16	91,857.78	-36.33
1. Energy industries	61,235.84	57,193.07	61,313.64	61,570.33	59,001.65	56,017.65	53,256.14	53,346.81	-5.84
2. Manufacturing industries and construction	16,075.31	15,822.06	11,993.42	11,102.58	10,805.75	10,224.91	9,614.36	9,828.15	-80.70
3. Transport	18,147.58	17,615.79	16,625.54	16,443.45	16,176.69	16,056.35	16,580.60	17,343.68	146.64
4. Other sectors	12,431.25	12,172.87	13,524.64	12,146.95	12,276.94	12,587.35	10,658.62	10,970.29	-63.00
5. Other	365.37	353.28	319.37	375.11	306.49	300.33	309.44	368.85	100.00
B. Fugitive emissions from fuels	298.04	259.45	266.72	262.40	265.97	201.35	203.13	193.92	-57.70
1. Solid fuels	288.00	250.22	259.30	255.45	259.41	194.88	196.83	188.53	-58.68
2. Oil and natural gas and other emissions from energy production	10.04	9.23	7.42	6.96	6.56	6.47	6.30	5.39	144.83
C. CO2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Industrial processes	13,442.09	11,005.32	11,804.64	11,820.36	11,411.07	11,323.73	11,837.84	11,235.63	-28.04
A. Mineral industry	3,648.66	3,055.09	3,023.19	3,381.34	3,066.24	2,394.21	2,538.66	2,533.91	-37.57
B. Chemical industry	1,951.12	1,814.26	1,921.18	1,766.53	1,855.42	1,760.92	1,989.50	1,679.63	-5.81
C. Metal industry	7,724.53	6,030.54	6,742.56	6,544.67	6,379.10	7,051.56	7,193.04	6,882.55	-28.65
D. Non-energy products from fuels and solvent use	117.78	105.44	117.72	127.82	110.32	117.04	116.64	139.55	11.14
E. Electronic industry									
F. Product uses as ODS substitutes									
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	0.00
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
3. Agriculture	194.95	149.47	172.72	190.59	251.46	261.19	207.32	349.99	-72.79
A. Enteric fermentation									
B. Manure management									
C. Rice cultivation									
D. Agricultural soils									
E. Prescribed burning of savannas									
F. Field burning of agricultural residues									
G. Liming	94.80	63.97	61.46	80.01	115.57	135.50	150.29	162.89	-86.17
H. Urea application	100.16	85.50	111.27	110.58	135.89	125.69	57.03	187.10	72.39
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO	NO	0.00
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land Use, Land-Use Change and Forestry	-7,098.52	-8,091.73	-7,368.35	-8,466.93	-8,636.09	-7,997.85	-7,886.71	-6,735.41	1.66
A. Forest land	-4,637.75	-6,586.63	-5,287.75	-7,168.34	-7,497.29	-7,454.97	-7,398.21	-6,141.46	23.18
B. Cropland	41.57	18.88	25.70	80.48	12.70	14.70	12.10	-0.31	-100.28
C. Grassland	-576.61	-595.80	-628.68	-558.70	-574.37	-592.02	-569.10	-550.34	278.67
D. Wetlands	19.87	18.41	34.26	37.45	24.67	31.41	26.76	25.18	17.09
E. Settlements	103.29	114.71	128.58	120.23	95.02	88.56	127.60	88.12	3.56
F. Other land	8.09	4.94	7.21	7.18	12.73	41.53	8.55	7.55	
G. Harvested wood products	-2,056.97	-1,066.23	-1,647.68	-985.24	-709.54	-127.07	-94.41	-164.15	-90.42
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
5. Waste	125.51	112.80	138.64	125.85	125.22	130.08	131.74	132.43	472.08
A. Solid waste disposal	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	0.00
B. Biological treatment of solid waste									
C. Incineration and open burning of waste	125.51	112.80	138.64	125.85	125.22	130.08	131.74	132.43	472.08

D. Waste water treatment and discharge									
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	0.00
International bunkers	1,118.55	1,021.55	957.18	948.92	884.22	853.09	875.23	887.50	69.46
Aviation	1,118.55	1,021.55	957.18	948.92	884.22	853.09	875.23	887.50	69.46
Navigation	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CO2 emissions from biomass	10,477.83	11,529.60	12,342.53	13,153.92	13,992.94	14,976.02	15,726.25	16,193.69	151.24
CO2 captured	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Long-term storage of C in waste disposal sites	32,936.58	34,146.78	35,278.38	36,337.47	37,327.22	38,283.61	39,196.76	40,084.60	157.64
Indirect N2O									
Indirect CO2 (3)	1,026.78	959.99	967.43	946.05	904.39	811.39	777.69	798.70	-62.36
Total CO2 equivalent emissions with land use, land-use change and forestry	115,217.42	106,592.38	108,790.99	105,570.68	101,985.16	99,105.08	94,912.47	97,034.34	-37.41
Total CO2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	116,244.20	107,552.37	109,758.42	106,516.74	102,889.55	99,916.47	95,690.16	97,833.03	-37.74
Note: All footnotes for this table are given at the end of the table on sheet 6.									

Abbreviations: CRF = common reporting format, LULUCF = land use, land-use change and forestry.

[a] The column “Base year” should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[b] Fill in net emissions/removals as reported in CRF table Summary 1.A of the latest reported inventory year. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

CTF Table 1b - Emission trends (CH_4)

(Sheet 1 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	*Base year[a]*	1990	1991	1992	1993	1994	1995	1996	1997
	kt								
1. Energy	520.95	520.95	468.20	439.06	430.57	407.31	397.90	392.89	383.83
A. Fuel combustion (sectoral approach)	64.82	64.82	58.98	51.31	48.37	44.28	40.20	40.71	37.96
1. Energy industries	0.66	0.66	0.65	0.65	0.66	0.69	0.77	0.86	0.85
2. Manufacturing industries and construction	4.33	4.33	3.72	3.95	3.27	2.79	2.14	2.06	2.06
3. Transport	1.54	1.54	1.39	1.79	1.71	1.84	1.85	1.95	1.92
4. Other sectors	58.28	58.28	53.22	44.92	42.73	38.96	35.43	35.84	33.13
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	456.12	456.12	409.22	387.75	382.20	363.04	357.71	352.18	345.87
1. Solid fuels	412.93	412.93	372.10	353.38	348.58	329.97	324.47	316.24	310.45
2. Oil and natural gas and other emissions from energy production	43.20	43.20	37.11	34.37	33.62	33.07	33.23	35.94	35.42
C. CO2 transport and storage									
2. Industrial processes	2.05	2.05	1.68	1.52	1.52	1.73	1.91	1.95	1.95
A. Mineral industry									
B. Chemical industry	1.45	1.45	1.14	1.26	1.28	1.45	1.40	1.46	1.48
C. Metal industry	0.60	0.60	0.54	0.26	0.24	0.28	0.50	0.50	0.47
D. Non-energy products from fuels and solvent use	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
E. Electronic industry									
F. Product uses as ODS substitutes									
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	300.28	300.28	284.11	257.03	226.34	198.23	191.87	189.03	177.68
A. Enteric fermentation	230.20	230.20	217.21	194.47	168.45	147.52	143.53	142.13	132.74
B. Manure management	70.08	70.08	66.90	62.56	57.89	50.71	48.34	46.90	44.94
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming									
H. Urea application									
I. Other carbon-containing fertilizers									
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry	4.69	4.69	3.50	3.67	4.24	4.37	4.10	5.39	5.82
A. Forest land	4.69	4.69	3.50	3.67	4.24	4.37	4.10	5.39	5.82
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products									
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	114.76	114.76	121.46	122.13	124.45	130.02	129.62	129.82	133.57
A. Solid waste disposal	79.17	79.17	82.79	85.97	89.48	92.95	96.20	97.12	99.89
B. Biological treatment of solid waste	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE

C. Incineration and open burning of waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Waste water treatment and discharge	35.59	35.59	38.67	36.16	34.97	37.07	33.42	32.70	33.68
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total CH4 emissions with CH4 from LULUCF	942.73	942.73	878.95	823.42	787.12	741.67	725.40	719.09	702.85
Memo items:									
Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Navigation	NO	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 emissions from biomass									
CO2 captured									
Long-term storage of C in waste disposal sites									
Indirect N2O									
Indirect CO2 (3)									

Note: All footnotes for this table are given on sheet 3.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy	363.56	331.71	302.38	287.64	269.05	266.68	256.40	273.41	283.63	265.31
A. Fuel combustion (sectoral approach)	31.72	29.04	30.23	30.81	30.22	30.99	31.08	29.60	31.66	30.11
1. Energy industries	0.88	0.86	0.86	0.90	0.90	1.03	1.11	0.91	0.92	1.01
2. Manufacturing industries and construction	1.84	1.56	1.93	1.72	1.83	1.68	1.70	1.92	1.95	1.81
3. Transport	1.80	1.86	1.72	1.72	1.67	1.72	1.63	1.57	1.49	1.47
4. Other sectors	27.19	24.75	25.69	26.45	25.80	26.54	26.61	25.17	27.27	25.79
5. Other	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.03	0.03	0.04
B. Fugitive emissions from fuels	331.84	302.67	272.14	256.83	238.83	235.68	225.32	243.81	251.97	235.20
1. Solid fuels	294.53	266.11	237.38	224.04	204.34	203.56	195.36	208.50	216.40	199.75
2. Oil and natural gas and other emissions from energy production	37.31	36.56	34.76	32.80	34.49	32.12	29.95	35.31	35.57	35.45
C. CO2 transport and storage										
2. Industrial processes	2.11	2.15	2.13	2.23	2.15	2.10	2.59	2.59	2.53	2.31
A. Mineral industry										
B. Chemical industry	1.63	1.72	1.68	1.76	1.68	1.63	2.08	2.12	1.99	1.83
C. Metal industry	0.48	0.43	0.45	0.47	0.47	0.47	0.51	0.47	0.54	0.48
D. Non-energy products from fuels and solvent use	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
E. Electronic industry										
F. Product uses as ODS substitutes										
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	167.92	171.31	165.10	165.45	163.87	162.52	157.83	153.73	151.64	152.58
A. Enteric fermentation	124.23	126.99	121.93	122.85	120.21	118.87	116.25	113.94	112.26	113.46
B. Manure management	43.68	44.32	43.17	42.60	43.65	43.65	41.58	39.80	39.38	39.12
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming										
H. Urea application										
I. Other carbon-containing fertilizers										
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry	5.08	4.70	4.32	4.49	4.83	6.05	5.54	5.29	6.55	8.51
A. Forest land	5.08	4.70	4.32	4.49	4.83	6.05	5.54	5.29	6.55	8.51
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products										
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	137.36	137.51	139.23	143.09	146.40	149.64	147.24	149.53	151.33	150.19
A. Solid waste disposal	102.65	105.48	107.27	109.78	112.26	115.14	113.40	114.69	115.95	114.85
B. Biological treatment of solid waste	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	0.14	0.12	1.47	1.46	2.09
C. Incineration and open burning of waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

D. Waste water treatment and discharge	34.71	32.04	31.96	33.30	34.14	34.35	33.72	33.37	33.92	33.25
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total CH4 emissions with CH4 from LULUCF	676.03	647.38	613.16	602.90	586.30	586.98	569.59	584.55	595.68	578.90
Memo items:										
Aviation	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
Navigation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 emissions from biomass										
CO2 captured										
Long-term storage of C in waste disposal sites										
Indirect N2O										
Indirect CO2 (3)										

Note: All footnotes for this table are given on sheet 3.

(Sheet 3 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
									%
1. Energy	264.36	251.64	256.03	254.02	246.90	212.89	207.87	203.88	-60.86
A. Fuel combustion (sectoral approach)	30.82	32.87	35.04	34.26	35.94	38.09	35.44	36.13	-44.26
1. Energy industries	1.03	1.06	1.19	1.24	1.27	1.24	1.24	1.31	96.35
2. Manufacturing industries and construction	1.82	1.87	1.35	1.35	1.33	1.33	1.37	1.43	-66.96
3. Transport	1.36	1.23	1.08	1.01	0.96	0.94	0.97	1.03	-33.32
4. Other sectors	26.57	28.68	31.39	30.62	32.36	34.55	31.83	32.32	-44.54
5. Other	0.04	0.04	0.03	0.04	0.03	0.03	0.03	0.04	100.00
B. Fugitive emissions from fuels	233.53	218.77	220.99	219.76	210.96	174.79	172.43	167.75	-63.22
1. Solid fuels	200.95	184.42	185.40	186.48	183.85	149.68	147.41	143.43	-65.26
2. Oil and natural gas and other emissions from energy production	32.59	34.35	35.59	33.28	27.11	25.12	25.02	24.32	-43.70
C. CO2 transport and storage									
2. Industrial processes	2.40	2.19	2.37	2.25	2.45	2.38	2.67	2.01	-1.92
A. Mineral industry									
B. Chemical industry	2.00	1.85	1.97	1.81	1.97	1.85	2.13	1.47	1.78
C. Metal industry	0.40	0.34	0.40	0.45	0.49	0.53	0.54	0.54	-10.82
D. Non-energy products from fuels and solvent use	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NO, NA	0.00
E. Electronic industry									
F. Product uses as ODS substitutes									
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	0.00
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
3. Agriculture	151.98	145.67	141.24	139.88	140.21	140.69	143.23	146.70	-51.15
A. Enteric fermentation	114.74	111.99	108.80	109.04	110.34	110.34	112.69	115.84	-49.68
B. Manure management	37.24	33.68	32.44	30.84	29.87	30.34	30.54	30.86	-55.97
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO	0.00
D. Agricultural soils	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	NA, NE	0.00
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	0.00
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Liming									
H. Urea application									
I. Other carbon-containing fertilizers									
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land use, land-use change and forestry	6.73	5.68	6.00	2.65	2.85	2.64	2.94	3.28	-30.20
A. Forest land	6.73	5.68	6.00	2.65	2.85	2.64	2.94	3.28	-30.20
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	0.00
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	0.00
E. Settlements	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	NO, NA	0.00
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Harvested wood products									
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
5. Waste	157.06	162.16	170.06	173.03	179.52	190.68	191.36	195.19	70.08
A. Solid waste disposal	120.39	124.46	128.96	130.22	131.90	134.56	133.23	135.41	71.03

B. Biological treatment of solid waste	3.30	4.23	6.67	9.03	14.25	22.84	24.51	25.36	100.00
C. Incineration and open burning of waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	472.08
D. Waste water treatment and discharge	33.37	33.47	34.42	33.78	33.37	33.29	33.62	34.42	-3.29
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total CH4 emissions with CH4 from LULUCF	582.53	567.35	575.70	571.83	571.93	549.26	548.07	551.06	-41.55
Memo items:									
Aviation	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	69.46
Navigation	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CO2 emissions from biomass									
CO2 captured									
Long-term storage of C in waste disposal sites									
Indirect N2O									
Indirect CO2 (3)									

Abbreviations: CRF = common reporting format, LULUCF = land use, land-use change and forestry.
[a] The column “Base year” should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

CTF Table 1c - Emission trends (N_2O)

(Sheet 1 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year[a]	1990	1991	1992	1993	1994	1995	1996	1997
	kt								
1. Energy	2.75	2.75	2.54	2.54	2.49	2.48	2.55	2.71	2.71
A. Fuel combustion (sectoral approach)	2.75	2.75	2.54	2.54	2.49	2.48	2.55	2.71	2.71
1. Energy industries	0.82	0.82	0.80	0.79	0.79	0.80	0.91	0.95	0.90
2. Manufacturing industries and construction	0.66	0.66	0.56	0.59	0.49	0.41	0.32	0.30	0.30
3. Transport	0.72	0.72	0.65	0.74	0.75	0.86	0.96	1.12	1.18
4. Other sectors	0.56	0.56	0.53	0.43	0.46	0.41	0.37	0.33	0.33
5. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive emissions from fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid fuels	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2. Oil and natural gas and other emissions from energy production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. CO2 transport and storage									
2. Industrial processes	4.47	4.47	3.20	3.81	3.11	3.77	4.21	4.07	4.18
A. Mineral industry									
B. Chemical industry	3.77	3.77	2.51	3.12	2.41	3.08	3.51	3.38	3.48
C. Metal industry	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Non-energy products from fuels and solvent use	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
E. Electronic industry									
F. Product uses as ODS substitutes									
G. Other product manufacture and use	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	27.71	27.71	24.25	20.79	18.47	17.33	17.55	16.91	16.75
A. Enteric fermentation									
B. Manure management	8.25	8.25	7.87	7.17	6.43	5.68	5.33	5.48	5.30
C. Rice cultivation									
D. Agricultural soils	19.45	19.45	16.39	13.62	12.04	11.65	12.22	11.43	11.45
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming									
H. Urea application									
I. Other carbon containing fertlizers									
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry	0.07	0.07	0.06	0.06	0.06	0.06	0.05	0.06	0.06
A. Forest land	0.03	0.03	0.02	0.03	0.03	0.03	0.03	0.04	0.04
B. Cropland	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02
C. Grassland	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products									
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	0.79	0.79	0.69	0.65	0.69	0.66	0.69	0.71	0.69
A. Solid waste disposal									
B. Biological treatment of solid waste	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE

C. Incineration and open burning of waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Waste water treatment and discharge	0.79	0.79	0.69	0.65	0.69	0.65	0.69	0.71	0.69
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total direct N2O emissions with N2O from LULUCF	35.78	35.78	30.74	27.85	24.82	24.31	25.05	24.46	24.39
Memo items:									
Aviation	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
Navigation	NO	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 emissions from biomass									
CO2 captured									
Long-term storage of C in waste disposal sites									
Indirect N2O	4.39	4.39	3.99	3.62	3.42	2.24	2.11	2.19	2.32
Indirect CO2 (3)									

Note: All footnotes for this table are given on sheet 3.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
1. Energy	2.74	2.83	2.33	2.37	2.41	2.54	2.63	2.71	2.77	2.88
A. Fuel combustion (sectoral approach)	2.74	2.83	2.33	2.37	2.41	2.54	2.63	2.71	2.77	2.88
1. Energy industries	0.88	0.84	0.90	0.93	0.91	0.92	0.93	0.91	0.91	0.97
2. Manufacturing industries and construction	0.27	0.23	0.28	0.25	0.26	0.24	0.25	0.27	0.28	0.26
3. Transport	1.27	1.43	0.80	0.84	0.89	1.00	1.06	1.16	1.20	1.27
4. Other sectors	0.31	0.32	0.34	0.34	0.33	0.35	0.36	0.34	0.36	0.35
5. Other	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03	0.02	0.03
B. Fugitive emissions from fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid fuels	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
2. Oil and natural gas and other emissions from energy production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. CO2 transport and storage										
2. Industrial processes	4.42	3.78	4.19	4.15	3.70	3.70	4.10	3.92	3.59	3.11
A. Mineral industry										
B. Chemical industry	3.73	3.09	3.50	3.46	3.01	3.00	3.41	3.23	2.90	2.42
C. Metal industry	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Non-energy products from fuels and solvent use	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
E. Electronic industry										
F. Product uses as ODS substitutes										
G. Other product manufacture and use	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	16.01	16.15	15.73	15.99	15.42	14.05	15.07	14.35	13.96	14.26
A. Enteric fermentation										
B. Manure management	5.05	5.11	4.80	4.64	4.48	4.31	4.14	3.97	3.86	3.82
C. Rice cultivation										
D. Agricultural soils	10.96	11.04	10.93	11.34	10.94	9.74	10.93	10.38	10.10	10.44
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming										
H. Urea application										
I. Other carbon containing fertlizers										
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Land use, land-use change and forestry	0.06	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.08
A. Forest land	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.05	0.06
B. Cropland	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
C. Grassland	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products										
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	0.72	0.68	0.67	0.69	0.69	0.69	0.71	0.82	0.78	0.80
A. Solid waste disposal										
B. Biological treatment of solid waste	NE, IE	NE, IE	NE, IE	NE, IE	NE, IE	NE, NO, IE	NE, NO, IE	0.08	0.07	0.09
C. Incineration and open burning of waste	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01

D. Waste water treatment and discharge	0.72	0.67	0.66	0.68	0.68	0.68	0.70	0.73	0.70	0.70
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total direct N2O emissions with N2O from LULUCF	23.95	23.50	22.97	23.25	22.28	21.04	22.57	21.85	21.17	21.13
Memo items:										
Aviation	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03	0.03	0.03
Navigation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO2 emissions from biomass										
CO2 captured										
Long-term storage of C in waste disposal sites										
Indirect N2O	2.02	1.87	1.68	1.68	1.63	1.64	1.63	1.60	1.56	1.55
Indirect CO2 (3)										

Note: All footnotes for this table are given on sheet 3.

(Sheet 3 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
									%
1. Energy	2.85	2.79	2.74	2.75	2.72	2.68	2.68	2.77	0.56
A. Fuel combustion (sectoral approach)	2.85	2.79	2.74	2.75	2.72	2.68	2.68	2.77	0.55
1. Energy industries	0.91	0.86	0.93	0.94	0.91	0.86	0.83	0.84	1.87
2. Manufacturing industries and construction	0.26	0.26	0.19	0.19	0.18	0.18	0.19	0.19	-70.39
3. Transport	1.28	1.25	1.19	1.19	1.18	1.17	1.21	1.27	77.05
4. Other sectors	0.37	0.38	0.40	0.40	0.42	0.44	0.43	0.43	-22.86
5. Other	0.03	0.03	0.03	0.04	0.03	0.03	0.03	0.04	100.00
B. Fugitive emissions from fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	160.62
1. Solid fuels	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NO, NA	0.00
2. Oil and natural gas and other emissions from energy production	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	160.62
C. CO2 transport and storage									
2. Industrial processes	3.02	2.52	2.09	2.24	2.27	1.71	1.86	1.94	-56.57
A. Mineral industry									
B. Chemical industry	2.27	1.77	1.34	1.49	1.52	0.96	1.11	1.19	-68.47
C. Metal industry	NA	NA	NA	NA	NA	NA	NA	NA	0.00
D. Non-energy products from fuels and solvent use	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NO, NA	0.00
E. Electronic industry									
F. Product uses as ODS substitutes									
G. Other product manufacture and use	0.75	0.75	0.75	0.75	0.75	0.75	0.75	0.75	8.38
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
3. Agriculture	14.73	13.89	13.62	14.15	13.89	14.60	15.08	14.99	-45.92
A. Enteric fermentation									
B. Manure management	3.72	3.49	3.43	3.30	3.26	3.36	3.32	3.38	-59.02
C. Rice cultivation									
D. Agricultural soils	11.01	10.40	10.19	10.85	10.63	11.24	11.75	11.60	-40.36
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	0.00
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Liming									
H. Urea application									
I. Other carbon containing fertlizers									
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land use, land-use change and forestry	0.07	0.06	0.06	0.04	0.04	0.04	0.04	0.04	-37.60
A. Forest land	0.05	0.04	0.04	0.02	0.02	0.02	0.02	0.02	-30.20
B. Cropland	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	-44.12
C. Grassland	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	0.00
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO	0.00
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO	0.00
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Harvested wood products									
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
5. Waste	0.84	0.79	0.83	0.78	0.75	0.78	0.79	0.82	4.10
A. Solid waste disposal									

B. Biological treatment of solid waste	0.13	0.09	0.12	0.09	0.09	0.11	0.12	0.15	100.00
C. Incineration and open burning of waste	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	472.08
D. Waste water treatment and discharge	0.70	0.70	0.70	0.68	0.65	0.66	0.66	0.66	-15.78
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
6. Other (as specified in the summary table in CRF)	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total direct N2O emissions with N2O from LULUCF	21.51	20.05	19.35	19.96	19.67	19.81	20.45	20.56	-42.55
Memo items:									
Aviation	0.03	0.03	0.03	0.03	0.03	0.02	0.02	0.03	69.88
Navigation	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CO2 emissions from biomass									
CO2 captured									
Long-term storage of C in waste disposal sites									
Indirect N2O	1.47	1.36	1.31	1.25	1.18	1.12	1.07	1.04	-76.38
Indirect CO2 (3)									

Abbreviations: CRF = common reporting format, LULUCF = land use, land-use change and forestry.
[a] The column “Base year” should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

CTF Table 1d - Emission trends (HFC, PFC, SF_6)

(Sheet 1 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	*Base year[a]*	1990	1991	1992	1993	1994	1995	1996	1997
	kt								
Emissions of HFCs and PFCs - (kt CO2 equivalent)	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	0.33	38.70	121.69
Emissions of HFCs - (kt CO2 equivalent)	NO	NO	NO	NO	NO	NO	0.32	38.02	119.96
HFC-23	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-32	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-41	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-43-10mee	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-125	NO	NO	NO	NO	NO	NO	NO	0.00	0.00
HFC-134	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134a	NO	NO	NO	NO	NO	NO	0.00	0.03	0.06
HFC-143	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-143a	NO	NO	NO	NO	NO	NO	NO	0.00	0.00
HFC-152	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-152a	NO	NO	NO	NO	NO	NO	NO	0.00	0.00
HFC-161	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-227ea	NO	NO	NO	NO	NO	NO	NO	0.00	0.00
HFC-236cb	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236ea	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236fa	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-245ca	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-245fa	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs(4) - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO
CF_4	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C_2F_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_3F_8	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00
C_4F_{10}	NO	NO	NO	NO	NO	NO	NO	NO	NO
$c\text{-}C_4F_8$	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_5F_{12}	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_6F_{14}	NO	NO	NO	NO	NO	NO	NO	NO	NO
C10F18	NO	NO	NO	NO	NO	NO	NO	NO	NO
c-C3F6	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of PFCs(4) - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs and PFCs - (kt CO2 equivalent)	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NF3	NO	NO	NO	NO	NO	NO	NO	NO	NO

Note: All footnotes for this table are given on sheet 3.

