REPORTING OF PROJECTIONS AND POLICIES AND MEASURES UNDER REGULATION (EU) No 525/2013

MARCH 2017

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Content

Executive summary

The Czech Republic (CR) is a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol. Under these international agreements CR is committed to provide annually information on its national anthropogenic greenhouse gas emissions by sources and removals by sinks for all greenhouse gases not controlled by the Montreal Protocol. As a member of the European Union, CR has reporting obligations also under the mechanism for monitoring European Community greenhouse gas emissions and for implementing the Kyoto Protocol (EU monitoring mechanism, Decision 280/2004/EC of the European Parliament, the Council, Decision 2005/166/EC of the European Council) and 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.

The reporting was organized and supported by the Czech Hydrometeorological Institute (Rostislav Neveceral). Rostislav Neveceral also prepared the energy and industrial sectors. Beata Ondrusová checked data and other information in templates and in the text. Text outputs and data in templates regarding F-gases, important input data in energy and industry sectors and chosen policies and measures in energy and industrial sectors were compiled by the company ENVIROS, s.r.o. (Jiri Spitz) using the EFOM/ENV model. Data and text outputs for the Agriculture and LULUCF sectors were provided by the company IFER, s.r.o. (Zuzana Exnerova and Emil Cienciala). Miroslav Havranek from the Environment Center of Charles University compiled all the information regarding the Waste sector. The ETS data were provided by the Ministry of Environment (Michal Danhelka). Jiri Dufek prepared and calculated the transport sector. The text was checked and supervised by the Ministry of Environment (Pavel Zamyslický and Michal Danhelka).

The presented GHG emission projections are based on “Optimized scenario” from the State Energy Policy adopted by the Government in 2015. The Policy was prepared by the Ministry of Industry and Trade.

The projections comprise two scenarios “with existing measures” (WEM) and “with additional measures” (WAM) according to guidelines published in the document FCCC/CP/1999/7, part II UNFCCC Reporting Guidelines on National Communication and further in the above mentioned documents of the EU.

The reference year for both scenarios “with existing measures” and “with additional measures” is 2014. The latest year with existing inventory was 2014 as well (submission in April 2014). The projection years are 2015, 2020, 2025, 2030 and 2035.

The following table shows the summary results of the projection. For comparison, the following table shows the results from the previous projections.

Tab. 1 Summary results of the 2017 GHG emissions projections (LULUCF excluded) [Mt CO_2eq]

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020	1990 – 2030	2005 – 2020	2005 – 2030
WEM	195,3	154,9	148,0	146,0	137,7	123,7	124.8	122.4	113.5	108.7	101.6	-37.3%	-44.3%	-16.1%	-25.5%
WAM	195,3	154,9	148,0	146,0	137,7	123,7	124.8	122.1	113.1	107.7	99.9	-37.5%	-44.9%	-16.4%	-26.2%

Tab. 2 Summary results of the 2015 GHG emissions projections (LULUCF excluded) [Mt CO_2eq]

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
WEM	199,0	154,0	148,1	147,7	138,9	133,5	131,8	119,6	108,0	104,7	99,6	-39,9%	-47,4%	-19,0%	-29,1%
WAM	199,0	154,0	148,1	147,7	138,9	133,5	130,1	114,0	102,4	98,9	94,3	-42,7%	-50,3%	-22,8%	-33,0%

There are differences between the old and the new projections. The differences have several causes:

- There were made some changes in the historical data in the CRF tables due to methodological improvements in the latest GHG emissions inventories.
- A higher increase of GVA in industrial sector is expected
- A higher increase of animal numbers and fertilizer amount in agriculture

1 Policies and measures

1.1 Cross-cutting measures

1.1.1 Energy Taxation

Characteristic: The measure transposes Energy Taxation Directive 2003/96/EC into Czech legislation. It is described in the Act on Stabilization of Public Budgets No. 261/2007 Coll. The act requires consumer tax levels on energy and electricity to be equal to minimal levels required by the EU directive.

Period of implementation: from 2007, **ongoing, existing measure**

The impact of the energy taxes was evaluated in the NEEAP 3 as about 1,700 TJ in the years 2008-2010. The corresponding CO_2 emissions decrease was calculated from CO_2 intensity of the final energy consumption.

1.1.2 Application of the IED Directive 2010/75/EU

Characteristics: Transposition of the Directive 2010/75/EU on industrial emissions (integrated pollution prevention and control) (Recast) amending and subsequently repealing Directives 96/61/EC and 2008/1/EC.

Period of implementation: 2003, **ongoing, existing measure**

Time framework: The law provisions of amended Directives were obligatory for new installations from the year 2003 and for existing installations from the year 2012. The new IED Directive shall be applied from 2016.

The IED Directive sets stricter emission limits for selected basic pollutants (in comparison to repealing Directives) and requires the use of the best available technologies (BAT).

The IED aims at minimizing pollution from various industrial sources. Operators of industrial installations operating activities covered by Annex I of the IED are required to obtain an integrated permit from the authorities in the EU countries.

The permit conditions including emission limit values (ELVs) must be based on the Best Available Techniques (BAT). BAT conclusions (documents containing information on the emission levels associated with the best available techniques) shall be the reference for setting permit conditions.

The Directive is implemented into the Czech legislation by the Act on Integrated Prevention and Pollution Control No. 69/2013 Coll. amending the Act No. 76/2002 Coll.

The Act has an indirect impact on GHG emissions through the emission limits for basic pollutants and through the use of BAT. The strict emission limits are expected to have an important impact especially on coal-fired power plants and combined power and heat plants.

The effects and costs were calculated according to the study "Podkladová analýza pro transpozici kapitoly III a přílohy V směrnice 2010/75/EU, o průmyslových emisích do nového zákona o ochraně ovzduší" prepared 2011 by the company ENVIROS, Ltd. in cooperation with the Czech Hydrometeorological Institute and the company Brucek, Ltd. and according to the Enviros, Ltd. model calculation results. It is expected that this Act has forced emission polluters not only to phase-out or reconstruct (e.g. installation of new boilers) some less efficient and outdated facilities but also to switch to cleaner fuels like natural gas or biomass.

1.1.3 Application of the Eco-design Directive

Characteristics: Eco-design is a method for the design and development of a product which also emphasizes a minimum negative impact of a product on the environment (including energy consumption). A set of requirements are imposed on products which must be met before products enter the market and which also ensures energy efficiency for manufacture, usage and disposal of products.

The Czech legislation has transposed the EU directives 2005/32/EC and 2009/125/EC (recast) to establish a framework for the setting of eco-design requirements for energy-using products.

Period of implementation: from 2007, **ongoing, existing measure**

The eco-design directives have been implemented into the Czech legislation by the Energy Management Act No. 406/2000 Coll. and by its amendment 393/2007 Coll. Under the EU directive a set of regulations requires a minimal energy efficiency of new electric appliances. Examples of products categories included in the regulations which are currently implemented in the CR and reflected in the projections are e.g.: Air conditioners and comfort fans, Air heating and cooling products, Circulators, Computers, Domestic cooking appliances, Electric motors, External power supplies, Household dishwashers, Household tumble driers, Household washing machines, Industrial fans, Lighting products in the domestic and tertiary sectors, Local space heaters, Heaters and water heaters, Power transformers, Professional refrigerated storage cabinets, Refrigerators and freezers, Simple set-top boxes, Solid fuel boilers, Standby and off mode electric power consumption of household and office equipment, and network standby, Televisions, Use of tolerances in verification procedures, Vacuum cleaners, Ventilation units, Water pumps.

The expected annual energy savings were calculated in the NEEAP III *[35]* and amount 1230 TJ/year since 2020.

1.1.4 EU ETS

Characteristic: The EU ETS is one of the most important economic tools to reduce GHG emissions. The scheme for GHG emission allowance trading within the Community is established in Directive 2003/87/EC amended or supplemented by Directives 2008/101/EC and 2009/29/EC, by Decision No. 1359/13/EU and by Regulation No. 421/2014/EU.

This legislation is transposed into the Czech legislation by Act No. 383/2012 Coll. on conditions for trading of emission allowances amending Acts No. 695/2004 Coll. and No. 164/2010 Coll.

Period of implementation: 2004 – **ongoing, existing measure**

Time framework: There have been agreed three trading periods. The first (2005 – 2007) and the second (2008 – 2012) and in those two periods all allowances were allocated free of charge in the CR. In the third period (2013 – 2020) there is a single EU-wide cap and allowances are allocated on the basis of harmonized rules. The single EU-wide cap on emission allowances replaces the previous system of national caps. The cap is cut each year (by 1.74%) so that by 2020 emissions will be 21% below the 2005 level. The free allocation of allowances is progressively replaced by auctioning in this period. Currently, the allowance price is still very low (about 5 EUR). The fourth trading period (2021-2030) is currently under debate in legislation process within the EU.

Manufacturing industry will continue to receive a share of allowances for free also after 2020. Free allocation is carried out on the basis of benchmarks of greenhouse gas emissions performance. Installations that meet the benchmarks should receive all the allowances they need. Those that do not reach the benchmark values will receive fewer allowances than they need. These installations will therefore have to reduce their emissions, or buy additional allowances to cover their emissions.

A product benchmark is based on a value reflecting the average greenhouse gas emission performance of the 10% best performing installations in the EU ETS.

The benchmarks have been established for various products. This means the benchmark methodology does not differentiate according to the technology, fuel used, or according to the size of an installation.

The EU ETS influences through the increase of electricity price also the industrial, domestic and commercial sectors. For example a substitution of electricity intensive industrial products may be expected.

In the first two phases, the cap on allowances was set at national level through national allocation plans (NAPs).The phase one caps were set mainly on the basis of historic emissions data. The total allocation of EU ETS allowances exceeded demand and in 2007 the price of phase one allowances fell close to zero.

In the second period the cap was cut by 6.5% compared to the 2005 level. Due to the economic crisis that began in late 2008 there was a surplus of unused allowances again. The aviation sector was brought into the EU ETS on 1 January 2012 through legislation adopted in 2008.

It is difficult to estimate the EU ETS effects on GHG emissions, because this instrument interacts with several other policies and regulations. Besides, the companies are also influenced by fuel and electricity prices and by the economic development.

It is expected that the EU ETS policy together with the IED Directive has forced emission polluters not only to phase-out or reconstruct (e.g. installation of new boilers) some less efficient and outdated facilities but also to switch to cleaner fuels like natural gas or biomass.

1.1.5 Act No. 201/2012 Coll., on protection of the air (the Air Protection Act)

Objective: To create a revised legal framework for air protection in the Czech Republic. .

Characteristics: Legislative instrument

Period of implementation: 2002 – **ongoing** (revision), **existing measure**

Time framework: not stipulated

Sector: energy production, industry

The Act No. 201/2012 Coll. replaced Act No. 86/2002 Coll. and provides the following significant changes:

a. Compensation measures

The current legislation will ensure that in areas with poor air quality a new pollution source won´t be put into operation, unless it demonstrates or applies measures to offset the new extra pollution. Compensation measures which are newly included in the Act have investment and operational character.

b. Implementation of low emission zones

Municipalities and cities can set zones within their territories only for cars complying with the emission limits. However, they must provide an alternative route outside the zone of the same or higher class.

c. New parameters for domestic boilers

The new legislation also affects households. Small boilers (power output up to 300 kW) put on the market in the Czech Republic must have significantly lower emissions comparing to current situation. The law also prohibits the burning of low-quality fuels.

Emission limits for small combustion plants up to 300 kW depend on the performance, dosage, type and calorific value of a fuel

d. Inspection of households

The new law establishes a mandatory verification of emission sources and technical parameters of boilers with a thermal input between 10 and 300 kW which is used for central water heating. These inspections will be carried out by persons authorized by the Ministry of Environment. In addition to the visual inspection these entities can also advise the owner regarding the adjustment, cleaning and optimal use of a boiler.

e. Individual evaluation of large polluters

The new law also allows individual access to air polluters. Competent regional authorities can also decrease the activity of an emission source which has a bad influence on the air quality in certain area.

f. Simple charges

The new law also significantly simplifies the payment of charges. The number of charged substances is reduced from 24 to four. Charges are approximately 10 times higher in comparison previous levels. From 2017 the charges will continue to growth gradually up to 2022.

The Act also allows a reduction of charges in case that an operator reduces emissions beyond the minimum legal requirements.

1.1.6 Act No. 318/2012 Coll., on energy management, which amends Act No. 406/2000 Coll.

Objective: Higher efficiency of energy management, transposition of the legislation of the EU.

Characteristics: Legislative instruments in the area of management of electricity and heat,

Period of implementation: 2000 – **ongoing** (revision), **existing measure**

Time framework: not stipulated

Sector: energy production and consumption in industry, services and housing sector

The Act transposes Directive 2010/31/EU on the energy performance of buildings, Directive 2010/30/EU on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products, Directive 2009/125/EC establishing a framework for the ecodesign requirements for energy-related products, Directive 2009/28/EC on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

This Act, which has been amended several times since 2000, stipulates e.g.:

- Measures for increasing the economic use of energy and the obligations of natural and legal persons in energy management
- Rules for the drafting of the National Energy Policy, Territorial Energy Policies, for the Promotion of Energy Conservation and the Use of Renewable Sources of Energy,
- Requirements on eco-design of energy-using products
- Energy labels
- Energy performance of buildings
- Energy audits and auditors

The State Energy Policy is a strategic document with an outlook of 30 years defining objectives of the State energy management and is revised and evaluated every five years.

The Policy is prepared by The Ministry of Industry and Trade which also evaluates its implementation.

The Act also deals with specific measures leading to energy savings such as efficiency of energy production, energy intensity of buildings, building energy performance certificate, energy labels, energy audit and eco-design. The mitigation effects of these and also other measures included in the Act were calculated separately.

1.1.7 Act No. 458/2000 Coll., on the conditions for operating business and on performance of state administration in energy sectors (the Energy Act)

Characteristics: Legislative instrument, framework measure (mitigation effects calculated in other PaMs)

Period of implementation: 2000 – **ongoing** (revision), **existing measure**

Time framework: not stipulated

Sector: energy production, including use of RES

The Act transposes relevant EU legislation[1], includes directly applicable EU legislation[2] and sets conditions for business, for public administration and for energy regulation (electricity, gas and heat).

It deals with CHP. The criterion for the CHP is the difference between the overall efficiency of a CHP installation and the reference value.

The electricity from high-efficiency CHP shall include electricity:

a. Generated in a certified facility
b. With relative savings evaluated monthly at a minimum level of 10% (sources with exceeding 1 MW)
c. Which complies with the requirements of monthly evaluated minimum efficiency in the use of energy[3]

The operator of the distribution or transmission system pays a contribution to the price of electricity from CHP or produced from secondary energy sources, provided the producer is directly connected to the transmission system. The Energy Regulatory

1 Directive 2009/72/EC of the European Parliament and of the Council 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 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC.

Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of cogeneration based on a useful heat demand in the internal energy market. Directive 2004/8/EC is repealed from 5 June 2014 and replaced by Directive 2012/27/EU of 25 October 2012 on energy efficiency.

Directive 2006/32/EC of the European Parliament and of the Council on energy end-use efficiency and energy services and repealing Council Directive 93/76/EEC.

Directive 2005/89/EC of the European Parliament and of the Council concerning measures to safeguard security of electricity supply and infrastructure investment.

Council Directive 2004/67/EC concerning measures to safeguard security of natural gas supply.

2 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 network.

Regulation (EC) No 714/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the network for cross-border exchanges in electricity.

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.

Council Regulation No 617/2010 of 24 June 2010 concerning the notification to the Commission of investment projects in energy infrastructure within the European Union.

Regulation (EU) No 994/2010 of the European Parliament and of the Council of 20 October 2010 concerning measures to safeguard security of gas supply.

3 Decree No 150/2001 laying down the minimum efficiency of energy use in the generation of power and heat.

Act No 406/2000 on energy management, as amended.

Office stipulates the amount of the contribution. Traders in electricity are obliged to preferentially purchase and supply electricity offered by CHP producers and from secondary energy sources.

1.1.8 The 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.

1.1.9 National Renewable Energy Action Plan (NREAP)

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 RE in 2020, while the total EU target is 20%.

The main aim of the RE 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 (NREAP) 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 [48]. The NREAP [48] 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%; see tab. 3 and 4). The main renewable energy sources in the CR are biomass, followed by biofuels for transportation, biogas, hydropower and photovoltaic.

Period of implementation: 2010 – 2020, **ongoing**, **existing measure**

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

Sectors: Households, Energy Industry, Public sector, Private business, Private Investors

Tab. 3 Share of RES on final consumption of energy in 2005 and the target according to Directive 2009/28/EC

	2005	**2020**
RES consumption [PJ]	76.2	**161.7**
The share of RES [%]	6.1	**13**

Tab. 4 Share of RES on final consumption of energy according to NREAP, 2015 [48]

	2005	**2020**
RES consumption [PJ]	76.2	**172.9**
The share of RES [%]	6.1	**15.3**

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

Characteristics: The Directive 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. It was set for the Czech Republic in 2015 at 50.67 PJ of new final energy savings by 2020.

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 (see tab. 5).

Framework measure – the mitigation effect is calculated in other measures.

Period of implementation: 2008 – 2020, **ongoing**, **existing measure**

Sectors: Energy consumers and industry

Tab. 5 Calculation of the binding savings target stipulated in the Directive, Article 7 (2) [47]

Year	**Savings in PJ**
2017	38.6
2018	48.25
2019	57.9
2020	67.55

1.1.11 State programme on the promotion of energy savings and the use of renewable energy sources (EFEKT)

Objective: The support of energy savings, of the energy efficiency increase and of the use of RES

Characteristics: Cross-cutting plan at a national level, sectorial structure (coordination MIT); the targeted areas are the state administration and local (municipalities) and regional governments, schools, social and health care facilities, private sector (undertakings) , households and NGO's.

Period of implementation: 2004 – 2020 MIT, since 2007 ongoing as the EFEKT Program implemented only by MIT, **ongoing**, **existing measure**

Time framework: Annual evaluation and determination, including the contents and budgets of the individual parts of the program (financing from the State budget)

The implementation and financing of the State Program is in compliance with Act No. 406/2000 Coll., on budget rules. The program contributes to reach the energy target according to Directive 2012/27/EU on energy efficiency. Since 2007 the Program is called **Program EFEKT** implemented only by MIT.

The energy savings in 2020 are expected to be 882 TJ. The budget of the program is estimated to be 0.1 bill. CZK *[35].*

1.1.12 Operational Program Environment 2007 – 2013 (OPE)

Characteristics: The Operational Programme Environment was focused on improving the quality of the environment. It helps to improve air, water and soil quality. It also addresses waste and industrial pollution. The program promoted landscape care, the use of renewable sources and the building of environmental infrastructure.

Period of implementation: 2007 – 2013, **expired measure**

Sectors: Public and partly commercial sectors

This program was primarily focused on the public sector (e.g. municipalities, regions, organizations partly funded from the public purse, state enterprises, non-governmental non-profit organizations). However, in certain areas also business entities and natural persons are included.

The Operational Programme Environment had eight priority axes. In terms of energy savings the priority axis 3 was the most significant. This priority axis supported projects for the construction or reconstruction of facilities using renewable energy sources and cogeneration and projects aimed at energy savings and the reuse of waste heat in the non-business sector. Priority axis 2 was also significant. It focused on improving air quality, which also resulted in reduction of energy consumption.

Total energy savings of the program were estimated to be 2 692 TJ.

1.1.13 Operational Program Environment 2014 - 2020 (OPE)

Characteristics: 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. 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 program projects were financed from the European Regional Development Fund (ERDF) and from the Cohesion Fund (CF).

Period of implementation: 2014 – 2020, **ongoing**, **existing measure**

Sectors: Energy production (RES), housing sector and municipalities

In the priority axis 2 the following activities are supported:

- The replacement of boilers burning solid fuels with new boilers combusting solid, liquid or gas fuels
- The above replacements combined with other non-combustion sources of thermal energy
- The above replacements combined with other non-combustion sources of thermal energy

The expected energy savings are evaluated in the NEEAP III *[35]*:

Tab. 6 Energy savings

	2014 -2016	2017-2020
Energy savings [TJ]	699	2 320
Running sum of energy savings [TJ]	699	3019

The total program budget for the priority axis 2 is 10 bill. CZK.

In the priority axis 5 the following activities are supported:

- Insulation of buildings
- 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 re-using waste heat
- Replacement of heat sources using solid or liquid fossil fuels with more efficient sources using biomass, gas or with heat pumps and co-generation facilities (micro-cogeneration) using RES or natural gas
- Installation of solar thermic collectors for auxiliary heating or for the production of hot water.

The expected energy savings are evaluated in the NEEAP III *[35]*:

Tab. 7 Energy savings

	2014 - 2016	2017 - 2020
Energy savings [TJ]	462	1 521
Running sum of energy savings [TJ]	462	1 983

The total budget for the priority axis 5 is 13.4 bill. CZK.

1.2 Energy production

1.2.1 Promotion of renewable energy sources (RES) in electricity production

Characteristic: Preferential feed-in tariffs (Act 165/2012 Coll.), together with obligation of distribution companies to connect sources using renewables and to purchase the produced electricity, serve as a main tool for the promotion of RES in the CR.

Act 165/2012 Coll. transposes Directive 2009/28/ES on the promotion of electricity produced from renewable energy sources in the internal electricity market.

Period of implementation: from 2004, **ongoing**, **existing measure**

Time framework: Continuous with annual settings of feed-in tariffs

This measure guarantees preferential feed-in tariffs or a green bonus for electricity produced in power plants from renewable energy for a plant life (20 – 30 years). The tariffs are calculated according to the investment costs divided into 15 years. The advantageous tariff is paid to the suppliers by the distribution companies and is fully reflected in the price of electricity sold by those distribution companies.

Not only electricity from biomass, but also photovoltaic-, wind- and hydropower plants are financially supported. In 2016 the installed capacity of photovoltaic and wind power plants reached 2127 MW and 285 MW respectively.

Disproportionately high feed-in tariffs caused an unforeseen solar boom in 2010. Therefore, a new law has been approved which significantly decreases these tariffs (especially for photovoltaic and wind electricity). Moreover, a special tax of 26% for the solar electricity was introduced for the period 2011 – 2013.

For the estimation of effects of the preferential feed-in tariffs about 50% of newly built power plants using RES are attributed to this measure.

Since 2014 new photovoltaic plants are not supported anymore. Other new plants using RES will be financed only if they received a permit for installation until the end of the year 2013. Small hydropower plants (up to the capacity of 10 MW) will be supported also in the next years. According to the Act 165/2012 Coll. on supported energy sources mainly co-generation power plants with the total efficiency above 75% will receive financial support in the future. By these plants not only electricity, but also heat production will be subsidized. The production of heat by biogas stations will receive also subsidies in future.

1.2.2 Promotion of Co-generation

Characteristic: Support for the combined power and heat generation

Period of implementation: from 2005, **ongoing**, **existing measure**

Time framework: Continuous with annual settings of feed-in tariffs

The Directive on promotion of cogeneration 2004/8/EC was amended by the Directive 2012/27/EU on energy efficiency. This Directive is transposed to the Czech legislation by the Act No. 318/2012 on energy management. The Act stipulates the obligation of power distribution companies to connect co-generation sources to the grid and to purchase the electricity produced from co-generation sources. Electricity production in co-generation is encouraged by preferential feed-in tariffs. The preferential feed-in tariffs are scaled by the installed capacity of the source and their levels are set by the Energy Regulatory Office on the annual basis.

The measured emission reductions were calculated using the MESSAGE model.

1.2.3 Efficiency Improvement of District Heating Systems

Characteristic: The measure provides an investment support to increase the heat supply efficiency. The measure aims at:

- Primary energy savings through the use of low-temperature heat from electricity production and through the introduction of CHP

- The modernization of heat supply systems, optimizing their operation and reducing heat losses during distribution

Period of implementation: 2014 - 2020, **ongoing**, **existing measure**

Time framework: Annual evaluation and budget setting.

Sectors: energy

Supported activities include:

- Installation of cogeneration units (with the exception of cogeneration units using biomass and biogas);
- Reconstruction of the existing CHP facilities to improve technical parameters and savings
- Building new district heating systems (DHS) and extension of existing DHS including heat exchange stations in order to maximize the heat recovery.

The annual energy savings were estimated to be 4 600 TJ/year from 2020 (NEEAP III *[35]*). The CO_2 emissions savings were calculated from energy savings and average emission coefficients of heat production *[49]*.

1.3 Manufacturing Industries

1.3.1 Operational Programme Industry and Enterprise (OPIE)

Characteristic: The Operational Program Industry and Enterprise offered subsidies from the EU Structural Funds. Various projects mainly by small and medium—sized enterprises were supported, e.g.:

- Innovation of industrial products, services and processes
- Research and development of new technologies, products and materials
- Energy reduction investment projects
    - Introduction of new technologies reducing energy consumption by energy generation, conversion and distribution
    - Modernization of existing equipment and of energy distribution systems
    - Implementation of cogeneration
    - The recovery of waste heat and the use of secondary heat sources.
    - Improvement of logistics and of the energy performance of industrial buildings
- Generation of heat and electricity from renewable energy sources (RES) – new technologies and the modernization of older equipment for the use of RES

Period of implementation: 2004 – 2006, **finished**, **existing measure**

Time framework: Annual evaluation and budget setting.

According to the Annual report of the program the total cost reached 32 M EUR.

The annual energy savings due to the program are about 160 TJ and the annual energy production from RES is 630 TJ *[1]*.

1.3.2 Operational Programme Enterprise and Innovation (OPEI): Eco-Energy

Characteristic: The Priority axis 3 (Eco-Energy) of the OPEI supported by The Ministry of Industry and Trade (MIT) had seven priority axes (e.g. Development of firms, Innovation, Business development services, Technical assistance). The priority axis 3 (Effective Energy or Eco-Energy) is focused on energy savings and on the use of RES (renewable energy sources) and thus aiming at GHG reduction.

The program aimed at reducing energy intensity in production processes, at reducing fossil fuel consumption and at a higher usage of renewable and secondary energy sources. The aid beneficiaries were not only small- or medium-sized, but also large enterprises.

The support focused also on building of new facilities for generation and transmission of electricity and thermal energy generated from RES and on the reconstruction of existing production facilities in order to use renewable energy sources. Further support was provided for modernization of existing energy production facilities to increase their efficiency and for implementation of systems for measurement and regulation of energy. Further, modernization and loss reduction in the transmission of electricity and heat and to the use of waste energy in industrial processes were encouraged.

Funding derives in part from European Regional Development Fund (ERDF) (85%) and partly from the state budget (15%). The support was provided in the form of subsidies or subsidized loans for all projects on the territory of the Czech Republic except the capital city of Prague. One half of the funds allocated to this priority was designated for energy savings and another half for the use of RES.

Period of implementation: 2007 – 2013, **expired measure**

Time framework: Annual evaluation and budget setting.

The aim of the program is to use the grants in order to stimulate enterprises in reducing the production energy requirements and the consumption of primary energy sources, and to promote a higher utilization of renewable and secondary energy sources.

According to the report of MIT (Podpora projektů energetické efektivnosti v rámci OP PIK PO3; 2015) the Axis 3 supported annual energy savings of 10.68 PJ with GHG emission reduction of 1 238 kt.

1.3.3 Operational Programme Enterprise and Innovation for Competitiveness – Part Industry

Characteristic: The program provides investment aid to increase energy efficiency in industry.

Period of implementation: 2014 – 2020, **existing measure**

Time framework: Annual evaluation and budget setting.

Sectors: Industry

The program includes the following activities:

- The modernization or replacement of existing industrial energy production facilities to increase their efficiency

- The introduction and upgrading of measurement and control systems
- The modernization and loss reduction in electricity and heat distribution systems in buildings and production plants
- The improvement of the energy performance of buildings in the business sector (building insulation, the replacement and renovation of windows and doors, , the installation of ventilation technology with waste heat recuperation, etc.)
- The use of waste energy in production processes
- The improvement of energy efficiency in production and technological processes
- The installation of renewable energy sources for industrial own consumption
- The installation of cogeneration units for internal consumption
- The support of extra costs for achieving the standard of a nearly zero energy consumption of existing or new buildings

Expected effects: The primary goal of the measure is energy saving. The following table shows the expected energy savings *[35]*.

Tab. 8 Energy savings

	2014-2016	2017-2020
Energy savings forecast [PJ]	8,571	11,429

The total program budget is 50 bill. CZK.

1.3.4 Support of voluntary commitments to energy savings in industry – Additional measure

Characteristics: Voluntary energy efficiency agreements focus on reducing energy consumption and related emissions or on increasing energy efficiency.

The principle of voluntary agreements is that the state imposes an obligation on industry and industry proposes an alternative way of meeting that obligation. In case of failure to fulfil obligations sanctions come into play, which typically take the form of the enforcement of the original obligation. If such voluntary agreements are to be prepared and concluded certain general requirements have to be met. In order to motivate undertakings a tax relief is possible.

Period of implementation: from 2017, **ongoing – additional measure**

The measure was introduced in the NEEAP III. The expected energy savings in 2020 are about 5 438 TJ/year *[35]*.

1.4 Domestic sector

1.4.1 Energy labelling of household electrical appliances

Characteristic: The energy labelling within the European Union has proved to be economically very effective for improving the energy efficiency of household electrical appliances. With minimum demands for public funds the measure brings a significant effect in energy savings. Energy labels help consumers choose energy efficient products. The labelling requirements for individual product groups are created under the EU's Energy Labelling Directive (Directive 2010/30/EU).

Period of implementation: from 2001, **ongoing**, **existing measure**

From 2020 energy savings from the labelling are 3 354 TJ/year *[35]*. These savings also include new appliance categories introduced for the labeling since 2011.

1.4.2 Programme PANEL/NEW PANEL/PANEL 2013+

Characteristic: The Programme PANEL (NEW PANEL since 2009, PANEL 2013+ since 2013) offers low-interest loans for a complex of refurbishments and modernizations of block of flats leading to the improvement of the utility value and to substantial lifetime prolongation.

Projects supported include e.g.:

• Insulation of the building

• Replacement of old external doors and windows in order to decrease releasing of heat and outside noise

• Reparation and insulation of roofs

• Installation of a heating system regulation

• Modernization of a heating system, including the use of RES

• Repair or modernization of ventilation technology

• Installation of thermo-solar panels

• Installation of measurement devices for heat consumption, hot and cold water consumption

• Modernization of the hot water system (e.g. lever taps replacement, riser pipe insulation)

• Acquisition of building energy performance certificate

Period of implementation: from 2001, **ongoing**, **existing measure**

Time framework: Annual evaluation and budget setting.

The program is based on the Decree No. 299/2001 Coll. The aid can be obtained by

- Physical or legal entities which own or co-own the building,
- Physical or legal entities which own or co-own a flat or a non-living space in the building
- A community of flat owners

Many kinds of refurbishments of multi-family houses are eligible for the support. The support can have the form of:

- A guarantee for the bank loan
- A subsidy of the credit interest

The total savings for the period 2008 – 2020 are expected to be 2 524 TJ. The expected annual budget for this period is estimated to be about 4.5 bill. CZK *[35]*.

1.4.3 Implementation of the Energy Performance of Buildings Directive (2002/91/EC)

Objective: Includes legislation and programs for reduction of energy consumption and increased use of RES in buildings.

Characteristics: 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.

Period of implementation: from 2007-2011**, expired measure**

Sector: the residential and tertiary sectors

Directive 91/2002/EC was transposed into the national legislation by the Law 406/2006 on Energy Management and by the Regulation 148/2007 on Energy Building Performance. According to the Czech legislation energy performance certificates for new buildings were issued since 2009. A methodology for the energy buildings performance evaluation was in compliance with the Directive.

Energy building performance included the total annual energy used for heating, ventilation, cooling, air-conditioning, hot water and lighting.

1.4.4 Implementation of the Recast of Building Performance Directive (2010/31/EU)

Objective: To promote the improvement of the energy performance of buildings.

To promote the improvement of the energy performance of buildings

Characteristics: 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. It includes Czech legislation and programs for reduction of energy consumption and increased use of RES in buildings.

Period of implementation: since 2012, **ongoing, existing measure**

Sector: the residential and tertiary sectors

The Directive is transposed by the Act No. 318/2012 Coll., on energy management. The directive defines new administrative tools to reduce energy building performance. It defines a building with zero energy consumption. It tightens requirements for energy building performance with the aim to reduce energy consumption and emission of GHG by 20% and increase the share of RES in the EU also by 20% in 2020 in comparison to 1990.

Energy building performance is defined as calculated/measured typical energy consumption which also includes energy used for heating, ventilation, cooling, air-conditioning, hot water and lighting.

Not only energy performance, but also optimal economic costs are emphasized. In 2011 the EC issued a methodological framework for the calculation of optimal cost levels for minimal requirements on energy building performance.

Until 2020 all new buildings shall be buildings with almost zero energy consumption. From 2019 all new buildings used or owned by public administration shall be buildings with almost zero energy consumption. According to the Directive "a building with almost zero energy consumption" is a building with very low energy performance. The energy performance shall be estimated in compliance with the Directive methodology. The low consumption should be mainly covered by RES.

The energy performance certificates according to the Recast directive contain new information, e.g. except energy performance and reference values (minimal requirements for energy performance) also recommendations for decreasing of energy performance taking into account cost optimization. Also contact to other information sources, especially regarding cost efficiency shall be included in the certificate.

Emission reduction effects of some measures (programs) are included under this PaM (e.g.: Support for the modernization of housing stock by means of the building saving schemes, Joint Boiler Replacement Promotion Scheme, Credits of Cities and Municipalities for Modernization of Housing, Program JESSICA, etc.)

1.4.5 Support for the modernization of housing stock by means of the building saving schemes

Characteristic: Building saving schemes is a financial product with an advantageous interest rate enhanced by the state support.

Building society savings schemes are advantageous because of the opportunity to borrow money to invest in housing. These loans have a fixed rate depending on the building society and amount of the loan selected.

Period of implementation: from 1995, **ongoing**, **existing measure**

Time framework: continuous

Sectors: households

The building savings are from their beginning the most popular way of financial savings in households. Building savings are generally intended to safeguard the needs of housing. Among supported activities are the reconstructions and modernizations of flats and houses, which are often accompanied by energy saving measures.

Estimated annual energy savings from 2020 are 5 400 TJ *[35].*

The mitigation effect is included under the measure: Implementation of the Recast of Building Performance Directive (2010/31/EU).

1.4.6 Joint Boiler Replacement Promotion Scheme

Characteristics:

The program offered subsidies for replacements of hand-fed solid fuel boilers by new efficient low-carbon heat sources in households.

Period of implementation: 2013 – 2016, **expired measure**

Time framework: Annual evaluation and budget setting.

Sectors: households

The program aimed to support replacements of boilers in order to reduce air pollution from small boilers using fossil fuels with a capacity up to 50 kW. The program was based on the principle that the same amount of financial aid is contributed by the Ministry of Environment and also by a region. This means that if a region manages to find more money it will also receive more money from the ministry.

The program budget was about 10.5 mil. EUR/year. Expected energy savings were about 118 TJ/year.

1.4.7 Credits of Cities and Municipalities for Modernization of Housing

Characteristics: Provision of soft loans to municipalities for complex refurbishments of residential buildings in their ownership.

Period of implementation: 2001 – 2016, **finished**, **expired measure**

Time framework: Annual evaluation and budget setting.

Sectors: Households

The program was intended for municipalities owning apartment buildings. A loan with a fixed interest rate of 3 % p.a. up to 10 years was provided. The loan could cover up to 50 % of total costs. The program was primarily focused on the complex regeneration of apartment buildings with the condition to achieve a required standard in thermal and technical parameters of buildings.

The mitigation effect is included under the measure: Implementation of the Recast of Building Performance Directive (2010/31/EU).

1.4.8 Awareness on Energy Savings in Heat Consumption in Households

Characteristics: Education and awareness campaigns on energy savings in households (the media, leaflets, lectures, etc.).

Period of implementation: 2000 – 2020, **ongoing**, **existing measure**

Time framework: Annual budget setting.

Sectors: households

The mitigation effect is included under the measure: Implementation of the Recast of Building Performance Directive (2010/31/EU).

1.4.9 Program JESSICA

Characteristics: The program offers long-term low-interest loans for reconstruction or modernization of residential buildings. The program is designed for all owners of residential houses:

- Municipalities
- Housing Cooperatives,
- Other legal and natural persons owning residential building
- Community of apartment owners,
- Non-profit organizations for social housing.

Period of implementation: 2014 – 2020, **ongoing**, **existing measure**

Time framework: Annual evaluation and budget setting

Sectors: households

The program focuses on:

- Insulation of internal structures and external cladding including replacement of windows and doors,
- Reconstruction of technical equipment (e.g. heating system, plumbing, heating, gas, water, air conditioning, elevators),
- Replacement or modernization of loggias, balconies, railings,
- Repairing static failures of supporting structures,
- Rehabilitation of foundations and waterproofing of substructures,
- Provision of modern social housing through renovation of existing buildings.

The mitigation effect is included in the measure: Implementation of the Recast of Building Performance Directive (2010/31/EU).

1.4.10 Electricity Savings in Households Lighting

Characteristics: The aim of the measure is a gradual replacement of energy-inefficient light sources (incandescent and halogen bulbs) by compact fluorescent and LED lamps. The main driving force of the measure is a gradual ban on sales of incandescent and halogen bulbs.

Period of implementation: since 2009, **ongoing**, **existing measure**

Sectors: households

Since 2009, the main driving force of energy savings in the lighting is a gradual ban on the sale of incandescent light bulbs set by Regulation 244/2009/EC. A schedule of the ban on light bulbs according to that regulation is:

- September 1, 2009: ban on all incandescent lamps with frosted glass, ban on bulbs 100 W and more
- September 1, 2010 – ban on bulbs 75 W and more
- September 1, 2011 – ban on bulbs 60 W and more
- September 1, 2012 – ban on all incandescent bulbs (lamps of classes poorer than C, ordinary light bulbs have class E)
- September 1, 2016 – ban on all light sources worse than Class B (so halogen lamps because they have classes C and D)

The energy savings resulting from the program were estimated to be 1 880 TJ/year since 2016 *[35].*

1.4.11 The Green Savings Programme, (The Ministry of the Environment and State Environmental Fund)

Characteristic: The Green Savings Programme supported the use of renewable energy sources (RES) for heating and the investments for energy savings in households (reconstructions and new development projects). The program supported a high-quality insulation of single-family buildings and multi-family buildings, the replacement of non-ecological heating with low-emission sources using e.g. biomass. Further, it financed the installation of energy efficient heat pumps, solar thermal collectors, and it also supported the constructions complying with the passive building standards.

Period of implementation: 2010 – 2012, **expired measure**

Time framework: Annual evaluation and budget setting

Sectors: Residential and partly Commercial/Institutional sectors

The Czech Republic obtained financial resources for this program through the selling of Assigned Amount Units (AAUs) under the Kyoto Protocol. The total allocation up to CZK 20 billion was envisaged for the program.

The following activities were supported by the programme:

A. Heating energy savings
B. New constructions to zero energy building standards
C. The use of RES for heating and hot water

The energy savings for space heating (e.g. improving the thermal insulation of buildings) were expected to bring the highest effect.

The subsidy could be obtained either for the complete building insulation or for a partial insulation if the energy saving would reach at least 20% of the annual heating energy consumption. The installation of solar collectors for water and space heating was eligible in the RES support category.

The energy savings of the program were 2 950 TJ in the period 2008-2010 and also further 2 950 TJ during the years 2011 - 2013 *[3]*. These savings also include the energy from the substitution of fossil fuels by RES.

Since August 2013 started the New Green Savings Programme 2013 and the New Green Savings Programme, which should run until 2020.

1.4.12 New Green Savings Program 2013

Characteristic: The New Green Savings Program 2013 was a subsidy program of the Ministry of Environment (administrated by the State Environmental Fund) focused on energy savings and the use of renewable energy in single-family buildings.

Period of implementation: 2013 – 2014 **– expired measure**

Time framework: Annual evaluation and budget setting

Sectors: Residential sector

The program exclusively focused on the insulation of family houses in combination with the replacement of inefficient boilers using solid fuels. The program further supported the installation of solar systems for hot water.

Expected effects: Expected energy savings and corresponding savings of CO_2 emissions are presented in the following table.

Tab. 9 Energy savings [35]

	2014 - 2016
Energy savings [TJ]	442.0

The total budget of the program is CZK 1 billion. The effects and costs of both Green savings programs are calculated together.

1.4.13 New Green Savings Program 2014 – 2020

Characteristics: This measure is a successor of the previous two Green Savings Programmes. It aims at the improvement of energy performance of single- and multi-family buildings (replacement of old inefficient boilers by new boilers using e.g. biomass; installation of heat pumps and solar systems for hot water).

Period of implementation: 2014 – 2020, **ongoing, existing measure**

Time framework: Annual evaluation and budget setting.

Sectors: Residential and partly Commercial/Institutional sectors

The measure should support owners of single-family houses, multi-family houses and also public sector buildings. Supported activities are:

- Improvement of the energy performance of existing single- and multi-family buildings
- Construction of single- and multi-family buildings with very high energy performance
- Efficient use of energy sources (e.g. biomass boilers, biomass fireplace stoves with a heat exchanger, heat pumps, gas condensing boilers, solar systems for heating and hot water, installation of mechanical ventilation systems with heat recovery)

Tab. 10 Energy savings [35]

	2014 - 2016	2017 - 2020
Energy savings [TJ]	3 667	10 641
Running sum of energy savings [TJ]	3 667	14 308

The total program budget is CZK 27 bill.

1.4.14 Operational Program Environment 2014 – 2020 – priority axis 2 (see cross-cutting measures, Ch. 1.1.13)

1.4.15 Integrated Regional Operating Programme

Characteristics: The program is divided into following priority axes:

- Competitive, affordable and secure regions
- Improvement of public services and living conditions for residential regions
- Good governance and the efficiency of public institutions
- Community-led local development
- Technical assistance

The priority axis 2 and its investment priority 4c “Promoting energy efficiency, intelligent systems energy management and use of energy from renewable sources public infrastructures, including in public buildings and in housing” is dealing with energy savings.

Period of implementation: 2014 – 2020, **ongoing**, **existing measure**

Time framework: Annual evaluation and budget setting

Sectors: households

Supported measures affecting the energy performance include:

- Insulation of residential building
- Replacement and refurbishment of windows and doors
- Passive heating and cooling, shielding,
- Installation of systems of controlled ventilation with heat recovery

Measures affecting equipment for space and water heating include:

- Replacement of space heating boilers using solid or liquid fossil fuels by efficient biomass boilers
- Replacement of water heating boilers using solid or liquid fossil fuels by efficient biomass boilers,
- Heat pumps
- Condensing gas boilers or equipment for combined electricity and heat generation using RES or natural gas and covering primarily the energy needs of buildings where located.

The expected annual energy savings are 9000 TJ since 2020. The total budget for the period 2014–2020 amounts 16.9 mld. CZK *[35]*.

1.5 Tertiary sector

1.5.1 Implementation of the Energy Performance of Buildings Directive (2002/91/EC) (see Ch. 1.4.3)

1.5.2 Implementation of the Recast of Building Performance Directive (2010/31/EU) (see Ch. 1.4.4)

1.5.3 Energy Star (the US energy efficiency standards for office equipment in the EU)

Characteristics: ENERGY STAR (The Labelling Energy Efficient Office Equipment) is a governmental program helping businesses and individuals to protect the environment and to reduce energy consumption through superior energy efficiency office equipment. In 2006 the EU and USA signed the Agreement on Energy Efficiency of Office Equipment. In 2009 they prolonged the agreement for another five years. New technical specifications for energy efficiency for e.g. computers and imaging equipment, i.e. printers, copiers, fax machines, multifunctional devices etc. were developed in the cooperation between the EU Member States, US Environmental Protection Agency and stakeholders.

The Energy Star program lets picks the most energy efficient models within the group of ENERGY STAR qualified office equipment.

Period of implementation: 2006 – not restricted, **ongoing**

Time framework: not stipulated

Sectors: Public sector, Private business, IT Technology,

The energy savings resulting from the Energy Star program are estimated to be 573 TJ/year since 2020 *[35]*.

1.5.4 Provision and Support of Energy Services in Tertiary Sector using the EPC Method

Characteristics: The purpose of the measure is to remove legal obstacles to the application of the EPC method (Energy Performance Contracting) and to prepare methodology for using EPC in government and public administration so that EPC become more preferred financing method of energy savings in buildings.

Period of implementation: since 2008 ongoing

Time framework: not applicable

Sectors: tertiary sector

At present, the Act no. 218/2000 Coll., on budgetary rules, especially its § 49, prevents the use of the EPC method in state institutions because it does not permit loans for them. The measure aims to remove legal barriers to the EPC application in governmental institutions.

The mitigation effect of this method is included in the measure: Implementation of the Recast of Building Performance Directive (2010/31/EU).

1.5.5 Extension of Public Sector Role in Demonstration of New Technologies

Characteristics: The main purpose of this measure is the introduction of a green procurement in public administration. This shall be mandatory for organizations falling within the scope of the effect of the Public Procurement Act.

Period of implementation: since 2010

Time framework: not applicable

Sectors: public sector

Since November 2010, ‘Rules for the application of environmental requirements in central and local government procurement procedure and purchasing’ have applied in the Czech Republic. These rules were adopted by the Government to promote green procurement in the public sector. The rules follow up on the European Community’s Sustainable Consumption and Production and Sustainable Industrial Policy Action Plan, approved in 2008. The rules were primarily drawn up for organizations governed by Act No 137/2006 on public procurement. However, they may also be used by businesses and other entities on both the demand and supply side.

Energy savings since 2020 account to 2 880 TJ/year.

1.5.6 Electricity Savings in Lighting in Tertiary Sector and Public Lighting

Characteristics: Office lighting: Gradual replacement of energy-inefficient light sources (incandescent and halogen bulbs) by compact fluorescent and LED lamps.