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
Emissions of HFCs and PFCs - (kt CO2 equivalent)	175.20	197.87	277.61	420.75	550.66	680.36	783.84	882.63	1,197.57	1,653.43
Emissions of HFCs - (kt CO2 equivalent)	173.54	196.78	272.92	411.01	534.27	671.81	771.03	867.74	1,166.49	1,624.43
HFC-23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.10
HFC-41	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-43-10mee	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-125	0.01	0.01	0.02	0.02	0.03	0.04	0.04	0.05	0.09	0.15
HFC-134	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134a	0.08	0.08	0.10	0.16	0.22	0.27	0.31	0.35	0.41	0.51
HFC-143	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-143a	0.01	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06
HFC-152	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-152a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-161	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-236cb	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236ea	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-245ca	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-245fa	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs(4) - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CF_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_2F_6	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_3F_8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_4F_{10}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
c-C_4F_8	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_5F_{12}	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_6F_{14}	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00
C10F18	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
c-C3F6	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of PFCs(4) - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs and PFCs - (kt CO2 equivalent)	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO
SF_6	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00
NF3	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Note: All footnotes for this table are given on sheet 3.

(Sheet 3 of 3)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2008	2009	2010	2011	2012	2013	2014	2015	Change from base to latest reported year
									%
Emissions of HFCs and PFCs - (kt CO2 equivalent)	1,941.90	2,056.25	2,396.99	2,628.30	2,772.36	2,993.56	3,232.55	3,457.04	100.00
Emissions of HFCs - (kt CO2 equivalent)	1,902.14	2,010.82	2,348.97	2,620.17	2,765.99	2,989.02	3,229.53	3,455.08	100.00
HFC-23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-32	0.13	0.14	0.18	0.22	0.24	0.26	0.28	0.31	100.00
HFC-41	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-43-10mee	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-125	0.20	0.21	0.26	0.31	0.33	0.35	0.38	0.41	100.00
HFC-134	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-134a	0.57	0.58	0.62	0.66	0.71	0.78	0.86	0.92	100.00
HFC-143	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-143a	0.07	0.07	0.09	0.09	0.09	0.10	0.10	0.11	100.00
HFC-152	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-152a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-161	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-236cb	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-236ea	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-236fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-245ca	NO	NO	NO	NO	NO	NO	NO	NO	0.00
HFC-245fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Unspecified mix of HFCs(4) - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CF_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
C_2F_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
C_3F_8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
C_4F_{10}	NO	NO	NO	NO	NO	NO	NO	NO	0.00
c-C_4F_8	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C_5F_{12}	NO	NO	NO	NO	NO	NO	NO	NO	0.00
C_6F_{14}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
C10F18	NO	NO	NO	NO	NO	NO	NO	NO	0.00
c-C3F6	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Unspecified mix of PFCs(4) - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Unspecified mix of HFCs and PFCs - (kt CO2 equivalent)	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	NE, NO	0.00
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.67
NF3	NO	NO	NO	NO	0.00	0.00	0.00	0.00	100.00

Abbreviations: CRF = common reporting format, LULUCF = land use, land-use change and forestry.

[a] The column “Base year” should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the Conference of the Parties. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.

[c]Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as CO2 equivalent emissions.

[d]In accordance with the “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part I: UNFCCC reporting guidelines on annual inventories”, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is kt of CO2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.)

CTF Table 2a - Description of quantified economy-wide emission reduction target: base year

Description of quantified economy-wide emission reduction target: base year[a]

Party	Czech Republic	
Base year /base period	1990	
Emission reduction target	% of base year/base period 20.00%	% of 1990 [b] 20.00%
Period for reaching target	BY-2020	

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] Optional.

CTF Table 2b - Description of quantified economy-wide emission reduction target: gases and sectors covered

Gases covered		*Base year for each gas (year):*
CO_2		1990
CH_4		1990
N_2O		1990
HFCs		1990
PFCs		1990
SF_6		1990
NF_3		
Other Gases (specify)		
Sectors covered[b]	Energy	Yes
	Transport[f]	Yes
	Industrial processes[g]	Yes
	Agriculture	Yes
	LULUCF	No
	Waste	Yes
	Other Sectors (specify)	

Abbreviations: LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] More than one selection will be allowed. If Parties use sectors other than those indicated above, the explanation of how these sectors relate to the sectors defined by the IPCC should be provided.

[f] Transport is reported as a subsector of the energy sector.

[g] Industrial processes refer to the industrial processes and solvent and other product use sectors.

CTF Table 2c - Description of quantified economy-wide emission reduction target: global warming potential values (GWP)

Gases	*GWP values [b]*
CO_2	4th AR
CH_4	4th AR
N_2O	4th AR
HFCs	4th AR
PFCs	4th AR
SF_6	4th AR
NF_3	4th AR
Other Gases (specify)	

Abbreviations: GWP = global warming potential

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] Please specify the reference for the GWP: Second Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) or the Fourth Assessment Report of the IPCC.

CTF Table 2d - Description of quantified economy-wide emission reduction target: approach to counting emissions and removals from the LULUCF sector

Role of LULUCF	LULUCF in base year level and target	Excluded
	Contribution of LULUCF is calculated using	

Abbreviation: LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

CTF Table 2e1 - Description of quantified economy-wide emission reduction target: market-based mechanisms under the Convention

Market-based mechanisms under the Convention	*Possible scale of contributions (estimated kt CO_2 eq)*
CERs	NE
ERUs	NE
AAUs[i]	NE
Carry-over units[j]	NE
Other mechanism units under the Convention (specify)[d]	

Abbreviations: AAU = assigned amount unit, CER = certified emission reduction, ERU = emission reduction unit.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[d] As indicated in paragraph 5(e) of the guidelines contained in annex I of decision 2/CP.17 .

[i] AAUs issued to or purchased by a Party.

[j] Units carried over from the first to the second commitment periods of the Kyoto Protocol, as described in decision 13/CMP.1 and consistent with decision 1/CMP.8.

CTF Table 2e2 - Description of quantified economy-wide emission reduction target: other market-based mechanisms

No information provided in table 2e2

CTF Table 2f - Description of quantified economy-wide emission reduction target: any other information

No information provided in table 2f

CTF Table 3 - Progress in achievement of the quantified economy-wide emission reduction target: information on mitigation actions and their effects

Name of mitigation action[a]	*Sector(s) affected*[b]	*GHG(s) affected*	*Objective and/or activity affected*	*Type of instrument*[c]	*Status of implementation*[d]	*Brief description*[e]	*Start year of implementation*	*Implementing entity or entities*	*Estimate of mitigation impact (not cumulative, in kt CO_2 eq)*[f]	
									2020	*2030* [f]
Program PANEL/NEW PANEL/PANEL 2013 +*	Energy	CO2	Efficiency improvements of buildings	Economic	Implemented	The programme offers credit guarantees and subsidy to credit interest for credits for retrofits of panel houses.	2001	State Housing Fund	189.00	158.00
State programme for the support of energy savings and use of renewable energy sources*	Energy	CO2	Efficiency improvements of buildings, Efficiency improvement in services/ tertiary sector, Efficiency improvement of appliances, Efficiency improvement in industrial end-use sectors, Increase in renewable energy	Economic	Implemented	The programme financially supports energy savings, the increase of energy effectiveness and the use of renewable energy sources. It is a cross-cutting plan at a national level with sectorial structure; the target areas are the state administration and local governments, private sector, households and NGO's This programme also provides information on energy efficiency issues (guidebooks, seminars, energy efficiency consulting centres etc. In detail the program supports the following activities: • Measures to reduce the energy intensity of public street lighting; • the reconstruction of a heating system and the heat generation in a building; • energy consulting provided by energy consulting and information centres; • courses and seminars about the energy sector; • publications, guides and informative materials about the energy sector; • the introduction of an energy management system; • the preparation of energy-saving projects financed using the EPC method.	2000	Ministry of Industry and Trade	94.00	77.00
IPPC*	Industry/industrial processes	CO2	Installation of abatement technologies, Reduction of emissions of fluorinated gases	Regulatory	Implemented	The IPPC directive sets among others emission limits of pollutants and requires use of the best avaliable technologies (BAT).	2003	Ministry of Environment	2,600.00	2,746.00

Preferential feed-in tariffs for electricity produced from renewable energy sources*	Energy	CO2	Increase in renewable energy Switch to less carbon-intensive fuels	Regulatory	Implemented	This is the principal measure for support of RES use in power generation. The law defines minimal feed-in tariffs for electricity produced from RES and garantees its long-term validity and obligation of distributors to connect sources using RES and purchase the electricity from RES.	2004	Energy Regulatory Authority	2,541.00	2,403.00
Directive on energy performance of buildings*	Energy	CO2	Efficiency improvements of buildings	Regulatory	Implemented	The measure stipulates minimum requirements as regards the energy performance of new and existing buildings, requires the certification of their energy performance and the regular inspection of boilers and air conditioning systems in buildings.	2002	Construction industries	325.00	272.00
Implementation of directive on co-generation*	Energy	CO2	Efficiency improvement in the energy and transformation sector	Regulatory	Implemented	Distibution companies are oblidged to connect CHPs to the grid and to purchase the produced electricity. Moreover, there is a preferential feed-in tariff for electricity from CHPs.	2005	Energy Regulatory Authority	1,876.00	1,367.00
Operational Programme Industry and Enterprise (OPIE)*	Industry/ industrial processes	CO2	Increase in renewable energy, Reduction of losses.	Economic	Implemented	The programme which was offering subsidies enterprises and industries. It comprised promotion of energy efficiency and use of RES in enterprises. It is superseded by the Operational programme Enterprise and innovation.	2004	Ministry of Industry and Trade	92.00	81.00
Operational Programme Enterprise and Innovation*	Industry/ industrial processes	CO2	Reduction of losses, Increase in renewable energy, Efficiency improvement in the energy and transformation sector.	Economic|Research|Education	Implemented	The main programme offering subsidies enterprises and industries. It comprises promotion of energy efficiency and use of RES in enterprises. It replaces the Operational programme Industry and enterprise.	2007	Ministry of Industry and Trade	1,238.00	1,089.00
Operational Programme Environment 2007-2013*	Energy, Industry/ industrial processes, Waste management /waste	CO2	Promotion of energy savings and use of RES.	Economic	Implemented	The main programme offers subsidies for environment protection. It comprises promotion of energy efficiency and use of RES mainly in the Commercial/Institutional sector (1A4a).	2007	State Environmental Fund	265.00	222.00

Green savings programme 2010-2013*	Energy	CO2	Efficiency improvements of buildings, Increase in renewable energy	Economic	Implemented	The programme supports, through investment subsidies, construction of low-energy family houses in passive standard, full or partial insulation of existing houses and introduction of RES for water heating.	2010	State Environmental Fund	665.00	557.00
Rural Development Program (2007-2013)*	Agriculture, Forestry/ LULUCF	CH4, N2O	Reduction of fertilizer/manure use on cropland, Improved management of organic soils, Afforestation and reforestation.	Other Regulatory	Implemented	Improving the competitiveness of the agricultural, food and forestry sectors falls within the first group of measures;Increasing biodiversity, water and soil protection and mitigating climate change is a joint objective of the second group of measures; Improving the quality of life in rural areas and to encourage the diversification of economic activities there; Helping the residents of rural micro-regions (applying the “from bottom to top” principle) to work out their local development strategy and to support the projects concerning development of the region they live in, the so called LEADER method.	2007	Ministry of Agriculture	NA	NA
Horizontal Rural Development *	Agriculture, Forestry/ LULUCF	CH4, N2O	Reduction of fertilizer/manure use on cropland, Other activities improving cropland management, Improved livestock management.	Regulatory	Implemented	The main goals: i) preservation and support of the agricultural system with low inputs, ii) protection and support of sustainable agriculture meeting environmental demands and iii) preservation and strengthening of a viable social structure in rural areas	2004	Ministry of Agriculture	NA	NA
Action Plan for Development of Organic farming *	Agriculture	CH4, N2O	Reduction of fertilizer/manure use on cropland, Other activities improving cropland management, Improved livestock management.	Economic	Implemented	Organic farming is an integral part of the agricultural policy of the Czech Republic. Its importance lies not only in the production of good-quality bio-foodstuffs but also in the farming methods that, through their environmentally friendly influence on nature, contribute substantially to the preservation of the rural character of the countryside An important benefit lies in reduction of nitrate leaching, retention of N in biomass before the onset of winter, increased biodiversity, creating a suitable environment for beneficial organisms and effects on plant health. The state administers support for organic farmers through subsidies.	2011	Ministry of Agriculture	250.00	NA

Economic and tax tools*	Transport	CO_2	Tax tools to support low-emission vehicles	Other (Fiscal)	Planned	The cars with lower GHG emissions will be exempted from road tax. The excise tax for vehicles with CNG propulsions will be decreased.	2020	Ministry of Finance	39.00	
Territorial planned measures*	Transport	CO_2	Demand management/reduction Improved transport infrastructure	Other (Planning)	Implemented	With help of the quality of territorial plans it is possible to achieve the reduction of travelling needs and length of journeys by the automobile transport (by building residential locations with job opportunities), changes transported labour division in favour of ecologically more friendly types of transport (for example quick line construction of public transport) and last but not least, traffic diversion from places where the population is directly exposed to emissions and noise from automobiles (planning of new roads, city and community bypasses, etc.).	2000	Ministry of transport, State Fund of Transport Infrastructure	387.00	676.00
Waste management plan (2003) Government Regulation No. 197/2003*	Waste management /waste, Energy	CH_4, CO_2	Increase in renewable energy Demand management / reduction Enhanced CH_4 collection and use, Enhanced recycling, Improved landfill management, Waste incineration with energy use, Reduced landfilling.	Regulatory| Economic| Fiscal	Implemented	Integrated framework document for waste management in the country. This is the main programme document of the Czech Republic regarding the waste sector. Since it is already outdated, a new version of the programme is under preparation now. The main targets are increasing the recovery of wastes with preference given to recycling, with a statutory target of 55% of all waste produced by year 2012, increasing the recovery of municipal waste to 50 % by 2010, decreasing of the maximum amount of biologically degradable municipal wastes (BDMW) deposited on landfills according to the Landfill Directive 99/31/EC, the preference for composting and anaerobic decomposition of biodegradable wastes with the use of the final product particularly in agriculture, in land reclamation and landscaping. Only wastes that cannot be used in this manner should be processed to produce substitute fuel or used anyway for energy production.	2003	Ministry of Environment	524.00	974.00

Waste management plan 2015-2024*	Waste management /waste, Energy	CH_4, CO_2	Increase in renewable energy, Demand management / reduction, Enhanced recycling, Improved treatment technologies, Reduced landfilling, Enhanced CH_4 collection and use, Improved wastewater management systems,	Regulatory|Economic|Fiscal|Other (Planning)	Implemented	This is a document governs whole waste management in the country. Sets preferences for management practice. Offers prognosis for waste development. This plan focuses on waste prevention, aims at a higher share of recycling (50% for paper, plastic, glass and metal wastes), compulsory separation of biologically degradable communal waste to reach the limit of maximal 35% going to landfill from the total biologically degradable communal waste.	2015	Ministry of Environment	330.00	330.00
EU ETS*	Energy, Transport, Industry/industrial processes, Cross-cutting	CO_2	Increase in renewable energy, Efficiency improvement in the energy and transformation sector, Demand management/reduction, Multi-sectoral policy.	Other (Fiscal)	Implemented	The decisive instrument to decrease emissions of greenhouse gases from big sources.	2005	Ministry of Environment	3,230.00	5,249.00
Support of voluntary commitments to energy savings*	Energy, Transport, Industry/industrial processes	CO_2	Efficiency improvements of buildings, Efficiency improvement in services/ tertiary sector, Demand management/reduction, Efficiency improvements of vehicles, Efficiency improvement in industrial end-use sectors	Other (Voluntary Agreement)	Implemented	Tax allowances, where applicable, possibility to draw the grants for energy end-users, who commit themselves to meet a certain reduction in energy efficiency (or absolute reduction in energy consumption or CO_2 emissions).	2015	Ministry of Industry and Trade	57.00	81.00

Energy labelling of household electrical appliances*	Energy	CO2	Efficiency improvement of appliances	Other (Economic)	Implemented	A thorough inspection of energy labelling of appliances in shops, checking the information content of labels by testing the electrical appliances; Financial support for information campaigns promoting energy-saving electrical appliances	2001	Ministry of Industry and Trade	296.00	312.00
Energy Star*	Energy	CO2	Efficiency improvement of appliances	Informatio n	Implemented	Promoting the selection of office appliances in bulk purchases; information support for all categories of consumers	2006	Ministry of Industry and Trade	38.00	40.00
Eco-design*	Energy	CO2	Efficiency improvement of appliances	Regulatory	Implemented	The directive imposes among others energy efficiency requirements to products from the early stage on the design phase in order to decrease energy consumption and impacts on the climate and environment. The whole product life cycle should be regarded in an integrated perspective. Among others, energy consumption of the whole product's life cycle should be taken into consideration.	2007	Ministry of Industry and Trade	104.00	114.00
Recast of the Directive on energy performance of buildings*	Energy	CO2	Efficiency improvements of buildings	Other (Informatio n)	Implemented	The measure stipulates minimum requirements as regards the energy performance of new and existing buildings, requires the certification of their energy performance and the regular inspection of boilers and air conditioning systems in buildings.	2011	Ministry of Industry and Trade	532.00	446.00
Regulation on CO2 from light-commercial vehicles*	Transport	CO2	Efficiency improvements of vehicles	Regulatory	Implemented	To decrease emissions from vans. The main objective of the vans Regulation is to cut CO2 emissions from vans to 175 grams of CO2 per kilometer by 2017, phasing in the reduction from 2014, and to reach 147g CO2/km by 2020. These cuts represent reductions of 14 % and 28 % respectively compared with the 2007 average of 203 g/km. The legislation affects vans, which account for around 12 % of the market for light-duty vehicles. This includes vehicles used to carry goods weighing up to 3.5 t (vans and car-derived vans, known as "N1") and which weigh less than 2610 kg when empty.	2011	Ministry of environment	486.00	787.00

Ecological Tax Reform*	Energy, Transport	CO_2	Switch to less carbon-intensive fuels, Efficiency improvement in the energy and transformation sector, Increase in renewable energy, Efficiency improvement in industrial end-use sectors, Modal shift to public transport or non-motorized transport, Demand management/reduction.	Fiscal	Implemented	The measure stipulates consumers' tax on energy carriers more or less exactly equal to minimal levels required by the EU directive.	2007	Ministry of Finance	128.00	117.00
Air Protection Act	Cross-cutting	CO_2, CH_4, N_2O	Framework policy	Regulatory	Implemented	The law introduces National programme for abatement of climate change of Earth. The law sets among other things emission limits and reduction targets and deadlines for substances influencing the climate system. There is also an obligation of operators of large plants above 5 MW to keep emission limits and to submit data on substances influencing climate system. The act is accompanied by a row of further legal documents setting emission and imissions limits, periodical inspections of boilers, fees for pollutions and various other aspects of air protection in all sectors. Since this act leads among others to fuel switches and energy efficiency improvements, it significantly influences emissions of GHGs.	2002	Ministry of Environment	NA	NA

Cross Compliance	Agriculture	CH_4, N_2O	Reduction of fertilizer/manure use on cropland, Other activities improving cropland management, Improved livestock management.	Other (Education)	Implemented	The subsidies can be granted only on the condition that a beneficiary meets the statutory management requirements addressing environment, public health, the health of animals and plants, and animal welfar, the standards of good agricultural and environmental conditions (GAEC); and minimum requirements for fertilizer and plant protection product use as part of agro-environmental measures.	2009	Ministry of Agriculture	NA	NA
Energy act	Energy	CO_2	Increase in renewable energy, Switch to less carbon-intensive fuels.	Regulatory	Implemented	This act establishes the rules for operating energy enterprises and energy markets. It is accompanied by a row of decreases dealing with specific issues. The law establishes the obligation of electricity distributors to buy electricity from combined heat and power plants and from renewable energy sources. It also opens the market with electricity.	2000	Ministry of Industry and Trade	NA	NA
Energy management act	Energy, Transport	CO_2	Increase in renewable energy, Efficiency improvement in the energy and transformation sector, Efficiency improvements of buildings, Efficiency improvement of appliances.	Regulatory	Implemented	This act sets the basic rules for efficient use of energy. It is accompanied by a row of decreases dealing with specific issues. Framework measure, effects and costs in other PAMs. This law covers more topics: 1. Sets the obligation for regional authorities to elaborate Regional energy concept which should define rules for efficient use of energY and for introduction of RES. 2. Establishes the National programme for effective use of energy and utilisation of renewable and secondary energy sources. 3. Defines minimal efficiencies for electricity and heat production, maximum losses for energy transmission and distribution and sets minimal technical requirements for buildings and appliances. 4. Defines measures for support of RES. 5. Introduces labeling of appliances. 6. Sets obligation to perform energy audits of defined categories of buildings.	2000	Ministry of Industry and Trade	NA	NA

National Energy Efficiency Action Plan	Energy, Industry/industrial processes	CO_2	Efficiency improvement in services/ tertiary sector Efficiency improvement in industrial end-use sectors	Regulatory|Economic|Fiscal|Information|Research|Voluntary Agreement|Other (Planning)	Implemented	Plan of measures to be implemented in order to fulfill the required energy savings in the period 2008 - 2016. This policy includes measures from both versions of NAPEE elaborated so far. Since it is a complex measure, its impacts are reported under many other measures. Framework measure, effects and costs of NAPEE measures are presented individually.	2008	Ministry of Industry and Trade	IE	IE
National programme for mitigation of consequences of climate change in the CR	Cross-cutting	CH_4, CO_2, HFCs, N_2O, PFCs, SF_6	Framework policy		Implemented	This is a strategic document of the Czech Government defining main targets and paths in the field of climate protection. The programme aims at reduction of greenhouse gas emissions and at ensuring of meeting the obligations resulting from Kyoto Protocol. The programme adopts new reduction targets in the period until 2020 (e.g. reduction of GHG emissions per inhabitant by 30%). The document also coordinates the sectorial and cross-cutting policies at a national level and also takes into consideration the requirements of the European Climate Change Program (ECCP), which became binding for the Czech Republic after the accession to the EU. The individual sectorial ministries were entrusted with implementation of these National Programme. The Programme was prepared according to the requirements of Council Decision 1999/296/EC. It introduces both specific reduction (mitigation) measures to reduce greenhouse gas emissions and also adaptation measures permitting society and ecosystems to adapt to climate change.	2004	Ministry of Environment	NA	NA
National Renewable Energy Resources Plan	Energy	CO_2	Increase in renewable energy	Economic|Fiscal|Regulatory	Implemented	Ensure the share of RES in accordance with the RES directive 2009/28/EC. Framework measure, individual actions are included in other measures.	2010	Ministry of Industry and Trade	NA	
Nitrate Directive (1991/676/EEC) - 3rd Action Plan	Agriculture	N_2O	Reduction of fertilizer/manure use on cropland	Regulatory	Implemented	Water protection against pollution caused by nitrates from agricultural sources. Remarcation of vulnerable areas and setting of rules for management	2015	Ministry of Agriculture	NA	

Biomass Action Plan in the Czech Republic for 2012-2020*	Agriculture	CO_2	Other agriculture, Increase in renewable energy, Afforestation and reforestation.	Other (Other (Planned))	Implemented	To define appropriate measures and principles to help the effective and efficient use of the energy potential of biomass	2015	Ministry of Agriculture	125.00	255.00
OP Rural development and Multifunctional Agriculture	Agriculture	CH_4, N_2O, CO_2	Other activities improving cropland management, Improved livestock management, Afforestation and reforestation.	Economic	Implemented	To support agricultural primary production and the processing of agricultural products, to support forest and water management and to ensure the continually sustainable development of the countryside	2007	Ministry of Agriculture	NA	NA
Strategy for Growth*	Agriculture	CO_2, CH_4, N_2O	Reduction of fertilizer/manure use on cropland, Other activities improving cropland management, Improved animal waste management systems,	Economic	Implemented	Conceptual material of Agriculture - plan of measures to be implemented in order to fulfill the required emission savings in the period 2013 - 2030	2015	Ministry of agriculture	NA	NA
Support of biofuels*	Transport	CO_2	Blending of the biodiesel to diesel oil and bioethanol to gasoline	Regulatory	Implemented	The objective is to decrease GHG emissions from transport and to use the renewable sources of energy due to the blending of the biodiesel to diesel oil and bioethanol to gasoline.The measure is in compliance with Directive 2009/30/EC. The directive requires that the emission intensity of transport fuels fell to 10% by 31 December 2020, at least 6% compared to the average emission levels. Directive 2009/28/EC was transposed by the Act on Air Protection 201/2012 Coll., which sets the minimal shares of biofuels in gasoline and diesel in accordance with EU directive.	2000	Ministry of Industry and Trade, Ministry of Transport	176.00	152.00

Rural Development Programme 2014-2020*	Agriculture	CO_2, CH_4, N_2O	Other activities improving cropland management, Afforestation and reforestation.	Other (Other (Planning))	Implemented	A basic strategic and program documents specifying in detail the measures for meeting the objectives of the development of rural areas of the Czech Republic To support agricultural primary production and the processing of agricultural products, to support forest and water management and to ensure the continually sustainable development of the countryside	2015	Ministry of Agriculture	200.00	357.00
Regulation on CO_2 from cars*	Transport	CO_2	Efficiency improvements of vehicles, Demand management/reduction	Regulatory	Implemented	The European Commission adopted the Directive No. 443 / 2009 about the emission limits of CO_2 for new passenger cars. Car manufacturers are obliged to ensure that new vehicles their average production does not contaminate more than 130 grams of CO_2 / km by 2015 and 95 grams in 2021. Regarding fuel consumption, these targets for 2015 roughly correspond to 5.6 liters of gasoline per 100 kilometers, or 4.9 liters of diesel per 100 km. Aim for the year 2021, then 4.1 l / 100 km (for petrol) and 3.6 l / 100 km (for diesel).	2000	Ministry of Transport, State Fund of Transport Infrastructure	237.00	803.00
Modal shift*	Transport	CO_2	Improved behaviour, modal shift to public transport or non-motorized transport	Regulatory	Implemented	Modal shift can be realized through increasing the attractiveness of public transport (Introduction of the integrated transport system, Increasing of passengers’ comfort, Preference of public transport vehicles and Introduction of “Park and Ride” system) and through systems of combined freight transport. The support of railway transport shall be realized through investment programs for improvement of infrastructure, increasing of speed, promotion of intermodal (container) transport, construction of transship points and of logistic centers. The aim of the measure is to shift 30% of long distanced freight transport from roads to railways (in trips over 300 km).	2000	Ministry of Environment, Ministry of Education, Municipalities, transport companies	134.00	109.00
Operational Programme Environment 2014 - 2020*	Energy	CO_2	multisectoral policy	Economic	Implemented	Promotion of energy savings and use of RES. The main programme offers subsidies for environment protection. It comprises promotion of energy efficiency and use of RES mainly in the Commercial/Institutional sector (1A4a).The measure supports energy efficiency improvement and use of RES in public sector. In priority axis 2 Improvement	2014	State Environmental Fund	528.00	443.00

						of air quality in human settlements, the following activities are supported: • The replacement of boilers running on solid fuel with new boilers running on solid fuel • The replacement of boilers running on solid fuel with new stationary combustion sources running on gaseous or liquid fuel • The replacement of boilers running on solid fuel with heat pumps • The above replacements combined with supplementary non-combustion sources of thermal energy In priority axis 5 Energy savings, the following activities are supported: • Insulation of the envelope of a building; • Replacement and renovation of windows and doors; • Implementation of structural measures having a demonstrated influence on the energy performance of buildings or improvements in the quality of the indoor climate; • Implementation of mechanical ventilation systems with waste heat recuperation; • Implementation of systems reusing waste heat; • Replacement of heat sources for spatial heating or for the production of hot water using solid or liquid fossil fuels with efficient sources using biomass, heat pumps, gas condensing boilers, or facilities for cogeneration (micro-cogeneration) using renewable sources or natural gas; • Installation of solar thermic collectors for auxiliary heating or only for the production of hot water. • Implementation of structural measures having a demonstrated influence on the energy performance of buildings or improvements in the quality of the indoor climate; • Implementation of mechanical ventilation systems with waste heat recuperation; • Implementation of systems reusing waste heat; • Replacement of heat sources for spatial heating or for the production of hot water using solid or liquid fossil fuels with efficient sources using biomass, heat pumps, gas condensing boilers, or facilities for cogeneration (micro-cogeneration) using renewable sources or natural gas; • Installation of solar thermic collectors for auxiliary heating or only for the production of hot water.				