Public lighting: Replacing of inefficient low-pressure discharge lamps and especially high-pressure mercury lamps with modern high-pressure sodium and metal halide light sources using only electronic accessories instead of loss electromagnetic coils.

Period of implementation: since 2009, **existing measure**

Time framework: not applicable

Sectors: tertiary sector

Since 2009, the main driving force of energy savings in the lighting is a gradual ban on the sale of incandescent light bulbs set by Regulation 244/2009/EC (see also the measure 'Electricity Savings in Households Lighting' in Ch. 1.4.10).

The energy savings resulting from the program are estimated to be 963 TJ/year since 2016 *[35]*.

1.5.7 Operational Program Environment 2014 – 2020 – priority axis 5 (see cross-sectoral measures, Ch. 1.1.13)

1.5.8 Operational Programme Enterprise and Innovation for Competitiveness – Part commercial services

Characteristic: The program provides investment subsidies to improve energy efficiency in commercial services.

Period of implementation: 2014 – 2020, **existing measure**

Time framework: Annual evaluation and budget setting.

Sectors: Commercial services.

The program will support the following activities:

- Introduction and modernization of metering and control systems,
- Modernization, reconstruction and decreasing losses in electricity and heat distribution in buildings
- Decreasing of energy intensity of buildings (insulations, heat recovery),
- The use of renewable energy sources
- Subsidies to additional costs necessary for reaching near zero energy consumption of existing or new buildings.

The primary goal of the measure is to save energy. The total energy savings up to 2020 are 10.68 PJ (MPO: Podpora projektů energetické efektivnosti v rámci OP PIK PO3, 2015).

1.6 Transport

1.6.1 EU regulation on CO_2 from light-commercial vehicles (vans) (2000-2035)

As part of its strategy to cut CO_2 emissions from light-duty vehicles, the European Commission adopted the Directive on the Promotion of Clean and Energy Efficient Road Transport Vehicles 2009/33/EC.

Regulation No 253/2014/EU amending Regulation No 510/2011/EU defines the modalities for reaching the 2020 target to reduce CO_2 emissions from new light commercial vehicles. The Regulation builds on a well-established process of measuring and monitoring the CO2 emissions of vehicles in accordance with Decision No 1753/2000/EC.

The main objective of the vans Regulation is to cut CO_2 emissions from vans to 175 g CO_2/km by 2017 and to reach 147g CO_2/km by 2020. These cuts represent reductions of 14% and 28% respectively compared with the 2007 average of 203 g/km.

The 2017 target is phased in 2014 and 2016 when an average of 70% and 80% respectively of each manufacturer's newly registered vans must comply with the limit value curve (heavier vans are allowed higher emissions than lighter vans).

If the average CO_2 emissions of a manufacturer's fleet exceed its limit value in any year from 2014, the manufacturer has to pay an excess emissions premium for each van registered. 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.

1.6.2 EU regulation on CO_2 from passenger cars (2000-2035)

The European Commission also issued Regulation No 333/2014/EU amending Regulation No 443/2009/EC Regulation about the emission limits of CO_2 for new passenger cars. The Regulation builds on a well-established process of measuring and monitoring the CO_2 emissions of vehicles in accordance with Decision No 1753/2000/EC.

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).

1.6.3 Support of biofuels (2000-2030)

The quality of fuels used in transport is regulated by Directive of the European Parliament and of the Council 2009/30/EC amending Directive 98/70/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. The Government

Decree 351/2012 Coll. sets sustainability criteria of biofuels. The Law on Consumption Tax 453/2016 Coll. levies biofuels with a lower tax rate.

The baseline shall be based on the EU average level life cycle GHG emissions per unit of energy from fossil fuel products in2010. Reducing greenhouse gas emissions is likely to be achieved by harnessing biofuels and fuels with lower carbon content (e.g. natural gas). The directive also sets rules for the sustainable use of biofuels. Greenhouse gas emissions from biofuels must be at least 35% lower than a fuel they replace. Since 2017, this figure rises to 50% and from 2018 to 60% for biofuels produced in facilities that started production on January 1, 2017 or later.

1.6.4 Modal shift

Increasing the attractiveness of public transport:

a) Introduction of the integrated transport system (IDS)

The integrated transportation provides public transport in a certain area via individual carriers in the rail transport and/or in other type of transport. The individual carriers and types of transport do not compete within this IDS system. On the contrary, they try to cooperate in order to gain new customers among users of passenger cars. The unified rules for IDS operation are not given and they differ from case to case but it is always a voluntary agreement of the carriers. Usually establishment of this type involves enforcement of the unified pricing policy (one travel record enables us to travel in the whole network with various carriers), mutual interlacing of the railway timetables of the integrated carriers and establishing new connecting links, elimination of the overlapping lines of more carriers and set-up of a tact railway timetable (the connections are going at regular intervals). The IDS systems in Prague, South Moravia and Ostrava city belong to the most efficient ones in the Czech Republic.

However, this measure is valid on urban and regional level and that is why it is impossible to quantify its emission reduction.

b) Increasing of passengers' comfort

In order to increase the comfort during the travelling modern low-ground vehicles enabling easier getting on and getting out for the passengers are put in the operation and are also suitable for the transport of disabled people and mothers with prams. The necessary standard in the urban public transport is quality information equipment for the passengers. For easier transfers the construction or modernization of the interchange terminals with introducing the edge-edge transfers (linked connections are setting off from various sides of one platform so the passengers do not have to go to other platforms through underpasses, overpasses, or even directly across the road in a complicated way) and sufficient maintenance in terms of travel culture. For example air-conditioning, cleanness and design of the internal environment etc. belong to other elements increasing the travel comfort of public transport.

Due to the character of this measure, it is also impossible to determinate its contribution to GHG emission reduction.

c) Preference of public transport vehicles

The speed of public transport vehicles in cities is mainly decreased due to cars. It leads to delays of urban public transport. To increase the attractiveness of public transport, extra lanes for buses and trolleybuses in exposed places and the preference of the urban public transport in the light controlled intersections are supported. Also this measure is on urban level.

d) Introduction of "Park and Ride" system

There is the effort in the Czech Republic to improve multi modal passenger transport by "Park and Ride" (P&R) In Prague, this system is now be combined with increasing rates of parking fees in the localities which have to be calmed down (so called "blue zones"). But efficient implementation requires Park and Ride with bigger capacity, e.g. parking houses with several floors, in the outer part of a city. Although the parking sites for Park and Ride are well situated and marked, this measure is not much successful until now, due to the lack of their capacity

Systems of combined freight transport:

Not only passenger transport but also freight transport can be realized in a multi-modal manner. In terms of mitigation of the effects on human health the goods should be transported by rail as far as possible. Water transport is considered to be used for "ecological" transport as well but this is questionable regarding the negative effects on water ecosystems. Road haulage is in this point of view considered to be the worst. However, rail transport is not able to provide all transport of the goods to the destination - meaning "from doors to doors". Therefore, no transfer of the whole haulage from the road to the railway is possible.

However, a part of transported work of selected commodities is possible to be transferred by railway with help of the construction of logistic centers in important railway stations. Places for storage of the goods should be constructed there because goods are sent from there via freight trucks to target destinations. This option of freight combination should be then offered to truck transport operators who are interested in these services mainly in transport to abroad. Locations for logistics centers must be directly connected with the main railway lines. Truck arrival routes should be kept outside of populated areas. The equipment of the station with the work-siding premises is beneficial. The construction of logistic centers could be one of the ways to revitalize the unused areas which are called „brownfields" (they tend to be trailed; there are storage and loading facilities, etc.). Each proposed solution of the logistic centers should be verified by the transport model of the freight.

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).

1.6.5 Operational Program Transport

Characteristic: The program provides support for construction, upgrading and development of the Trans-European Transport Networks (TEN-T) and regional rail transport networks.

Period of implementation: 2007 – 2020, **ongoing, existing measure**

Time framework: Annual evaluation and budget setting.

Sectors: Transport

The Operational Program Transport implements transport strategy and other transport aspects of the National Development Plan. It focuses on modernization of railway and road networks. The main program indicators include a reduction of the accident rate, an increase of the transport capacity, time- saving and GHG emission reduction.

Basic overview of priority axes of the program:

- Priority Axis 1 – Upgrading the TEN-T
- Priority Axis 2 – Construction and modernization of the road network TEN-T
- Priority Axis 3 – Modernization of the railway network outside TEN-T
- Priority Axis 4 – Upgrading of roads outside TEN-T
- Priority 5 – Modernization and Development of the Prague Underground and systems of management of road transport in the City of Prague
- Priority 6 – Support of Multimodal Freight Transport and Development IWT
- Priority 7 – Technical Assistance

The total allocation of the program was 5.8 bill. EUR for the period 2007-2013. The same amount is assumed for the period 2014 – 2020. The annual CO_2 emission drop was calculated from average emission coefficients of transport and annual energy savings estimated to 3 016 TJ/year from 2020 *[34]*.

1.6.6 National Strategy of Cycling Transport Development

Characteristic: The measure supports the construction of cycling infrastructure. It is financed mainly from the State Transport Infrastructure Fund, which supports the following activities (see also: www.cyklostrategie.cz):

- Construction and maintenance of cycling infrastructure
- Connection to public transport
- The use of existing roads for the needs of cyclists
- Construction and reconstruction of cycling infrastructure (e.g. cycle lanes, bicycle underpasses)

Period of implementation: 2014 – 2020, **ongoing**, **existing measure**

Time framework: Annual evaluation and budget setting

Sectors: Transport

The program is focused on the construction and maintenance of cycling paths. Cycling can partly replace vehicular traffic in urban and suburban areas and thus lead to energy and emission savings.

The annual energy savings were estimated *[35]* to be 585 TJ/year from 2020 with the annual budget of 150 mill. CZK.

1.6.7 Territorial planning measures (2000-2030)

Law 183/2006 Col. on territorial planning sets the rules for territorial development. A suitable territorial plan improves transport networks and increases mobility efficiency and thus indirectly decreases GHGs emissions.

The processing of the territorial plans is one of very significant measures for reduction of the environmental burden in the traffic. The territorial plan represents a preventive tool which solves the causes, not consequences. With help of the quality 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 labor division in favor 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.).

1.6.8 ICAO agreement (2010-2030)

The International Civil Aviation Organization (ICAO) is a UN specialized agency to manage the administration and governance of the Convention on International Civil Aviation (Chicago Convention). ICAO cooperates with Member States (MS) and industry groups on international civil aviation Standards and Recommended Practices (SARPs) and policies in support of a safe, efficient, secure, economically sustainable and environmentally responsible civil aviation sector.

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.

The following PaMs in transport are **additional.**

1.6.9 Economic and tax tools (from 2020) – Additional measure

The objective is to encourage the use of less polluting vehicles. This group of measures involve: charging the use of the transport infrastructure for freight vehicles (Road Traffic Law 13/1997 and its amendments), a road tax reduction for the "purer" vehicles (Road Tax Law 190/1993 and its amendments), excise tax on fuel (Excise Law 353/2003) which supports alternative fuels with lower CO_2 emissions (e.g. compressed natural gas – CNG, bio fuels – tax free).

The Transport Policy 2014 – 2020 contains following aims:

- To apply measures minimizing negative impacts of traffic emissions and noise by appropriate transport infrastructure
- To promote low emission freight transport

- To gradually implement measures to decrease noise and vibrations in densely populated areas
- To minimize negative impacts of transport on public health and ecosystem stability
- The construction and reconstruction of traffic structures for functional permeability for animals
- Preferably strengthen the capacity of existing transport corridors before building new communications with similar transport capacity serving the same territory
- To reduce the dependence of transport on energy based on fossil fuels
- To introduce speed limits on motorways and highways (higher speed causes more energy consumption and higher emissions).

A shift from a road to modes with the lower impact on the environment (railway, waterway, the use of multimodal transport systems

1.6.10 Road toll (from 2020) – Additional measure

Characteristic: 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.

1.7 Industrial processes

1.7.1 Regulation 517/2014/EU on fluorinated greenhouse gases – existing measure

The European Parliament and Council approved in 2014 Regulation 517/2014/EU on fluorinated greenhouse gases repealing Regulation 842/2006/EC setting strict bans on the use of fluorinated gases with high global warming potentials. The regulation is applied in the industrial sector in the Czech Republic. All limitations and bans resulting from this regulation were incorporated into the scenario "with existing measures". The mitigation effects of the older and repealing Regulations are included under the measure: Regulation 517/2014/EU on fluorinated greenhouse gases.

1.8 Agriculture

The concept of sustainable and multifunctional agriculture in the Czech Republic takes into account the reduction of greenhouse gas emissions and possible needs for adaptation measures, along with other environmental and socio-economic considerations. These objectives can be achieved by the Common Agricultural Policy of the EU, as well as through national measures. New national measures to reduce greenhouse gas emissions are being prepared and introduced continuously.

The implemented agrarian policies and measures should undoubtedly increase CO_2 fixation in the agriculture sector. The policies and measures in agriculture leading to greenhouse gas 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 agrarian policy has declared the goal of reducing nitrogen leaching and run-off.

Important measures to reduce emissions of GHGs in agriculture are optimal timing of fertilization, the exact amount of fertilizer application to crop use and optimal (covered) storage of manure.

The EU Common Agricultural Policy (CAP) has a significant relationship to the extent, orientation and profitability of agriculture. The common agricultural policy (CAP) in the EU is based on three principles – a common market for agricultural products based on common prices, preferences for agricultural production in the EU countries against external competition and financial solidarity - financing from common funds to which everyone pays contributions. The implementation of the CAP can affect the trend in GHG emissions from agriculture (methane and nitrous oxide emissions) in both directions (up or down) depending on the individual implemented measures, practices and policies in the Czech Republic.

The main target for the EU in 2020 is also a climate change and energy sustainability greenhouse gas emissions 20% (or even 30%, if the conditions are right) lower than 1990, 20% of energy from renewable sources, 20% increase in energy efficiency.

On 16 December 2013 the Council of EU Agriculture Ministers formally adopted the 4 Basic Regulations for the reformed CAP as well as the Transition Rules for 2014. This follows on the approval of these Regulations by the European Parliament in November. On 20 December 2013 the four Basic Regulations and the Transition Rules were published in the Official Journal. With these new rules, the vast majority of CAP legislation will be defined under four following consecutive Regulations covering Rural development, "Horizontal" issues, Direct payments for farmers and Market issues:

1. Regulation (EU) No 1307/2013 - Direct payments
2. Regulation (EU) No 1308/2013 - Common organization of the markets
3. Regulation (EU) No 1305/2013 - Rural development
4. Regulation (EU) No 1306/2013 - Financing, management and monitoring
5. Supporting Regulation (EU) No 1310/2013 - Transitional provisions

Agricultural direct payments are part of the first pillar of the EU Common Agricultural Policy. This policy had undergone recently a reform, which resulted into new rules for the period 2015-2020.

Direct Payments have been a key safety net and a driver for the modernization of agricultural holdings. In 2014, Czech farmers received around EUR 879 million in Direct Payments, benefitting 28 460 farmers and farm businesses. Some 7.3 % of Czech beneficiaries received a payment above EUR 100 000, relative to the EU-28 average of 0.45 %. Moreover, in 2014, the EU spent around EUR 15 million on market measures in the Czech Republic, primarily in the fruit and vegetables and wine sectors.

In the following Chapters are presented **existing PaMs**.

1.8.1 Cross Compliance

Cross compliance has been employed in the Czech Republic since 1 January 2009. The direct payments and other selected subsidies can be granted only on the condition that a beneficiary meets the statutory management requirements addressing the environment, public health, the health of animals and plants, and animal welfare, 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.

The implementation of Cross Compliance should reduce direct emissions from fertilizers (N_2O) and emissions from enteric fermentation (CH_4) by improvement of breeding management and a healthier animal population.

The cross-compliance conditions, including GAEC, are reflected as a part of the continuing commitment of the AEO program from 2007-2014. Preparing changes to cross compliance controls are still in negotiations. Any changes will be made with regard to the legal framework of the European Regulation no. 1306/2013, no. 809/2014 and no. 640/2014. In May 2013, the material describing a Good Agriculture and Environmental condition for Czech Republic was elaborated and published.

1.8.2 Strategy for growth (2013)

The most of the national instruments implemented to the Czech agrarian strategy and policy are available on: http://eagri.cz/public/web/mze/.

Strategy for growth - Czech agriculture and food related to CAP after 2013 (new conceptual study), which will over time confronted, whose values and objectives will be revised, if necessary. The document presents prognosis of activity data and targets of agricultural management also in terms of agro-environmental measures and policies.

1.8.3 Czech Rural Development Program (2007-2013)

For the new seven-year program period, the European Agricultural Fund for Rural Development (EAFRD) was founded on the basis of European Council Regulation No. 1290/2005 on the financing of the Common Agricultural Policy (CAP). With the purpose of withdrawing finances, the Czech Republic prepared basic strategic and program documents specifying in detail the measures for meeting the objectives of the development of rural areas in the Czech Republic.

The program consists of 4 basic parts (Axis = groups of measures), each of them meeting some of its objectives, A1 - improving the competitiveness of the agricultural, food and forestry sectors falls within the first group of measures A2 - increasing biodiversity, water and soil protection and mitigating climate change is a joint objective of the second group of measures, A3 – improving the quality of life in rural areas and encouraging the diversification of economic activities there, and A4 - helping the residents of rural micro-regions (applying the “from bottom to top” principle) to work out their local development strategy and to support projects related to the development of the region they live in, called the LEADER method.

For the whole program period of 2007-2013 the Czech Republic was allocated EUR 2.8 billion from the European Agricultural Fund for Rural Development and together with the finances from the state budget the total amounts to approx. EUR 3.6 billion. Pillar 1 - market policy - is financed by EAFG (European Agricultural Fund for Guarantee.

EAFRD is the financial instrument of the second pillar - rural development policy - of the CAP.

1.8.4 Czech Rural Development Program (2014-2020)

The European Commission approved the final version of the fundamental programming document of the Rural Development Programme of the Czech Republic for the period 2014-2020 on 26.05.2015. Rural Development Programme (RDP) is subsidized by nearly EUR 3.55 billion over the next years. Of that, EUR 2.3 billion will come from the EU sources and EUR 1.25 billion from the Czech budget.

The principal objective of the program is to restore, preserve and improve the ecosystems dependent on agriculture by means of agri-environmental measures, to invest into the competitiveness and innovation of agricultural enterprises, to encourage young people into farming, or to improve landscape infrastructure. On the agri-climate measures is allocated ca. 1 % of the total amount.

In line with the Europe 2020 strategy, those general objectives of rural development support in the period 2014–2020 are more specifically expressed in the following six priorities applicable to the whole of the EU. Each measure from the offer of the rural development regulation may contribute to the objectives of several priorities.

The program will support diversification of rural economic activities with the aim of creating new jobs and enhancing economic development. It will support community-led local development and, more specifically, the LEADER method which contributes to better targeting of the support at the local needs of specific rural areas and to the development of cooperation among stakeholders at the local level. Its horizontal priority is sharing knowledge and innovation in the form of educational activities and consulting and collaboration in agriculture and forestry.

1.8.5 Action Plan for the Development of Organic Farming in the CR 2011-2015

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, especially in the mountains and foothills of the Czech Republic. 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 and the National Rural Development Program (see above). Disbursements under the grant in the area of organic agriculture rapidly increased during in the 1998-2009 period, from 1.9 million Euros in 1998 to 39.2 million Euros in 2009 (www.eagri.cz).

The organic farming legislation limits the number of organic farms in the area of livestock and thereby reduces the number of animals and CH_4 emissions from enteric fermentation and manure storage. Organic farming does not use industrial fertilizers, the production of which creates large amounts of CO_2 and for the growing of feed for organic farming is based on substantially reduced use of inorganic fertilizers. Pesticides (herbicides) and growth regulators and the resulting production CO_2 emissions are prohibited in organic agriculture. Organic farming promotes the application of nitrogen at the appropriate time, when its uptake by plants is greatest, and thus reduces the amount of N in the soil and N_2O emissions, which are determined on the amount of N in the soil.

In collaboration with non-governmental organizations the Ministry of Agriculture has prepared an **Action Plan for the Development of Organic Farming** in the Czech Republic 2011-2015, which follows on from the Action Plan to 2010. The Czech government adopted the new Action Plan in December 2010. The main objectives of the Action Plan are to achieve a 15 % proportion of organic farming by 2015, a 60 % share of Czech organic foods in the organic foods market, and a 3 % share of organic foods in the food market overall.

1.8.6 Action Plan for biomass in the Czech Republic (2012-2020)

The main aim of Action Plan for biomass in Czech Republic (2012-2020) was to define appropriate measures and principles that will help the effective and efficient use of the energy potential of biomass. 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 with a view to 2020.

1.8.7 Ministry of Agriculture Strategy with a view to the 2030

The document (published in 2016) is designed as an open living document and a fundamental basis for strategic management processes within the Ministry of Agriculture. 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. The prognosis data published in this material were used to project GHG emissions in Agriculture sector in period 2015-2035.

In the following Chapters are presented **additional PaMs**.

1.8.8 Nitrate Directive – 4rd Action Plan (2016-2020) – additional measure

Nitrates Directive (91/676/EEC) generally requires Member States to:

- monitor waters and identify waters which are polluted or are liable to be polluted by nitrates from agriculture
- establish a code of good agricultural practice to protect waters from this pollution
- promote the application by farmers of the code of good agricultural practice
- identify the area or areas to which an action program should be applied to protect waters from pollution by nitrates from agricultural sources
- develop and implement action programs to reduce and prevent this pollution in identified areas: action programs are to be implemented and updated on a four-year cycle
- monitor the effectiveness of the action programs and report to the EU Commission on progress

The Directive specifies the maximum amount of livestock manure which may be applied (as the amount of fertilizers containing nitrogen per hectare per year, i.e. 170 kg N/ha).

Since August 2016, the Fourth Action Plans has been implemented. The main changes are: the expansion of territory of vulnerable areas, the new specifications for prohibition and limits of fertilization, crop rotation and farming on slopes etc.

It should be noted that the costs associated with implementation of the above measures and policies are not possible to estimate at present. They represent an inherent part of the landscape (agricultural and forest) management practice applied in accordance with the local environmental and other specific conditions. Hence, the implemented measures carry over its spatial heterogeneity and discerning the particular costs is not feasible.

1.8.9 Action Plan for Development of Organic farming (2016-2020) – additional measure

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 RDP 2014-2020.

1.9 LULUCF

The land use, land use change and forestry (LULUCF) sector is linked to Agriculture and some of the policies listed above in the section 1.7.1 are partly common for both sectors. Policies and measures in the LULUCF sector are generally focused on sustainable use of natural resources, preserving biodiversity and securing all functions and services that these resources provide to society.