ICAO Agreement*	Transport	CO2	Demand management	Regulatory	Implemented	The measure ‘ICAO agreement’ is related to the resolution A37-19 from 2010 about consolidation and continuation of policies regarding climate change. MS agreed not to increase GHG emissions in aviation in 2020 in comparison to 2005. MS also approved to increase fuel use efficiency by 2% in 2020 comparing to 2010.	2000	Ministry of Transport	6.00	17.00
Road Toll	Transport	CO2	Demand management	Fiscal	Planned	This measure imposes currently a toll also for trucks with the weight more than 3.5 t. The range and price of road charging for freight vehicles will change. Only motorways are charged now in the Czech Republic. The road charging will involve selected first and second class roads as well.	2020	Ministry of Transport	126.00	103.00
Operational Programme Enterprise and Innovation for Competitiveness*	Energy	CO2	Efficiency improvement in the energy and transformation sector, Efficiency improvement in services/ tertiary sector, Efficiency improvement in industrial end-use sectors.	Economic	Implemented	The measure supports energy efficiency improvement and use of RES in industry and services. With the framework of the Operational Program Enterprise and Innovation for the period 2007–2013, the Ministry of Industry and Trade is introducing a total of 15 aid programs, one of them is oriented on Eco-energy. Eco-energy is oriented on energy savings by means of replacing old technologies and on generation of electricity or heat from renewable resources. Funding derives in part from EU structural funds (85%) and in part from the state budget (15%). Funding is paid out in the form of non-returnable subsidies, preferential loans and guarantees. The program covers the following measures: • the modernisation or replacement of existing energy production facilities for internal purposes, which will increase their efficiency; • the introduction and upgrading of measurement and control systems; • modernisation, reconstruction and loss reduction in electricity and heat distribution systems in buildings and production plants; • the implementation of measures to improve the energy performance of buildings in the business sector (building envelope insulation, the replacement and renovation of windows and doors, other structural measures having a demonstrable	2014	Ministry of Industry and Trade	2,320.00	2,040.00

						influence on the energy performance of buildings, the installation of ventilation technology with waste heat recuperation); • re-use of waste energy in production processes; • improvements in energy performance and energy efficiency in production and technological processes; • the installation of renewable energy sources for an undertaking's own consumption; • the installation of a cogeneration unit with maximum use of electricity and thermal energy for the undertaking's internal consumption, the support of extra costs in achieving the standard of a nearly zero-energy building and a passive energy standard in the reconstruction or construction of new business buildings. Extra costs will be derived from model examples and, for the purposes of support, will be set as a fixed amount for a clearly measurable quantity (e.g. per square metre of energy-related area). The target audience includes business entities (small, medium-sized and, where appropriate, large enterprises); for intervention in the field of energy savings (the insulation of production and business structures), also agricultural holdings, food businesses, undertakings providing accommodation and catering services, and retail organisations.				
Action Plan for Development of Organic Farming 2016 - 2020	Agriculture	N_2O, CH_4	Reduction of fertilizer/manure use on cropland, Improved management of organic soils	Economic	Planned	The main goal is to promote the growth of organic farming in the Czech Republic until 2020, particularly to harness the potential of organic farming in the nature protection, for research and innovation in organic farming, counseling or education. AP is closely linked to Rural Development Program 2014-2020.	2016	Ministry of Agriculture	NA	NA
New Green savings programme 2015 - 2020*	Energy	CO_2	Efficiency improvements of buildings Increase in renewable energy	Economic	Implemented	The programme is financed from sold emission allowances. It supports, through investment subsidies, construction of low-energy family houses in passive standard, full or partial insulation of existing houses and introduction of RES for water heating.	2015	State Environmental Fund	1,069.00	896.00

Ministry of Agriculture Strategy with view until 2030 (since 2016)	Agriculture	N2O, CH4	Reduction of fertilizer/manure use on cropland, Improved livestock management, Improved management of organic soils	Economic	Implemented	Conceptual material including stategic PAM and predicted activity data (animal population) trends until 2030. Priorities, objectives and actions of the Strategy will be implemented in the relevant programs. The material was approved by the Government of the Czech Republic on 3rd May 2016.	2016	Ministry of Agriculture	NA	NA
Integrated Regional Operating Programme*	Energy	CO2	Efficiency improvements of buildings	Economic	Implemented	The program supports modernizations and refurbishments of living houses. Owners of living houses (any physical or legal body) can obtain advantageous long-term loan with fixed interest covering up to 80 % of the total investment. In terms of energy savings is significant priority axis 2 of the program and its investment priority 4c “Promoting energy efficiency, intelligent systems energy management and use of energy from renewable sources for public infrastructures, including in public buildings and in housing”. Supported measures affecting the energy performance include e.g.: insulation of residential buildings, replacement and refurbishment of windows and doors, passive heating and cooling, shielding, installation of systems controlled ventilation with heat recovery	2014	Ministry of Reginal Development	672.00	563.00
Electricity Savings in Households Lighting*	Energy	CO2	Efficiency improvement of appliances	Regulatory	Implemented	The measure aims at reduction of electic energy consumption for lighting in households. The measure gradually bans introduction of inefficient lightbulbs to the market.	2009	Ministry of Industry and Trade	532.00	446.00
Extension of Public Sector Role in Demonstration of New Technologies*	Energy	CO2	Efficiency improvement in services/ tertiary sector	Regulatory	Implemented	The public sector is obliged to follow certains rules leading to purchases of energy efficient appliances.	2010	Ministry of Reginal Development	285.00	232.00
Electricity Savings in Lighting in Tertiary Sector and Public Lighting*	Energy	CO2	Efficiency improvement in services/ tertiary sector	Regulatory	Implemented	The measure gradually bans introduction of inefficient lightbulbs to the market. It leads to necessity of modernization of lighting systems.	2009	Ministry of Industry and Trade	95.00	78.00

National Strategy of Cycling Transport Development*	Transport	CO2	Modal shift to public transport or non-motorized transport	Economic	Implemented	Municipalities can obtain investment subsidies supporting development of cycling infrastructure.	2015	State Fund of Transport Infrastructure	100.00	89.00
Operational Programme Transport*	Transport	CO2	Improved transport infrastructure	Economic	Implemented	The Operation Program Transport supports mainly investments into transport infrastructure. Side effect of better transport infrastructure is decreased energy consumption and thus lower GHG emissions.	2007	State Fund of Transport Infrastructure	177.00	173.00
Efficiency Improvement of District Heating Systems*	Energy	CO2	Efficiency improvement in the energy and transformation sector	Economic	Implemented	Heat producing companies can receive subsidy to integration of CHP, heat distribution system reconstruction or building a new district heating system.	2015	Ministry of Industry and Trade	621.00	495.00
Regulation (EU) No 517/2014 of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006*	Industry/industrial processes	HFCs	Replacement of fluorinated gases by other substances	Regulatory	Implemented	Ban on introduction of fluorinated gases with high GWP for given purposes of use.	2014	Ministry of Environment	552.00	2,029.00

Note: The two final columns specify the year identified by the Party for estimating impacts (based on the status of the measure and whether an ex post or ex ante estimation is available).

Abbreviations: GHG = greenhouse gas; LULUCF = land use, land-use change and forestry.

[a] Parties should use an asterisk (*) to indicate that a mitigation action is included in the 'with measures' projection.

[b] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors, cross-cutting, as appropriate.

[c] To the extent possible, the following types of instrument should be used: economic, fiscal, voluntary agreement, regulatory, information, education, research, other.

[d] To the extent possible, the following descriptive terms should be used to report on the status of implementation: implemented, adopted, planned.

[e] Additional information may be provided on the cost of the mitigation actions and the relevant timescale.

[f] Optional year or years deemed relevant by the Party.

CTF Table 4 - Reporting on progress

	Total emissions excluding LULUCF	*Contribution from LULUCF*[d]	*Quantity of units from market based mechanisms under the Convention*		*Quantity of units from other market based mechanisms*	
Year[c]	*(kt CO_2 eq)*	*(kt CO_2 eq)*	*(number of units)*	*(kt CO_2 eq)*	*(number of units)*	*(kt CO_2 eq)*
Base year/period (1990)	197,948.82	NA	NA	NA	NA	NA
2010	139,593.28	NA	NA	NA	NA	NA
2011	137,863.57	NA	NA	NA	NA	NA
2012	134,465.77	NA	NA	NA	NA	NA
2013	130,561.18	NA	0.00	0.00	NA	NA
2014	126,616.31	NA	0.00	0.00	NA	NA
2015	127,925.53	NA	0.00	0.00	NA	NA
2016						

Abbreviation: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] For the base year, information reported on the emission reduction target shall include the following: (a) total GHG emissions, excluding emissions and removals from the LULUCF sector; (b) emissions and/or removals from the LULUCF sector based on the accounting approach applied taking into consideration any relevant decisions of the Conference of the Parties and the activities and/or land that will be accounted for; (c) total GHG emissions, including emissions and removals from the LULUCF sector. For each reported year, information reported on progress made towards the emission reduction targets shall include, in addition to the information noted in paragraphs 9(a–c) of the UNFCCC biennial reporting guidelines for developed country Parties, information on the use of units from market-based mechanisms.

[c] Parties may add additional rows for years other than those specified below.

[d] Information in this column should be consistent with the information reported in table 4(a)I or 4(a)II, as appropriate. The Parties for which all relevant information on the LULUCF contribution is reported in table 1 of this common tabular format can refer to table 1.

CTF Table 4a1 Progress in achieving the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the contribution of the land use, land-use change and forestry sector

Progress in achieving the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the contribution of the land use, land-use change and forestry sector in 2014 [a,b]

	Net GHG emissions/removals from LULUCF categories [c]	*Base year/period or reference level value* [d]	*Contribution from LULUCF for reported year*	*Cumulative contribution from LULUCF* [e]	*Accounting approach* [f]
	(kt CO_2 eq)				
Total LULUCF	NA	NA	NA	NA	
A. Forest land	NA	NA	NA	NA	
1. Forest land remaining forest land	NA	NA	NA	NA	
2. Land converted to forest land	NA	NA	NA	NA	
3. Other [g]					
B. Cropland	NA	NA	NA	NA	
1. Cropland remaining cropland	NA	NA	NA	NA	
2. Land converted to cropland	NA	NA	NA	NA	
3. Other [g]					
C. Grassland	NA	NA	NA	NA	
1. Grassland remaining grassland	NA	NA	NA	NA	
2. Land converted to grassland	NA	NA	NA	NA	
3. Other [g]					
D. Wetlands	NA	NA	NA	NA	
1. Wetland remaining wetland	NA	NA	NA	NA	
2. Land converted to wetland	NA	NA	NA	NA	
3. Other [g]					
E. Settlements	NA	NA	NA	NA	
1. Settlements remaining settlements	NA	NA	NA	NA	

2. Land converted to settlements	NA	NA	NA	NA	
3. Other [g]					
F. Other land	NA	NA	NA	NA	
1. Other land remaining other land	NA	NA	NA	NA	
2. Land converted to other land	NA	NA	NA	NA	
3. Other [g]					
G. Other					
Harvested wood products					

Abbreviations: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] Parties that use the LULUCF approach that is based on table 1 do not need to complete this table, but should indicate the approach in table 2. Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[c] For each category, enter the net emissions or removals reported in the most recent inventory submission for the corresponding inventory year. If a category differs from that used for the reporting under the Convention or its Kyoto Protocol, explain in the biennial report how the value was derived.

[d] Enter one reference level or base year/period value for each category. Explain in the biennial report how these values have been calculated.

[e] If applicable to the accounting approach chosen. Explain in this biennial report to which years or period the cumulative contribution refers to.

[f] Label each accounting approach and indicate where additional information is provided within this biennial report explaining how it was implemented, including all relevant accounting parameters (i.e. natural disturbances, caps).

Progress in achieving the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the contribution of the land use, land-use change and forestry sector in 2015 [a, b]

	Net GHG emissions/removals from LULUCF categories [c]	*Base year/period or reference level value [d]*	*Contribution from LULUCF for reported year*	*Cumulative contribution from LULUCF [e]*	*Accounting approach [f]*
	(kt CO_2 eq)				
Total LULUCF	NA	NA	NA	NA	
A. Forest land	NA	NA	NA	NA	
1. Forest land remaining forest land	NA	NA	NA	NA	
2. Land converted to forest land	NA	NA	NA	NA	
3. Other [g]					
B. Cropland	NA	NA	NA	NA	
1. Cropland remaining cropland	NA	NA	NA	NA	
2. Land converted to cropland	NA	NA	NA	NA	
3. Other [g]					
C. Grassland	NA	NA	NA	NA	
1. Grassland remaining grassland	NA	NA	NA	NA	
2. Land converted to grassland	NA	NA	NA	NA	
3. Other [g]					
D. Wetlands	NA	NA	NA	NA	
1. Wetland remaining wetland	NA	NA	NA	NA	
2. Land converted to wetland	NA	NA	NA	NA	
3. Other [g]					
E. Settlements	NA	NA	NA	NA	
1. Settlements remaining settlements	NA	NA	NA	NA	
2. Land converted to settlements	NA	NA	NA	NA	
3. Other [g]					

F. Other land	NA	NA	NA	NA	
1. Other land remaining other land	NA	NA	NA	NA	
2. Land converted to other land	NA	NA	NA	NA	
3. Other [g]					
G. Other					
Harvested wood products					

Abbreviations: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] Parties that use the LULUCF approach that is based on table 1 do not need to complete this table, but should indicate the approach in table 2. Parties should fill in a separate table for each year, namely 2011 and 2012, where 2014 is the reporting year.

[c] For each category, enter the net emissions or removals reported in the most recent inventory submission for the corresponding inventory year. If a category differs from that used for the reporting under the Convention or its Kyoto Protocol, explain in the biennial report how the value was derived.

[d] Enter one reference level or base year/period value for each category. Explain in the biennial report how these values have been calculated.

[e] If applicable to the accounting approach chosen. Explain in this biennial report to which years or period the cumulative contribution refers to.

[f] Label each accounting approach and indicate where additional information is provided within this biennial report explaining how it was implemented, including all relevant accounting parameters (i.e. natural disturbances, caps).

[g] Specify what was used for the category “other”. Explain in this biennial report how each was defined and how it relates to the categories used for reporting under the Convention or its Kyoto Protocol.

CTF Table 4a2 Progress in achievement of the quantified economy-wide emission reduction targets – further information on mitigation actions relevant to the counting of emissions and removals from the land use, land-use change and forestry sector in relation to activities under Article 3, paragraphs 3 and 4, of the Kyoto Protocol

GREENHOUSE GAS SOURCE AND SINK ACTIVITIES	*Base year*[d]	*Net emissions/removals*[e]									*Accounting parameters*[h]	*Accounting quantity*[i]
		2013	2014	2015	2016	2017	2018	2019	2020	Total[g]		
	(kt CO_2 eq)											
A. Article 3.3 activities												
A.1. Afforestation/reforestation		-492.61	-549.75	-589.37						-1,631.74		-1631.74
Excluded emissions from natural disturbances(5)		NA	NA	NA						NA		NA
Excluded subsequent removals from land subject to natural disturbances(6)		NO	NO	NO						NO		NO
A.2. Deforestation		234.27	231.19	179.73						645.19		645.19
B. Article 3.4 activities												
B.1. Forest management										-17,761.73		-3703.73
Net emissions/removalse		-6,405.31	-6,280.87	-5,075.56						-17,761.73		
Excluded emissions from natural disturbances(5)		NA	NA	NA						NA		NA
Excluded subsequent removals from land subject to natural disturbances(6)		NO	NO	NO						NO		NO
Any debits from newly established forest (CEF-ne)(7),(8)		NA	NA	NA						NA		NA
Forest management reference level (FMRL)(9)											-4686.00	
Technical corrections to FMRL(10)											NA	
Forest management capl											55425.67	-3703.73
B.2. Cropland management (if elected)	NA	NA	NA	NA						NA		NA
B.3. Grazing land management (if elected)	NA	NA	NA	NA						NA		NA
B.4. Revegetation (if elected)	NA	NA	NA	NA						NA		NA
B.5. Wetland drainage and rewetting (if elected)	NA	NA	NA	NA						NA		NA

CTF Table 4b Reporting on progress

Units of market based mechanisms			*Year*	
			2015	*2016*
Kyoto Protocol units[d]	*Kyoto Protocol units*	*(number of units)*	NA, NO	NA, NO
		(kt CO_2 eq)	NA, NO	NA, NO
	AAUs	*(number of units)*	NA	NA
		(kt CO2 eq)	NA	NA
	ERUs	*(number of units)*	NA	NA
		(kt CO2 eq)	NA	NA
	CERs	*(number of units)*	NA	NA
		(kt CO2 eq)	NA	NA
	tCERs	*(number of units)*	NO	NO
		(kt CO2 eq)	NO	NO
	lCERs	*(number of units)*	NO	NO
		(kt CO2 eq)	NO	NO
Other units [d,e]	*Units from market-based mechanisms under the Convention*	*(number of units)*		
		(kt CO_2 eq)		
	Units from other market-based mechanisms	*(number of units)*		
		(kt CO_2 eq)		
Total		*(number of units)*	NA, NO	NA, NO
		(kt CO_2 eq)	NA, NO	NA, NO

Abbreviations: AAUs = assigned amount units, CERs = certified emission reductions, ERUs = emission reduction units, lCERs = long-term certified emission reductions, tCERs = temporary certified emission reductions.

Note: 2011 is the latest reporting year.

[a] Reporting by a developed country Party on the information specified in the common tabular format does not prejudge the position of other Parties with regard to the treatment of units from market-based mechanisms under the Convention or other market-based mechanisms towards achievement of quantified economy-wide emission reduction targets.

[b] For each reported year, information reported on progress made towards the emission reduction target shall include, in addition to the information noted in paragraphs 9(a-c) of the reporting guidelines, on the use of units from market-based mechanisms.

[c] Parties may include this information, as appropriate and if relevant to their target.

[d] Units surrendered by that Party for that year that have not been previously surrendered by that or any other Party.

[e] Additional rows for each market-based mechanism should be added, if applicable.

CTF Table 5 Summary of key variables and assumptions used in the projections analysis

Key underlying assumptions		*Historical*[b]							Projected			
Assumption	*Unit*	*1990*	*1995*	2000	2005	2010	2011	2014	2015	2020	2025	2030
Population	*thousands*					10,517.00		10,513.28	10,511.33	10,502.45	10,478.44	10,428.37
Number of households	thousands					4,614.00		4,467.72	4,491.31	4,585.08	4,647.45	4,687.02
GDP growth rate	%					2.69		2.72	3.75	3.25	2.78	2.42
International oil price	EUR / GJ							9.62	7.18	11.60	13.20	14.50
International coal price	EUR / GJ							1.87	1.98	2.20	2.60	3.20
International gas price	EUR / GJ							10.58	7.40	7.50	8.10	8.80
Population growth	*%*					100.04		100.00	99.98	99.90	99.67	99.19

[a] Parties should include key underlying assumptions as appropriate.

[b] Parties should include historical data used to develop the greenhouse gas projections reported.

CTF Table 6a Information on updated greenhouse gas projections under a 'with measures' scenario

	GHG emissions and removals[b]							GHG emission projections	
	(kt CO_2 eq)							(kt CO_2 eq)	
	Base year (1990)	1990	1995	2000	2005	2010	2015	2020	2030
***Sector**[d,e]*									
Energy	151,288.88	151,288.88	118,032.04	108,852.80	102,456.54	94,253.70	80,226.05	75,650.10	66,021.20
Transport	7,284.03	7,284.03	9,354.55	11,934.42	17,106.65	17,007.86	17,747.55	18,550.93	15,883.07
Industry/industrial processes	17,080.37	17,080.37	14,157.41	14,720.47	14,591.83	14,965.30	15,413.84	14,763.16	13,169.89
Agriculture	17,049.98	17,049.98	10,245.64	8,975.75	8,257.49	7,761.98	8,482.99	8,638.93	9,682.33
Forestry/LULUCF	-6,487.71	-6,487.71	-8,046.44	-8,805.07	-8,134.59	-7,200.07	-6,640.69	-3,483.22	-3,483.22
Waste management/waste	3,126.83	3,126.83	3,517.95	3,743.17	4,117.16	4,637.01	5,256.41	4,894.68	4,064.32
Other (specify)									
Gas									
CO_2 emissions including net CO_2 from LULUCF	155,024.01	155,024.01	121,571.62	116,859.87	116,275.45	108,790.99	97,034.34	97,676.74	84,932.85
CO_2 emissions excluding net CO_2 from LULUCF	161,649.59	161,649.59	129,736.95	125,788.18	124,558.95	116,159.34	103,769.75	100,255.60	88,500.79
CH_4 emissions including CH_4 from LULUCF	23,568.21	23,568.21	18,135.00	15,328.91	14,613.64	14,392.54	13,776.39	13,331.61	12,362.48
CH_4 emissions excluding CH_4 from LULUCF	23,450.87	23,450.87	18,032.44	15,221.02	14,481.46	14,242.64	13,694.48	13,258.04	12,288.70
N_2O emissions including N_2O from LULUCF	10,663.05	10,663.05	7,465.74	6,845.16	6,512.18	5,765.04	6,125.54	6,549.48	7,073.60
N_2O emissions excluding N_2O from LULUCF	10,642.52	10,642.52	7,449.40	6,829.79	6,495.44	5,746.66	6,112.73	6,538.50	7,062.65
HFCs	NO	NO	0.32	272.92	867.74	2,348.97	3,455.08	2,333.75	858.29
PFCs	NO	NO	0.01	4.69	14.89	48.01	1.96	3.77	3.55
SF_6	84.10	84.10	88.47	107.99	111.18	80.23	90.55	105.51	104.27
NF_3	NO	NO	NO	NO	NO	NO	2.29	2.58	2.58
Other (specify)									
Total with LULUCF[f]	189,339.37	189,339.37	147,261.16	139,419.54	138,395.08	131,425.78	120,486.15	120,003.44	105,337.62
Total without LULUCF	195,827.08	195,827.08	155,307.59	148,224.59	146,529.66	138,625.85	127,126.84	122,497.75	108,820.83

Abbreviations: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] In accordance with the “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications”, at a minimum Parties shall report a ‘with measures’ scenario, and may report ‘without measures’ and ‘with additional measures’ scenarios. If a Party chooses to report ‘without measures’ and/or ‘with additional measures’ scenarios they are to use tables 6(b) and/or 6(c), respectively. If a Party does not choose to report ‘without measures’ or ‘with additional measures’ scenarios then it should not include tables 6(b) or 6(c) in the biennial report.

[b] Emissions and removals reported in these columns should be as reported in the latest GHG inventory and consistent with the emissions and removals reported in the table on GHG emissions and trends provided in this biennial report. Where the sectoral breakdown differs from that reported in the GHG inventory Parties should explain in their biennial report how the inventory sectors relate to the sectors reported in this table.