Despite numerous EU policy processes that are linked to LULUCF such as the Ministerial Conference on the Protection of Forests in Europe (Forest Europe, http://www.foresteurope.org), Natura 2000 etc., none of those are prescriptive in terms of CO_2, CH_4 and N_2O and emissions and removals. Their effect on greenhouse gas balance of the LULUCF sector may be indirect, however, not practicably quantifiable. Similarly, the adopted Decision No 529/2013/EU (on accounting rules on greenhouse gas emissions and removals resulting from activities relating to land use, land-use change and forestry and on information concerning actions relating to those activities) is in principle not prescriptive with respect to concrete actions and targets in the LULUCF sector, but regulates accounting rules and providing information.

1.9.1 National Forest Program II - existing measure

The most important land category of the Czech LULUCF sector in terms of greenhouse gas emission balance is Forest Land. Forestry in the Czech Republic is regulated by the Forestry Act (The Act no. 289/1995 Coll. on Forests and Amendments to some Acts), which is the principal legislative instrument. Also this instrument does not specifically target carbon balance, but its provisions affect carbon budget and greenhouse gas emissions & removals in numerous ways indirectly.

Beyond the legislative above, the National Forest Program II for the period 2008 to 2013 (NLP II) is the basic national strategic document for forestry and forestry-related sectors. Implemented within the environmental pillar, specifically Key Action 6 lists the measures being or to be implemented to alleviate the impact of expected global climate change and extreme meteorological conditions. These measures generally focus on creating more resilient forest ecosystems by promoting diversified forest stand utilizing to the greatest possible extent natural processes, appropriate species composition and variability of silvicultural approaches, reflecting the current international treaties, agreements, conventions and EU directives.

1.9.2 Updated Recommendations for implementing the proposed measures of NLP II – additional measure (since 2017)

The Conclusions of the Coordinating Council for the implementation of the National Forestry Program II (2013) summarized the recommendations for implementing the proposed measures of NLP II after lengthy consultations by forestry experts in the country. For the emission balance of the LULUCF sector, particularly important are the elaborated recommendations of Key Action 6 NLP II *[35]*, which are directly aimed at reducing the impacts of global climate change and extreme weather events. These recommendations applicable to forestry are also carried over in the recently adopted National adaptation strategy (Adaptation strategy to climate change in the conditions of the Czech Republic; ME 2015) and further elaborated in the associated National Action Plan for Adaptation adopted in 2017.

It should be noted that the costs associated with implementation of the above measures and policies are not possible to estimate at present. They represent an inherent part of the landscape (agricultural and forest) management practice applied in accordance with the local environmental and other specific conditions. Hence, the implemented measures carry over its spatial heterogeneity and discerning the particular costs is not feasible.

1.10 Waste

Greenhouse gas emissions generated by the waste sector in the Czech Republic have been growing due to organic carbon that is accumulated in landfills, increasing amount of produced MSW (municipal solid waste) and unfavorable mix of MSW treatment options. Recently this trend started to turn and we observe mild stagnation of emissions from landfills (a key source of this sector in the Czech Republic). The slowing we observe is mainly due to increased LFG (landfill gas) capturing. There is an additional potential for emission reductions in fulfilling EU required measures and other national measures with emission reduction effects which are related to common waste policy in the country. Waste incineration measures will also affect industrial waste generated by other industries. Policies and measures in the waste sector aim at reducing the amount of produced waste, minimizing the delivery of the biodegradable waste in landfills, promoting the incineration and digestion of non-recyclable waste, increasing the landfill gas recovery and improving of the waste water treatment in sparsely populated areas.

The Czech waste legislation is largely based on EU legislation. The EU legislation with direct impact on GHG emissions from waste includes Landfill Directive (1999/31/EC) and Waste Directive (2006/12/EC). In accordance with the Commission Decision 2011/753/EU, establishing rules and calculation methods for verifying compliance with the objectives set out in the Directive of the European Parliament and Council Directive 2008/98/EC on waste, using method 2 of calculating the objective, the Czech Republic in the year 2010 attained 45.5% recycling of paper, metal, plastic, glass - components of household waste and similar waste. The assumption is that in 2020 the objective of the Waste Directive (50%) will be achieved.

There are several policies that are not part of waste legislation that already have or will have impact on GHG emissions from waste. Most of them are mentioned in the cross sectoral section in this report but above all is worthy to mention EU ETS, Climate & Energy Package and Energy Tax Directive which provide direct and indirect support on LFG recovery and therefore significantly influencing landfill emissions.

1.10.1 Waste Management Plan 2003 and 2011 (2003-2014) – expired measure

The most important instrument on the national level was waste management plan (WMP). The WMP 2003 was valid until 2011 and then the Plan had been reworked with certain shifts in waste management practice (e.g. more focus on waste incineration). Most of targets and measures were in compliance with obligatory EU legislation. There were several programs aimed at reaching goals of WMP. The main one was the Operational Programme Environment, priority axis 4: Waste Management and the Rehabilitation of Existing Ecological Burdens. This axis had budget EUR over 776 million from the EU Cohesion Fund. Funded project that had relevance to GHG emissions reduction focused on: Integrated waste management systems, Regional systems for the use of bio waste or for the mechanical and biological treatment of municipal waste, Systems of separated collection, storage and waste management, etc. The WMP 2003 and 2011 included several targets and measures that had direct effect on GHG emission:

- 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
- A decrease of the maximum amount of biologically degradable municipal wastes (BDMW) deposited in landfills, so that according to the Landfill Directive 99/31/EC the faction of these components equals a maximum of 75 % by weight in 2010 and 50% in 2013 and, in the future, in 2020, a maximum of 35 % of the total amount of BDMW produced in 1995. Impact on GHG emissions is direct as BDMW is a key parameter for CH_4 emissions.
- A preference for composting and anaerobic decomposition of biodegradable wastes (except for paper and cardboards wastes) with the use of the final product particularly in agriculture, in land reclamation and landscaping – 2014 is the first year

where composting will be part of the inventory, so far it looks that it´s contribution will be very small;

• Only wastes that cannot be used in this manner should be processed to produce substitute fuel or used anyway for energy production – this is likely to change in new WMP and Waste-to-energy plants (energy recycling) will have same priority as material recycling.

1.10.2 Waste Management Plan 2014 (2015-2024) – existing measure

The most important instrument on the national level is the Waste management plan *[46]*. This year projections are based on the new WMP adopted in 2014 that should be valid up to 2024. The WMP contains exhaustive list of measures that are implemented and will be implemented in upcoming period. The binding part contains the objectives, principles, and measures that take into account environmental policy of the Czech Republic, European commitments of the Czech Republic and the needs of the current waste management in the Czech Republic. The binding part of the Waste management plan of the Czech Republic, is based on the principle of respect for the waste management hierarchy which is:

1. Waste prevention
2. Preparing for re-use
3. Waste recycling
4. Other recovery, e.g. energy
5. Waste disposal

List of all measures adopted in plan is too large to be discussed in this material in detail, however entire WMP *[46]* is publically available in Czech and in English.

Other main policies related to GHG emission from waste management are:

- State Environmental Policy of the Czech Republic 2012-2020, which defines the plan for the implementation of effective environmental protection in the Czech Republic until the year 2020. This policy was updated in 2016.
- Raw Material Policy of the Czech Republic 2012-2032.This document reflects the economic developments in Europe and in the world and the changes in global raw materials market. The document aims to ensure the raw material security of the state.
- Secondary raw materials policy of the Czech Republic – the basic vision of this document is "turning waste into resource." The document was created in order to create favourable conditions for the recovery of "secondary raw materials" from products and materials, which have completed their life cycle, and for their processing and recovery. The main objective is the replacement of primary natural resources by "secondary raw materials" and to contribute in this way to reducing material and energy intensity of production.
- Biomass Action Plan of the Czech Republic 2012-2020. The plan presents an analysis of the use of biomass in the Czech Republic for energy purposes and proposes appropriate measures for the sustainability of the connection between agriculture and energy sector until 2020.
- State Energy Policy of the Czech Republic. This is a strategic document defining the objectives of the state in energy management in accordance with

the needs for economic and social development, including environmental protection, serving also for the development of territorial energy concepts.

The new WMP includes modelling of the proposed and implemented measures and their impact on activity data – waste quantity and waste management practices. Result of this modelling was used as a basis for the estimation of GHG emissions in this material.

2 National projections of greenhouse gas emissions by gas and by source

2.1 Methodologies and key assumptions

The methodology employed for preparation of emission projections is in accordance with the methodology used for preparation of projections for the Third to Sixth National Communications which, amongst other things, permits them to be compared. The methodology includes the following set of steps:

(i) inventory of greenhouse gases

(ii) selection of base and final year and cross-cutting years for creating projections,

(iii) selection of the actual methodology and model instruments for preparing the projection,

(iv) collection and analysis of input data for the projection,

(v) establishment of initial assumptions,

(vi) definition of scenarios,

(vii) calculation of scenarios and presentation of their results,

(viii) sensitivity analysis on selected assumptions.

The results of the individual steps are described in the following chapters.

2.1.1 Inventory of greenhouse gas emissions

Inventories of greenhouse gas emissions are prepared by the Czech Hydrometeorological Institute; the last summary inventory during the projection preparation was available for 2014 (April submission 2016). Total greenhouse gas emissions calculated as CO_{2eq} for 2014 were 115,858.02 thousand t including sinks and 123,650.70 thousand t excluding sinks.

The results of greenhouse gas inventories (LULUCF included) indicate that energy sector produced 82% of GHG emissions. 95.8% of GHG emissions in energy sector resulted from combustion of fuels. The largest amount of GHG emissions comes from the energy production sector (56.7%), followed by industry including corporate energy production and industrial processes (22.7%), households, agriculture and the tertiary sector (10.4%). Transport contributed 17.7% and exceeded the share from households, agriculture and the tertiary sector.

2.1.2 Base year and cross-cutting period of the projections

The year 2014 was selected as the base year. It was the latest year with available information on macroeconomic development, energy and emission balances and the national greenhouse gases emission inventory. The year 2035 was selected as the final year for projections of greenhouse gases emissions, in accordance with the recommendations of the European Commission. The years 2014, 2015, 2020, 2025, 2030 and 2035 were selected as cross-cutting years for preparing the projections. Measures introduced before 1^{st} July 2016 are considered as existing measures.

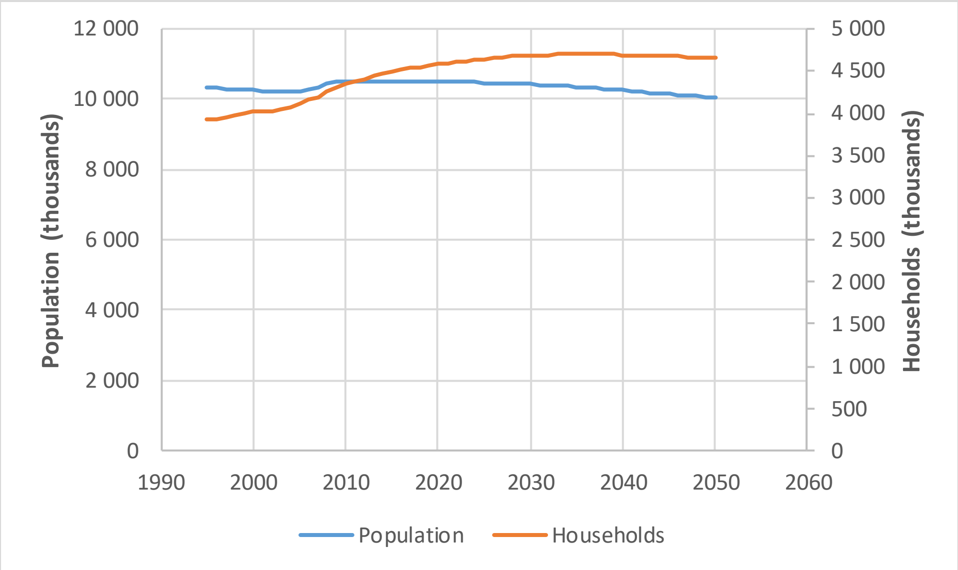
Measures expected to be introduced on this date and later are considered as additional measures.

2.1.3 Initial assumptions and scenarios

2.1.3.1 Scenario of demographic trends

Predictions of the number of inhabitants are based on information from the Czech Statistical Office (CSO) *[33]*; the number of households, which is also required for calculation of energy demand, was estimated. CSO prepared population projections in three variants; the mean variant was used here.

Fig. 1 Demographic projection (thousand)

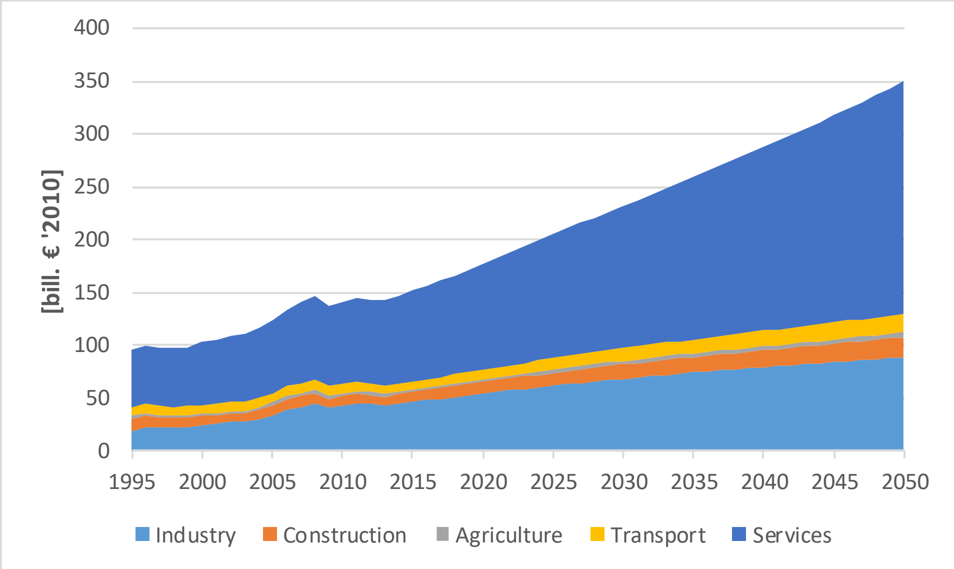


Source: CSO, EGÚ Brno, a. s.

2.1.3.2 Scenario of economic development

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) in September 2015. These projections are made every year and approved by a group of experts organized by the OTE.

Fig. 2 ***Projection of trends in gross added value (constant prices[4] of 2010) in bill. €***



Source: CSO, EGÚ Brno, a. s.

Tab. 11 ***Projection of trends in gross added value (constant prices of 2010) in bill. €***

[bill. € '2010]	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**
Industry	18,9	24,6	33,2	42,4	46,2	53,8	61,5	68,1	73,8	78,9	83,9	88,8
Construction	11,3	7,8	9,2	9,7	9,4	10,7	12,0	13,3	14,6	15,8	17,1	18,4
Agriculture	2,6	2,5	3,1	2,4	2,7	3,0	3,3	3,6	3,8	4,0	4,3	4,5
Transport	8,2	8,6	8,9	8,7	7,8	9,1	10,5	11,9	13,3	14,7	16,1	17,5
Services	53,7	59,0	70,0	78,4	85,7	100,1	117,1	135,0	153,8	174,1	196,2	220,7
Total	**94,7**	**102,5**	**124,4**	**141,7**	**151,9**	**176,6**	**204,4**	**231,9**	**259,3**	**287,5**	**317,6**	**350,0**

Source: CSO, EGÚ Brno, a. s.

2.1.3.3 Scenario of trends in global prices of fuel and energy

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 the European Commission document "Recommended parameters for reporting on GHG projections in 2017, Final, 14/06/2016".

[4] Exchange rate 25.29 CZK/€ – average for 2010, 25.974 CZK/€ – average for 2013

Tab. 12 Global prices of fuels (€/GJ, constant prices of 2013)

€ (2010)/GJ	2010	2015	2020	2025	2030	2035
oil	9.3	11.9	11.6	13.2	14.5	15.1
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

2.1.3.4 Scenario of trends in domestic prices and availability of fuel and energy

The 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.

The 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[5]. The legislation[6] guaranteed favorable 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 panels 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.

2.1.3.5 Scenario of the 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. 13 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.

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[5] ERA Price Decisions, stipulating the subsidies to supported energy sources (https://www.eru.cz/elektrina/cenova-rozhodnuti, in Czech language)

[6] Act No. 165/2012 Coll., on the promotion of production of electricity and from renewable energy sources and on amendment to some laws (Act on Promotion of Use of Renewable Sources)

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.

Tab. 13 Projections of domestic coal mining

Category of coal (company – mine)	Maximum mining (units)	2016	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
Brown steam coal (CC - Vršanská uhelná)	PJ	62.4	67.6	67.6	67.6	62.4
	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, spol. s r. o.

2.1.3.6 Price of emission allowances

As recommended by the European Commission in “Recommended parameters for reporting on GHG projections in 2015”, the following carbon prices were used (expressed in constant prices of 2013):

Tab. 14 EU ETS carbon price

€2010/tCO_2	2015	2020	2025	2030	2035
EU ETS carbon price	7	15	22.5	33.5	42

Source: Recommended parameters for reporting on GHG projections in 2017, Final, 14/06/2016

2.1.3.7 Energy production scenario

The energy consumption and production scenario of the projections is in compliance with the “Optimized scenario” of the State Energy Policy *[33]*. The scenarios evaluated in the frame of the State Energy Policy were based on three priorities: safety – sustainability – competitiveness. There were set constrains for the acceptable development of the primary energy mix and electricity generation. Various scenarios within these constrains were analyzed. The “Optimized scenario” represents the most presumable energy system development.

The most important assumptions were used for model calculations of greenhouse gas emissions:

a. The Temelín nuclear power plant will remain in normal operation for the whole monitored period (2000 – 2035).
b. The operation license for the Dukovany nuclear power plant will be prolonged and the power plant decommissioned gradually in the period 2035 – 2037.
c. 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.
d. The territorial environmental limits on mining of brown coal will be retained at the ČSA mine and partly relaxed at the Bílina mine.
e. No limits will be introduced on the import of petroleum, gas and hard coal.
f. Imports and exports of electricity will be limited by technical capabilities of transmission lines.

2.1.4 Energy (sector 1)

The bottom-up MESSAGE (Model for Energy Supply Strategy Alternatives and their General Environmental Impacts) model was used for the projections of CO_2, CH_4 a N_2O emissions from energy and industrial sectors. The model was developed at IIASA (International Institute for Applied Systems Analysis) and designed for the optimization of energy system. The main principle of the MESSAGE is optimization of an objective function under a set of constraints. The model uses input data for individual emission sources from the EU ETS database (e.g. emissions, fuel consumption and fuel parameters). Electricity, heat production and financial support of renewable sources are provided by Energy regulatory office. Energy or industrial companies are directly contacted to get information about future plans (constructions of new sources or shutdowns), technical details, life expectancy, investment and operating costs. The Ministry of Industry and Trade (The State Energy Policy) and OTE, a.s. provides information regarding the development of energy production and consumption. Further data are obtained from the association for energy information and statistics (ENERGOSTAT).

Following activities were included in calculation of emission projections for the individual greenhouse gases:

- **carbon dioxide** - combustion of fuels in fuel conversion processes (public and factory energy production), combustion of fuels for final consumption (industrial processes, transport, households, agriculture and the sector of public and commercial services), fuel improvement processes (refineries, post-mining treatment of coal and coking) and removal of SO_2 from combustion products using limestone,
- **methane –** coal mining and its post-mining treatment; mining, storage, transport and distribution of natural gas and mining, storage, transport and refining of petroleum,
- **nitrous oxide –** combustion of fuels in stationary sources.

2.1.4.1 Fuel Combustion

GHG emissions from fuel combustion are calculated by the MESSAGE model. The model energy outputs are in compliance with the Czech Statistical Office energy balance and with the new State Energy Policy *[34]*.

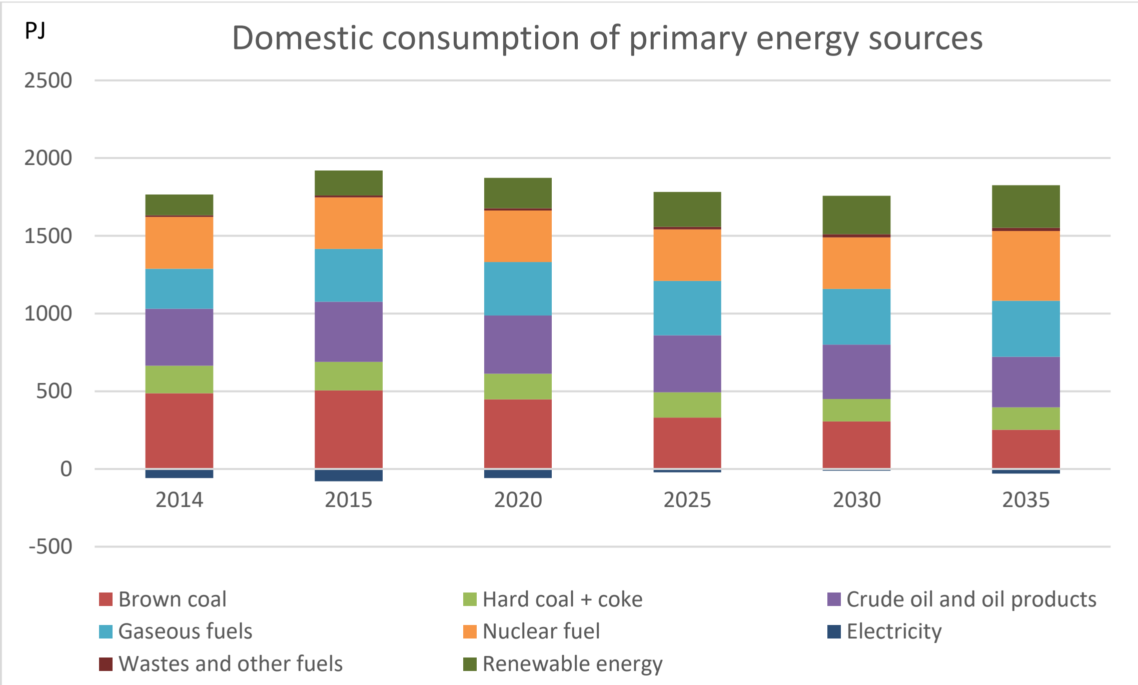
2.1.4.1.1 Gross inland consumption

Tab. 15 Domestic consumption of primary energy sources

Domestic consumption of primary energy sources [PJ]	2014	2015	2020	2025	2030	2035
Brown coal	487	505	449	330	307	253
Hard coal + coke	178	185	164	163	144	143
Crude oil and oil products	365	386	374	367	349	326
Gaseous fuels	259	339	345	349	358	361
Nuclear fuel	332	332	332	332	332	449
Electricity	-59	-80	-59	-22	-12	-30
Wastes and other fuels	11	13	14	17	20	20
Renewable energy	135	161	196	224	248	274
TOTAL	**1,708**	**1,841**	**1,815**	**1,760**	**1,746**	**1,796**

Source: CSO and MoI [34]

Fig. 3 Domestic consumption of primary energy sources



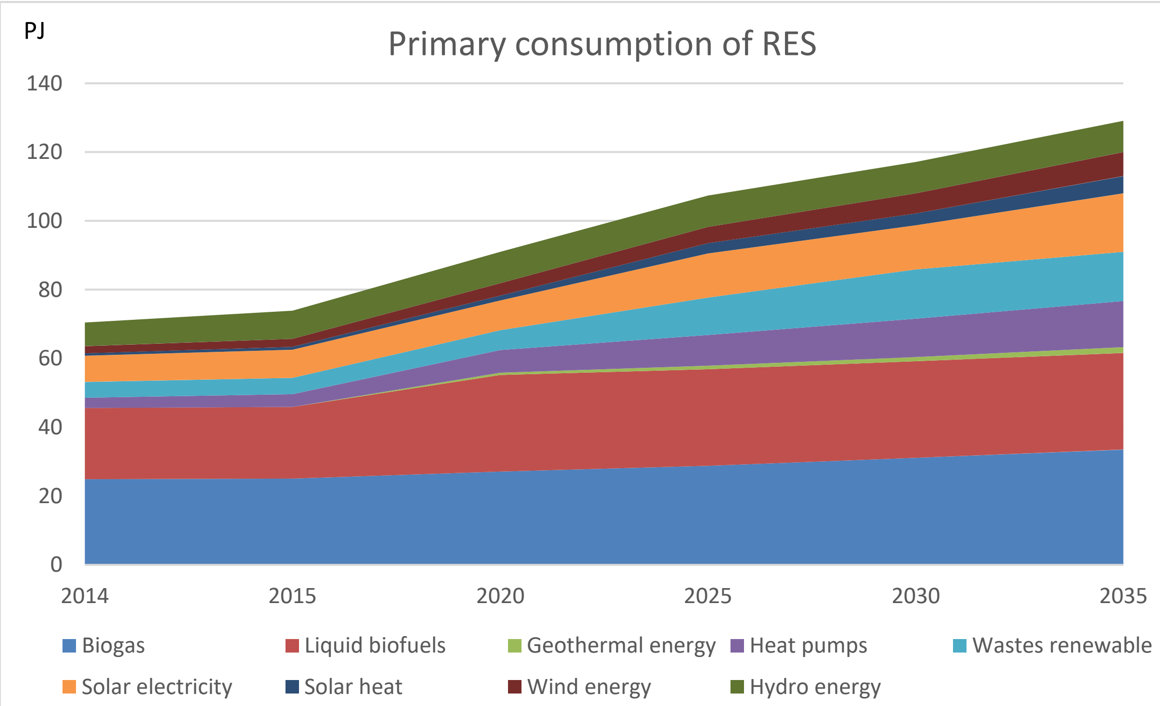
Source: CSO and MoI [34]

Tab. 16 Domestic consumption of renewable energy sources

Domestic consumption of renewable energy sources [PJ]	**2014**	**2015**	**2020**	**2025**	**2030**	**2035**
Biomass	95.5	95.7	104.7	116.6	130.4	144.6
Biogas	24.9	25.1	27.1	28.8	31.1	33.5
Liquid biofuels	20.7	20.8	28.1	28.1	28.1	28.1
Geothermal energy	0.0	0.0	0.7	1.0	1.2	1.7
Heat pumps	3.0	3.7	6.6	8.9	11.2	13.4
Wastes renewable	4.6	4.8	5.7	10.9	14.3	14.3
Solar electricity	7.6	8.2	8.7	12.8	12.8	17.0
Solar heat	0.7	0.8	1.4	3.0	3.5	5.0
Wind energy	2.1	2.3	3.6	4.8	5.8	7.0
Hydro energy	6.9	8.2	9.1	9.1	9.1	9.1
TOTAL	**166.0**	**169.6**	**195.7**	**224.0**	**247.5**	**273.7**

Source: CSO and MoI [34]

Fig. 4 Domestic consumption of renewable energy sources



Source: CSO and MoI [34]

The economic recovery after the recession period will be followed by a decrease of the total domestic consumption of primary energy sources (PES) after 2015. The energy saving tendency will overweigh or at least compensate the energy consumption growth driven by the growing economy in the following periods. The fluctuations of the PES consumption result from changes of electricity exports.

The RES share develops in accordance with the State Energy Policy *[33]*. The biggest role among RES plays and will play biomass.

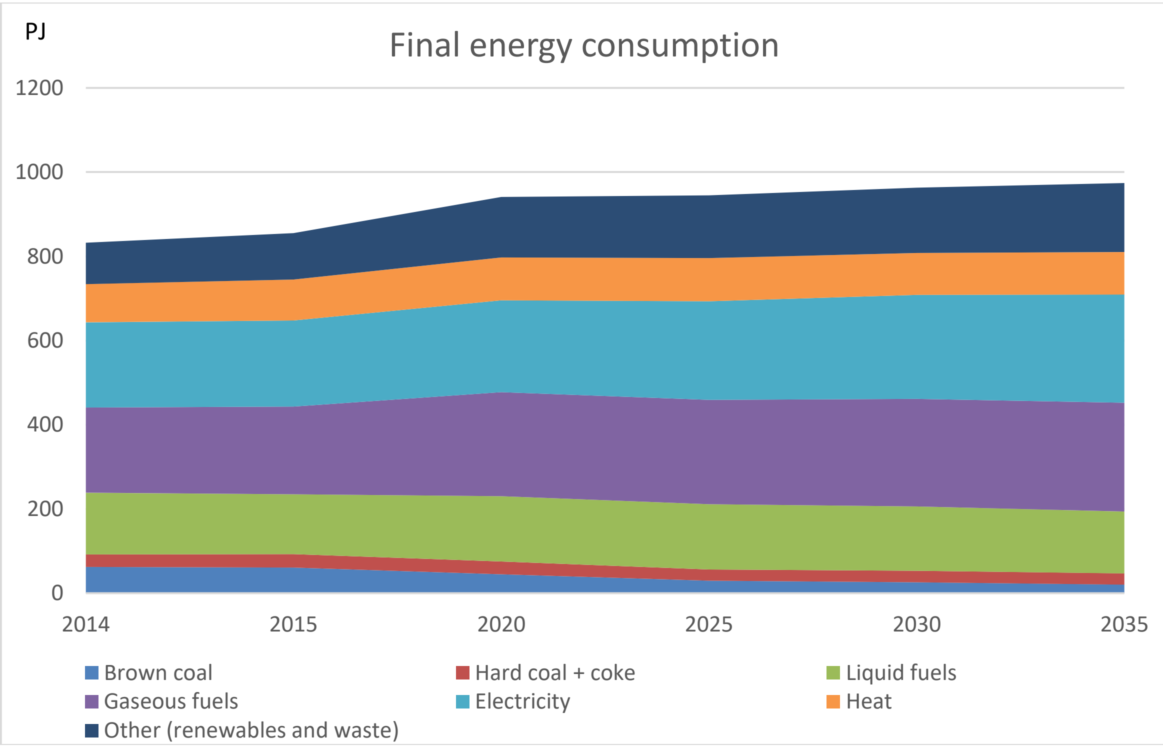
2.1.4.1.2 *Final energy consumption*

Tab. 17 Final energy consumption

Final energy consumption [PJ]	**2014**	**2015**	**2020**	**2025**	**2030**	**2035**
Brown coal	62.4	61.0	44.7	29.6	26.2	20.3
Hard coal + coke	29.5	31.8	30.9	26.8	27.1	26.6
Liquid fuels	146.6	142.4	154.9	154.8	153.0	147.1
Gaseous fuels	202.5	208.0	247.0	247.7	255.4	258.6
Electricity	202.4	204.1	217.7	234.1	246.8	256.8
Heat	90.6	97.9	102.4	102.7	99.2	100.8
Other (renewables and waste)	98.2	109.7	143.1	149.1	155.7	163.9
TOTAL	**832.2**	**854.9**	**940.7**	**944.8**	**963.4**	**974.1**

Source: CSO and CHMI

Fig. 5 Final energy consumption



Source: CSO and CHMI

The final energy consumption was strongly influenced by the economic recession starting in the year 2008. Therefore, an increase in energy efficiency will be compensated by the higher economic growth starting in 2014. A small energy consumption growth in tertiary and industrial sectors will partially offset a decline in the households sector, as displayed in the following tables and graphs. The total final energy consumption shows a slight increase.

Tab. 18 Final energy consumption of households

Final energy consumption in households [PJ]	2014	2015	2020	2025	2030	2035
Brown coal	18.2	15.8	9.2	2.6	1.8	1.8
Hard coal	3.5	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	68.9	65.5	60.1	55.4	55.0	54.4
Electricity	50.9	50.5	50.4	50.4	50.8	50.1
Heat	45.8	45.2	43.3	41.7	39.0	38.1
Other (renewables and waste)	50.2	55.3	68.4	75.8	75.7	79.5
TOTAL	**237.7**	**236.0**	**235.0**	**229.5**	**225.9**	**227.5**

Source: CSO and CHMI

In households we expect a decline in final energy consumption. The main cause of this tendency is insulation and revitalization of family, panel and other collective houses. With the current trend we may expect that the main insulation process will be finished between years 2015 – 2020. After 2015 the new building standards will drive further decline of energy consumption in households. Around 2020 we can expect beginning of the second insulation round due to the ending lifetime of insulations installed at the beginning of the first round. On the other hand the electricity consumption is supposed to growth despite increasing efficiency of appliances and because of lower appliances ownership ratios in comparison with more developed countries.

Tab. 19 Final energy consumption of industry

Final energy consumption in industry [PJ]	2014	2015	2020	2025	2030	2035
Brown coal	27.8	29.9	27.3	21.6	19.7	14.8
Hard coal	25.7	27.7	26.8	22.7	23.1	22.6
Liquid fuels	12.4	12.8	16.8	17.7	17.3	13.0
Natural gas	85.0	90.6	94.3	88.1	85.1	83.4
Electricity	82.8	84.6	90.6	97.7	102.0	104.7
Heat	26.2	30.2	35.1	34.9	33.8	34.3
Other (renewables and waste)	26.0	30.6	31.2	31.5	37.7	43.4
TOTAL	**285.9**	**306.4**	**322.1**	**314.2**	**318.7**	**316.2**

Source: CSO and CHMI

Tab. 20 Final energy consumption of commercial and other

Final energy consumption in services [PJ]	2014	2015	2020	2025	2030	2035
Brown coal	0.7	1.4	1.1	0.7	0.6	0.5
Hard coal	0.3	0.5	0.5	0.5	0.4	0.4
Liquid fuels	15.1	14.4	13.9	13.6	12.9	12.0
Natural gas	46.1	48.6	65.8	69.1	71.2	72.7
Electricity	63.0	62.4	67.0	73.9	78.4	81.6
Heat	18.6	22.5	24.0	26.1	26.4	28.4
Other (renewables and waste)	8.7	9.5	15.4	13.7	14.2	12.9
TOTAL	**152.5**	**159.3**	**187.7**	**197.6**	**204.1**	**208.5**

Source: CSO and CHMI

As services have the highest expected economic growth, the final energy consumption is likely to increase. The use of coal and liquid fuels will rather stagnate or decline, however other energy sources are expected to increase.

Tab. 21 Final energy consumption in transport

Final energy consumption in transport [PJ]	**2012**	**2015**	**2020**	**2025**	**2030**	**2035**
Liquid biofuels	13.3	14.3	28.1	28.1	28.1	28.1
Electricity	5.7	6.6	9.7	12.1	15.6	20.4
Liquid fuels	224.7	212.2	202.2	195.9	180.0	164.4
Natural gas	2.5	3.3	26.8	35.1	44.1	48.1
TOTAL	**246.2**	**236.4**	**266.8**	**271.2**	**267.8**	**261.0**

Source: CSO and CHMI

The final energy consumption in transport shows a slight increase as a result of trade-off between increasing mobility and improving energy efficiency of transport vehicles.

2.1.4.1.3 Electricity generation

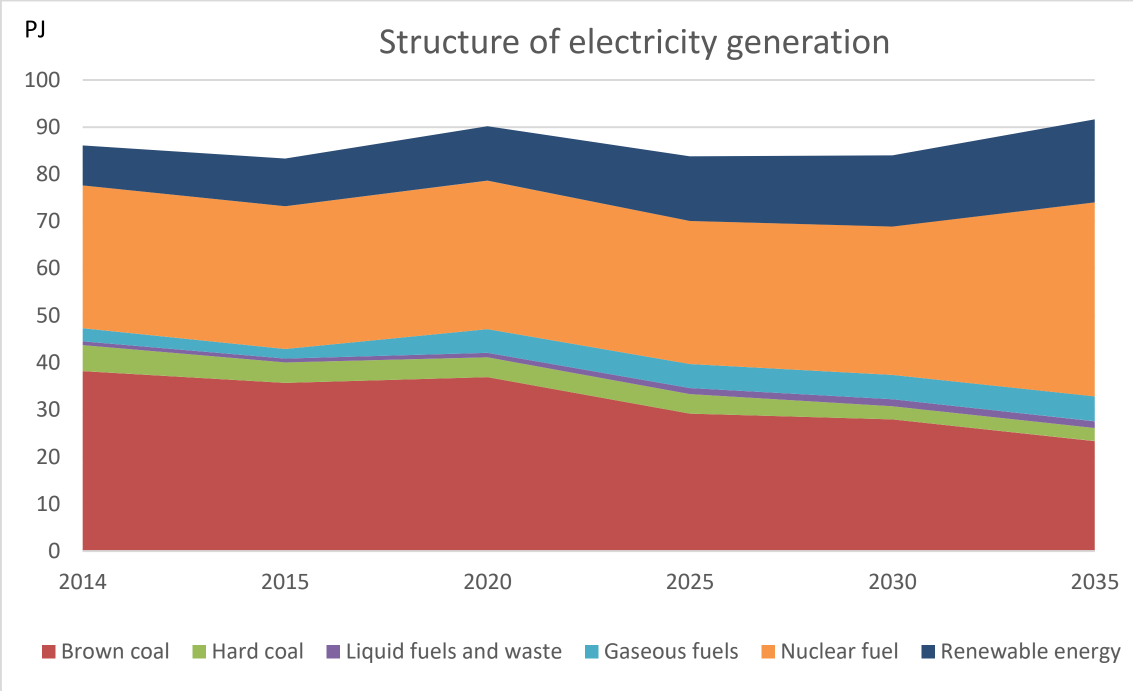
Tab. 22 Structure of electricity generation

Structure of electricity generation [TWh]	**2014**	**2015**	**2020**	**2025**	**2030**	**2035**
Brown coal	38.20	36.26	36.95	29.17	27.95	23.37
Hard coal	5.52	4.34	4.20	4.13	2.82	2.75
Liquid fuels and waste	0.81	0.80	0.92	1.30	1.45	1.45
Gaseous fuels	2.78	2.03	5.05	5.10	5.17	5.26
Nuclear fuel	30.33	30.33	31.50	30.38	31.50	41.18
Renewable energy	8.48	10.13	11.55	13.74	15.13	17.64
TOTAL	**86.12**	**83.89**	**90.17**	**83.82**	**84.02**	**91.65**

Source: CSO and CHMI

The total electricity generation from coal is decreasing. Gas, nuclear energy and renewable energy overtake the role of coal. The first new nuclear unit is planned for the year 2033 as partial replacement of the nuclear power plant Dukovany, which will be decommissioned in the period 2035 – 2037.

Fig. 6 Structure of electricity generation



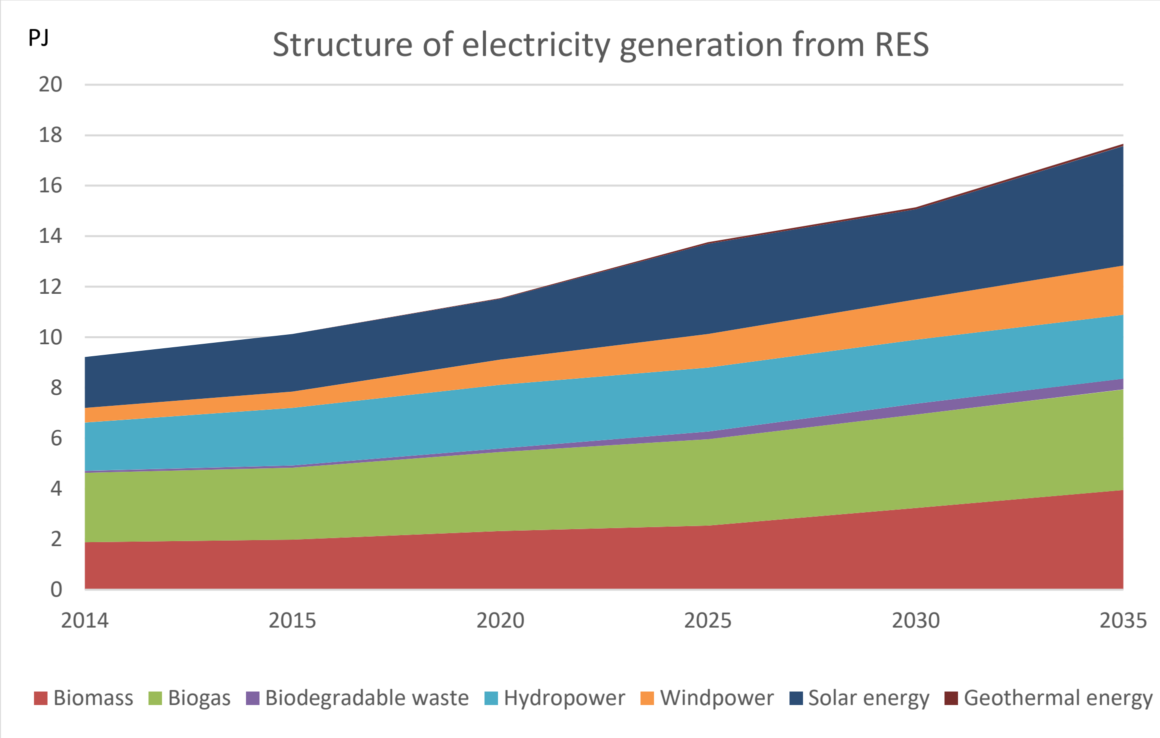
Source: CSO and CHMI

Tab. 23 Structure of electricity generation from renewable energy

Structure of electricity generation [TWh]	**2014**	**2015**	**2020**	**2025**	**2030**	**2035**
Biomass	1.88	1.98	2.33	2.54	3.24	3.95
Biogas	2.75	2.85	3.12	3.42	3.70	3.98
Biodegradable waste	0.08	0.09	0.14	0.31	0.43	0.43
Hydropower	1.91	2.28	2.52	2.53	2.53	2.53
Wind power	0.58	0.65	1.01	1.33	1.60	1.95
Solar energy	2.02	2.28	2.40	3.57	3.57	4.73
Geothermal energy	0.00	0.00	0.02	0.06	0.07	0.09
TOTAL	**9.22**	**10.13**	**11.54**	**13.76**	**15.14**	**17.66**

Source: CSO and CHMI

Fig. 7 ***Electricity generation from renewable energy***



Source: CSO and CHMI

Due to preferential feed-in tariffs for electricity produced from renewable energy sources, namely electricity from photovoltaic panels, there was an extremely rapid increase of photovoltaic electricity production up to year 2010. Since the rapid growth of photovoltaic power plants caused a significant increase of electricity price, the government adopted measures to cut further installations of big photovoltaic plants after the year 2010. Further development of renewable energy sources is in accordance with the "Optimized scenario of the State Energy Policy *[33].*

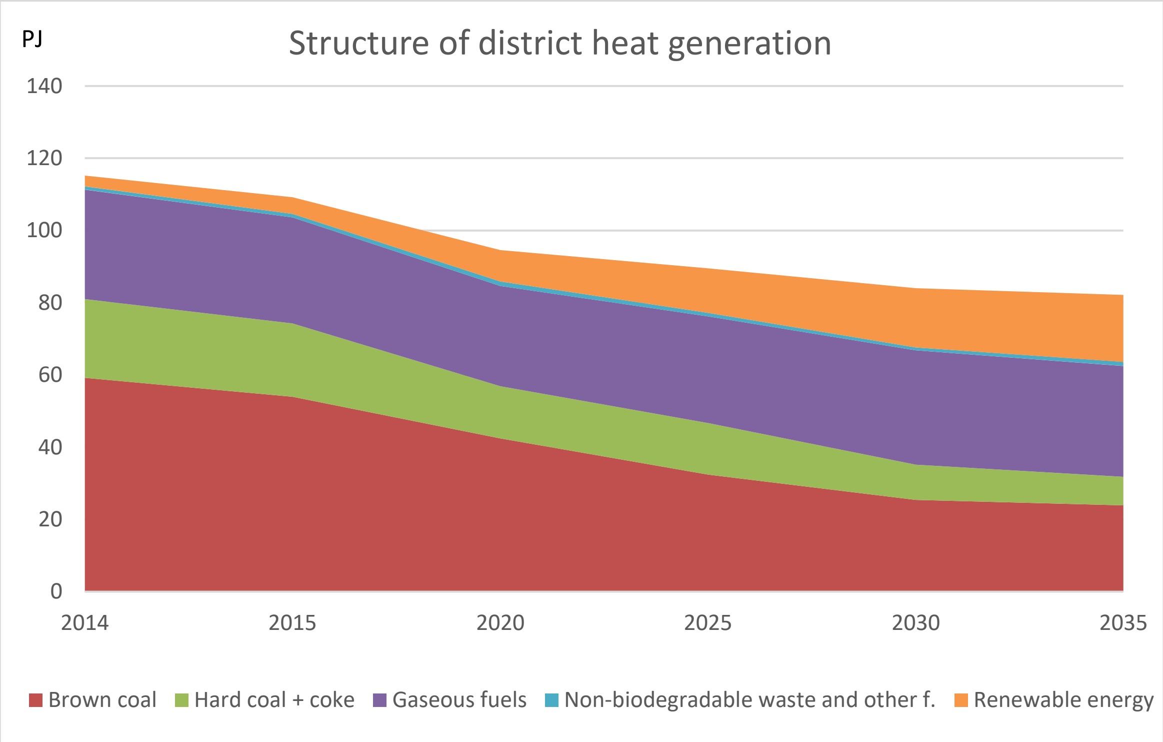
2.1.4.1.4 District heat generation

Tab. 24 ***Structure of district heat generation***

Structure of heat generation [PJ]	**2014**	**2015**	**2020**	**2025**	**2030**	**2035**
Brown coal	59.2	54.0	42.4	32.4	25.4	23.9
Hard coal + coke	21.8	20.3	14.5	14.3	9.8	7.9
Gaseous fuels	30.3	29.3	27.7	29.5	31.6	30.7
Non-biodegradable waste and other f.	0.9	1.0	1.3	1.0	0.8	1.1
Renewable energy	3	4.6	8.7	12.3	16.4	18.6
TOTAL	**115.2**	**109.2**	**94.6**	**89.5**	**84.0**	**82.2**

Source: CSO and CHMI

Fig. 8 Structure of district heat generation



Source: CSO and CHMI

As the demand for district heat, mainly in households, sinks the total district heat generation decreases. Heat generation from coal remains crucial for heat supply of households and so the coal share, in contrast to electricity generation, does not decline so quickly.