[c] 20XX is the reporting due-date year (i.e. 2014 for the first biennial report).

[d] In accordance with paragraph 34 of the “Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications”, projections shall be presented on a sectoral basis, to the extent possible, using the same sectoral categories used in the policies and measures section. This table should follow, to the extent possible, the same sectoral categories as those listed in paragraph 17 of those guidelines, namely, to the extent appropriate, the following sectors should be considered: energy, transport, industry, agriculture, forestry and waste management.

[e] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors (i.e. cross-cutting), as appropriate.

[f] Parties may choose to report total emissions with or without LULUCF, as appropriate.

CTF Table 6c Information on updated greenhouse gas projections under a ‘with additional measures’ scenario

	GHG emissions and removals[b] (kt CO_2 eq)							GHG emission projections (kt CO_2 eq)	
	Base year (1990)	1990	1995	2000	2005	2010	2015	2020	2030
Sector[d,e]									
Energy	151,285.88	151,285.88	118,032.04	108,852.80	102,456.54	94,253.70	80,226.05	75,592.70	65,940.60
Transport	7,284.03	7,284.03	9,354.55	11,932.42	17,106.65	17,007.86	17,747.55	18,290.85	15,631.87
Industry/industrial processes	17,080.37	17,080.37	14,157.41	14,720.47	14,591.83	14,965.30	15,413.84	14,763.16	13,169.89
Agriculture	17,049.98	17,049.98	10,245.64	8,975.75	8,257.49	7,761.98	8,482.99	8,596.11	9,278.97
Forestry/LULUCF	-6,487.71	-6,487.71	-8,046.44	-8,805.07	-8,134.59	-7,200.07	-6,640.69	-2,952.92	-3,877.87
Waste management/waste	3,126.83	3,126.83	3,517.95	3,743.17	4,117.16	4,637.01	5,256.41	4,894.68	3,788.78
Other (specify)									
Gas									
CO_2 emissions including net CO_2 from LULUCF	155,024.01	155,024.01	121,571.62	116,859.87	116,275.45	108,790.99	97,034.34	96,900.68	84,206.35
CO_2 emissions excluding net CO_2 from LULUCF	161,649.59	161,649.59	129,736.95	125,788.18	124,558.95	116,159.34	103,769.75	99,938.15	88,168.94
CH_4 emissions including CH_4 from LULUCF	23,568.21	23,568.21	18,135.00	15,328.91	14,613.64	14,392.54	13,776.39	13,331.61	12,086.94
CH_4 emissions excluding CH_4 from LULUCF	23,450.87	23,450.87	18,032.44	15,221.02	14,481.46	14,242.64	13,694.48	13,258.04	12,013.16
N_2O emissions including N_2O from LULUCF	10,663.05	10,663.05	7,465.74	6,845.16	6,512.18	5,765.04	6,125.54	6,506.65	6,670.24
N_2O emissions excluding N_2O from LULUCF	10,642.52	10,642.52	7,449.40	6,829.79	6,495.44	5,746.66	6,112.73	6,495.67	6,659.29
HFCs	NO	NO	0.32	272.92	867.74	2,348.97	3,455.08	2,333.75	858.29
PFCs	NO	NO	0.01	4.69	14.89	48.01	1.96	3.77	3.55
SF_6	84.10	84.10	88.47	107.99	111.18	80.23	90.55	105.51	104.27
NF_3	NO	NO	NO	NO	NO	NO	2.29	2.58	2.58
Other (specify)									
Total with LULUCF[f]	189,339.37	189,339.37	147,261.16	139,419.54	138,395.08	131,425.78	120,486.15	119,184.55	103,932.22
Total without LULUCF	195,827.08	195,827.08	155,307.59	148,224.59	146,529.66	138,625.85	127,126.84	122,137.47	107,810.08

Abbreviations: GHG = greenhouse gas, LULUCF = land use, land-use change and forestry.

[a] In accordance with the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", at a minimum Parties shall report a 'with measures' scenario, and may report 'without measures' and 'with additional measures' scenarios. If a Party chooses to report 'without measures' and/or 'with additional measures' scenarios they are to use tables 6(b) and/or 6(c), respectively. If a Party does not choose to report 'without measures' or 'with additional measures' scenarios then it should not include tables 6(b) or 6(c) in the biennial report.

[b] Emissions and removals reported in these columns should be as reported in the latest GHG inventory and consistent with the emissions and removals reported in the table on GHG emissions and trends provided in this biennial report. Where the sectoral breakdown differs from that reported in the GHG inventory Parties should explain in their biennial report how the inventory sectors relate to the sectors reported in this table.

[c] 20XX is the reporting due-date year (i.e. 2014 for the first biennial report).

[d] In accordance with paragraph 34 of the "Guidelines for the preparation of national communications by Parties included in Annex I to the Convention, Part II: UNFCCC reporting guidelines on national communications", projections shall be presented on a sectoral basis, to the extent possible, using the same sectoral categories used in the policies and measures section. This table should follow, to the extent possible, the same sectoral categories as those listed in paragraph 17 of those guidelines, namely, to the extent appropriate, the following sectors should be considered: energy, transport, industry, agriculture, forestry and waste management.

[e] To the extent possible, the following sectors should be used: energy, transport, industry/industrial processes, agriculture, forestry/LULUCF, waste management/waste, other sectors (i.e. cross-cutting), as appropriate.

[f] Parties may choose to report total emissions with or without LULUCF, as appropriate.

CTF Table 7 Provision of public financial support: summary information

Provision of public financial support: summary information in 2015[a]

Allocation channels	*Year*									
	Czech koruna - CZK					*USD*[b]				
	Core/ general[c, 1]	*Climate-specific*[d, 2]				*Core/ general*[c, 1]	*Climate-specific*[d, 2]			
		Mitigation	*Adaptation*	*Cross-cutting*[e]	*Other*[f]		*Mitigation*	*Adaptation*	*Cross-cutting*[e]	*Other*[f]
Total contributions through multilateral channels:	416,575,574.00			75,145,509.00		16,933,965.00			3,054,695.00	
Multilateral climate change funds[g]	20,140,621.00			75,145,509.00		818,724.00			3,054,695.00	
Other multilateral climate change funds[h]				15,623,950.00					635,120.00	
Multilateral financial institutions, including regional development banks	338,043,850.00					13,741,619.00				
Specialized United Nations bodies	58,391,103.00					2,373,622.00				
Total contributions through bilateral, regional and other channels		80,563,471.00	67,766,500.00				3,274,938.00	2,742,941.00		
Total	416,575,574.00	80,563,471.00	67,766,500.00	75,145,509.00		16,933,965.00	3,274,938.00	2,742,941.00	3,054,695.00	

Note: Explanation of numerical footnotes is provided in the documentation box after tables 7, 7(a) and 7(b).

Abbreviation: USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2015 and 2016, where 2018 is the reporting year.

[b] Parties should provide an explanation of the methodology used for currency exchange for the information provided in tables 7, 7(a) and 7(b) in the documentation box.

[c] This refers to support to multilateral institutions that Parties cannot specify as being climate-specific.

[d] Parties should explain in their biennial reports how they define funds as being climate-specific.

[e] This refers to funding for activities that are cross-cutting across mitigation and adaptation.

[f] Please specify.

[g] Multilateral climate change funds listed in paragraph 17(a) of the “UNFCCC biennial reporting guidelines for developed country Parties” in decision 2/CP.17.

[h] Other multilateral climate change funds as referred in paragraph 17(b) of the “UNFCCC biennial reporting guidelines for developed country Parties” in decision 2/CP.17.

Provision of public financial support: summary information in 2016[a]

Allocation channels	*Year*									
	Czech koruna - CZK					*USD*[b]				
	Core/ general[c, 1]	*Climate-specific*[d, 2]				*Core/ general*[c, 1]	*Climate-specific*[d, 2]			
		Mitigation	*Adaptation*	*Cross-cutting*[e]	*Other*[f]		*Mitigation*	*Adaptation*	*Cross-cutting*[e]	*Other*[f]
Total contributions through multilateral channels:	34,471,969.00			241,527,844.00		1,410,935.00			9,885,716.00	
Multilateral climate change funds[g]	20,140,621.00			75,145,829.00		824,354.00			3,075,713.00	
Other multilateral climate change funds[h]				15,623,950.00					639,487.00	
Multilateral financial institutions, including regional development banks				166,382,015.00					6,810,003.00	
Specialized United Nations bodies	14,331,348.00					586,581.00				
Total contributions through bilateral, regional and other channels		43,202,376.00	74,804,368.00	10,923,763.00			1,768,273.00	3,062,559.00	447,109.00	
Total	34,471,969.00	43,202,376.00	74,804,368.00	252,451,607.00		1,410,935.00	1,768,273.00	3,062,559.00	10,332,825.00	

Note: Explanation of numerical footnotes is provided in the documentation box after tables 7, 7(a) and 7(b).

Abbreviation: USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2015 and 2016, where 2018 is the reporting year.

[b] Parties should provide an explanation of the methodology used for currency exchange for the information provided in tables 7, 7(a) and 7(b) in the documentation box.

[c] This refers to support to multilateral institutions that Parties cannot specify as being climate-specific.

[d] Parties should explain in their biennial reports how they define funds as being climate-specific.

[e] This refers to funding for activities that are cross-cutting across mitigation and adaptation.

[f] Please specify.

[g] Multilateral climate change funds listed in paragraph 17(a) of the “UNFCCC biennial reporting guidelines for developed country Parties” in decision 2/CP.17.

[h] Other multilateral climate change funds as referred in paragraph 17(b) of the “UNFCCC biennial reporting guidelines for developed country Parties” in decision 2/CP.17.

CTF Table 7a Provision of public financial support: contribution through multilateral channels

Provision of public financial support: contribution through multilateral channels in 2015[a]

Donor funding	*Total amount*				*Status*[b, 3]	*Funding source*[f, 4]	*Financial instrument*[f, 5]	*Type of support*[f, g, 6]	*Sector*[c, f, 7]
	Core/general[d, 1]		*Climate-specific*[e, 2]						
	Czech koruna CZK	*USD*	*Czech koruna CZK*	*USD*					
Total contributions through multilateral channels	243,243,649.00	9,887,952.00	75,145,509.00	3,054,695.00					
Multilateral climate change funds	20,140,621.00	818,724.00	75,145,509.00	3,054,695.00					
1. Global Environment Facility	20,140,621.00	818,724.00	9,521,559.00	387,055.00	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund									
3. Special Climate Change Fund									
4. Adaptation Fund									
5. Green Climate Fund			50,000,000.00	2,032,520.00	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
6. UNFCCC Trust Fund for Supplementary Activities									
7. Other multilateral climate change funds			15,623,950.00	635,120.00					
8. Multilateral Fund for the Implementation of the Montreal Protocol			15,623,950.00	635,120.00	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Multilateral financial institutions, including regional development banks	164,711,925.00	6,695,606.00							
1. World Bank									
2. International Finance Corporation									
3. African Development Bank									
4. Asian Development Bank									
5. European Bank for Reconstruction and Development							Grant		

6. Inter-American Development Bank									
7. Other	164,711,925.00	6,695,606.00							
8. International Bank for Reconstruction and Development	48,251,925.00	1,961,460.00			Disbursed	ODA	Equity	Cross-cutting	Cross-cutting
9. International Development Association	116,460,000.00	4,734,146.00			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Specialized United Nations bodies	58,391,103.00	2,373,622.00							
1. United Nations Development Programme	45,500,000.00	1,849,593.00							
UNDP	45,500,000.00	1,849,593.00			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. United Nations Environment Programme	12,891,103.00	524,029.00							
UNEP	12,891,103.00	524,029.00			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
3. Other									

Abbreviations: ODA = official development assistance, OOF = other official flows, USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2015 and 2016, where 2018 is the reporting year.

[b] Parties should explain, in their biennial reports, the methodologies used to specify the funds as disbursed and committed. Parties will provide the information for as many status categories as appropriate in the following order of priority: disbursed and committed.

[c] Parties may select several applicable sectors. Parties may report sectoral distribution, as applicable, under “Other”.

[d] This refers to support to multilateral institutions that Parties cannot specify as being climate-specific.

[e] Parties should explain in their biennial reports how they define funds as being climate-specific.

[f] Please specify.

Provision of public financial support: contribution through multilateral channels in 2016[a]

Donor funding	*Total amount*				*Status[b, 3]*	*Funding source[f, 4]*	*Financial instrument[f, 5]*	*Type of support[f, g, 6]*	*Sector[c, f, 7]*
	Core/general[d, 1]		*Climate-specific[e, 2]*						
	Czech koruna CZK	*USD*	*Czech koruna CZK*	*USD*					
Total contributions through multilateral channels	34,471,969.00	1,410,935.00	241,527,844.00	9,885,716.00					
Multilateral climate change funds	20,140,621.00	824,354.00	75,145,829.00	3,075,713.00					
1. Global Environment Facility	20,140,621.00	824,354.00	9,521,879.00	389,730.00	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. Least Developed Countries Fund									
3. Special Climate Change Fund									
4. Adaptation Fund									
5. Green Climate Fund			50,000,000.00	2,046,496.00	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
6. UNFCCC Trust Fund for Supplementary Activities									
7. Other multilateral climate change funds			15,623,950.00	639,487.00					
8. Multilateral Fund for the Implementation of the Montreal Protocol			15,623,950.00	639,487.00	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Multilateral financial institutions, including regional development banks			166,382,015.00	6,810,003.00					
1. World Bank									
2. International Finance Corporation									
3. African Development Bank									
4. Asian Development Bank									
5. European Bank for Reconstruction and Development									
6. Inter-American Development Bank									
7. Other			166,382,015.00	6,810,003.00					
8. International Bank for Reconstruction and Development			49,922,015.00	2,043,304.00	Disbursed	ODA	Equity	Cross-cutting	Cross-cutting

9. International Development Association			116,460,000.00	4,766,699.00	Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
Specialized United Nations bodies	14,331,348.00	586,581.00							
1. United Nations Development Programme	1,000,000.00	40,930.00							
UNDP	1,000,000.00	40,930.00			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
2. United Nations Environment Programme	13,331,348.00	545,651.00							
UNEP	13,331,348.00	545,651.00			Disbursed	ODA	Grant	Cross-cutting	Cross-cutting
3. Other									

Abbreviations: ODA = official development assistance, OOF = other official flows, USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2015 and 2016, where 2018 is the reporting year.

[b] Parties should explain, in their biennial reports, the methodologies used to specify the funds as disbursed and committed. Parties will provide the information for as many status categories as appropriate in the following order of priority: disbursed and committed.

[c] Parties may select several applicable sectors. Parties may report sectoral distribution, as applicable, under “Other”.

[d] This refers to support to multilateral institutions that Parties cannot specify as being climate-specific.

[e] Parties should explain in their biennial reports how they define funds as being climate-specific.

[f] Please specify.

[g] This refers to funding for activities that are cross-cutting across mitigation and adaptation.

CTF Table 7b Provision of public financial support: contribution through bilateral, regional and other channels

rovision of public financial support: contribution through bilateral, regional and other channels in 2015[a]

Recipient country/ region/project/programme[b]	*Total amount*		*Status[c, 3]*	*Funding source[g, 4]*	*Financial instrument[g, 5]*	*Type of support[g, h, 6]*	*Sector[d, g, 7]*	*Additional information[e]*
	Climate-specific[f, 2]							
	Czech koruna - CZK	*USD*						
Total contributions through bilateral, regional and other channels	148,329,971.00	6,017,879.00						
Afghanistan / Support of agricultural production	8,467,955.00	344,226.00	Committed	ODA	Grant	Adaptation	Agriculture	
Armenia / Public awareness raising on modern methods of agriculture for safer environment	250,000.00	10,163.00	Committed	ODA	Grant	Mitigation	Agriculture	
Armenia / Energy Efficiency for Gas Utilization and Business Development	143,867.00	5,848.00	Committed	ODA	Grant	Mitigation	Industry, Energy	
Bolivia / Strengthening of fruit production, building solar ovens	290,347.00	11,803.00	Committed	ODA	Grant	Mitigation	Agriculture	
Bosnia and Herzegovina / Supporting small enterprises in producing wood biomass fuel in Bosnia and Herzegovina	277,626.00	11,286.00	Committed	ODA	Grant	Mitigation	Energy	
Bosnia and Herzegovina / Exploitation of renewable geothermal energy in the municipality of Doboj	9,300,000.00	378,049.00	Committed	ODA	Grant	Mitigation	Energy	
Bosnia and Herzegovina / Ensuring of energetical efficiency of hospital	329,599.00	13,398.00	Committed	ODA	Grant	Mitigation	Energy	
Bosnia and Herzegovina / Increasing Energy Efficiency at the Cantonal Hospital in Bihac	21,500,000.00	873,984.00	Committed	ODA	Grant	Mitigation	Energy	

Cambodia / Developing sustainable, market-driven biogas and solar energy solutions for rural communities	6,000,000.00	243,902.00	Committed	ODA	Grant	Mitigation	Energy	
Cuba / Biogas Digesters in Defence of the Environment	200,000.00	8,130.00	Committed	ODA	Grant	Mitigation	Energy	
Cuba / Water for everyone	200,000.00	8,130.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Ethiopia / Degraded lands sanitation and reclamation as a base of sustainable management of natural resources	4,440,000.00	180,488.00	Committed	ODA	Grant	Mitigation	Forestry	
Ethiopia / Support of agricultural consultancy development	5,118,120.00	208,054.00	Committed	ODA	Grant	Adaptation	Agriculture	
Ethiopia / Ensuring sustainable access to the drinkable water	2,000,000.00	81,301.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Ethiopia / Support of Small Farmers and Agricultural Education	1,500,000.00	60,976.00	Committed	ODA	Grant	Adaptation	Agriculture	
Ethiopia / Support of educational and consulting services for local farmers	2,000,000.00	81,301.00	Committed	ODA	Grant	Adaptation	Agriculture	
Ethiopia / Support to Agriculture Livelihoods and Sustainable Management of Natural Resources	2,000,000.00	81,301.00	Committed	ODA	Grant	Adaptation	Agriculture	
Ethiopia / Establishment of Sustainable System of Drinking Water Supply	4,915,000.00	199,797.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Ethiopia / Establishment of Sustainable System of Drinking Water Supply in Small Towns	9,490,000.00	385,772.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Ethiopia / Use of water resources for sustainable agricultural production	7,543,625.00	306,651.00	Committed	ODA	Grant	Adaptation	Agriculture	

Ethiopia / Determination of the feasibility of locating shallow groundwater resources for watering the family farms through technological set	500,000.00	20,325.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Ethiopia / Establishment of sustainable system of drinking water supply	940,000.00	38,211.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Ethiopia / Hydrologeological and Hydrochemical Mapping	950,000.00	36,618.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Ethiopia / Study of Natural Phenomena Threatening Agricultural Production in Selected Areas in SNNPR	1,700,000.00	69,106.00	Committed	ODA	Grant	Adaptation	Other (Disaster Prevention)	
Ethiopia / Improvement of quality level of education of the applied geology and creation of research center at the University of Arba Minch	999,400.00	40,626.00	Committed	ODA	Grant	Adaptation	Other (Government and Civil Society)	
Ethiopia / Access to potable water in Qetane and Gedeb Community in Gurage Zone	850,000.00	34,553.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Georgia / Evaluation of landslide susceptibility in the mountainous parts	5,241,925.00	213,086.00	Committed	ODA	Grant	Adaptation	Other (Disaster Prevention)	
Georgia / Feasibility Study and Technical Expertise of Hydrometeroological System	352,969.00	14,348.00	Committed	ODA	Grant	Adaptation	Other (Government and Civil Society)	
Kyrgyzstan / Study tour: Energy Efficiency and Waste Management	729,082.00	29,637.00	Committed	ODA	Grant	Mitigation	Energy	
Kyrgyzstan / Study Tour to Czech Republic to learn Experience in Small Hydro Power Development	507,099.00	20,614.00	Committed	ODA	Grant	Mitigation	Energy	

Republic of Moldova / Enhancing capacities of Moldova central and local public authorities in management and restoration of natural ecosystems under pending climate risks	514,696.00	20,923.00	Committed	ODA	Grant	Adaptation	Cross-cutting	
Republic of Moldova / Renovation of monitoring net in river Prut basin - modernization of information system of flood protection	272,250.00	11,067.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Mongolia / Reconstruction of the Coal Handling Workshop at the Ulaanbaatar Third Power Plant	8,141,776.00	330,967.00	Committed	ODA	Grant	Mitigation	Energy	
Mongolia / Turning sheep wool into environmentally friendly building material	1,550,000.00	63,008.00	Committed	ODA	Grant	Mitigation	Energy	
Mongolia / Development of forests and the gene pool of local forest tree ecotypes in Mongolia	11,367,741.00	462,103.00	Committed	ODA	Grant	Mitigation	Forestry	
Mongolia / Implementation of hydrogeological Water-well Building	2,216,849.00	80,321.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Montenegro / Transfer of Czech Experience: UNFCCC (MRV, Mitigation)	734,704.00	29,866.00	Committed	ODA	Grant	Mitigation	Other (General Environment Protection)	
Other (Palestinian Adm. Areas) / Support for a construction of PV power plant in Tubas	8,500,000.00	345,528.00	Committed	ODA	Grant	Mitigation	Energy	
Other (Palestinian Adm. Areas) / Projects in agricultural sector	8,500,000.00	345,528.00	Committed	ODA	Grant	Adaptation	Agriculture	
Philippines / Supporting Yolanda survivors and Ormoc vegetable growers	199,485.00	8,109.00	Committed	ODA	Grant	Adaptation	Agriculture	

Serbia / Assessment of technical and economical parameters and risks of connecting Srbobran city CZT system to alternative sources of energy	633,300.00	25,744.00	Committed	ODA	Grant	Mitigation	Energy	
Serbia / Creating opportunities for energy consulting and financing of the implementation of the effective and renewable energy resources	498,330.00	20,257.00	Committed	ODA	Grant	Mitigation	Energy	
Serbia / Development of biodiversity indicators related to climate changes	151,620.00	6,163.00	Committed	ODA	Grant	Adaptation	Other (Government and Civil Society)	
Serbia / Modernization of a central district heating system in the town of Srbobran with possible use of alternative heat source	5,170,000.00	210,163.00	Committed	ODA	Grant	Mitigation	Energy	
Serbia / Preparation and management of emergencies and crisis situations following natural disasters	494,820.00	20,115.00	Committed	ODA	Grant	Adaptation	Other (General Environment Protection)	
Serbia / Support of developing activities of regions and municipalities in the field of floodwater danger and crisis management	447,786.00	18,203.00	Committed	ODA	Grant	Adaptation	Other (General Environment Protection)	
South Africa / Water and sanitation	200,000.00	8,130.00	Committed	ODA	Grant	Adaptation	Water and sanitation	

Abbreviations: ODA = official development assistance, OOF = other official flows; USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2015 and 2016, where 2018 is the reporting year.

[b] Parties should report, to the extent possible, on details contained in this table.

[c] Parties should explain, in their biennial reports, the methodologies used to specify the funds as disbursed and committed. Parties will provide the information for as many status categories as appropriate in the following order of priority: disbursed and committed.

[d] Parties may select several applicable sectors. Parties may report sectoral distribution, as applicable, under “Other”.

[e] Parties should report, as appropriate, on project details and the implementing agency.

[f] Parties should explain in their biennial reports how they define funds as being climate-specific.

[g] Please specify.

[h] This refers to funding for activities that are cross-cutting across mitigation and adaptation.

Provision of public financial support: contribution through bilateral, regional and other channels in 2016[a]

Recipient country/ region/project/programme[b]	*Total amount*		*Status*[c, 3]	*Funding source*[g, 4]	*Financial instrument*[g, 5]	*Type of support*[g, h, 6]	*Sector*[d, g, 7]	*Additional information*[e]
	Climate-specific[f, 2]							
	Czech koruna - CZK	*USD*						
Total contributions through bilateral, regional and other channels	128,930,507.00	5,277,941.00						
Afghanistan / Improving Water Accesss through Pipeline Construction in Klor-e-Bala village	471,235.00	19,288.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Afghanistan / Natural Resource Management and Promotion of Sustainable Agrarian Livelihoods in four Districts of Samangan (Northern Afghanistan)	1,000,000.00	40,930.00	Committed	ODA	Grant	Cross-cutting	Agriculture	
Afghanistan / Participatory agricultural development of the Samangan province	6,995,505.00	286,326.00	Committed	ODA	Grant	Adaptation	Agriculture	

Africa / Urgent food assistance to El Nino affected population	3,000,000.00	122,790.00	Committed	ODA	Grant	Cross-cutting	Other (Reconstruction Relief)	
Bosnia and Herzegovina / Exploitation of renewable geothermal energy in the municipality of Doboj / Ensuring pumping test in Ševarlije-Doboj	1,972,825.00	80,748.00	Committed	ODA	Grant	Mitigation	Energy	
Bosnia and Herzegovina / Solar energy for Dr. Safet Muji? Hospital in Mostar	4,563,213.00	186,772.00	Committed	ODA	Grant	Mitigation	Energy	
Bosnia and Herzegovina / Using biomass for development of rural areas in Bosnia and Herzegovina	2,885,218.00	118,092.00	Committed	ODA	Grant	Mitigation	Energy	
Cambodia / Developing sustainable, market-driven biogas and solar energy solutions for rural communities in Cambodia	6,000,000.00	245,580.00	Committed	ODA	Grant	Mitigation	Energy	
Ecuador / Reconstruction of small craft workshops after the earthquake	3,000,000.00	122,790.00	Committed	ODA	Grant	Mitigation	Other (Reconstruction Relief)	
Ethiopia / Access to potable water in Qetane and Gedeb Community in Gurage Zone	880,000.00	36,018.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Ethiopia / Degraded lands sanitation and reclamation as a base of sustainable management of natural resources in Awassa Zuriya Woreda	3,500,000.00	143,255.00	Committed	ODA	Grant	Mitigation	Forestry	
Ethiopia / Ensuring sustainable access to the drinkable water in Alaba Special Woreda, SNNPR, Ethiopia	2,000,000.00	81,860.00	Committed	ODA	Grant	Adaptation	Water and sanitation	

Ethiopia / Establishment of sustainable system of drinking water supply of Sidama Zone, SNNPR, Ethiopia, III	6,400,000.00	261,952.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Ethiopia / Food security and decrease of malnutrition	2,000,000.00	81,860.00	Committed	ODA	Grant	Adaptation	Other (Reconstruction Relief)	
Ethiopia / Geophysical Survey Realization in woredas Boricha, Loka Abaya and Darra in Sidama Zone in SNNPR, Ethiopia	140,000.00	5,730.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Ethiopia / Hydrologeological and Hydrochemical Mapping	1,988,800.00	81,401.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Ethiopia / Implementation of holistic management and Climate Smart Agriculture in the Baso River catchment, Arba Minch Zuria Woreda, SNNPR, Ethiopia	5,000,000.00	204,650.00	Committed	ODA	Grant	Adaptation	Agriculture	
Ethiopia / Improved small scale irrigation practice for sustainable development	465,840.00	19,067.00	Committed	ODA	Grant	Adaptation	Agriculture	
Ethiopia / Improvment of quality level of education of the applied geology and creation of research center at the University of Arba Minch	999,400.00	40,905.00	Committed	ODA	Grant	Adaptation	Other (Higher Education)	
Ethiopia / Increased Ecological Stability of Dijo and Bilate Watersheds	4,000,000.00	163,720.00	Committed	ODA	Grant	Adaptation	Agriculture	
Ethiopia / Providing access to dring water in the areas Gumuma, Teso, Bargo and Huluka in the Sidama Zone	7,494,293.00	306,741.00	Committed	ODA	Grant	Adaptation	Water and sanitation	

Ethiopia / Study of Natural Phenomena Threatening Agricultural Production in Selected Areas in SNNPR	2,400,000.00	98,232.00	Committed	ODA	Grant	Adaptation	Agriculture	
Ethiopia / Support of agricultural consultancy development in Ethiopia	3,248,640.00	132,967.00	Committed	ODA	Grant	Adaptation	Agriculture	
Ethiopia / Support of Small Farmers and Agricultural Education in the District Alaba, Southern Nations Region	1,480,000.00	60,576.00	Committed	ODA	Grant	Adaptation	Agriculture	
Ethiopia / Use of water resources for sustainable agricultural production in Kembata Tembara Zone in Ethiopia	4,000,000.00	163,720.00	Committed	ODA	Grant	Adaptation	Agriculture	
Georgia / Evaluation of landslide susceptibility in the mountainous parts of Georgia on the example of edangered settlements	3,230,240.00	133,213.00	Committed	ODA	Grant	Adaptation	Other (Disaster Prevention)	
Georgia / Feasibility study on use of biofuels in Imereti region, Georgia	442,750.00	18,122.00	Committed	ODA	Grant	Mitigation	Energy	
Georgia / Increasing meteorological safety on TRACECA corridor / Strengthening capacities in road meteorology	150,212.00	6,148.00	Committed	ODA	Grant	Adaptation	Other (Disaster Prevention)	
Georgia / Increasing meteorological safety on TRACECA corridor / Strengthening capacities in road meteorology II	79,319.00	3,247.00	Committed	ODA	Grant	Adaptation	Other (Disaster Prevention)	
Georgia / Installation of meteorological stations at selected transport corridors, Georgia	2,453,970.00	100,441.00	Committed	ODA	Grant	Adaptation	Other (Disaster Prevention)	
Kenya / iWASH expension - Lower Yatta	250,000.00	10,232.00	Committed	ODA	Grant	Adaptation	Water and sanitation	

Malaysia / Technology Adaptation of Energetic Use of Waste to Local Conditions in Malaysia	497,500.00	20,363.00	Committed	ODA	Grant	Mitigation	Energy	
Republic of Moldova / Regional project of the Czech UNDP trust fund	167,800.00	6,868.00	Committed	ODA	Grant	Adaptation	Other (Disaster Prevention)	
Mongolia / Development of forests and the gene pool of local forest tree ecotypes in Mongolia	6,088,205.00	249,190.00	Committed	ODA	Grant	Cross-cutting	Forestry	
Mongolia / Drinking water supply for Great Gobi B, Strictly Protected Area	487,500.00	19,953.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Mongolia / Implementation of hydrogeological Water-well Building in the Province of Zavkhan, Mongolia	1,232,864.00	50,461.00	Committed	ODA	Grant	Adaptation	Water and sanitation	
Mongolia / Improving the quality and relevance of education at the Mongolian University of Science and Technology	910,100.00	37,250.00	Committed	ODA	Grant	Mitigation	Other (Higher Education)	
Mongolia / Reconstruction of the Coal Handling Workshop at the Ulaanbaatar Third Power Plant	10,343,898.00	423,375.00	Committed	ODA	Grant	Mitigation	Energy	
Mongolia / Reconstruction of the Coal Handling Workshop at the Ulaanbaatar Third Power Plant - additional delivery	1,554,508.00	63,626.00	Committed	ODA	Grant	Mitigation	Energy	
Mongolia / Turning sheep wool into environmentally friendly building material - integrated approach for supply chain development in Mongolia	725,000.00	29,674.00	Committed	ODA	Grant	Cross-cutting	Energy	

Montenegro / Regional project of the Czech UNDP trust fund	117,625.00	4,814.00	Committed	ODA	Grant	Mitigation	Other (Government and Civil Society)	
Myanmar / Reconstruction of regions affected by floods	2,000,000.00	81,860.00	Committed	ODA	Grant	Adaptation	Other (Reconstruction Relief)	
Myanmar / Rehabilitation of sources of livelihood after floods	2,000,000.00	81,860.00	Committed	ODA	Grant	Adaptation	Other (Reconstruction Relief)	
Nepal / Reconstruction of schools affected by the earthquake	2,000,000.00	81,860.00	Committed	ODA	Grant	Adaptation	Other (Reconstruction Relief)	
Nepal / Rehabilitation of sources of livelihood after the earthquake	2,000,000.00	81,860.00	Committed	ODA	Grant	Adaptation	Other (Reconstruction Relief)	
Peru / Landslide research for risk reduction and climate change adaptation in high mountain environments of Peru	200,000.00	8,186.00	Committed	ODA	Grant	Adaptation	Other (Disaster Prevention)	
Serbia / Development of biodiversity indicators related to climate changes	110,558.00	4,525.00	Committed	ODA	Grant	Cross-cutting	Other (Government and Civil Society)	
Serbia / Installation of SCADA system for central district heating system in the town of Srbobran	636,621.00	26,057.00	Committed	ODA	Grant	Mitigation	Energy	
Serbia / Modernization of a central district heating system in the town of Srbobran	5,370,000.00	219,794.00	Committed	ODA	Grant	Mitigation	Energy	
Serbia / Regional project of the Czech UNDP trust fund	118,750.00	4,680.00	Committed	ODA	Grant	Adaptation	Agriculture	

Other (South Sudan) / Resilient Agriculture for Improved Nutrition (RAIN)	2,000,000.00	81,860.00	Committed	ODA	Grant	Adaptation	Other (Reconstruction Relief)		
Other (South Sudan) / Strengthening food security and nutrition status and improving livelihoods of the most vulnerable population in Eastern Equatioria State	1,970,000.00	80,632.00	Committed	ODA	Grant	Adaptation	Other (Reconstruction Relief)		
Other (South Sudan) / Strengthening of human resilience to impacts of El Niño	2,000,000.00	81,860.00	Committed	ODA	Grant	Adaptation	Other (Reconstruction Relief)		
Sri Lanka / Biogas as a Sustainable Consumption and Production Technology	299,868.00	12,274.00	Committed	ODA	Grant	Mitigation	Energy		
Sri Lanka / Energy recovery of waste in JA ELA , Sri Lanka, with an emphasis on intensive sorting of waste at the system entry	498,000.00	20,383.00	Committed	ODA	Grant	Mitigation	Energy		
Sri Lanka / Reconstruction of basic infrastructure and strengthening resilience after floods	2,500,000.00	102,325.00	Committed	ODA	Grant	Adaptation	Other (Reconstruction Relief)		
Tajikistan / Regional project of the Czech UNDP trust fund	310,250.00	12,699.00	Committed	ODA	Grant	Mitigation	Other (Government and Civil Society)		
Zimbabwe / Improving ICT access by OVC by installing a solar power system at Dzikwa Centre	300,000.00	12,279.00	Committed	ODA	Grant	Mitigation	Energy		

Abbreviations: ODA = official development assistance, OOF = other official flows; USD = United States dollars.

[a] Parties should fill in a separate table for each year, namely 2015 and 2016, where 2018 is the reporting year.

[b] Parties should report, to the extent possible, on details contained in this table.

[c] Parties should explain, in their biennial reports, the methodologies used to specify the funds as disbursed and committed. Parties will provide the information for as many status categories as appropriate in the following order of priority: disbursed and committed.

[d] Parties may select several applicable sectors. Parties may report sectoral distribution, as applicable, under “Other”.

[e] Parties should report, as appropriate, on project details and the implementing agency.

[f] Parties should explain in their biennial reports how they define funds as being climate-specific.

[g] Please specify.

[h] This refers to funding for activities that are cross-cutting across mitigation and adaptation.

CTF Table 8 Provision of technology development and transfer support

No information provided in table 8

CTF Table 9 Provision of capacity-building support

No information provided in table 9

ANNEX 2 Overall inventory of greenhouse gases in the 1990 – 2015 period

1990-1997 period

Sector specific aggregate CO_2 eq. emissions	1990	1991	1992	1993	1994	1995	1996	1997
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	158570	145281	139704	134456	126412	127387	129113	124793
A. Fuel Combustion (Sectoral Approach)	146708	134652	129614	124523	116968	118082	119958	115802
1. Energy Industries	56916	55540	54705	54321	54969	61850	66578	62867
2. Manufacturing Industries and Construction	51234	43482	46354	38583	30860	26178	24625	24608
3. Transport	7284	6390	7973	8076	8812	9355	10366	10602
4. Other Sectors	31274	29240	20582	23543	22327	20699	18390	17725
5. Other	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	11862	10628	10090	9933	9444	9305	9155	8991
1. Solid Fuels	10779	9698	9227	9088	8612	8468	8250	8099
2. Oil and Natural Gas	1082	931	863	845	832	837	905	892
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes	17080	13823	14588	13430	14668	14157	14834	15727
A. Mineral industry	4059	3346	3486	3176	3228	3002	3229	3415
B. Chemical industry	2944	2309	2625	2378	2876	2808	2898	2889
C. Metal industry	9662	7768	8059	7491	8155	7948	8274	8923
D. Non-energy products from fuels and solvent use	126	110	126	93	114	104	90	77
E. Electronic industry	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	1
F. Product uses as ODS substitutes	NO	NO	NO	NO	NO	0	39	121
G. Other product manufacture and use	290	290	291	293	294	295	304	302
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	17050	14776	12837	11358	10315	10246	9978	9593
A. Enteric fermentation	5755	5430	4862	4211	3688	3588	3553	3319
B. Manure management	4211	4017	3701	3364	2962	2797	2806	2704

Sector specific aggregate CO_2 eq. emissions	1990	1991	1992	1993	1994	1995	1996	1997
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	5797	4883	4058	3588	3471	3641	3406	3411
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming	1178	313	108	103	103	110	112	92
H. Urea application	109	132	109	93	91	109	100	67
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	-6488	-9609	-10096	-9693	-7569	-8046	-8394	-7477
A. Forest Land	-4859	-9252	-10858	-9564	-7115	-7117	-7345	-6533
B. Cropland	121	112	115	153	132	128	133	134
C. Grassland	-145	-197	-187	-183	-293	-326	-544	-374
D. Wetlands	22	28	10	9	6	9	12	14
E. Settlements	85	38	63	177	124	91	121	122
F. Other Land	0	0	0	0	0	0	0	0
G. Harvested wood products	-1713	-340	759	-286	-425	-834	-772	-841
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	3127	3270	3279	3361	3510	3518	3529	3620
A. Solid waste disposal	1979	2070	2149	2237	2324	2405	2428	2497
B. Biological treatment of solid waste	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE
C. Incineration and open burning of waste	24	28	33	45	64	72	72	76
D. Waste water treatment and discharge	1124	1172	1097	1079	1122	1041	1028	1047
E. Other	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in Summary 1.A)	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	528	434	502	418	520	563	423	487

Sector specific aggregate CO_2 eq. emissions	1990	1991	1992	1993	1994	1995	1996	1997
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Aviation	528	434	502	418	520	563	423	487
Navigation	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	6445	6548	7286	7039	6709	5787	5822	6448
CO_2 captured	NO	NO	NO	NO	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	15558	16328	17129	17949	18775	19620	20499	21410
Indirect N_2O	1307	1188	1079	1020	667	629	652	692
Indirect CO_2 (3)	2122	2011	1974	1923	1745	1745	1718	1702
Total CO_2 equivalent emissions without land use, land-use change and forestry	195827	177149	170409	162606	154905	155308	157453	153734
Total CO_2 equivalent emissions with land use, land-use change and forestry	189339	167540	160312	152913	147336	147261	149060	146257
Total CO_2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	197949	179160	172383	164529	156650	157053	159171	155436
Total CO_2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	191461	169551	162287	154836	149081	149006	150777	147959

NE – Not Estimated; NA – Not Aplicable; NO – Not Occuring; LULUCF – Land Use, Land Use Change and Forestry *Source: CHMI*

1998-2005 period

Sector specific aggregate CO_2 eq emissions	1998	1999	2000	2001	2002	2003	2004	2005
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	119051	112492	120785	120948	117757	120348	120151	119563
A. Fuel Combustion (Sectoral Approach)	110414	104611	113659	114196	111452	114133	114204	113154

Sector specific aggregate CO_2 eq emissions	1998 (Gg)	1999 (Gg)	2000 (Gg)	2001 (Gg)	2002 (Gg)	2003 (Gg)	2004 (Gg)	2005 (Gg)
1. Energy Industries	60726	58225	62062	64245	62800	62449	62568	63166
2. Manufacturing Industries and Construction	22509	18507	23426	20879	19999	19937	19569	18845
3. Transport	10747	11986	11932	12662	13244	15018	15773	17107
4. Other Sectors	16259	15727	16059	16248	15168	16484	16020	13764
5. Other	173	167	180	161	242	245	273	273
B. Fugitive Emissions from Fuels	8636	7881	7126	6752	6305	6215	5947	6409
1. Solid Fuels	7696	6959	6250	5925	5431	5399	5186	5513
2. Oil and Natural Gas	940	922	876	828	873	816	762	896
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes	15834	13282	14720	13980	13767	14816	15745	14592
A. Mineral industry	3575	3531	3608	3297	3039	3139	3300	3315
B. Chemical industry	3013	2766	2937	2802	2476	2667	3010	2838
C. Metal industry	8643	6363	7435	7035	7269	7864	8195	7103
D. Non-energy products from fuels and solvent use	126	122	149	120	106	115	131	136
E. Electronic industry	1	9	11	21	20	5	4	7
F. Product uses as ODS substitutes	174	197	275	414	538	679	780	877
G. Other product manufacture and use	301	294	306	290	320	347	326	316
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	9203	9272	8976	9082	8855	8389	8583	8257
A. Enteric fermentation	3106	3175	3048	3071	3005	2972	2906	2848
B. Manure management	2597	2631	2510	2449	2427	2374	2273	2178
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	3267	3291	3258	3380	3261	2903	3257	3093
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming	90	87	112	105	99	79	76	64

Sector specific aggregate CO_2 eq emissions	1998 (Gg)	1999 (Gg)	2000 (Gg)	2001 (Gg)	2002 (Gg)	2003 (Gg)	2004 (Gg)	2005 (Gg)
H. Urea application	143	88	48	77	64	61	70	74
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	-7621	-7905	-8805	-9133	-8766	-7266	-7788	-8135
A. Forest Land	-7112	-7048	-7280	-7604	-7331	-5513	-5946	-6407
B. Cropland	258	121	89	56	38	54	45	49
C. Grassland	-309	-408	-497	-500	-513	-514	-532	-527
D. Wetlands	24	25	26	13	33	23	19	21
E. Settlements	184	208	132	112	115	178	178	164
F. Other Land	0	0	0	0	0	0	6	10
G. Harvested wood products	-668	-803	-1278	-1211	-1108	-1495	-1560	-1446
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	3723	3716	3743	3868	3989	4139	4074	4117
A. Solid waste disposal	2566	2637	2682	2745	2806	2879	2835	2867
B. Biological treatment of solid waste	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	4	3	61
C. Incineration and open burning of waste	76	78	64	88	126	196	184	138
D. Waste water treatment and discharge	1081	1002	997	1035	1056	1061	1052	1051
E. Other	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in Summary 1.A)	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	576	542	594	631	545	733	942	979
Aviation	576	542	594	631	545	733	942	979
Navigation	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	6716	7009	6653	7149	7952	7790	8434	8667
CO_2 captured	NO	NO	NO	NO	NO	NO	NO	NO

Sector specific aggregate CO_2 eq emissions	1998	1999	2000	2001	2002	2003	2004	2005
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Long-term storage of C in waste disposal sites	22359	23266	24249	25259	26298	27343	28398	29472
Indirect N_2O	603	558	500	501	487	488	485	476
Indirect CO_2 (3)	1550	1400	1156	1115	1061	1046	1006	1083
Total CO_2 equivalent emissions without land use, land-use change and forestry	147810	138763	148225	147878	144369	147691	148554	146530
Total CO_2 equivalent emissions with land use, land-use change and forestry	140189	130858	139420	138744	135603	140425	140766	138395
Total CO_2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	149361	140163	149380	148993	145430	148738	149560	147613
Total CO_2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	141739	132258	140575	139860	136664	141471	141772	139478

NE – Not Estimated; NA – Not Aplicable; NO – Not Occuring; LULUCF – Land Use, Land Use Change and Forestry *Source: CHMI*

2006-2011 period

Sector specific aggregate CO_2 eq. emissions	2006	2007	2008	2009	2010	2011
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	120251	120821	116012	110540	111262	109071
A. Fuel Combustion (Sectoral Approach)	113615	114638	109875	104811	105470	103315
1. Energy Industries	62615	66264	61533	57477	61621	61881
2. Manufacturing Industries and Construction	18543	16659	16197	15948	12083	11191
3. Transport	17765	18691	18564	18019	17008	16823
4. Other Sectors	14433	12677	13204	13003	14429	13032
5. Other	259	347	377	364	329	387
B. Fugitive Emissions from Fuels	6635	6183	6136	5729	5792	5756

Sector specific aggregate CO_2 eq. emissions	2006 (Gg)	2007 (Gg)	2008 (Gg)	2009 (Gg)	2010 (Gg)	2011 (Gg)
1. Solid Fuels	5735	5287	5312	4861	4894	4917
2. Oil and Natural Gas	900	897	825	868	897	839
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO
2. Industrial Processes	15664	16482	16439	13964	14965	15258
A. Mineral industry	3417	3795	3649	3055	3023	3381
B. Chemical industry	2621	2304	2679	2389	2371	2256
C. Metal industry	7974	8278	7735	6039	6753	6556
D. Non-energy products from fuels and solvent use	140	153	118	105	118	128
E. Electronic industry	26	20	34	43	40	4
F. Product uses as ODS substitutes	1176	1634	1914	2021	2357	2625
G. Other product manufacture and use	310	299	310	311	304	309
H. Other	NO	NO	NO	NO	NO	NO
3. Agriculture	8112	8265	8383	7930	7762	7904
A. Enteric fermentation	2807	2837	2868	2800	2720	2726
B. Manure management	2134	2116	2039	1881	1833	1755
C. Rice cultivation	NO	NO	NO	NO	NO	NO
D. Agricultural soils	3010	3111	3280	3099	3037	3232
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO
G. Liming	78	80	95	64	61	80
H. Urea application	83	122	100	85	111	111
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	-5969	-3760	-6911	-7932	-7200	-8389
A. Forest Land	-3177	-428	-4456	-6433	-5126	-7097
B. Cropland	39	28	46	24	31	86

Sector specific aggregate CO_2 eq. emissions	2006 (Gg)	2007 (Gg)	2008 (Gg)	2009 (Gg)	2010 (Gg)	2011 (Gg)
C. Grassland	-555	-559	-577	-596	-629	-559
D. Wetlands	19	19	20	18	34	37
E. Settlements	129	102	103	115	129	120
F. Other Land	5	14	8	5	7	7
G. Harvested wood products	-2431	-2937	-2057	-1066	-1648	-985
H. Other	NO	NO	NO	NO	NO	NO
5. Waste	4186	4114	4302	4402	4637	4684
A. Solid waste disposal	2899	2871	3010	3112	3224	3256
B. Biological treatment of solid waste	57	79	121	131	203	252
C. Incineration and open burning of waste	173	122	128	115	141	128
D. Waste water treatment and discharge	1057	1041	1043	1044	1069	1048
E. Other	NO	NO	NO	NO	NO	NO
6. Other (as specified in Summary 1.A)	NO	NO	NO	NO	NO	NO
International bunkers	1015	1065	1128	1030	965	957
Aviation	1015	1065	1128	1030	965	957
Navigation	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	9134	9740	10478	11530	12343	13154
CO_2 captured	NO	NO	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	30578	31755	32937	34147	35278	36337
Indirect N_2O	465	462	438	406	391	372
Indirect CO_2 (3)	1097	1049	1027	960	967	946
Total CO_2 equivalent emissions without land use, land-use change and forestry	148212	149683	145135	136836	138626	136918

Sector specific aggregate CO_2 eq. emissions	2006 (Gg)	2007 (Gg)	2008 (Gg)	2009 (Gg)	2010 (Gg)	2011 (Gg)
Total CO_2 equivalent emissions with land use, land-use change and forestry	142243	145923	138225	128904	131426	128529
Total emissions including emissions from LULUCF	149309	150731	146162	137796	139593	137864
Total emissions excluding emissions from LULUCF	143340	146972	139251	129864	132393	129475

2012-2015 period

Sector specific aggregate CO_2 eq. emissions	2012 (Gg)	2013 (Gg)	2014 (Gg)	2015 (Gg)
1. Energy	125009	121830	118038	120486
A. Fuel Combustion (Sectoral Approach)	105816	101510	96619	97974
1. Energy Industries	100276	96939	92105	93586
2. Manufacturing Industries and Construction	59304	56306	53534	53629
3. Transport	10893	10312	9704	9922
4. Other Sectors	16552	16430	16967	17748
5. Other	13211	13581	11582	11907
B. Fugitive Emissions from Fuels	316	309	319	381
1. Solid Fuels	5540	4571	4514	4388
2. Oil and Natural Gas	4856	3937	3882	3774
C. CO_2 transport and storage	684	634	632	613
2. Industrial Processes	NO	NO	NO	NO
A. Mineral industry	15012	14983	15788	15414
B. Chemical industry	3066	2394	2539	2534
C. Metal industry	2357	2094	2373	2071
D. Non-energy products from fuels and solvent use	6391	7065	7207	6896
E. Electronic industry	110	117	117	140
F. Product uses as ODS substitutes	3	17	20	19

Sector specific aggregate CO_2 eq. emissions	2012	2013	2014	2015
	(Gg)	(Gg)	(Gg)	(Gg)
G. Other product manufacture and use	2771	2993	3232	3457
H. Other	313	303	301	298
3. Agriculture	NO	NO	NO	NO
A. Enteric fermentation	7896	8129	8281	8483
B. Manure management	2759	2759	2817	2896
C. Rice cultivation	1718	1759	1753	1779
D. Agricultural soils	NO	NO	NO	NO
E. Prescribed burning of savannas	3168	3350	3503	3458
F. Field burning of agricultural residues	NO	NO	NO	NO
G. Liming	NO	NO	NO	NO
H. Urea application	116	135	150	163
I. Other carbon-containing fertilizers	136	126	57	187
J. Other	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	NO	NO	NO	NO
A. Forest Land	-8553	-7920	-7801	-6641
B. Cropland	-7420	-7384	-7319	-6053
C. Grassland	18	20	17	5
D. Wetlands	-574	-592	-569	-550
E. Settlements	25	31	27	25
F. Other Land	95	89	128	88
G. Harvested wood products	13	42	9	8
H. Other	-710	-127	-94	-164
5. Waste	NO	NO	NO	NO
A. Solid waste disposal	4838	5128	5151	5256
B. Biological treatment of solid waste	3298	3364	3331	3385
C. Incineration and open burning of waste	383	603	649	679
D. Waste water treatment and discharge	127	132	134	135

Sector specific aggregate CO_2 eq. emissions	2012 (Gg)	2013 (Gg)	2014 (Gg)	2015 (Gg)
E. Other	1029	1029	1037	1058
6. Other (as specified in Summary 1.A)	NO	NO	NO	NO
International bunkers	892	860	883	895
Aviation	892	860	883	895
Navigation	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO
CO_2 emissions from biomass	13993	14976	15726	16194
CO_2 captured	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	37327	38284	39197	40085
Indirect N_2O	353	335	319	309
Indirect CO_2 (3)	904	811	778	799
Total CO_2 equivalent emissions without land use, land-use change and forestry	133561	129750	125839	127127
Total CO_2 equivalent emissions with land use, land-use change and forestry	125009	121830	118038	120486
Total emissions including emissions from LULUCF	134466	130561	126616	127926
Total emissions excluding emissions from LULUCF	125913	122641	118815	121285