Contrary to fossil fuels, the RES share in heat generation shows a fast growth with biomass being the main driver. The increasing amount of biomass will be covered by energy crops and plants.

2.1.4.2 Fugitive Emissions

The calculation of fugitive emissions is based on results of the MESSAGE model and includes methane leakages from deep and open coal mines, crude oil mining and cracking, natural gas leakages from mining, transmission a distribution of natural gas and natural gas leakages from power plants and heating plants. The implied emission factors from the GHG inventory (April 2016) were used.

2.1.5 Industrial processes (sector 2)

A combined procedure with the EFOM/ENV (company ENVIROS, s.r.o.) model and a table processor was used for projections of trends in greenhouse gas emissions from industrial processes. The projection was concerned only with activities with a major contribution to greenhouse gas emissions. Other emissions and activities with a minor contribution were derived on the basis of an increase in GDP in the processing industry, amongst other things, because of the lack of information on potential future trends (e.g. production of steel, coke, polymers, nitric acid, etc.). There is an expected increase of clinker production related to the construction of new nuclear units. Another foreseeable tendency is decrease of lime use for desulphurization of flue gases as a consequence of decreasing coal use.

Tab. 25 Projection of activity data for industrial processes

Activity data [kt]	2011	2012	2013	2014	2015	2020	2025	2030	2035
A. Mineral industry									
1. Cement production	3,132	2,838	2,472	2,792	2,800	2,900	3,000	3,100	3,200
2. Lime production	858	758	778	814	820	800	780	761	742
3. Glass production	1,381	1,058	1,158	1,119	1,100	1,200	1,200	1,200	1,200
4. Other process uses of carbonates									
a. Ceramics	1,390	1,318	1,499	1,534	1,550	1,550	1,550	1,550	1,550
b. Other uses of soda ash	2.559	2.620	2.492	2.666	2.600	2.600	2.600	2.600	2.600
c. Non-metallurgical magnesium production									
d. Other	C	C	C	C	C	C	C	C	C
B. Chemical industry									
1. Ammonia production(5)	230	239	184	211	235	235	235	235	235
2. Nitric acid production	562	550	515	550	550	550	550	550	550
3. Adipic acid production	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Caprolactam, glyoxal and glyoxylic acid production									
a. Caprolactam	C	C	C	C	C	C	C	C	C
b. Glyoxal	NO	NO	NO	NO	NO	NO	NO	NO	NO
c. Glyoxylic acid	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Carbide production									
a. Silicon carbide	NO	NO	NO	NO	NO	NO	NO	NO	NO
b. Calcium carbide	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Titanium dioxide production	45	45	45	45	45	45	45	45	45
7. Soda ash production	NO	NO	NO	NO	NO	NO	NO	NO	NO
8. Petrochemical and carbon black production									
a. Methanol	NO	NO	NO	NO	NO	NO	NO	NO	NO
b. Ethylene	412	441	426	491	490	483	476	468	461
c. Ethylene dichloride and vinyl chloride monomer	99	94	101	130	120	120	120	120	120
d. Ethylene oxide	NO	NO	NO	NO	NO	NO	NO	NO	NO
e. Acrylonitrile	NO	NO	NO	NO	NO	NO	NO	NO	NO
f. Carbon black	25.5	25.5	25.5	24.2	25.5	25.5	25.5	25.5	25.5
g. Other(6)									
Styrene	142	160	142	163	165	165	165	165	165
10. Other (please specify)									
Non selective catalytic reduction	5.0	5.4	5.0	5.5	5.2	5.2	5.2	5.2	5.2
Other non energy use in chemical industry	76.4	77.6	74.4	75.7	75.6	75.6	75.6	75.6	75.6
C. Metal industry									
1. Iron and steel production									
a. Steel	5,678	5,164	5,222	5,404	5,400	5,319	5,240	5,162	5,085

Activity data [kt]	2011	2012	2013	2014	2015	2020	2025	2030	2035
b. Pig iron	4,137	3,935	4,040	4,170	4,100	4,039	3,979	3,919	3,861
c. Direct reduced iron	NO	NO	NO	NO	NO	NO	NO	NO	NO
d. Sinter	5,148	5,089	5,543	5,764	5,747	5,661	5,577	5,494	5,412
e. Pellet	NO	NO	NO	NO	NO	NO	NO	NO	NO
f. Other (please specify)									
Metallurgical coke	2,586	2,467	2,489	2,539	2,537	2,500	2,462	2,426	2,389
Use of limestone and dolomite	2,642	2,537			2,339	2,028	1,756	1,661	1,457
2. Ferroalloys production	C	C	C	C	C	C	C	C	C
3. Aluminium production	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. Magnesium production	NO	NO	NO	NO	NO	NO	NO	NO	NO
5. Lead production	C	C	C	C	C	C	C	C	C
6. Zinc production	C	C	C	C	C	C	C	C	C
7. Other (please specify)									
D. Non-energy products from fuels and solvent use									
1. Lubricant use	177	149	161	157	156	156	156	156	156
2. Paraffin wax use	13	11	10	12	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	4,800	4,800	4,800
Solvent use	509	517	447	407	400	390	380	371	362
Other (please specify)									
Urea used as catalyst	66.4	67.1	68.1	71.4	70.7	70.7	70.7	70.7	70.7
G. Other product manufacture and use									
3. N2O from product uses									
a. Medical applications	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
b. Other(7)									
Propellant for pressure and aerosol products	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
4. Other									
Laboratory (Experimental) use	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Other (please specify)(8)									
2.H.3 Other (please specify)									

Source: CRF tables 2011 – 2014, Czech Statistical Office, ENVIROS, s. r. o.

The implied emission coefficients from the latest inventory were used for emissions calculations as shown in the following table:

Tab. 26 Emission coefficients for industrial processes

Implied emission coefficients (2014) [t/t]	CO_2	CH_4	N_2O
A. Mineral industry			
1. Cement production	0.5307831		
2. Lime production	0.7723337		
3. Glass production	0.1000000		
4. Other process uses of carbonates			
a. Ceramics	0.0587974		
b. Other uses of soda ash	0.4200000		
c. Non-metallurgical magnesium production			

Implied emission coefficients (2014) [t/t]	CO_2	CH_4	N_2O
d. Other			
B. Chemical industry			
1. Ammonia production(5)	3.2730000		
2. Nitric acid production			0.0015592
3. Adipic acid production			
4. Caprolactam. glyoxal and glyoxylic acid production			
a. Caprolactam			
b. Glyoxal			
c. Glyoxylic acid			
5. Carbide production			
a. Silicon carbide			
b. Calcium carbide			
6. Titanium dioxide production			
7. Soda ash production			
8. Petrochemical and carbon black production			
a. Methanol			
b. Ethylene	1.9030000	0.0030000	
c. Ethylene dichloride and vinyl chloride monomer	0.2940000	0.0000226	
d. Ethylene oxide			
e. Acrylonitrile			
f. Carbon black	2.6200000	0.0000600	
g. Other(6)			
Styrene	0.2700000	0.0040000	
10. Other (please specify)			
Non selective catalytic reduction	2.7032920		
Other non energy use in chemical industry	2.7032920		
C. Metal industry			
1. Iron and steel production			
a. Steel			
b. Pig iron			
c. Direct reduced iron			
d. Sinter		0.0000700	
e. Pellet			
f. Other (please specify)			
Metallurgical coke			
Use of limestone and dolomite			
2. Ferroalloys production			
3. Aluminium production			
4. Magnesium production			
5. Lead production			
6. Zinc production			
7. Other (please specify)			
D. Non-energy products from fuels and solvent use			
1. Lubricant use	0.5894973		
2. Paraffin wax use	0.5894973		
3. Other (please specify)(5)(6)			
Road paving with asphalt			
Solvent use			
Other (please specify)			

Implied emission coefficients (2014) [t/t]	CO_2	CH_4	N_2O
Urea used as catalyst	0.2383333		
G. Other product manufacture and use			
3. N2O from product uses			
a. Medical applications			1.0000000
b. Other(7)			
Propellant for pressure and aerosol products			1.0000000
4. Other			
Laboratory (Experimental) use			
H. Other (please specify)(8)			
2.H.3 Other (please specify)			

Source: CRF table 2014

2.1.5.1 Fluorinated gases

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.

Tab. 27 Projection of use of fluorinated gases [kt CO_{2eq}]

Usage	Gas	2005	2010	2014	2015	2020	2025	2030	2035	2040
Industrial and domestic refrigeration	**C2F6**	0,203	0,401	0,331	0,082	0,000	0,000	0,000	0,000	0,000
	C3F8	6,767	8,377	4,464	4,004	0,221	0,000	0,000	0,000	0,000
	C6F14	0,233	0,317	0,060	0,140	0,000	0,000	0,000	0,000	0,000
	HFC-125	123,045	708,691	1 100,424	1 193,033	1 104,841	787,248	111,912	0,000	0,000
	HFC-134a	191,672	284,406	352,401	322,732	203,418	180,689	240,473	76,725	0,000
	HFC-143a	143,696	297,928	396,402	371,192	187,356	161,052	73,554	8,149	0,000
	HFC-152a	0,262	0,155	0,107	0,114	0,063	0,057	0,072	0,068	0,068
	HFC-227ea	0,020	0,264	0,843	0,686	0,855	0,424	0,225	0,000	0,000
	HFC-23	3,571	5,088	4,053	2,567	0,824	0,366	0,106	0,003	0,000
	HFC-245fa	0,000	0,075	0,395	0,504	0,223	0,112	0,000	0,000	0,000
	HFC-32	3,025	94,420	152,195	217,417	128,112	11,645	0,000	0,000	0,000
Mobile refrigeration	**HFC-134a**	185,870	507,631	790,077	769,861	685,765	704,993	401,892	221,075	87,178
Fire extinguishers	**C3F8**	0,015	0,024	0,032	0,040	0,000	0,000	0,000	0,000	0,000
	HFC-227ea	0,303	2,052	5,224	4,499	9,917	13,636	16,779	21,712	21,712
	HFC-236fa	5,818	12,596	15,655	9,374	10,375	11,524	12,014	11,289	9,605
Metered Dose Inhalers	**HFC-134a**	36,733	30,302	8,108	4,365	0,000	0,000	0,000	0,000	0,000
Foam blowing	**HFC-134a**	3,630	3,047	2,535	2,421	1,923	1,527	1,213	0,964	0,766
	HFC-227ea	0,015	0,108	0,090	0,086	0,068	0,054	0,043	0,034	0,027
	HFC-245fa	0,052	0,017	0,014	0,014	0,011	0,009	0,007	0,005	0,004
Electrical equipment	**SF6**	85,601	77,897	75,560	79,718	81,983	84,066	85,980	87,740	89,358

Usage	Gas	2005	2010	2014	2015	2020	2025	2030	2035	2040
Sound proof windows	**SF6**	15,721	3,390	3,257	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	0,000
	CF4	0,927	6,754	0,455	3,547	3,547	3,547	3,547	3,547	3,547
	C2F6	4,590	33,449	0,000	0,000	0,000	0,000	0,000	0,000	0,000
	SF6	1,126	0,000	17,198	5,700	5,700	5,700	5,700	5,700	5,700
	NF3	0,000	0,000	2,353	2,580	2,580	2,580	2,580	2,580	2,580
Total		**812,895**	**2 077,389**	**2 932,233**	**2 997,928**	**2 445,611**	**1 975,116**	**968,683**	**439,591**	**220,545**

Source: CRF tables 2005 – 2014 ENVIROS, s. r. o.

2.1.6 Non-energy products and solvent use (sector 2.D)

There is expected a stable production of non-energy products. The GHG emission will stay low in comparison to other sectors. Efficient abatement measures regarding NMVOC will decrease these emissions from solvent use.

The implied emission coefficient of 21 kg/ton from the latest inventory was used for emissions of CO_2 from paint application, degreasing and dry cleaning, chemical products, manufacture and processing and other solvent use.

2.1.7 Agriculture (sector 4)

Emissions from Agriculture represent more than 6% of total GHG emissions in the Czech Republic. The methane emissions from agriculture correspond to almost 25% of total national methane emissions, while nitrous oxide emissions from agriculture represent 70% of total national nitrous oxide emissions. Emissions from Agriculture rapidly decreased (approx. 40%) due to the transformation to market conditions and privatization in the 1990-1996 period. During time period 1990-2015 emission decreased by almost 50 % *[26]*.

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 projections of emissions in Agriculture retain the trend in emissions from the 1990-2015 period *[26]*, taking into account the current status and hypothetic developments in this sector. 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).

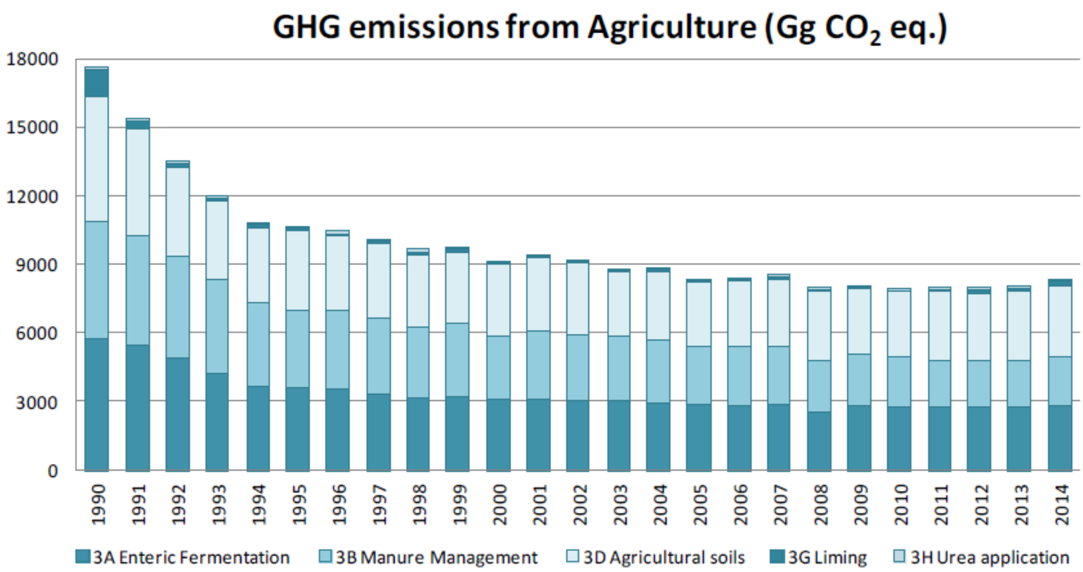
Year 2014, for which the last emission inventory is available, is the base year. The projection years are 2015, 2020, 2025, 2030 and 2035. The scenario with measures includes the measures implemented until June 2016.

Definition of scenario WEM: Existing policies are those which have been either adopted or implemented until June 2016 and are assumed to continue in the WEM scenario. Definition of scenario WAM: The WAM scenario reflects the range of impacts of policies which are currently either in the planning or research stages in the Czech Republic (since July 2016). Policies and measures for both scenarios are described in Ch. 1.8.

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.

Fig. 9 The emission trend in agricultural sector during reporting period 1990-2014



2.1.7.1 Methane emissions

The methane emissions consist of emissions from enteric fermentation and manure management. While the animal population rapidly declined in the 1990-2014 period (cattle by more than 60%), in the future, we can expect an increase in this emission source. 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 growth of animal population is recommended by conceptual materials mentioned in the section 1.8.

The following table gives the reported (1990, 2014) and forecast (2015, 2020, 2025, 2030 and 2035) activity data. The emission coefficients used to estimate methane emissions are taken from the National Inventory Report *[5]*. The methodology of emission estimation is linked to the IPCC 2006 Guidelines and the emission categories are linked to the CRF format.

Tab. 28 Activity data – animal population (thous. of heads)

	1990	**2014**	**2015**	**2020**	**2025**	**2030**	**2035**
Cattle	3 532	1374	1 407	1 485	1 560	1 605	1 630
Swine	4 790	1617	1 560	1 800	2 100	2 400	2 500
Sheep	430	225	232	235	240	250	260
Goats	41	24	27	30	35	40	42
Horses	27	33	34	35	35	40	40
Poultry	31 971	21 464	22 508	22 500	23 000	25 000	25 500

Source: 1990, 2014 and 2015 – CSO data; 2020, 2025, 2030 and 2035 – MA

2.1.7.2 Nitrous oxide emissions

The total emissions from agricultural soils decreased by 45% in the 1990-2014 period (mostly during the 1990-1995 period, by about 40%), direct emissions decreased by 40% and indirect emissions decreased by 50%. Amount of applied mineral nitrogen fertilizers decreased by 45% in the same period. 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 areas vulnerable in relation to nitrogen covered ca. 50% of agricultural land in 2014. A decrease in indirect N_2O emissions from nutrient leaching can be anticipated following the implementation of appropriate policies and measures (Nitrates Directives).

The following tables give the reported (1990, 2014) and forecast (2015, 2020, 2025, 2030 and 2035) activity data. The emission coefficients used to estimate the nitrous oxide emissions were taken from the National Inventory Report *[5].* The methodology of emission estimation corresponds to the IPCC 2006 Guidelines and the emission categories are linked to the CRF format.

Tab. 29 Activity data – application of mineral fertilizers (t)

	1990	**2014**	**2015**	**2020**	**2025**	**2030**	**2035**
Mineral fertilizers (t N)	418 144	267 706	270 023	275 000	280 000	280 000	285 000

Tab. 30 Activity data – annual harvests (kt)

	1990	2014	2015	2020	2025	2030	2035
Crops (cereals)	8 947	8 779	8 184	8 470	8 100	7 930	8 060
Pulses	152	54	96	91	104	113	117
Potatoes	1 755	698	505	612	629	683	700
Sugar beet	4 026	4 425	3 421	3 720	3 844	4 030	4 347
Fodder	7 444	3 449	2 708	3 250	3 551	3 850	4 163
Soya	2	16	20	25	30	36	48

2.1.8 Land Use, Land-Use Change and Forestry (sector 5)

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. Carbon accounting has always been challenging for the LULUCF sector, despite voluminous methodological advice compiled specifically for this sector by IPCC *[27,28,42,43]*. Therefore, the estimates related to the LULUCF sector are commonly accompanied by the largest uncertainty, commonly in range of tens of percent and larger.

2.1.8.1 Land use categories and their development

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 land-use representation and the land-use change identification system of the LULUCF emission inventory use annually updated COSMC data, elaborated at the level of about 13 thousand individual cadastral units. The observed development of the six major IPCC land use categories is reported in the latest Czech emission inventory (NIR 2016) for the period 1990 to 2014. The projections beyond 2014 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 Tab. 31 and Fig. 10 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 2014 until 2035, the end year of the projection period. During that time, the area share of cropland would decrease from 40.8% to 39.7% in the country (Fig. 11), which means a loss of 88 kha in this 20-year 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 (Fig. 10).

Tab. 31 Land use areas (kha): reported until 2014, projected until 2035

	Year											
	Reported area (kha)							Projected area (kha)				
Land use category	**2000**	**2005**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2020**	**2025**	**2030**	**2035**
Forest Land	2637	2647	2657	2660	2662	2664	2666	2668	2676	2681	2683	2685
Cropland	3319	3286	3248	3240	3233	3225	3218	3195	3168	3150	3138	3131
Grassland	961	974	986	989	992	994	997	1014	1027	1037	1045	1052
Wetlands	159	161	163	163	164	164	165	164	166	167	169	168
Settlements	703	712	726	728	731	733	735	740	746	747	747	747
Other Land	107	107	106	106	106	106	105	106	105	105	104	104

Source: NIR 2016, IFER

Fig. 10 Actual areas of the major IPCC land use categories in the Czech Republic for the period 1990 to 2014 and the projected trends shown for the period until 2035

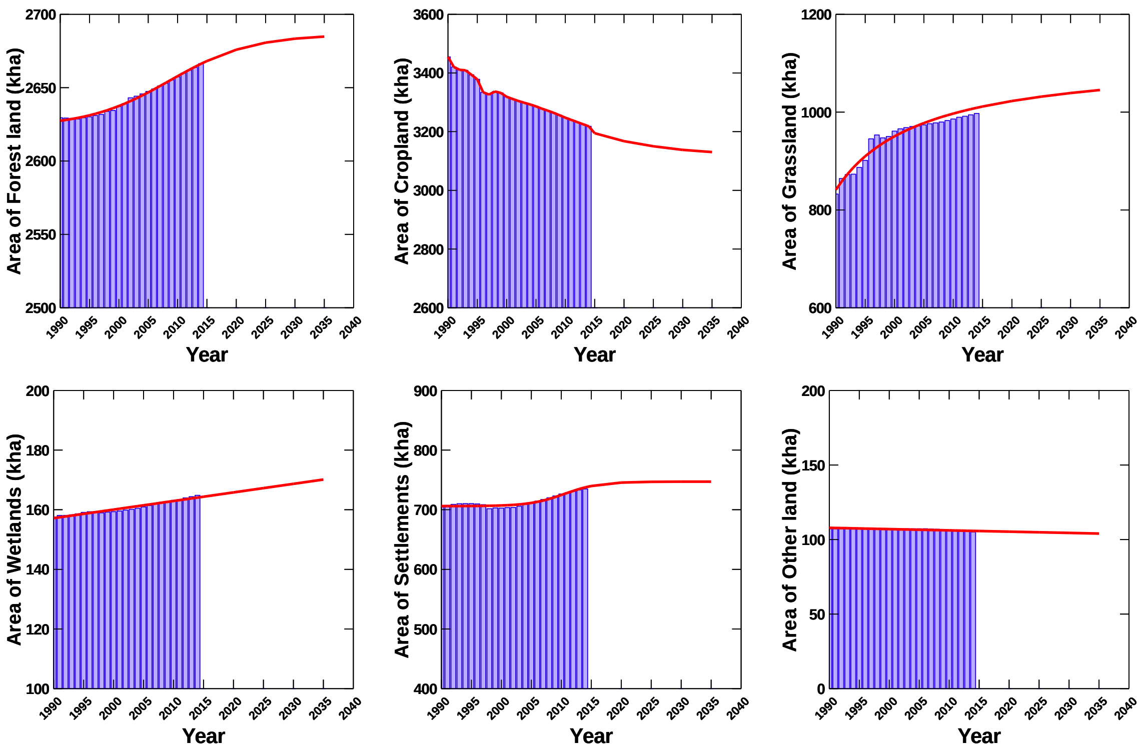
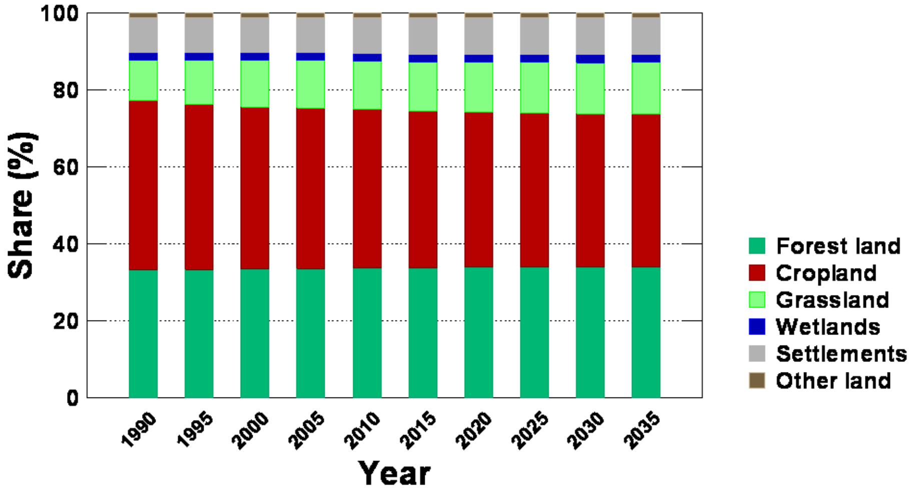


Fig. 11 Share of areas for the six IPCC land use categories in 5-year intervals since 1990 to 2035, using the actual data until 2014 (until year 2010 in the graph) and projections until 2035.