NE – Not Estimated; NA – Not Aplicable; NO – Not Occuring; LULUCF – Land Use, Land Use Change and Forestry *Source: CHMI*

1990-1997 period

Sector specific aggregate CO_2 emissions	1990	1991	1992	1993	1994	1995	1996	1997
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	144726	132820	127970	122950	115488	116679	118482	114389
A. Fuel Combustion (Sectoral Approach)	144268	132421	127574	122572	115121	116317	118132	114044
1. Energy Industries	56654	55285	54453	54069	54713	61561	66272	62578
2. Manufacturing Industries and Construction	50930	43223	46079	38356	30667	26030	24483	24467
3. Transport	7032	6163	7709	7809	8510	9022	9982	10202
4. Other Sectors	29651	27750	19332	22337	21231	19705	17395	16798
5. Other	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	458	398	396	378	368	362	350	345
1. Solid Fuels	456	395	393	373	363	356	344	338
2. Oil and Natural Gas	2	3	3	5	5	6	6	7
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes	15614	12743	13330	12380	13414	12767	13436	14217
A. Mineral industry	4059	3346	3486	3176	3228	3002	3229	3415
B. Chemical industry	1783	1533	1665	1626	1923	1726	1855	1814
C. Metal industry	9647	7754	8053	7485	8148	7936	8262	8912
D. Non-energy products from fuels and solvent use	126	110	126	93	114	104	90	77
E. Electronic industry								
F. Product uses as ODS substitutes								
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	1286	445	217	196	194	220	213	160
A. Enteric fermentation								
B. Manure management								
C. Rice cultivation								
D. Agricultural soils								

Sector specific aggregate CO_2 emissions	1990	1991	1992	1993	1994	1995	1996	1997
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
E. Prescribed burning of savannas								
F. Field burning of agricultural residues								
G. Liming	1178	313	108	103	103	110	112	92
H. Urea application	109	132	109	93	91	109	100	67
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	-6626	-9714	-10206	-9817	-7696	-8165	-8546	-7639
A. Forest Land	-4986	-9346	-10957	-9679	-7233	-7228	-7491	-6690
B. Cropland	112	104	106	145	124	121	128	130
C. Grassland	-145	-197	-187	-183	-293	-326	-544	-374
D. Wetlands	22	28	10	9	6	9	12	14
E. Settlements	85	38	63	177	124	91	121	122
F. Other Land	0	0	0	0	0	0	0	0
G. Harvested wood products	-1713	-340	759	-286	-425	-834	-772	-841
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	23	28	33	44	63	71	71	74
A. Solid waste disposal	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
B. Biological treatment of solid waste								
C. Incineration and open burning of waste	23	28	33	44	63	71	71	74
D. Waste water treatment and discharge								
E. Other	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in Summary 1.A)	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	524	430	498	414	515	558	419	483
Aviation	524	430	498	414	515	558	419	483
Navigation	NO	NO	NO	NO	NO	NO	NO	NO

Sector specific aggregate CO_2 emissions	1990	1991	1992	1993	1994	1995	1996	1997
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	6445	6548	7286	7039	6709	5787	5822	6448
CO_2 captured	NO	NO	NO	NO	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	15558	16328	17129	17949	18775	19620	20499	21410
Indirect N_2O								
Indirect CO_2 (3)	2122	2011	1974	1923	1745	1745	1718	1702
Total CO_2 emissions without land use, land-use change and forestry	161650	146035	141549	135570	129160	129737	132202	128840
Total CO_2 emissions with land use, land-use change and forestry	155024	136321	131344	125753	121464	121572	123656	121201
Total CO_2 emissions, including indirect CO2, without land use, land-use change and forestry	163771	148047	143524	137493	130905	131482	133919	130542
Total CO_2 emissions, including indirect CO2, with land use, land-use change and forestry	157146	138332	133318	127676	123209	123317	125373	122902

NE – Not Estimated; NA – Not Aplicable; NO – Not Occuring; LULUCF – Land Use, Land Use Change and Forestry *Source: CHMI*

1998-2005 period

Sector specific aggregate CO_2 emissions	1998	1999	2000	2001	2002	2003	2004	2005
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	109145	103357	112532	113051	110313	112924	112959	111920
A. Fuel Combustion (Sectoral Approach)	108805	103043	112210	112719	109979	112601	112644	111606
1. Energy Industries	60443	57953	61773	63945	62506	62149	62263	62871
2. Manufacturing Industries and Construction	22383	18400	23293	20762	19875	19822	19453	18715
3. Transport	10324	11512	11650	12368	12938	14676	15416	16722

Sector specific aggregate CO_2 emissions	1998 (Gg)	1999 (Gg)	2000 (Gg)	2001 (Gg)	2002 (Gg)	2003 (Gg)	2004 (Gg)	2005 (Gg)
4. Other Sectors	15486	15014	15317	15487	14425	15716	15247	13033
5. Other	170	164	177	158	234	238	265	265
B. Fugitive Emissions from Fuels	340	314	322	332	334	323	314	314
1. Solid Fuels	333	306	315	324	323	310	302	301
2. Oil and Natural Gas	7	8	7	8	11	13	13	13
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes	14194	11808	13033	12168	11938	12837	13554	12366
A. Mineral industry	3575	3531	3608	3297	3039	3139	3300	3315
B. Chemical industry	1861	1802	1853	1727	1536	1731	1941	1824
C. Metal industry	8631	6352	7424	7023	7257	7852	8182	7091
D. Non-energy products from fuels and solvent use	126	122	149	120	106	115	131	136
E. Electronic industry								
F. Product uses as ODS substitutes								
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	233	175	160	182	163	140	146	138
A. Enteric fermentation								
B. Manure management								
C. Rice cultivation								
D. Agricultural soils								
E. Prescribed burning of savannas								
F. Field burning of agricultural residues								
G. Liming	90	87	112	105	99	79	76	64
H. Urea application	143	88	48	77	64	61	70	74
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO

Sector specific aggregate CO_2 emissions	1998	1999	2000	2001	2002	2003	2004	2005
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
4. Land Use, Land-Use Change and Forestry	-7766	-8039	-8928	-9261	-8902	-7436	-7944	-8284
A. Forest Land	-7249	-7176	-7396	-7726	-7462	-5676	-6095	-6550
B. Cropland	252	115	84	51	33	49	40	44
C. Grassland	-309	-408	-497	-500	-513	-514	-532	-527
D. Wetlands	24	25	26	13	33	23	19	21
E. Settlements	184	208	132	112	115	178	178	164
F. Other Land	0	0	0	0	0	0	6	10
G. Harvested wood products	-668	-803	-1278	-1211	-1108	-1495	-1560	-1446
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	75	76	63	86	124	192	180	135
A. Solid waste disposal	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
B. Biological treatment of solid waste								
C. Incineration and open burning of waste	75	76	63	86	124	192	180	135
D. Waste water treatment and discharge								
E. Other	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in Summary 1.A)	NO	NO	NO	NO	NO	NO	NO	NO
International bunkers	571	538	589	626	540	727	934	970
Aviation	571	538	589	626	540	727	934	970
Navigation	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	6716	7009	6653	7149	7952	7790	8434	8667
CO_2 captured	NO	NO	NO	NO	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	22359	23266	24249	25259	26298	27343	28398	29472
Indirect N_2O								

Sector specific aggregate CO_2 emissions	1998 (Gg)	1999 (Gg)	2000 (Gg)	2001 (Gg)	2002 (Gg)	2003 (Gg)	2004 (Gg)	2005 (Gg)
Indirect CO_2 [(3)]	1550	1400	1156	1115	1061	1046	1006	1083
Total CO_2 emissions without land use, land-use change and forestry	123647	115416	125788	125486	122538	126093	126839	124559
Total CO_2 emissions with land use, land-use change and forestry	115881	107378	116860	116226	113635	118657	118895	116275
Total CO_2 emissions, including indirect CO2, without land use, land-use change and forestry	125197	116817	126944	126602	123599	127139	127845	125642
Total CO_2 emissions, including indirect CO2, with land use, land-use change and forestry	117432	108778	118015	117341	114697	119703	119902	117359

NE – Not Estimated; NA – Not Aplicable; NO – Not Occuring; LULUCF – Land Use, Land Use Change and Forestry *Source: CHMI*

2006-2011 period

Sector specific aggregate CO_2 emissions	2006 (Gg)	2007 (Gg)	2008 (Gg)	2009 (Gg)	2010 (Gg)	2011 (Gg)
1. Energy	112335	113330	108553	103417	104043	101901
A. Fuel Combustion (Sectoral Approach)	111999	113027	108255	103157	103777	101638
1. Energy Industries	62321	65949	61236	57193	61314	61570
2. Manufacturing Industries and Construction	18413	16537	16075	15822	11993	11103
3. Transport	17370	18276	18148	17616	16626	16443
4. Other Sectors	13645	11928	12431	12173	13525	12147
5. Other	252	336	365	353	319	375
B. Fugitive Emissions from Fuels	336	303	298	259	267	262
1. Solid Fuels	325	293	288	250	259	255
2. Oil and Natural Gas	11	10	10	9	7	7
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO

Sector specific aggregate CO_2 emissions	2006 (Gg)	2007 (Gg)	2008 (Gg)	2009 (Gg)	2010 (Gg)	2011 (Gg)
2. Industrial Processes	13223	13751	13442	11005	11805	11820
A. Mineral industry	3417	3795	3649	3055	3023	3381
B. Chemical industry	1706	1537	1951	1814	1921	1767
C. Metal industry	7961	8266	7725	6031	6743	6545
D. Non-energy products from fuels and solvent use	140	153	118	105	118	128
E. Electronic industry						
F. Product uses as ODS substitutes						
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO
H. Other	NO	NO	NO	NO	NO	NO
3. Agriculture	160	202	195	149	173	191
A. Enteric fermentation						
B. Manure management						
C. Rice cultivation						
D. Agricultural soils						
E. Prescribed burning of savannas						
F. Field burning of agricultural residues						
G. Liming	78	80	95	64	61	80
H. Urea application	83	122	100	85	111	111
I. Other carbon-containing fertilizers	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	-6152	-3996	-7099	-8092	-7368	-8467
A. Forest Land	-3354	-658	-4638	-6587	-5288	-7168
B. Cropland	34	23	42	19	26	80
C. Grassland	-555	-559	-577	-596	-629	-559
D. Wetlands	19	19	20	18	34	37
E. Settlements	129	102	103	115	129	120

Sector specific aggregate CO_2 emissions	2006	2007	2008	2009	2010	2011
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
F. Other Land	5	14	8	5	7	7
G. Harvested wood products	-2431	-2937	-2057	-1066	-1648	-985
H. Other	NO	NO	NO	NO	NO	NO
5. Waste	170	120	126	113	139	126
A. Solid waste disposal	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
B. Biological treatment of solid waste						
C. Incineration and open burning of waste	170	120	126	113	139	126
D. Waste water treatment and discharge						
E. Other	NO	NO	NO	NO	NO	NO
6. Other (as specified in Summary 1.A)	NO	NO	NO	NO	NO	NO
International bunkers	1006	1056	1119	1022	957	949
Aviation	1006	1056	1119	1022	957	949
Navigation	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass	9134	9740	10478	11530	12343	13154
CO_2 captured	NO	NO	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	30578	31755	32937	34147	35278	36337
Indirect N_2O						
Indirect CO_2 (3)	1097	1049	1027	960	967	946
Total CO_2 emissions without land use, land-use change and forestry	125889	127403	122316	114684	116159	114038
Total CO_2 emissions with land use, land-use change and forestry	119737	123407	115217	106592	108791	105571
Total emissions including emissions from LULUCF	126986	128452	123343	115644	117127	114984

Sector specific aggregate CO_2 emissions	2006 (Gg)	2007 (Gg)	2008 (Gg)	2009 (Gg)	2010 (Gg)	2011 (Gg)
Total emissions excluding emissions from LULUCF	120834	124456	116244	107552	109758	106517

2012-2015 period

Sector specific aggregate CO_2 emissions	2012 (Gg)	2013 (Gg)	2014 (Gg)	2015 (Gg)
1. Energy	98833	95388	90622	92052
A. Fuel Combustion (Sectoral Approach)	98568	95187	90419	91858
1. Energy Industries	59002	56018	53256	53347
2. Manufacturing Industries and Construction	10806	10225	9614	9828
3. Transport	16177	16056	16581	17344
4. Other Sectors	12277	12587	10659	10970
5. Other	306	300	309	369
B. Fugitive Emissions from Fuels	266	201	203	194
1. Solid Fuels	259	195	197	189
2. Oil and Natural Gas	7	6	6	5
C. CO_2 transport and storage	NO	NO	NO	NO
2. Industrial Processes	11411	11324	11838	11236
A. Mineral industry	3066	2394	2539	2534
B. Chemical industry	1855	1761	1989	1680
C. Metal industry	6379	7052	7193	6883
D. Non-energy products from fuels and solvent use	110	117	117	140
E. Electronic industry				
F. Product uses as ODS substitutes				
G. Other product manufacture and use	NO	NO	NO	NO
H. Other	NO	NO	NO	NO
3. Agriculture	251	261	207	350

Sector specific aggregate CO_2 emissions	2012 (Gg)	2013 (Gg)	2014 (Gg)	2015 (Gg)
A. Enteric fermentation				
B. Manure management				
C. Rice cultivation				
D. Agricultural soils				
E. Prescribed burning of savannas				
F. Field burning of agricultural residues				
G. Liming	116	135	150	163
H. Urea application	136	126	57	187
I. Other carbon-containing fertilizers	NO	NO	NO	NO
J. Other	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	-8636	-7998	-7887	-6735
A. Forest Land	-7497	-7455	-7398	-6141
B. Cropland	13	15	12	0
C. Grassland	-574	-592	-569	-550
D. Wetlands	25	31	27	25
E. Settlements	95	89	128	88
F. Other Land	13	42	9	8
G. Harvested wood products	-710	-127	-94	-164
H. Other	NO	NO	NO	NO
5. Waste	125	130	132	132
A. Solid waste disposal	NE,NO	NE,NO	NE,NO	NE,NO
B. Biological treatment of solid waste				
C. Incineration and open burning of waste	125	130	132	132
D. Waste water treatment and discharge				
E. Other	NO	NO	NO	NO
6. Other (as specified in Summary 1.A)	NO	NO	NO	NO

Sector specific aggregate CO_2 emissions	2012 (Gg)	2013 (Gg)	2014 (Gg)	2015 (Gg)
International bunkers	884	853	875	887
Aviation	884	853	875	887
Navigation	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO
CO_2 emissions from biomass	13993	14976	15726	16194
CO_2 captured	NO	NO	NO	NO
Long-term storage of C in waste disposal sites	37327	38284	39197	40085
Indirect N_2O				
Indirect CO_2 (3)	904	811	778	799
Total CO_2 emissions without land use, land-use change and forestry	110621	107103	102799	103770
Total CO_2 emissions with land use, land-use change and forestry	101985	99105	94912	97034
Total emissions including emissions from LULUCF	111526	107914	103577	104568
Total emissions excluding emissions from LULUCF	102890	99916	95690	97833

NE – Not Estimated; NA – Not Aplicable; NO – Not Occuring; LULUCF – Land Use, Land Use Change and Forestry *Source: CHMI*

1990-1997 period

Sector specific aggregate CH_4 emissions	1990 (Gg)	1991 (Gg)	1992 (Gg)	1993 (Gg)	1994 (Gg)	1995 (Gg)	1996 (Gg)	1997 (Gg)
1. Energy	520.95	468.20	439.06	430.57	407.31	397.90	392.89	383.83
A. Fuel Combustion (Sectoral Approach)	64.82	58.98	51.31	48.37	44.28	40.20	40.71	37.96
1. Energy Industries	0.66	0.65	0.65	0.66	0.69	0.77	0.86	0.85
2. Manufacturing Industries and Construction	4.33	3.72	3.95	3.27	2.79	2.14	2.06	2.06
3. Transport	1.54	1.39	1.79	1.71	1.84	1.85	1.95	1.92
4. Other Sectors	58.28	53.22	44.92	42.73	38.96	35.43	35.84	33.13
5. Other	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	456.12	409.22	387.75	382.20	363.04	357.71	352.18	345.87
1. Solid Fuels	412.93	372.10	353.38	348.58	329.97	324.47	316.24	310.45
2. Oil and Natural Gas	43.20	37.11	34.37	33.62	33.07	33.23	35.94	35.42
C. CO_2 transport and storage								
2. Industrial Processes	2.05	1.68	1.52	1.52	1.73	1.91	1.95	1.95
A. Mineral industry								
B. Chemical industry	1.45	1.14	1.26	1.28	1.45	1.40	1.46	1.48
C. Metal industry	0.60	0.54	0.26	0.24	0.28	0.50	0.50	0.47
D. Non-energy products from fuels and solvent use	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
E. Electronic industry								
F. Product uses as ODS substitutes								
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	300.28	284.11	257.03	226.34	198.23	191.87	189.03	177.68
A. Enteric fermentation	230.20	217.21	194.47	168.45	147.52	143.53	142.13	132.74
B. Manure management	70.08	66.90	62.56	57.89	50.71	48.34	46.90	44.94
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming								
H. Urea application								
I. Other carbon-containing fertilizers								
J. Other	NO	NO	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	4.69	3.50	3.67	4.24	4.37	4.10	5.39	5.82
A. Forest Land	4.69	3.50	3.67	4.24	4.37	4.10	5.39	5.82
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products								
H. Other	NO	NO	NO	NO	NO	NO	NO	NO

Sector specific aggregate CH_4 emissions	1990 (Gg)	1991 (Gg)	1992 (Gg)	1993 (Gg)	1994 (Gg)	1995 (Gg)	1996 (Gg)	1997 (Gg)
5. Waste	114.76	121.46	122.13	124.45	130.02	129.62	129.82	133.57
A. Solid waste disposal	79.17	82.79	85.97	89.48	92.95	96.20	97.12	99.89
B. Biological treatment of solid waste	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE
C. Incineration and open burning of waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Waste water treatment and discharge	35.59	38.67	36.16	34.97	37.07	33.42	32.70	33.68
E. Other	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in Summary 1.A)	NO	NO	NO	NO	NO	NO	NO	NO
Total CH_4 emissions without land use, land-use change and forestry	938.03	875.45	819.74	782.88	737.30	721.30	713.70	697.03
Total CH_4 emissions with land use, land-use change and forestry	942.73	878.95	823.42	787.12	741.67	725.40	719.09	702.85
International bunkers	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aviation	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Navigation	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass								
CO_2 captured								
Long-term storage of C in waste disposal sites								
Indirect N_2O								
Indirect CO_2 (3)								

NE – Not Estimated; NA – Not Aplicable; NO – Not Occuring; LULUCF – Land Use, Land Use Change and Forestry *Source: CHMI*

1998-2005 period

Sector specific aggregate CH_4 emissions	1998 (Gg)	1999 (Gg)	2000 (Gg)	2001 (Gg)	2002 (Gg)	2003 (Gg)	2004 (Gg)	2005 (Gg)
1. Energy	363.56	331.71	302.38	287.64	269.05	266.68	256.40	273.41
A. Fuel Combustion (Sectoral Approach)	31.72	29.04	30.23	30.81	30.22	30.99	31.08	29.60
1. Energy Industries	0.88	0.86	0.86	0.90	0.90	1.03	1.11	0.91
2. Manufacturing Industries and Construction	1.84	1.56	1.93	1.72	1.83	1.68	1.70	1.92
3. Transport	1.80	1.86	1.72	1.72	1.67	1.72	1.63	1.57
4. Other Sectors	27.19	24.75	25.69	26.45	25.80	26.54	26.61	25.17
5. Other	0.01	0.01	0.02	0.02	0.03	0.03	0.03	0.03
B. Fugitive Emissions from Fuels	331.84	302.67	272.14	256.83	238.83	235.68	225.32	243.81
1. Solid Fuels	294.53	266.11	237.38	224.04	204.34	203.56	195.36	208.50
2. Oil and Natural Gas	37.31	36.56	34.76	32.80	34.49	32.12	29.95	35.31
C. CO_2 transport and storage								
2. Industrial Processes	2.11	2.15	2.13	2.23	2.15	2.10	2.59	2.59
A. Mineral industry								
B. Chemical industry	1.63	1.72	1.68	1.76	1.68	1.63	2.08	2.12

Sector specific aggregate CH_4 emissions	1998	1999	2000	2001	2002	2003	2004	2005
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
C. Metal industry	0.48	0.43	0.45	0.47	0.47	0.47	0.51	0.47
D. Non-energy products from fuels and solvent use	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
E. Electronic industry								
F. Product uses as ODS substitutes								
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	167.92	171.31	165.10	165.45	163.87	162.52	157.83	153.73
A. Enteric fermentation	124.23	126.99	121.93	122.85	120.21	118.87	116.25	113.94
B. Manure management	43.68	44.32	43.17	42.60	43.65	43.65	41.58	39.80
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming								
H. Urea application								
I. Other carbon-containing fertilizers								
J. Other	NO	NO	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	5.08	4.70	4.32	4.49	4.83	6.05	5.54	5.29
A. Forest Land	5.08	4.70	4.32	4.49	4.83	6.05	5.54	5.29
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products								
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	137.36	137.51	139.23	143.09	146.40	149.64	147.24	149.53
A. Solid waste disposal	102.65	105.48	107.27	109.78	112.26	115.14	113.40	114.69
B. Biological treatment of solid waste	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	0.14	0.12	1.47
C. Incineration and open burning of waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Waste water treatment and discharge	34.71	32.04	31.96	33.30	34.14	34.35	33.72	33.37
E. Other	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in Summary 1.A)	NO	NO	NO	NO	NO	NO	NO	NO
Total CH_4 emissions without land use, land-use change and forestry	670.94	642.68	608.84	598.41	581.47	580.94	564.05	579.26
Total CH_4 emissions with land use, land-use change and forestry	676.03	647.38	613.16	602.90	586.30	586.98	569.59	584.55
International bunkers	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Aviation	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.01
Navigation	NO	NO	NO	NO	NO	NO	NO	NO

Sector specific aggregate CH_4 emissions	1998	1999	2000	2001	2002	2003	2004	2005
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass								
CO_2 captured								
Long-term storage of C in waste disposal sites								
Indirect N_2O								
Indirect CO_2 (3)								

NE – Not Estimated; NA – Not Aplicable; NO – Not Occuring; LULUCF – Land Use, Land Use Change and Forestry *Source: CHMI*

2006-2013 period

Sector specific aggregate CH_4 emissions	2006	2007	2008	2009	2010	2011	2012	2013
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	283.63	265.31	264.36	251.64	256.03	254.02	246.90	212.89
A. Fuel Combustion (Sectoral Approach)	31.66	30.11	30.82	32.87	35.04	34.26	35.94	38.09
1. Energy Industries	0.92	1.01	1.03	1.06	1.19	1.24	1.27	1.24
2. Manufacturing Industries and Construction	1.95	1.81	1.82	1.87	1.35	1.35	1.33	1.33
3. Transport	1.49	1.47	1.36	1.23	1.08	1.01	0.96	0.94
4. Other Sectors	27.27	25.79	26.57	28.68	31.39	30.62	32.36	34.55
5. Other	0.03	0.04	0.04	0.04	0.03	0.04	0.03	0.03
B. Fugitive Emissions from Fuels	251.97	235.20	233.53	218.77	220.99	219.76	210.96	174.79
1. Solid Fuels	216.40	199.75	200.95	184.42	185.40	186.48	183.85	149.68
2. Oil and Natural Gas	35.57	35.45	32.59	34.35	35.59	33.28	27.11	25.12
C. CO_2 transport and storage								
2. Industrial Processes	2.53	2.31	2.40	2.19	2.37	2.25	2.45	2.38
A. Mineral industry								
B. Chemical industry	1.99	1.83	2.00	1.85	1.97	1.81	1.97	1.85
C. Metal industry	0.54	0.48	0.40	0.34	0.40	0.45	0.49	0.53
D. Non-energy products from fuels and solvent use	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
E. Electronic industry								
F. Product uses as ODS substitutes								
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	151.64	152.58	151.98	145.67	141.24	139.88	140.21	140.69
A. Enteric fermentation	112.26	113.46	114.74	111.99	108.80	109.04	110.34	110.34
B. Manure management	39.38	39.12	37.24	33.68	32.44	30.84	29.87	30.34
C. Rice cultivation	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural soils	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming								

Sector specific aggregate CH_4 emissions	2006 (Gg)	2007 (Gg)	2008 (Gg)	2009 (Gg)	2010 (Gg)	2011 (Gg)	2012 (Gg)	2013 (Gg)
H. Urea application								
I. Other carbon-containing fertilizers								
J. Other	NO	NO	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	6.55	8.51	6.73	5.68	6.00	2.65	2.85	2.64
A. Forest Land	6.55	8.51	6.73	5.68	6.00	2.65	2.85	2.64
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products								
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	151.33	150.19	157.06	162.16	170.06	173.03	179.52	190.68
A. Solid waste disposal	115.95	114.85	120.39	124.46	128.96	130.22	131.90	134.56
B. Biological treatment of solid waste	1.46	2.09	3.30	4.23	6.67	9.03	14.25	22.84
C. Incineration and open burning of waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Waste water treatment and discharge	33.92	33.25	33.37	33.47	34.42	33.78	33.37	33.29
E. Other	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in Summary 1.A)	NO	NO	NO	NO	NO	NO	NO	NO
Total CH_4 emissions without land use, land-use change and forestry	589.13	570.39	575.80	561.67	569.71	569.18	569.08	546.63
Total CH_4 emissions with land use, land-use change and forestry	595.68	578.90	582.53	567.35	575.70	571.83	571.93	549.26
International bunkers	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Aviation	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Navigation	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass								
CO_2 captured								
Long-term storage of C in waste disposal sites								
Indirect N_2O								
Indirect CO_2 [(3)]								

2014-2015 period

Sector specific aggregate CH_4 emissions	2014 (Gg)	2015 (Gg)
1. Energy	207.87	203.88
A. Fuel Combustion (Sectoral Approach)	35.44	36.13

Sector specific aggregate CH_4 emissions	2014 (Gg)	2015 (Gg)
1. Energy Industries	1.24	1.31
2. Manufacturing Industries and Construction	1.37	1.43
3. Transport	0.97	1.03
4. Other Sectors	31.83	32.32
5. Other	0.03	0.04
B. Fugitive Emissions from Fuels	172.43	167.75
1. Solid Fuels	147.41	143.43
2. Oil and Natural Gas	25.02	24.32
C. CO_2 transport and storage		
2. Industrial Processes	2.67	2.01
A. Mineral industry		
B. Chemical industry	2.13	1.47
C. Metal industry	0.54	0.54
D. Non-energy products from fuels and solvent use	NA,NO	NO,NA
E. Electronic industry		
F. Product uses as ODS substitutes		
G. Other product manufacture and use	NO	NO
H. Other	NO	NO
3. Agriculture	143.23	146.70
A. Enteric fermentation	112.69	115.84
B. Manure management	30.54	30.86
C. Rice cultivation	NO	NO
D. Agricultural soils	NA,NE	NA,NE
E. Prescribed burning of savannas	NO	NO
F. Field burning of agricultural residues	NO	NO
G. Liming		
H. Urea application		
I. Other carbon-containing fertilizers		
J. Other	NO	NO
4. Land Use, Land-Use Change and Forestry	2.94	3.28
A. Forest Land	2.94	3.28
B. Cropland	NO	NO
C. Grassland	NO	NO
D. Wetlands	NO	NO
E. Settlements	NO,NA	NO,NA
F. Other Land	NO	NO
G. Harvested wood products		
H. Other	NO	NO
5. Waste	191.36	195.19
A. Solid waste disposal	133.23	135.41
B. Biological treatment of solid waste	24.51	25.36

Sector specific aggregate CH_4 emissions	2014	2015
	(Gg)	(Gg)
C. Incineration and open burning of waste	0.00	0.00
D. Waste water treatment and discharge	33.62	34.42
E. Other	NO	NO
6. Other (as specified in Summary 1.A)	NO	NO
Total CH_4 emissions without land use, land-use change and forestry	545.13	547.78
Total CH_4 emissions with land use, land-use change and forestry	548.07	551.06
International bunkers	0.01	0.01
Aviation	0.01	0.01
Navigation	NO	NO
Multilateral operations	NO	NO
CO_2 emissions from biomass		
CO_2 captured		
Long-term storage of C in waste disposal sites		
Indirect N_2O		
Indirect CO_2 [(3)]		

NE – Not Estimated; NA – Not Aplicable; NO – Not Occuring; LULUCF – Land Use, Land Use Change and Forestry *Source: CHMI*

1990-1997 period

Sector specific aggregate N_2O emissions	1990 (Gg)	1991 (Gg)	1992 (Gg)	1993 (Gg)	1994 (Gg)	1995 (Gg)	1996 (Gg)	1997 (Gg)
1. Energy	2.75	2.54	2.54	2.49	2.48	2.55	2.71	2.71
A. Fuel Combustion (Sectoral Approach)	2.75	2.54	2.54	2.49	2.48	2.55	2.71	2.71
1. Energy Industries	0.82	0.80	0.79	0.79	0.80	0.91	0.95	0.90
2. Manufacturing Industries and Construction	0.66	0.56	0.59	0.49	0.41	0.32	0.30	0.30
3. Transport	0.72	0.65	0.74	0.75	0.86	0.96	1.12	1.18
4. Other Sectors	0.56	0.53	0.43	0.46	0.41	0.37	0.33	0.33
5. Other	NO	NO	NO	NO	NO	NO	NO	NO
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. CO_2 transport and storage								
2. Industrial Processes	4.47	3.20	3.81	3.11	3.77	4.21	4.07	4.18
A. Mineral industry								
B. Chemical industry	3.77	2.51	3.12	2.41	3.08	3.51	3.38	3.48
C. Metal industry	NA	NA	NA	NA	NA	NA	NA	NA
D. Non-energy products from fuels and solvent use	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
E. Electronic industry								
F. Product uses as ODS substitutes								
G. Other product manufacture and use	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	27.71	24.25	20.79	18.47	17.33	17.55	16.91	16.75
A. Enteric fermentation								
B. Manure management	8.25	7.87	7.17	6.43	5.68	5.33	5.48	5.30
C. Rice cultivation								
D. Agricultural soils	19.45	16.39	13.62	12.04	11.65	12.22	11.43	11.45
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming								
H. Urea application								
I. Other carbon-containing fertilizers								
J. Other	NO	NO	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	0.07	0.06	0.06	0.06	0.06	0.05	0.06	0.06
A. Forest Land	0.03	0.02	0.03	0.03	0.03	0.03	0.04	0.04
B. Cropland	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02
C. Grassland	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products								
H. Other	NO	NO	NO	NO	NO	NO	NO	NO

Sector specific aggregate N_2O emissions	1990	1991	1992	1993	1994	1995	1996	1997
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
5. Waste	0.79	0.69	0.65	0.69	0.66	0.69	0.71	0.69
A. Solid waste disposal								
B. Biological treatment of solid waste	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE
C. Incineration and open burning of waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
D. Waste water treatment and discharge	0.79	0.69	0.65	0.69	0.65	0.69	0.71	0.69
E. Other	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in Summary 1.A)	NO	NO	NO	NO	NO	NO	NO	NO
Total N_2O emissions without land use, land-use change and forestry	35.71	30.68	27.79	24.76	24.25	25.00	24.40	24.33
Total N_2O emissions with land use, land-use change and forestry	35.78	30.74	27.85	24.82	24.31	25.05	24.46	24.39
International bunkers	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
Aviation	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
Navigation	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass								
CO_2 captured								
Long-term storage of C in waste disposal sites								
Indirect N_2O	4.39	3.99	3.62	3.42	2.24	2.11	2.19	2.32
Indirect CO_2 (3)								

NE – Not Estimated; NA – Not Aplicable; NO – Not Occuring; LULUCF – Land Use, Land Use Change and Forestry *Source: CHMI*

1998-2005 period

Sector specific aggregate N_2O emissions	1998	1999	2000	2001	2002	2003	2004	2005
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	2.74	2.83	2.33	2.37	2.41	2.54	2.63	2.71
A. Fuel Combustion (Sectoral Approach)	2.74	2.83	2.33	2.37	2.41	2.54	2.63	2.71
1. Energy Industries	0.88	0.84	0.90	0.93	0.91	0.92	0.93	0.91
2. Manufacturing Industries and Construction	0.27	0.23	0.28	0.25	0.26	0.24	0.25	0.27
3. Transport	1.27	1.43	0.80	0.84	0.89	1.00	1.06	1.16
4. Other Sectors	0.31	0.32	0.34	0.34	0.33	0.35	0.36	0.34
5. Other	0.01	0.01	0.01	0.01	0.02	0.02	0.02	0.03
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. CO_2 transport and storage								
2. Industrial Processes	4.42	3.78	4.19	4.15	3.70	3.70	4.10	3.92
A. Mineral industry								
B. Chemical industry	3.73	3.09	3.50	3.46	3.01	3.00	3.41	3.23

Sector specific aggregate N_2O emissions	1998 (Gg)	1999 (Gg)	2000 (Gg)	2001 (Gg)	2002 (Gg)	2003 (Gg)	2004 (Gg)	2005 (Gg)
C. Metal industry	NA	NA	NA	NA	NA	NA	NA	NA
D. Non-energy products from fuels and solvent use	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
E. Electronic industry								
F. Product uses as ODS substitutes								
G. Other product manufacture and use	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	16.01	16.15	15.73	15.99	15.42	14.05	15.07	14.35
A. Enteric fermentation								
B. Manure management	5.05	5.11	4.80	4.64	4.48	4.31	4.14	3.97
C. Rice cultivation								
D. Agricultural soils	10.96	11.04	10.93	11.34	10.94	9.74	10.93	10.38
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming								
H. Urea application								
I. Other carbon-containing fertilizers								
J. Other	NO	NO	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	0.06	0.05	0.05	0.05	0.05	0.06	0.06	0.06
A. Forest Land	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04
B. Cropland	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
C. Grassland	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products								
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	0.72	0.68	0.67	0.69	0.69	0.69	0.71	0.82
A. Solid waste disposal								
B. Biological treatment of solid waste	NE,IE	NE,IE	NE,IE	NE,IE	NE,IE	NE,NO,IE	NE,NO,IE	0.08
C. Incineration and open burning of waste	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01
D. Waste water treatment and discharge	0.72	0.67	0.66	0.68	0.68	0.68	0.70	0.73
E. Other	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in Summary 1.A)	NO	NO	NO	NO	NO	NO	NO	NO
Total N_2O emissions without land use, land-use change and forestry	23.89	23.44	22.92	23.19	22.22	20.98	22.52	21.80
Total N_2O emissions with land use, land-use change and forestry	23.95	23.50	22.97	23.25	22.28	21.04	22.57	21.85
International bunkers	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03
Aviation	0.02	0.02	0.02	0.02	0.02	0.02	0.03	0.03
Navigation	NO	NO	NO	NO	NO	NO	NO	NO

Sector specific aggregate N_2O emissions	1998 (Gg)	1999 (Gg)	2000 (Gg)	2001 (Gg)	2002 (Gg)	2003 (Gg)	2004 (Gg)	2005 (Gg)
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass								
CO_2 captured								
Long-term storage of C in waste disposal sites								
Indirect N_2O	2.02	1.87	1.68	1.68	1.63	1.64	1.63	1.60
Indirect CO_2 (3)								

NE – Not Estimated; NA – Not Aplicable; NO – Not Occuring; LULUCF – Land Use, Land Use Change and Forestry *Source: CHMI*

2006-2013 period

Sector specific aggregate N_2O emissions	2006 (Gg)	2007 (Gg)	2008 (Gg)	2009 (Gg)	2010 (Gg)	2011 (Gg)	2012 (Gg)	2013 (Gg)
1. Energy	2.77	2.88	2.85	2.79	2.74	2.75	2.72	2.68
A. Fuel Combustion (Sectoral Approach)	2.77	2.88	2.85	2.79	2.74	2.75	2.72	2.68
1. Energy Industries	0.91	0.97	0.91	0.86	0.93	0.94	0.91	0.86
2. Manufacturing Industries and Construction	0.28	0.26	0.26	0.26	0.19	0.19	0.18	0.18
3. Transport	1.20	1.27	1.28	1.25	1.19	1.19	1.18	1.17
4. Other Sectors	0.36	0.35	0.37	0.38	0.40	0.40	0.42	0.44
5. Other	0.02	0.03	0.03	0.03	0.03	0.04	0.03	0.03
B. Fugitive Emissions from Fuels	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. CO_2 transport and storage								
2. Industrial Processes	3.59	3.11	3.02	2.52	2.09	2.24	2.27	1.71
A. Mineral industry								
B. Chemical industry	2.90	2.42	2.27	1.77	1.34	1.49	1.52	0.96
C. Metal industry	NA	NA	NA	NA	NA	NA	NA	NA
D. Non-energy products from fuels and solvent use	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
E. Electronic industry								
F. Product uses as ODS substitutes								
G. Other product manufacture and use	0.69	0.69	0.75	0.75	0.75	0.75	0.75	0.75
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	13.96	14.26	14.73	13.89	13.62	14.15	13.89	14.60
A. Enteric fermentation								
B. Manure management	3.86	3.82	3.72	3.49	3.43	3.30	3.26	3.36
C. Rice cultivation								
D. Agricultural soils	10.10	10.44	11.01	10.40	10.19	10.85	10.63	11.24
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO
F. Field burning of agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO
G. Liming								

Sector specific aggregate N_2O emissions	2006	2007	2008	2009	2010	2011	2012	2013
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
H. Urea application								
I. Other carbon-containing fertilizers								
J. Other	NO	NO	NO	NO	NO	NO	NO	NO
4. Land Use, Land-Use Change and Forestry	0.06	0.08	0.07	0.06	0.06	0.04	0.04	0.04
A. Forest Land	0.05	0.06	0.05	0.04	0.04	0.02	0.02	0.02
B. Cropland	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
C. Grassland	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
D. Wetlands	NO	NO	NO	NO	NO	NO	NO	NO
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO
G. Harvested wood products								
H. Other	NO	NO	NO	NO	NO	NO	NO	NO
5. Waste	0.78	0.80	0.84	0.79	0.83	0.78	0.75	0.78
A. Solid waste disposal								
B. Biological treatment of solid waste	0.07	0.09	0.13	0.09	0.12	0.09	0.09	0.11
C. Incineration and open burning of waste	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
D. Waste water treatment and discharge	0.70	0.70	0.70	0.70	0.70	0.68	0.65	0.66
E. Other	NO	NO	NO	NO	NO	NO	NO	NO
6. Other (as specified in Summary 1.A)	NO	NO	NO	NO	NO	NO	NO	NO
Total N_2O emissions without land use, land-use change and forestry	21.10	21.05	21.44	19.99	19.28	19.92	19.63	19.77
Total N_2O emissions with land use, land-use change and forestry	21.17	21.13	21.51	20.05	19.35	19.96	19.67	19.81
International bunkers	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02
Aviation	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.02
Navigation	NO	NO	NO	NO	NO	NO	NO	NO
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 emissions from biomass								
CO_2 captured								
Long-term storage of C in waste disposal sites								
Indirect N_2O	1.56	1.55	1.47	1.36	1.31	1.25	1.18	1.12
Indirect CO_2 (3)								

2014-2015 period

Sector specific aggregate N_2O emissions	2014	2015
	(Gg)	(Gg)
1. Energy	2.68	2.77
A. Fuel Combustion (Sectoral Approach)	2.68	2.77

Sector specific aggregate N_2O emissions	2014 (Gg)	2015 (Gg)
1. Energy Industries	0.83	0.84
2. Manufacturing Industries and Construction	0.19	0.19
3. Transport	1.21	1.27
4. Other Sectors	0.43	0.43
5. Other	0.03	0.04
B. Fugitive Emissions from Fuels	0.00	0.00
1. Solid Fuels	NA,NO	NO,NA
2. Oil and Natural Gas	0.00	0.00
C. CO_2 transport and storage		
2. Industrial Processes	1.86	1.94
A. Mineral industry		
B. Chemical industry	1.11	1.19
C. Metal industry	NA	NA
D. Non-energy products from fuels and solvent use	NA,NO	NO,NA
E. Electronic industry		
F. Product uses as ODS substitutes		
G. Other product manufacture and use	0.75	0.75
H. Other	NO	NO
3. Agriculture	15.08	14.99
A. Enteric fermentation		
B. Manure management	3.32	3.38
C. Rice cultivation		
D. Agricultural soils	11.75	11.60
E. Prescribed burning of savannas	NO	NO
F. Field burning of agricultural residues	NO	NO
G. Liming		
H. Urea application		
I. Other carbon-containing fertilizers		
J. Other	NO	NO
4. Land Use, Land-Use Change and Forestry	0.04	0.04
A. Forest Land	0.02	0.02
B. Cropland	0.02	0.02
C. Grassland	NA,NO	NA,NO
D. Wetlands	NO	NO
E. Settlements	NO	NO
F. Other Land	NO	NO
G. Harvested wood products		
H. Other	NO	NO
5. Waste	0.79	0.82
A. Solid waste disposal		
B. Biological treatment of solid waste	0.12	0.15

Sector specific aggregate N_2O emissions	2014	2015
	(Gg)	(Gg)
C. Incineration and open burning of waste	0.01	0.01
D. Waste water treatment and discharge	0.66	0.66
E. Other	NO	NO
6. Other (as specified in Summary 1.A)	NO	NO
Total N_2O emissions without land use, land-use change and forestry	20.41	20.51
Total N_2O emissions with land use, land-use change and forestry	20.45	20.56
International bunkers	0.02	0.03
Aviation	0.02	0.03
Navigation	NO	NO
Multilateral operations	NO	NO
CO_2 emissions from biomass		
CO_2 captured		
Long-term storage of C in waste disposal sites		
Indirect N_2O	1.07	1.04
Indirect CO_2 (3)		

NE – Not Estimated; NA – Not Aplicable; NO – Not Occuring; LULUCF – Land Use, Land Use Change and Forestry *Source: CHMI*

1990-1998

	1990	1991	1992	1993	1994	1995	1996	1997	1998
Emissions of HFCs and PFCs - (kt CO_2 equivalent)	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	0.33	38.70	121.69	175.20
Emissions of HFCs - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	0.32	38.02	119.96	173.54
HFC-23	NO	NO	NO	NO	NO	NO	NO	0.00	0.00
HFC-32	NO	NO	NO	NO	NO	NO	NO	0.00	0.00
HFC-41	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-43-10mee	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-125	NO	NO	NO	NO	NO	NO	0.00	0.00	0.01
HFC-134	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134a	NO	NO	NO	NO	NO	0.00	0.03	0.06	0.08
HFC-143	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-143a	NO	NO	NO	NO	NO	NO	0.00	0.00	0.01
HFC-152	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-152a	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00
HFC-161	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-227ea	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00
HFC-236cb	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236ea	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236fa	NO	NO	NO	NO	NO	NO	NO	0.00	0.00
HFC-245ca	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-245fa	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs(4) - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions of PFCs - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	0.01	0.68	1.73	1.66
CF_4	NO	NO	NO	NO	NO	NO	NO	0.00	0.00
C_2F_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_3F_8	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00
C_4F_{10}	NO	NO	NO	NO	NO	NO	NO	NO	NO
c-C_4F_8	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_5F_{12}	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_6F_{14}	NO	NO	NO	NO	NO	NO	NO	NO	NO
$C_{10}F_{18}$	NO	NO	NO	NO	NO	NO	NO	NO	NO
c-C_3F_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of PFCs(4) - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs and PFCs - (kt CO_2 equivalent)	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
Emissions of SF_6 - (kt CO_2 equivalent)	84.10	83.94	85.23	86.40	87.48	88.47	98.06	95.83	94.56
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions of NF_3 - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO

1999-2007

	1999	2000	2001	2002	2003	2004	2005	2006	2007
Emissions of HFCs and PFCs - (kt CO_2 equivalent)	197.87	277.61	420.75	550.66	680.36	783.84	882.63	1197.57	1653.43
Emissions of HFCs - (kt CO_2 equivalent)	196.78	272.92	411.01	534.27	671.81	771.03	867.74	1166.49	1624.43
HFC-23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-32	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.10
HFC-41	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-43-10mee	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-125	0.01	0.02	0.02	0.03	0.04	0.04	0.05	0.09	0.15
HFC-134	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134a	0.08	0.10	0.16	0.22	0.27	0.31	0.35	0.41	0.51
HFC-143	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-143a	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.06
HFC-152	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-152a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-161	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-236cb	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236ea	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-245ca	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-245fa	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs[(4)] - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions of PFCs - (kt CO_2 equivalent)	1.10	4.69	9.75	16.39	8.55	12.81	14.89	31.09	29.00
CF_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_2F_6	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_3F_8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_4F_{10}	NO	NO	NO	NO	NO	NO	NO	NO	NO
$c\text{-}C_4F_8$	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_5F_{12}	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_6F_{14}	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00
$C_{10}F_{18}$	NO	NO	NO	NO	NO	NO	NO	NO	NO
$c\text{-}C_3F_6$	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of PFCs[(4)] - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs and PFCs - (kt CO_2 equivalent)	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
Emissions of SF_6 - (kt CO_2 equivalent)	95.53	107.99	98.41	120.80	144.19	120.00	111.18	108.28	93.41
SF_6	0.00	0.00	0.00	0.01	0.01	0.01	0.00	0.00	0.00

Emissions of NF_3 - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO

2008-2015

	2008	2009	2010	2011	2012	2013	2014	2015	
Emissions of HFCs and PFCs - (kt CO_2 equivalent)	1941.90	2056.25	2396.99	2628.30	2772.36	2993.56	3232.55	3457.04	1941.90
Emissions of HFCs - (kt CO_2 equivalent)	1902.14	2010.82	2348.97	2620.17	2765.99	2989.02	3229.53	3455.08	1902.14
HFC-23	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-32	0.13	0.14	0.18	0.22	0.24	0.26	0.28	0.31	0.13
HFC-41	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-43-10mee	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-125	0.20	0.21	0.26	0.31	0.33	0.35	0.38	0.41	0.20
HFC-134	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134a	0.57	0.58	0.62	0.66	0.71	0.78	0.86	0.92	0.57
HFC-143	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-143a	0.07	0.07	0.09	0.09	0.09	0.10	0.10	0.11	0.07
HFC-152	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-152a	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-161	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-227ea	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-236cb	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236ea	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-236fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-245ca	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-245fa	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs(4) - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO
Emissions of PFCs - (kt CO_2 equivalent)	39.76	45.44	48.01	8.13	6.36	4.55	3.02	1.96	39.76
CF_4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_2F_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_3F_8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C_4F_{10}	NO	NO	NO	NO	NO	NO	NO	NO	NO
c-C_4F_8	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_5F_{12}	NO	NO	NO	NO	NO	NO	NO	NO	NO
C_6F_{14}	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
$C_{10}F_{18}$	NO	NO	NO	NO	NO	NO	NO	NO	NO
c-C_3F_6	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of PFCs(4) - (kt CO_2 equivalent)	NO	NO	NO	NO	NO	NO	NO	NO	NO
Unspecified mix of HFCs and PFCs - (kt CO_2 equivalent)	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO

Emissions of SF_6 - (kt CO_2 equivalent)	93.29	96.06	80.23	85.39	89.63	92.35	94.73	90.55	93.29
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Emissions of NF_3 - (kt CO_2 equivalent)	NO	NO	NO	NO	1.80	3.82	2.35	2.29	NO
NF_3	NO	NO	NO	NO	0.00	0.00	0.00	0.00	NO

NE – Not Estimated; NA – Not Aplicable; NO – Not Occuring; LULUCF – Land Use, Land Use Change and Forestry *Source: CHMI*

ANNEX 3 Summary of supplementary information pursuant to Article 7.2 of the Kyoto Protocol

Following table gives a summary of supplementary information pursuant to Art. 7.2 of the Kyoto Protocol in classification according to the 7th National Communication.

Summary of supplementary information pursuant to Article 7.2 of the Kyoto Protocol

Information pursuant to Art. 7.2		Relevant part of the 7th National Communication
National system of inventories of greenhouse gases pursuant to Art. 5.1		Chapter 3.3
National registry of trading in allowances		Chapter 3.4
Mechanisms pursuant to Art. 6, 12 and 17		Chapter 5.5
Policies and measures pursuant to Art. 2		Chapter 4.2, 4.3 and 4.4
Domestic and regional programs, legislative instruments, effectiveness and administrative procedures		Chapter 4.1
Information pursuant to Art. 10	Art. 10a	Chapter 3.3
	Art. 10b	Chapter 4.1, 4.2, 4.3 and 4.4
	Art. 10c	Chapter 7.3
	Art. 10d	Chapter 8
	Art. 10e	Chapter 9
Funding		Chapter 7

ANNEX 4 Summary of all quantifiable implemented and prepared measures

Title of measure (framework / multisectoral measure)	Expected benefit in reducing greenhouse gas emissions (in kt CO_2 eq./year)					Status of implementation
	2015	2020	2025	2030	2035	
State Program Supporting Energy Savings and the Use of Renewable Energy Sources	38	55	87	77	77	implemented
Program PANEL/NEW PANEL/PANEL 2013 +	186	189	168	158	158	implemented
IPPC (Industrial Emissions Directive)	500	2600	2746	2746	2746	implemented
Promotion of renewable energy sources (Preferential feed-in tariffs)	2903	2541	2490	2403	1852	implemented
Ecological Tax Reform	136	127	120	117	108	implemented
Implementation of Directive on energy performance of buildings	273	325	289	272	272	implemented
Implementation of the recast of the Directive on energy performance of buildings	532	532	474	446	446	implemented
Implementation of directive on co-generation	2143	1876	1838	1774	1367	implemented
Operational Programme Industry and Enterprise (OPIE)	92	92	90	81	81	implemented
Operational Programme Enterprise and Innovation	1238	1238	1143	1089	1089	implemented
Operational Programme Enterprise and Innovation for Competitiveness	2320	2320	2140	2040	2040	implemented
Operational Program Environment 2007-2013	195	265	235	222	222	implemented
Operational Program Environment 2014-2020	63	528	471	443	443	implemented
Green savings programme 2010-2013	665	665	593	557	557	implemented
New Green savings programme 2014-2020	186	1069	953	896	896	implemented
EU ETS	1050	3230	4199	5249	6036	implemented
Support of voluntary commitments to energy savings	0	57	82	81	76	planned
Energy labelling of household electrical appliances	209	296	323	312	240	implemented
Energy Star	22	38	42	40	35	implemented
Eco-design	52	104	119	114	88	implemented
Integrated Regional Operating Programme	91	672	599	563	563	implemented
Electricity Savings in Households Lighting	67	532	474	446	446	implemented
Extension of Public Sector Role in Demonstration of New Technologies	78	285	253	232	232	implemented
Electricity Savings in Lighting in Tertiary Sector and Public Lighting	35	95	85	78	78	implemented
National Strategy of Cycling Transport Development	20	34	34	33	33	planned
Operational Programme Transport	103	177	173	173	169	implemented
Efficiency Improvement of District Heating Systems	148	621	543	495	438	planned
Regulation (EU) No 517/2014 of 16 April 2014 on fluorinated greenhouse gases	121	552	1022	2029	2558	implemented
The support of biofuels	159	176	173	152	121	implemented
Regulation on CO2 from cars	0	237	610	803	828	implemented
Regulation on CO2 from vans	0	48	117	178	227	implemented
ICAO agreement	0	6	11	17	22	implemented
Modal shift in transport	0	134	124	109	90	implemented
Economical and tax tools	0	0	8	39	83	planned
Road toll	0	126	117	103	85	planned
Territorial planned measures	108	387	607	676	707	implemented
EU draft regulation on CO_2 from light-commercial vehicles (vans)	147	486	788	787	786	implemented
Rural Development Program (2007-2013)	325	NA	NA	NA	NA	implemented
Horizontal Rural Development	150	NA	NA	NA	NA	implemented

Title of measure (framework / multisectoral measure)	Expected benefit in reducing greenhouse gas emissions (in kt CO_2 eq./year)					Status of implementation
	2015	2020	2025	2030	2035	
Action Plan for Development of Organic farming 2011-2015	NA	250	NA	NA	NA	implemented
OP Rural development and Multifunctional Agriculture	100	NA	NA	NA	NA	implemented
Strategy for Growth	50	250	NA	300	NA	implemented
Biomass Action Plan in the Czech Republic for 2012-2020	NA	125	NA	255	NA	implemented
Rural Development Programme 2014-2020	NA	200	NA	357	NA	implemented
Conclusions and recommendations of Coordinating Council to implement the National Forestry Programme II	117	458	584	394	NA	planned
Waste management plan (2003)	50,00	136	292	NA	NA	implemented
Waste management plan (2011)	154,00	388	682	NA	NA	implemented
Waste management plan (2015-2024)	NA	330	NA	NA	NA	implemented

Source: CHMI

ANNEX 5 Information on selected important national research projects

o *CzechGlobe - Global Change Research Institute of the Czech Academy of Sciences*

The Ministry of Education, Youth and Sports supported project ED1.1.00/02.0073 and the chief beneficiary was the **Global Change Research Institute of the Czech Academy of Sciences**. Project ran from 2010 to 2014.