2.1.8.2 Projection of emission estimates

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 emission 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 *[29, 30, 31]*, which will be described in larger detail below.

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. HWP contribution was projected using the constant activity data as reported for the base year of 2014 in the 2016 submission of the National Inventory Report.

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 *[32].* The calibration data used were obtained from the database of forest management plans administered by the Forest Management Institute, Brandys n. L. They corresponded to the state of the Czech forests as of 2010. Since the model used, i.e., EFISCEN, ver. 3.3 *[31]*, works with a time step of 5 years, the calibration data were considered fully applicable for the projections required here. The model was applied on matrices at the level of 27 specific management units, 17 age classes and aggregation of five major tree species used in the Czech Forestry. The model predictions were constrained by the actual recommendations of the Czech Forestry Act as for the regeneration period, thinning and felling that were accordingly implemented on the level of individual management groups. The felling level request was adopted in the model identically across model scenarios. It was constructed as an average felling volume of the recent 5-year period (2009 to 2013), including the share of so called unregistered felling volumes, which relate to the harvest loss and accidental (sanitary/unplanned) felling in individual years. This way constructed total felling (thinning and final cut) reached 17.29 mil m^3 of merchantable wood volume annually. This includes 15.60 mil. m^3 harvested volume as reported by the official statistics, while the rest represents the unregistered harvest loss and losses reported by the Czech Statistical Office. This is consistent with the felling volumes as used in the emission inventory of the Czech Republic. Other details of this EFISCEN model implementation are described in *[32].*

The mode projections were used for the predictions beyond 2015 until 2035. For 2015, the inventory estimates available at the emission inventory team at the time of preparation of this report (November 2016) were used, which were based on the already reported activity data for 2015 applicable to the Forest land category (4A). The methodological details associated with this estimate are fully described in the latest NIR submission *[45]*. The reported harvest of merchantable wood was 16.16 mil. m^3 for 2015, while the associated biomass loss associated with harvest reached additional 12.4 % (Czech Statistical Office 2016). These quantities form the total wood volume (biomass, carbon) drain from the forests in 2015, directly affecting the emission estimates for Forest land for this year, estimated in the same manner as described in the NIR *[45]*.

2.1.8.3 Definition of WEM and WAM scenarios in LULUCF

The WEM (With Existing Measures) scenario includes the development of land areas of individual land use categories as shown in Tab. 31 and Fig. 10. That development of land areas and land use changes drives the emissions of the reference year (2014) in response to the projected are change for the individual land use categories with exception of CO_2 emissions from Forest Land and HPW 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 felling request remains stable and as of today (17.29 mil. m^3/year) for the entire projection period with exception of year 2015 with its already reported and available felling quantity. For HWP contribution, the input activity data of 2014 were applied across the entire projected period until year 2035.

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 proposed species change is driven by the actual management groups and by altitude of their locations. The details of this management scenario correspond to SSC2 scenario as described in the background study of Cienciala *[44]*.

This is the essence of the recommendations of the elaborated 2nd National Forest Program (Key Action 6) *[44]*

2.1.9 Waste (sector 6)

Waste sector (IPCC guidelines sector no. 5) in the Czech Republic can be separated in to 4 distinctive source categories. First, so far dominant, category is 5A, emissions from solid waste disposal sites. This category is source of methane. Emissions of CO_2 from this category are of a biogenic origin and are not part of UNFCCC agreement. Second source category is a category 5B - biological treatment of waste. This source category consists mainly from composting and up to small degree to anaerobic digestion of waste. As composting is aerobic process and anaerobic digestion is technologically controlled process, an emission from this source category tends to be negligible, even when this category seems to be growing in the country. Emissions from usage of biogas produced in anaerobic digestion is not part of this source category as it should be accounted in in 1A – Energy or in 2B Fugitive emissions, depending which kind of pollutant is in question, emissions (leakages) from digestion process are accounted, however. Third source category is 5C -waste incineration. This category should be also accounted in energy sector should waste incineration produce useable energy, in 5C only hazardous and industrial waste incineration is accounted, which is same approach as in national inventories of GHGs. Waste incineration produces all three major greenhouse gasses, but predominantly its fossil CO_2 source. Last category is 5D - waste water treatment. This category includes both public and private waste water treatment plants as well as industrial counterparts and it is source of methane and nitrous oxide.

Overall development of the waste sector in past decades is dominated by landfilling (SWDS) 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.

Waste sector have highly uncertain in regards of emissions levels as many of processes behind the emissions are either not sufficiently understood or are strongly dependent on local conditions which makes top down assessment such as this very difficult. Waste sector is ultimate end point of all consumption and economic activities is therefore also highly dependent of whole economy setting, which makes it even harder to predict as well. Default uncertainty for the GHG emission levels in waste sector are around +/-40%, with some source subcategories reaching to factor of 2. This uncertainty originates mainly from emission factors. Activity data is also uncertain, but due to economic nature of waste management it is regularly scrutinised and controlled.

Main activity data comes from WMP of the Czech Republic. Key assumptions in WMP for the future GHG emissions (mainly form municipal waste MW) development are following: “The developed forecasts of MW production imply that municipal waste 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[7] 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 MRW 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 (i.e. more or less waste of group 20, because the products of waste treatment are reported in group 19 and inert waste (soil etc. represents in group 20 a marginal item) in the period after 2025." *[46]*

Table 32 Forecast of total MMW production by all subjects in the Czech Republic (Mt); source WMP 2014

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

Table 33 Forecast of municipal waste management (Mt); source WMP 2015

	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

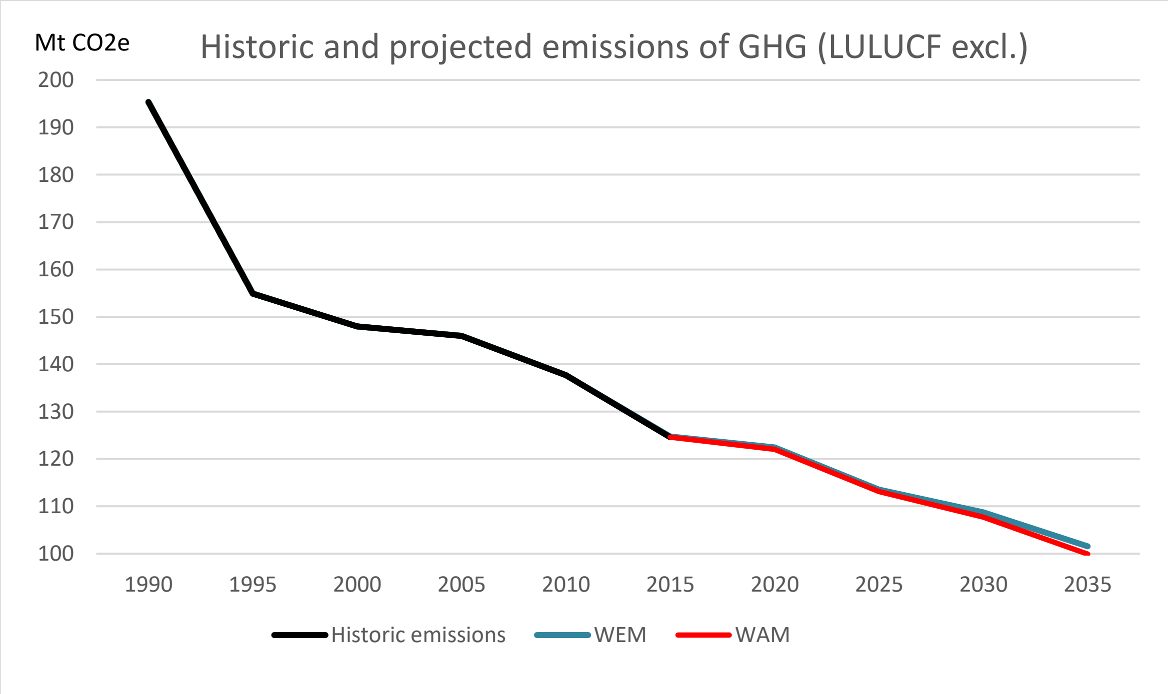
To have prolonged timelines we have used outlined scenarios and build upon them up to 2040. Assumptions source category 5D – wastewater management are based purely on population development and current technology mix and industrial water are coupled with domestic.

[7] Please note that waste to energy processes are part of energy, not waste sector.

2.2 Projections

2.2.1 Summary projections

Fig. 12 Historic and projected emissions of GHG (LULUCF excluded)



Tab. 34 Historic and projected emissions of GHG (LULUCF excluded) [Mt CO_2 eq.]

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 – 2030(%)	2005 – 2020(%)	2005 – 2030(%)
WEM	195,34	154,89	147,99	145,97	137,69	123,65	124.75	122.41	113.52	108.74	101.56	-37.33	-44.34	-16.14	-25.51
WAM	195,34	154,89	147,99	145,97	137,69	123,65	124.59	122.05	113.14	107.72	99.93	-37.52	-44.85	-16.39	-26.20

The projected decrease of GHG emissions between years 1990 and 2020 reaches 37.3% in the scenario with existing measures. Implementation of additional measures would slightly raise this decrease. Between the years 2005 – 2030, the decrease amounts 25.5% in the WEM scenario and 26.2% in the WAM scenario.

Carbon dioxide is the dominant greenhouse gas and its share in the total GHG emissions was 81.8% in 2014. Since methane and nitrous monoxide are influenced by other sectors than energy, they show different percentage drops than CO_2. Emissions of fluorinated gases culminate about the year 2015 and then they quite rapidly drop.

Tab. 35 Breakdown of historic and projected emissions of GHG by gases (LULUCF excluded) – scenario with existing measures

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 – 2030(%)	2005 – 2020(%)	2005 – 2030(%)
CO2	161,67	129,77	125,85	124,60	115,77	101,15	102.04	100.26	92.16	88.50	83.07	-37.99	-45.26	-19.54	-28.97
CH4	22,45	17,20	14,43	13,67	13,66	13,24	13.43	13.26	12.65	12.29	11.10	-40.94	-45.26	-3.01	-10.10
N2O	11,15	7,83	7,40	6,88	6,18	6,32	6.36	6.54	6.82	7.06	7.03	-41.36	-36.66	-4.96	2.65
HFC	NO	0,00	0,20	0,70	1,95	2,83	2.90	2.33	1.87	0.86	0.34			233.39	22.61
PFC	NO	0,00	0,00	0,01	0,05	0,01	0.01	0.00	0.00	0.00	0.00			-62.32	-64.53
SF6	0,09	0,09	0,20	0,11	0,08	0,10	0.09	0.11	0.10	0.10	0.09	17.24	15.85	-4.08	-5.21
Total	195,34	154,89	147,99	145,97	137,69	123,65	124.75	122.41	113.52	108.74	101.56	-37.33	-44.34	-16.14	-25.51

Tab. 36 Breakdown of historic and projected emissions of GHG by gases (LULUCF excluded) – scenario with additional measures

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 – 2030(%)	2005 – 2020(%)	2005 – 2030(%)
CO2	161,67	129,77	125,85	124,60	115,77	101,15	102.04	99.94	91.82	88.17	82.73	-38.18	-45.46	-19.79	-29.24
CH4	22,45	17,20	14,43	13,67	13,66	13,24	13.43	13.26	12.70	12.01	10.21	-40.94	-46.49	-3.01	-12.12
N2O	11,15	7,83	7,40	6,88	6,18	6,32	6.20	6.50	6.71	6.66	6.62	-41.74	-40.28	-5.59	-3.21
HFC	NO	0,00	0,20	0,70	1,95	2,83	2.90	2.33	1.87	0.86	0.34			233.39	22.61
PFC	NO	0,00	0,00	0,01	0,05	0,01	0.01	0.00	0.00	0.00	0.00			-62.32	-64.53
SF6	0,09	0,09	0,20	0,11	0,08	0,10	0.09	0.11	0.10	0.10	0.09	17.24	15.85	-4.08	-5.21
Total	195,34	154,89	147,99	145,97	137,69	123,65	124.59	122.05	113.14	107.72	99.93	-37.52	-44.85	-16.39	-26.20

The main amount of greenhouse gases is emitted from energy producing and consuming activities – 82.0% in the year 2014. This sector has also the highest contribution to the total drop of GHG emissions. This tendency results mainly from fuel switch and also from increased energy efficiency on the demand side and introduction of renewable energy sources.

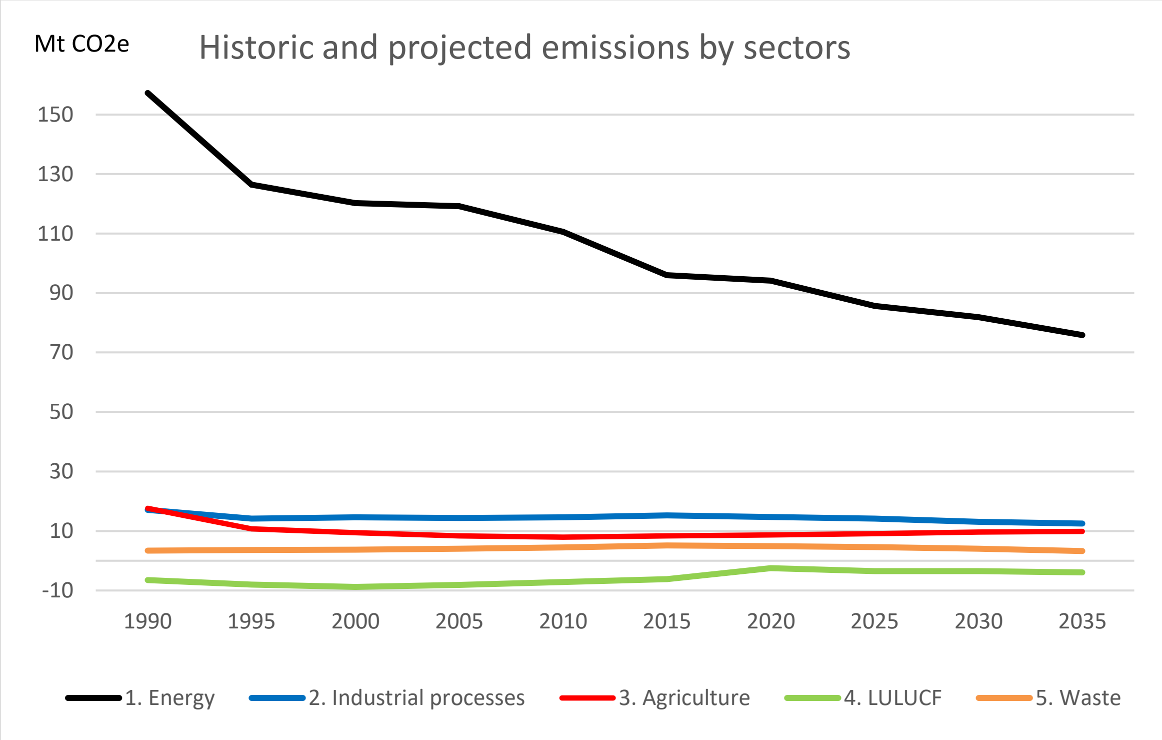
Tab. 37 Breakdown of historic and projected emissions of GHG by sectors – scenario with existing measures

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 – 2030(%)	2005 – 2020(%)	2005 – 2030(%)
1. Energy	157,27	126,44	120,24	119,20	110,58	95,03	95.98	94.20	85.64	81.90	75.88	-40.10	-47.92	-20.97	-31.29
2. Industrial processes	17,09	14,16	14,64	14,39	14,65	15,28	15.27	14.68	14.16	13.08	12.51	-14.11	-23.43	2.00	-9.07
3. Agricult.	17,62	10,67	9,38	8,33	7,93	8,29	8.36	8.64	9.12	9.68	9.90	-50.96	-45.04	3.65	16.17
4. LULUCF	-6,47	-8,03	-8,79	-8,11	-7,18	-7,79	-6.17	-2.49	-3.45	-3.48	-3.91	-61.44	-46.15	-69.26	-57.07
5. Waste	3,38	3,62	3,74	4,05	4,52	5,05	5.14	4.89	4.61	4.06	3.27	45.02	20.42	20.97	0.44
Total including LULUCF	188,88	146,86	139,20	137,85	130,51	115,86	118.57	119.92	110.07	105.25	97.64	-36.51	-44.27	-13.01	-23.65

Tab. 38 Breakdown of historic and projected emissions of GHG by sectors – scenario with additional measures

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 – 2030(%)	2005 – 2020(%)	2005 – 2030(%)
1. Energy	157,27	126,44	120,24	119,20	110,58	95,03	95.98	93.88	85.31	81.57	75.55	-40.30	-48.13	-21.24	-31.57
2. Industrial processes	17,09	14,16	14,64	14,39	14,65	15,28	15.27	14.68	14.16	13.08	12.51	-14.11	-23.43	2.00	-9.07
3. Agriculture	17,62	10,67	9,38	8,33	7,93	8,29	8.20	8.60	9.02	9.28	9.50	-51.20	-47.33	3.13	11.33
4. LULUCF	-6,47	-8,03	-8,79	-8,11	-7,18	-7,79	-6.17	-2.95	-4.04	-3.88	-4.40	-54.35	-40.05	-63.60	-52.20
5. Waste	3,38	3,62	3,74	4,05	4,52	5,05	5.14	4.89	4.66	3.79	2.37	45.02	12.25	20.97	-6.36
Total including LULUCF	188,88	146,86	139,20	137,85	130,51	115,86	118.41	119.10	109.10	103.85	95.53	-36.94	-45.02	-13.61	-24.67

Fig. 13 Historic and projected emissions of GHG by sectors



2.2.2 Split of projections between EU-ETS and ESD sectors

Tab. 39 Split of projected ETS and ESD emissions in the WEM scenario

[Mt CO2eq]	2005	2014	2020	2030	2005 – 2020 (%)	2005 – 2030 (%)
EU-ETS	82,46	62,91	60,54	54,30	-26,58	-34,15
ESD	63,51	60,74	61,86	54,42	-2,60	-14,31

Tab. 40 Split of projected ETS and ESD emissions in the WAM scenario

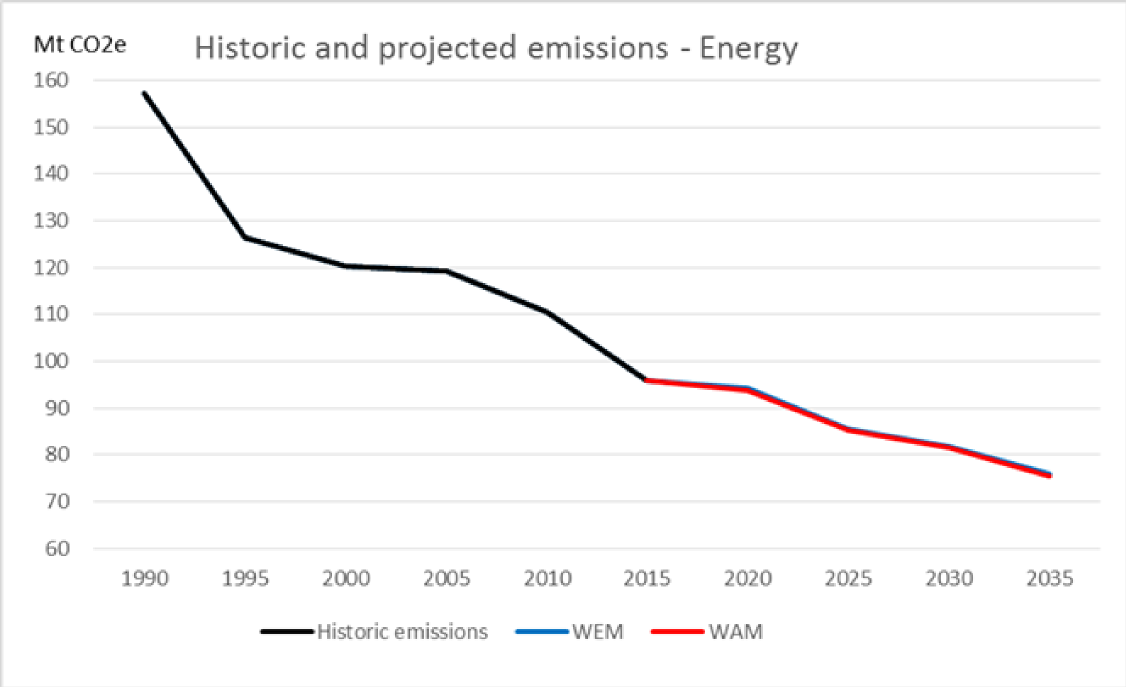
[Mt CO2eq]	2005	2014	2020	2030	2005 – 2020 (%)	2005 – 2030 (%)
EU-ETS	82,46	62,91	60,49	54,23	-26,64	-34,23
ESD	63,51	60,74	61,55	53,47	-3,09	-15,81

The drop of GHG emissions in the EU-ETS sectors reaches 26.58% for the WEM scenario in the period 2005 – 2020. The drop increases to 26.64 % in the WAM scenario. Similar figures for the period 2005 – 2030 are 34.15% (WEM) and 34.23% (WAM).

Emissions of greenhouse gases in the ESD sectors drop by 2.6% in the WEM scenario and by 3.09 % in the WAM scenario during the period 2005 – 2020. The drops in the period 2005 – 2030 are estimated to 14.31% for the WEM scenario and 15.81% for the WAM scenario.

2.2.3 Energy

Fig. 14 Historic and projected emissions of GHG – Energy



Tab. 41 Historic and projected emissions of GHG – Energy [Mt CO_2 eq.]

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020%	1990 – 2030%	2005 – 2020%	2005 – 2030%
WEM	157,3	126,4	120,2	119,2	110,6	95,0	95.98	94.20	85.64	81.90	75.88	-40.10	-47.92	-20.97	-31.29
WAM	157,3	126,4	120,2	119,2	110,6	95,0	95.98	93.88	85.31	81.57	75.55	-40.30	-48.13	-21.24	-31.57

The expected drop of GHG emissions in the WEM scenario in the energy sector is 40.0% between years 1990 and 2020. Realization of additional measures would increase the drop to 40.3%. A decrease between years 2005 and 2030 equals to 31.3% for the WEM scenario and 31.6% for the WAM scenario.