The main objective of the CzechGlobe project was deep professional knowledge of the problem of global climate change, the development of procedures for reducing its impact or adapting to its action. The solution to the CzechGlobe project was based on three basic questions: 1. To what extent is the earth's biosphere able to absorb the demonstrable surplus of carbon dioxide emitted by humans into the atmosphere with a potential impact on the greenhouse effect? 2. Are the terrestrial ecosystems truly the most vulnerable element of Earth's carbon storage? 3. Is the development of human society in relation to global climate change sustainable? Research and Application Objectives: 1. Development of tools for modeling climate extremes, tools for the design of local climate change scenarios, development of a regional climatic model with very high spatial resolution, and creation of a regional spatial study of the impact of global climate change on managed ecosystems. 2. Elaboration of methodologies for enhancing ecosystems capacities to capture CO_2 from the atmosphere based on long-term monitoring of greenhouse gases, methodology of measures to reduce negative impacts of global climate change on hydrological and biogeochemical cycles of forest basins, development of remote sensing methods for mapping of biochemical and biophysical parameters vegetation and ecosystems as indicators of carbon cycle processes and effects of stress factors, development of methodologies to reduce global climate change negative impacts on biodiversity 3. Methods of management of adaptation and regulatory mechanisms of plants related to global climate change impacts in order to reduce the vulnerability of ecosystems to ongoing changes. Development of optical diagnostic methods for early diagnosis of stress, identification and use of metabolites with biological effect as antistress agents, growth regulators, resistance inducing agents, antioxidants etc. 4. Development of tools and indicators for global climate change impact analysis on socio-economic systems and prediction of impacts of mitigating and adaptation measures.

<u>The original project was followed by a new one:</u>

o *CzechGlobe 2020 - Development of the Global Change Research Institute of the Czech Academy of Sciences*

The Ministry of Education, Youth and Sports supported project LO1415 and the chief beneficiary is the **Global Change Research Institute of the Czech Academy of Sciences**. Project is running from 2015 to 2019.

The main objective of the project is research and development of CzechGlobe research infrastructure in order to strengthen the competitiveness of Czech research on the impacts of global change in the following areas: - Supporting and implementing research on the effects of global change on climate, ecosystems and human society, developing appropriate adaptive and innovative procedures. - Development of CzechGlobe research infrastructure in connection with the requirements of global change research, creating conditions for the development of human resources with an emphasis on strengthening the education, education and mobility of students and researchers. - Enhance long-term international cooperation, particularly through active participation in European research infrastructures and other international programs. - Intensive cooperation with the public and private sector in order to implement the results created in CzechGlobe, thereby enhancing the social and economic development of the Czech Republic.

- *Damage risk assessment, economic impact and mitigation strategies for sustainable preservation of cultural heritage in the times of climate change*

The Ministry of Education, Youth and Sports supported project 7E10028 and the chief beneficiary was the **Faculty of Mechanical Engineering Czech Technical University in Prague**. Project ran from 2010 to 2014.

Climate change is one of the most critical global challenges of our time which also threatens cultural heritage. As a non-renewable important resource to the European identity, sustainable adaptation strategies are required for long term preservation. For this purpose and for the first time ever, the CLIMATE FOR CULTURE project coupled completely new high resolution (10x10km) climate change evolution scenarios with whole building simulation models to identify the risks for specific regions. The innovation lied in the elaboration of a more reliable damage assessment by connecting the future climate data with whole building simulation models and new damage assessment functions. In situ measurements at UNESCO sites throughout Europe will allow a muchmore precise and integrated assessment of the real damage impact of climate change on cultural heritage. Appropriate sustainable mitigation/adaptation strategies, also from previous projects, are further developed and applied on the basis.

- *Public health impacts in URban environments of Greenhouse gas Emissions reduction strategies*

The Ministry of Education, Youth and Sports supported project 7E11057 and the chief beneficiary was **Charles University, Environment Center**. Project ran from 2011 to 2014.

The project examined the health impacts of greenhouse gas (GHG) reduction policies in urban settings in Europe, China and India, using case studies of 3-4 large urban centres and three smaller urban centres. Sets of realistic interventions were proposed, tailored to local needs, to meet published abatement goals for GHG Emissions for 2020, 2030 and 2050. Mitigation actions were defined in four main sectors: power generation/industry, household energy, transport and food and agriculture. The chief pathways by which such measures influence health were described, and models developed to quantify changes in health-related exposures and health behaviours. Models included ones relating to outdoor air pollution, indoor air quality and temperature, physical activity, dietary intake, road injury risks and selected other exposures. Integrated quantitative models of health impacts were based on life table methods encompassing both mortality and morbidity outcomes modelled over 20 year time horizons. Where possible, exposure-response relationships were based on review evidence published by the Comparative Risk Assessment initiative or systematic reviews. Uncertainties in model estimates were characterized using a mathematical Framework to quantify the influence of uncertainties in both model structure and parameter estimates. Particular attention was given to economic assessments, both in terms of behavioural choices/uptake of various forms of mitigation measure (with new surveysto address evidence gaps), and in terms of health benefits and costs calculated from societal, health service and household perspectives. A decision analysis framework were developed to compare different mitigation options. Experts and user groups were consulted to define the mitigation questions to be examined, and the results were discussed in consultative workshops scheduled for the final months of the project.

- *Adaptive Strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems*

The Ministry of Education, Youth and Sports supported project 7E11059 and the chief beneficiary was the **Biology Centre of the Czech Academy of Sciences**. Project ran from 2011 to 2014.

Understanding how freshwater ecosystems will respond to future climate change is essential for the development of policies and implementation strategies needed to protect aquatic and riparian ecosystems. REFRESH advanced our fundamental and applied science in 5 key areas: 1) understanding how the functioning of freshwater ecosystems is affected by climate change; 2) new indicators of functional response and tools for assessing vulnerability; 3) modelling ecological processes; 4) integrated modelling; and 5) adaptive management.

- *Impacts Quantification of global changes*

The Ministry of Education, Youth and Sports supported project 7E12058 and the chief beneficiary was the **Charles University, Environment Center**. Project ran from 2012 to 2014.

World societies experience today large transformation processes both in the social, economic and environmental dimensions. These transformations are usually described under the heading of ´global change´, to emphasize the increasing interactions betweenthem. The objective of the proposal is three-fold: (1) to provide significant advances in the estimation of socio-economic impacts of global challenges ? at Global, European and regional scale; (2) to identify optimal adaptation strategies; (3) to evaluate total costs and the optimal mix of adaptation and mitigation against global changes. Work Package (WP) 1 examined the sources, interactions and characteristics of global changes, including the emergence of fast-growing economies, environmental degradation, competition on the use of exhaustible resources, international competitiveness issues. A primary objective of the proposal was to estimate socio-economic impacts arising from global changes by using economic models. The consortium is endowed with a large set of state-of-the-art, internationally renown, modeling tools. Models were further expanded and enriched in WP 3. Key areas of research were: agriculture, forestry, land use, energy, EU competitiveness, labor, international trade. The socio-economic impact of these challenges on key sectors/areas were examined with the enhanced set of models in WP 4 and WP 5. While in WP 4 impacts of global challenges were studied assuming limited adaptive capacity, in WP 5 optimal adaptation strategies were examined. WP 5 also informed on total costs of global challenges and on the optimal mix of mitigation and adaptation. In WP 2 were develop empirical and theoretical insights on key issues which had a value per se and were also beused to enhance models in WP 3. WP 6 was complement the analysis of WP 4 and WP 5 developing theoretical innovations concerning discounting, risk and ambiguity and by testing them numerically with models.

- *Strengthening international cooperation of the KLIMATEXT research team*

The Ministry of Education, Youth and Sports supported project EE.2.3.20.0086 and the chief beneficiary was the **Technical University of Liberec, Faculty of Sciences and Humanities and Education**. Project ran from 2011 to 2014.

The development of statistical models of extreme probabilities is one of the key themes of current climatology and statistics. This interdisciplinary project leaded to closer research into the international activities and top foreign workplaces in the Czech Republic, effectively connected scientists working in various fields of statistics and climatology and increased the awareness of the current state of solving the problems and the possibilities of these advanced methods among the wider professional public and students.

o *Development of methods for Integrated Drought Tracking System*

The Ministry of Education, Youth and Sports supported project LH11010 and the chief beneficiary was the **Mendel University in Brno, Faculty of AgriSciences**. Project ran from 2011 to 2014.

The aim of the project were to develop a complete methodological approach that would enable real-time drought monitoring on the basis of the latest technologies to analyze the medium and long-term outlook of its development, in a resolution that can be used for strategic planning and operational decision making. The method at the same time allowed to assess the risk of drought in the context of historical data as well as expected climate change. The existence of an effective monitoring system was one of the key preconditions for successful adaptation of a number of sectors (eg agricultural production) to climate change. The intent of the team was to integrate the most perspective drought monitoring approaches so that through high resolution output information (0.5-1km) they were cost-effective. This were achieved by the use of existing measurement networks, freely accessible satellite data, a high degree of automation and integration of procedures into an integrated drought monitoring system. Part of the objective was to develop a methodology for the preparation of plans for the occurrence of drought episodes.

o *Climate Research Partnership and Adaptation Strategies*

The Ministry of Education, Youth and Sports supported project EE2.4.31.0056 and the chief beneficiary was the **Global Change Research Institute of the Czech Academy of Sciences** and the **Mendel University in Brno, Faculty of AgriSciences.** Project ran from 2012 to 2014.

The main objective of the project was to establish a strategic partnership between the Center for Global Change Research, Academy of Sciences of the Czech Republic, v.v.i. and Mendel University in Brno in the field of climate research and adaptation to the impacts of climatic extremes. The emergence of a multidisciplinary team composed of scientists representing tertiary education institutions and research organizations created the conditions for high-quality research and above-standard publishing activities. Creating this partner team allowed for mutual cooperation in the creation of high-quality scientific outputs of this project.

o *Research on measures to ensure the supply of potable water during climate change*

The Ministry of Agriculture of the Czech Republic supported project QI112A132 and the chief beneficiary was the **Faculty of Mining and Geology, Technical University of Ostrava**. Project ran from 2011 to 2014.

The aim of the project was to elaborate a comprehensive proposal for securing the supply of drinking water in dry periods with water shortages in the sources.

- *Influence of expected climatic changes on land of the Czech Republic and evaluation of their production function*

The Ministry of Agricultue supported project QJ1230056 and the chief beneficiary was the **Research Institute for Soil and Water Conservation**, **Faculty of Civil Engineering of the Czech Technical University in Prague** and the **Mendel University in Brno, Faculty of AgriSciences**. Project ran from 2012 to 2016.

The aim of the project was a new view of soil assessment, especially from the production point of view, with the involvement of the influence of non-productive functions in connection with the notified climate change. This topic is currently very socially up to date and it is necessary to look for new knowledge that will solve the current vacuum in the area. In many places of the Czech Republic there are demonstrably changes in soil climatic conditions, and the currently used soil assessment system based on biodiesel soil (BPEJ) has to respond very quickly to these facts. The existing system is based on the conditions of the socialist way of life, and at the same time there were changes in the natural conditions in which the original criteria were created. This was mainly the shift in climatic conditions, degradative effects on the soil (water and wind erosion, the emergence of collisions, etc.), the greater representation of anthropically created soils and others.

- *Integrated assessment of impacts of global change on the environmental safety of the Czech Republic*

The Ministry of the Interior of the Czech Republic supported project VG20122015091 and the chief beneficiary was the **Global Change Research Institute of the Czech Academy of Sciences**, **CENIA - Czech Environmental Information Agency** and the **Environment Center of the Charles University.** Project ran from 2012 to 2015.

The main objective of the project was to develop integrated procedures for evaluating and monitoring the impacts of global changes on the environmental safety of the Czech Republic and evaluating the resulting security risks for ecosystems in the Czech Republic. The sub-objectives included: 1. A partial objective is to develop and fulfill the commitments of the Czech Republic resulting from the GEOSS and GMES environmental security monitoring programs. 2. Development of methodological and information tools providing support for planning and organizing activities leading to the prevention or mitigation of situations resulting from threats or damage to ecosystems. 3. To identify the main effects of adaptation and mitigation measures on environmental safety. 4. Develop scenarios for possible development of ecosystem services in the Czech Republic based on anticipated global changes and socio-economic development.

- *Erosion - Increased risk of population hazards and water quality in connection with expected climate change*

The Ministry of the Inteior supported project VG20122015092 and the chief beneficiary was the **T. G. Masaryk Water Research Institute - public research institution** and the **Faculty of Civil Engineering of the Czech Technical University in Prague**. Project ran from 2012 to 2015.

The main objective of the proposed project was to propose conceptual procedures and to develop technical means for assessing the area with regard to the risks of impacts of increased erosion associated with expected climate change. Conceptual procedures served to ensure a uniform procedure for evaluating the territory of the Czech Republic at the level of central government authorities in relation to the expected risk to the population and residential infrastructure, threats to water resources or the degradation of other land use purposes. The technical resources that were developed in the project allowed users to perform simple simulations that will result in a detailed risk analysis in the assessed territory. The current technical means included the possibility of proposing standardized measures to limit the impact of erosion to the level of individual plots. The use of technical means in the form of interactive software was envisaged especially at the level of the higher territorial administrative units (regions and municipalities with extended competence), but also in the management of river basin districts or other administrative activities, covering the entire territory of the CR or a part thereof.

- *Sustainable use of water resources in climate change conditions*

The Technology Agency of the Czech Republic supported project TA01020508 and the chief beneficiary was the **T. G. Masaryk Water Research Institute - public research institution,** the **Elbe River Basin, State Enterprise**, the **Ohře River Basin, State Enterprise** and the **Vltava River Basin, state enterprise**. Project ran from 2011 to 2014.

The objective was to estimate the probable development of the water balance affected by ongoing climate change when assessing the projected status of surface and groundwater. Existing recommended approaches to the water balance of the projected state do not correspond to the current conditions in which the climate change and thus the change of the water regime in the Czech Republic are already reflected. For this evaluation, we needed to prepare software resources. The first solved the links between the hydrological balance of water and the components of the water balance of surface and groundwater. The second software dealed with a prospective assessment of the amount of water. Based on the verification of software resources and related methodologies in selected pilot river basins, the resulting certified methodology was developed at the end of the project (2014) to assess the projected status of a number of surface and groundwater.

ANNEX 6 Examples of EE&A-related projects in the field of climate change implemented by NGOs in 2013 – 2016

- ***NESEHNUTÍ Brno - Environmental education meets the current social challenges***

The project focuses on a comprehensive campaign for public administration, university students, civic initiatives and active and professional public in the field of environmental education and public involvement in decision-making processes in relation to environmental issues. The core activities of the project are educational programs for individual target groups and a model EVVO campaign including online learning materials aimed at transferring good practice and transdisciplinary approach in adapting communities to climate change. The project activities include 3 training events, 1 awareness campaign, 3 analyzes, 1 conference, 5 panel discussions, and 1 new online training for EVVO.

- ***ZO ČSOP Veronica – From Vulnerability to Resilience***

The project is aimed at enhancing competences in the topic of adaptation and mitigation of climate change and the issue of impact management and increased resilience. The target group is public administration in rural regions, as well as schools and the public, especially from rural areas. The project consists of 3 interrelated activities - communication, capacity building and motivation, vulnerability analysis and education. There will be 2 seminars, 5 analyzes, 1 campaign, 1 conference and 3 workshops.

- ***Junák - Czech Scout, Kaprálův mlýn, z.s. - We're blocking emissions***

The project is aimed at promoting measures to eliminate both direct and indirect greenhouse gas emissions. The target group is to be the public and the leaders and members of organizations working with children and youth. Within the framework of the project, a conference on Natural Construction from A to Z (4th year) is to be held, which allows the meeting of experts and managers of environmentally friendly houses with future builders, designers and architects. Furthermore, the promotion of the theme of ecological construction to the public should be ensured. Another independent part of the project is the implementation of the WSEP World Scouting Environmental Education Program. The project has 2 conferences, educational events, 5 new types of materials and tools for EVVO.

- ***Czech Environmental Partnership Foundation – (CEPF) - For water! Raising Awareness of Adaptation Measures to Climate Change in the Czech Republic***

The aim of the project is to raise awareness of the real possibilities of adapting to climate change. Attention is paid to flood and drought prevention (retention of water in the countryside, protection of groundwater, revitalization of watercourses, green infrastructure), water management in municipalities, agriculture and industry, saving of drinking water and the use of gray water. There will be 14 training events, 24 seminars, 10 new materials for EVVO.

- ***CI2, p.b.o. - Our climate - a common thing***

The subject of the project is to support the public administration and the public about the possibilities of climate protection and adaptation to its changes in towns and municipalities, including the possibility of implementing specific adaptation and mitigation measures at the local level. The project has 8 city awareness campaigns, 5 analyzes, 5 surveys, 7 training events, 8 workshops, 5 planning documents to be created and 4 new types of materials and tools for EVVO.

- ***Ecocentre Koniklec, p.b.o. - Local adaptation forums - Initiation of adaptation activities (MAFIAA)***

The project is aimed at developing pupils 'and students' competencies needed for environmentally responsible behavior, in particular on the possibility of their own influence on the prevention and solution of environmental problems, namely climate change and adaptation measures. This development should take place through research activities with primary and secondary school pupils, local adaptation fora with citizens and representatives. The project has 15 training events and 10 seminars. In addition, one evaluation should be carried out, 5 methodologies, 10 seminars should be created and a new kind of EVVO materials to be created.

- ***The union of the creation and maintenance of green - Green roofs – healthy environment to the cities***

The subject of the project is the implementation and promotion of the use of roofs and claddings of building structures such as structures for the foliage, which is one of the key technologies of the future. The main objective of the project is to promote the greening of roofs and walls of buildings and other building structures as part of sustainable construction, environmental protection and return of the jedi into the settlements, to raise awareness and the awareness of the public, professional circles and the public administration on this issue for the purpose of her support and wider use, improve the professional level in the field of designing and building a green space on the structures.

- ***Ecocentre Koniklec, p.b.o. - Water school***

The main objectives of the project are: 1) the Acquisition of knowledge, skills and attitudes of pupils II. grade of elementary school and the lower grades of multiannual grammar schools to the issue of savings of drinking water and management of rainwater (HDV), consolidating their sense of responsibility for the environment at the global, national, regional (Prague) and the local (the urban part) of the scale, and also the development of research skills and key competences – in particular competence to the solution of problems, communications, personnel, social, labor and civic competences. 2) Further education of teachers II. grade of elementary school and the lower grades of multiannual grammar schools in the field of modern forms of teaching and the issue of drinking water and rain water from the point of view of protection of the environment. 3) the Greening of the operation of the school and direct the improvement of the environment in the field of savings of drinking water and HDV in the area through measures which pupils in the framework of the projects they propose and with the help of school staff, parents, or public place. 4) Increase the awareness and interest of parents, pupils and other citizens of Prague about the issue of dealing with drinking and rain water especially in the place of his residence through involved in the project schools.

- ***River coalition - Support the accumulation of water in the landscape in the form of self-help interventions***

The main objective of the project is to engage local associations in the implementation of the minor measures that can be done by yourself (adjusting the space for the floods overflow of water, dredging the pools). The activation of a network of volunteers, their theoretical and practical preparation for further independent work to promote better accumulation of water in the landscape. Preparation of three proposals for specific measures in the form of the study. The sub-aim of the project is to expand awareness of the public, especially the rural population and local associations, about the need for restoration of the natural storage capabilities of the landscape. In the framework of the project held an awareness campaign aimed at the general public, especially the promotion of interventions that enhance the accumulation of water in the landscape in the form of presentation of positive examples.

- ***Ecocentre PALETA - How to improve the house***

Professionally processed methodological simulation game, which clearly and vividly in a few steps will bring practical guidance on possible improvements of the energy balance of the house, the financial costs and savings for implementation and operation, environmental impacts. Comprehensively developed program will simplify and streamline the preparation of activities in schools and centres of environmental education.

- ***Čmelák - the Society of friends of nature - Wetlands for life - to experience and understand the***

The main objective of the project is the practical performances of the functioning of the wetland as an ecosystem through the creation of interactive educational trail in a revitalized wetland location in Jablonné v Podještědí (creation of 4 interactive stop of the nature trail, whose central topic will be ecosystem services of wetlands, all delivered interactively and comprehensible to the general public; installation of the contact water of the pier over one of the pools). The long-term intention is to bring visitors to the beautifully reclaimed wetlands to understand their tremendous positive meaning and accept it as a natural and positively perceived part of our landscape. At the same time, to make it more attractive locations for environmentally-friendly tourism in the site, which is classified as economically below-average area of the Liberec region and is not touristy too used.

- ***Arnika - The celebrations of water***

The subject of the project is a series of events on the occasion of the significant days. Action alert the public on the importance of water conservation and linked ecosystems in Prague, including the management of drinking water, or prevention of releases of toxic substances into the environment. The participants were presented the protection of waters and aquatic ecosystems in a broader context.

- ***The union of the creation and maintenance of green - Green roofs - a hope for the future II***

The main objective of the project is to increase knowledge and awareness of the public, professional circles and the authorities of the state and local administrations on the use of green roofs as a possible adaptation measures to climate change. Increased awareness will lead to promotion of the greening of roofs of buildings and other building structures, which is an integral component of sustainable construction, protection of the environment and the return of greenery to the residences. The project prepared also the conditions for increasing the quality of the design and implementation of green roofs.

- ***Czech Otter Foundation Fund - Pilot verification of the use of a model extensive green roof***

The subject of the project training program. For the implementation of the programme had constructed a model extensive green roof. The purpose of the tutorial is to increase awareness about the functions and effectiveness of the extensive vegetative roofs as one of the possible adaptation measures to mitigate the impacts of climate change and mitigating the effect of urban "heat island", to raise awareness about the functions and effectiveness of extensive vegetative roofs, and to promote changes to the prejudices hindering their wider application.

- ***Mařížský park - Floodplain in Maříž – solution, and an example of the sustainability of the valuable habitat in the village***

The project addresses the local unsustainable status of the floodplain and the bed of the brook in the village and at the same time, the results of the solution presented as an example for the conceptual planning of the care of public greenery in the village. In the framework of the project implemented activities for the preparation of the revitalization of the floodplain and the bed of the creek downstream on the návesní pond and Mařížský park according to the current knowledge of landscape management.

- ***CI2, p.b.o. - Adaptation of cities to climate change - selection of measures and public participation***

The general intention of the project is the adaptation of Czech cities to climate change. This intent will be achieved by involving experts and citizens of the selected cities in the Czech Republic in the selection of appropriate adaptation measures for the city, to further the sharing of experience and examples of good practice between cities and active dissemination of information on climate change and its impacts to the cities. The project directly involved the towns of Kopřivnice and Hlučín, indirectly the municipality with extended competence in the Czech Republic.

- ***Juniperia - Renewal of land management as a means for the restoration and conservation of biologically valuable wetland habitats in the floodplain of the upper Luznice.preservation of biologically valuable wetland habitats in the floodplain of the upper Lužnice***

The aim of the project is the restoration of biologically valuable wetland habitats in the three selected long-abandoned parts of the floodplain of the upper Luznice through the reintroduction of management in the floodplain (grazing, obtaining firewood, etc.). In the implementation of management interventions are actively involved local residents, who can from the natural resources provided by the blue cheese profit and at the same time, my activities - management - will contribute to the restoration of biological, cultural and social values of the floodplain. Compared to the standard procedure for ensuring management in naturally valuable localities (one-time contractual implementation of works without a closer relationship) it is a substantially more rational and longer-term sustainable process, since it is in substantially lesser extent dependent on external funding sources.

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