Tab. 42 Breakdown of historic and projected emissions of GHG by gases in energy sector – scenario with existing measures

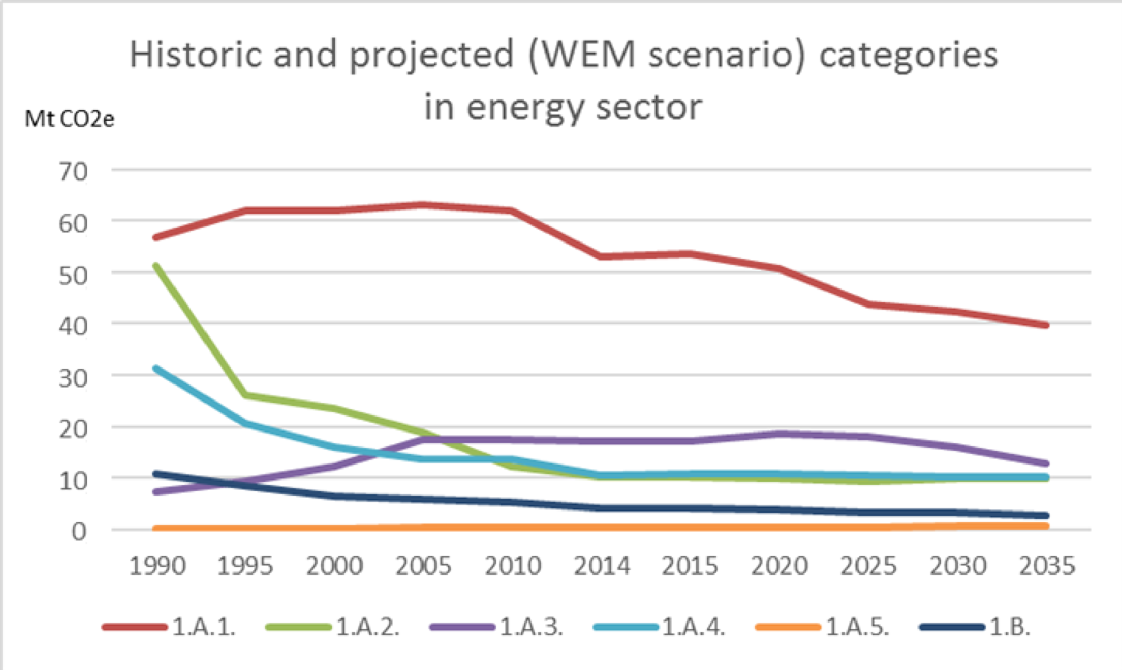
[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 – 2030(%)	2005 – 2020(%)	2005 – 2030(%)
CO2	144,74	115,52	112,60	111,99	103,92	89,59	90,47	88,69	80,64	77,04	71,65	-38.72	-46.78	-20.81	-31.21
CH4	11,75	9,01	6,77	6,09	5,57	4,41	4,45	4,31	4,77	3,69	3,20	-63.28	-68.60	-29.12	-39.38
N2O	0,78	0,72	0,87	1,12	1,09	1,03	1,06	1,20	1,23	1,18	1,04	53.82	51.71	6.78	5.31
Total	157,27	126,44	120,24	119,20	110,58	95,03	95,98	94,20	85,64	81,90	75,88	-40.10	-47.92	-20.97	-31.29

Tab. 43 Breakdown of historic and projected emissions of GHG by gases in energy sector – scenario with additional measures

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 - 2030(%)	2005 - 2020(%)	2005 - 2030(%)
CO2	144,74	115,52	112,60	111,99	103,92	89,59	90.5	88.4	80.3	76.7	71.3	-38.94	-47.01	-21.09	-31.51
CH4	11,75	9,01	6,77	6,09	5,57	4,41	4.45	4.31	3.77	3.69	3.20	-63.28	-68.60	-29.12	-39.38
N2O	0,78	0,72	0,87	1,12	1,09	1,03	1.06	1.20	1.23	1.18	1.04	53.82	51.71	6.78	5.31
Total	157,27	126,44	120,24	119,20	110,58	95,03	95.98	93.88	85.31	81.57	75.55	-40.30	-48.13	-21.24	-31.57

Carbon dioxide with a share of 89.6% in the year 2014 is the decisive greenhouse gas produced in the energy sector. Methane is released mainly as a result of coal mining and its share was 4.4% in 2014.

Fig. 15 Breakdown of historic and projected emissions of GHG by sectors – Energy

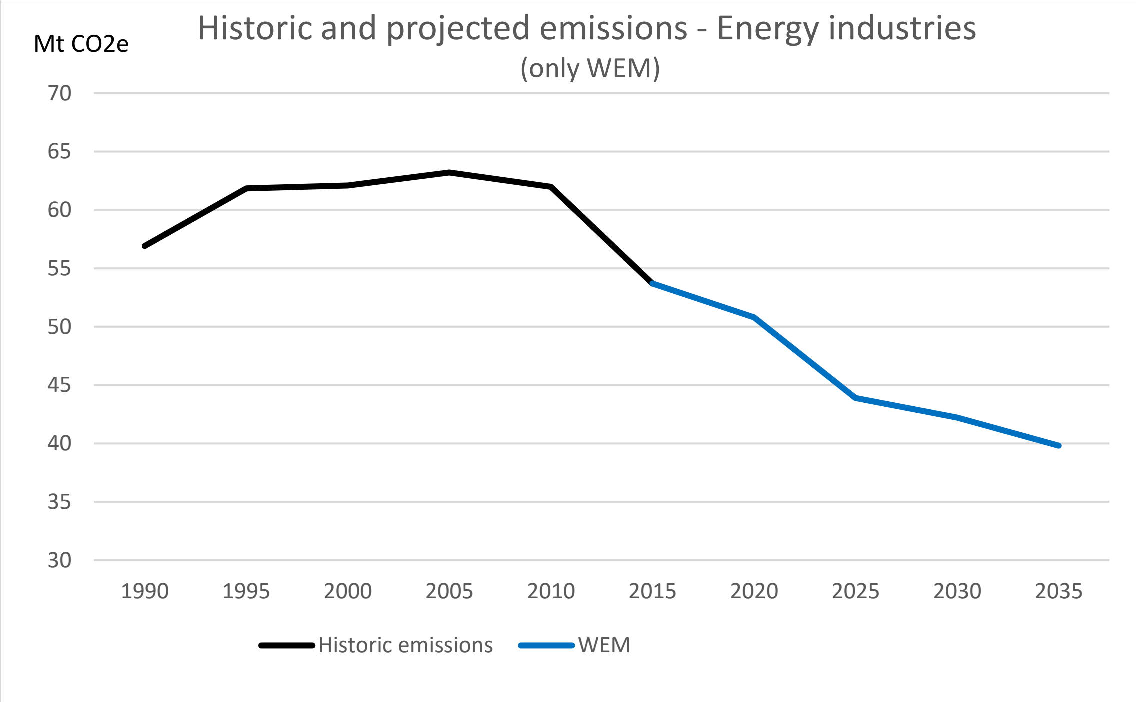


In 2014 the dominant GHG emissions source is represented by energy industries 1.A.1. (55.9%), followed by transport 1.A.3. (18.1%), other sectors 1.A.4. (10.9%) and manufacturing industries (10.6%). Fugitive emissions 1.B. constitute in this year about 4.1%. A significant reduction of GHG emissions can be observed in manufacturing industries and others sectors in the past years. This resulted mainly from the switch from domestic coal to other fuels, mainly to gas. As easily accessible domestic reserves of brown coal are getting close to depletion a similar tendency in energy industries can be assumed.

Because of the importance of energy sector individual subsectors are described in detail in the following sections.

2.2.3.1 Energy industries (1.A.1.)

Fig. 16 Historic and projected emissions of GHG – Energy industries



Tab. 44 Historic and projected emissions of GHG – Energy industries 1.A.1. [Mt CO_2 eq.]

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 - 2030(%)	2005 - 2020(%)	2005 - 2030(%)
WEM	56,91	61,86	62,11	63,21	61,98	53,15	53,70	50,80	43,88	42,22	39,81	-10.74	-25.82	-19.64	-33.21
WAM	56,91	61,86	62,11	63,21	61,98	53,15	53,70	50,80	43,88	42,22	39,81	-10.74	-25.82	-19.64	-33.21

Tab. 45 Breakdown of historic and projected emissions of GHG by gases in energy industries – scenario with existing measures (no additional measures in this subsector)

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 - 2030(%)	2005 - 2020(%)	2005 - 2030(%)
CO2	56,67	61,59	61,84	62,94	61,70	52,89	53,44	50,53	43,64	41,96	39,56	-10.82	-25.95	-19.71	-33.33
CH4	0,02	0,02	0,02	0,02	0,02	0,03	0,03	0,04	0,04	0,05	0,05	122.13	180.31	98.72	150.77
N2O	0,23	0,25	0,25	0,25	0,26	0,23	0,23	0,23	0,21	0,21	0,21	1.42	-8.03	-8.35	-16.89
Total	56,91	61,86	62,11	63,21	61,98	53,15	53,70	50,80	43,88	42,22	39,81	-10.74	-25.82	-19.64	-33.21

The emission trend of public electricity and heat production shows a higher decrease after the year 2010. This change in electricity generation is a result of depleting reserves of domestic brown coal. The previous projection was based on the assumption that one integrated gas and steam unit of 840 MW would be put into operation in the period 2010 – 2015 and other two between 2015 and 2020. The first unit was built in the power plant Pocerady but it is not regularly utilized because it is not economically competitive with current fuel prices relations. Plans to build other two gas units were discarded. The installed capacity in coal-fired plants will decrease by 1,550 MW in the period 2012 – 2020 and by another 743 MW between the years 2020 and

2030. On the other hand, two new 660 MW brown coal units are considered in the power plant Pocerady in the period 2020 – 2025. This is the only plant in the Czech Republic having coal reserves sufficient beyond the year 2055. Construction of new nuclear units was postponed by 10 years in comparison with the previous projection and now is expected around the year 2035.

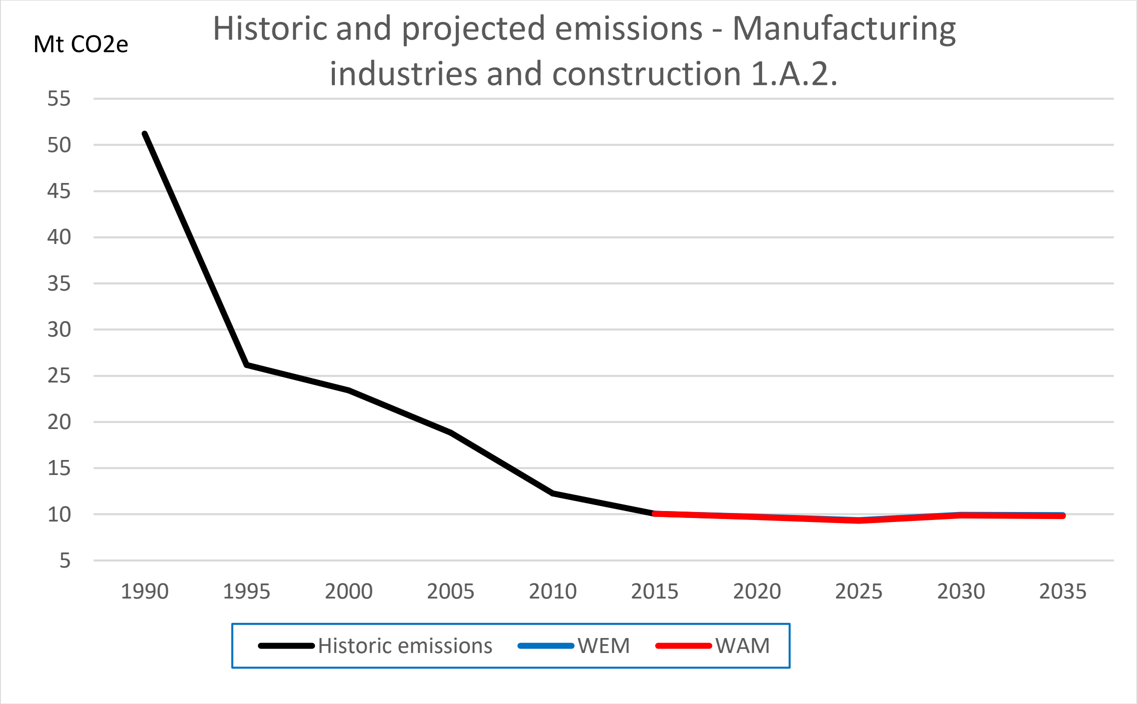
The decrease of GHG emissions is also caused by the increased share of RES in electricity and heat generation.

Scenario with additional measures

There aren´t additional measures in this sub-sector.

2.2.3.2 Manufacturing industries and construction (1.A.2.)

Fig. 17 Historic and projected emissions of GHG – Manufacturing industries and construction



Tab. 46 Historic and projected emissions of GHG – Manufacturing industries and construction [Mt CO_2 eq.]

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 - 2030(%)	2005 - 2020(%)	2005 - 2030(%)
WEM	51,22	26,17	23,42	18,84	12,26	10,04	10,06	9,75	9,37	9,94	9,90	-80.97	-80.59	-48.26	-47.21
WAM	51,22	26,17	23,42	18,84	12,26	10,04	10,06	9,69	9,29	9,86	9,82	-81.09	-80.74	-48.56	-47.63

Tab. 47 Breakdown of historic and projected emissions of GHG by gases in manufacturing industries and construction – scenario with existing measures

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 - 2030(%)	2005 - 2020(%)	2005 - 2030(%)
CO2	50,93	26,03	23,29	18,72	12,17	9,95	9,98	9,67	9,29	9,86	9,81	-81.02	-80.63	-48.35	-47.30
CH4	0,11	0,05	0,05	0,05	0,03	0,03	0,03	0,03	0,03	0,03	0,03	-70.77	-70.48	-30.87	-30.20
N2O	0,19	0,09	0,08	0,08	0,05	0,05	0,05	0,05	0,05	0,05	0,05	-73.52	-73.27	-34.65	-34.02
Total	51,22	26,17	23,42	18,84	12,26	10,04	10,06	9,75	9,37	9,94	9,90	-80.97	-80.59	-48.26	-47.21

Tab. 48 Breakdown of historic and projected emissions of GHG by gases in manufacturing industries and construction – scenario with additional measures

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 - 2030(%)	2005 - 2020(%)	2005 - 2030(%)
CO2	50,93	26,03	23,29	18,72	12,17	9,95	9,98	9,61	9,21	9,78	9,74	-81.13	-80.79	-48.66	-47.73
CH4	0,11	0,05	0,05	0,05	0,03	0,03	0,03	0,03	0,03	0,03	0,03	-70.77	-70.48	-30.87	-30.20
N2O	0,19	0,09	0,08	0,08	0,05	0,05	0,05	0,05	0,05	0,05	0,05	-73.52	-73.27	-34.65	-34.02
Total	51,22	26,17	23,42	18,84	12,26	10,04	10,06	9,69	9,29	9,86	9,82	-81.09	-80.74	-48.56	-47.63

The GHG emission projections in manufacturing industries and construction are based on the expected final energy consumption in industry (Tab. 19).

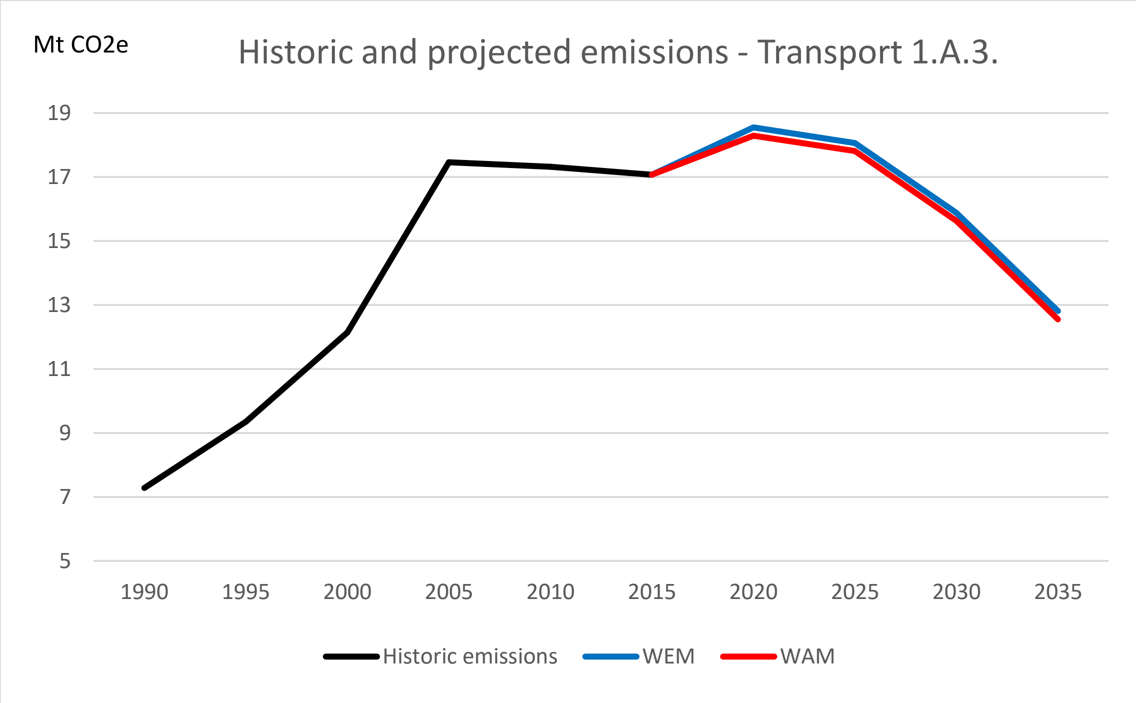
The final energy consumption in this sector is slightly increasing. The electricity consumption is, after the crisis related drop in 2010, growing and the share of fossil fuels is decreasing. The drop of GHG emission is 48.6% in the period 2005 – 2020 and 47.6% between the years 2005 and 2030 in the WEM scenario.

Scenario with additional measures

The WAM scenario is influenced by one additional measure - *Support of voluntary commitments to energy savings* – in the manufacturing sector. The supposed energy savings are 5.4 PJ in the year 2020 according to the third National Action Plan for Energy Efficiency. These energy savings will lead to additional drop of CO_2 emissions by about 60 kt in 2020.

2.2.3.3 Transport

Fig. 18 Historic and projected emissions of GHG – Transport



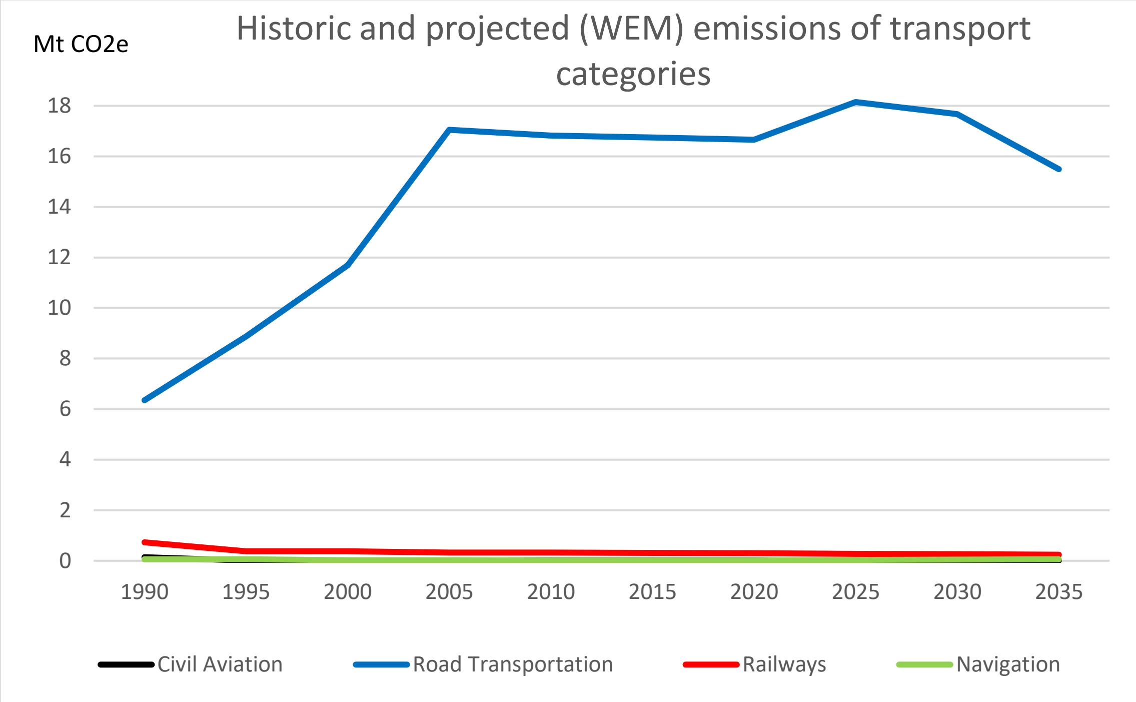
Tab. 49 Historic and projected emissions of GHG – Transport [Mt CO_2 eq.]

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 - 2030(%)	2005 - 2020(%)	2005 - 2030(%)
WEM	7,28	9,35	12,14	17,46	17,32	17,16	17.07	18.55	18.06	15.88	12.81	154.68	118.05	6.25	-9.03
WAM	7,28	9,35	12,14	17,46	17,32	17,16	17.07	18.29	17.81	15.63	12.55	151.11	114.60	4.76	-10.47

Tab. 50 Breakdown of historic and projected emissions of GHG by gases in transport – scenario with existing measures

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 - 2030(%)	2005 - 2020(%)	2005 - 2030(%)
CO2	7,03	9,02	11,65	16,72	16,62	16,49	16.38	17.75	17.21	15.08	12.15	152.36	114.52	6.12	-9.79
CH4	0,04	0,05	0,04	0,04	0,03	0,02	0.02	0.02	0.01	0.01	0.01	-60.50	-79.39	-61.29	-79.80
N2O	0,21	0,29	0,45	0,70	0,67	0,64	0.67	0.79	0.85	0.79	0.66	269.91	270.05	13.10	13.14
Total	7,28	9,35	12,14	17,46	17,32	17,16	17.07	18.55	18.06	15.88	12.81	154.68	118.05	6.25	-9.03

Fig. 19 Breakdown of historic and projected emissions of GHG by modes – Transport



Tab. 51 Breakdown of historic and projected emissions of GHG by modes in transport

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 - 2030(%)	2005 - 2020(%)	2005 - 2030(%)
Civil Aviation	0,14	0,01	0,01	0,01	0,01	0,01	0.01	0.01	0.01	0.01	0.01	0.01	-93.67	-93.60	0.54
Road Transportation	6,35	8,88	11,69	17,05	16,82	16,75	16.75	16.66	18.15	17.67	15.49	124.2	185.82	143.94	6.48
Railways	0,73	0,37	0,37	0,32	0,33	0,31	0.31	0.30	0.28	0.26	0.24	0.22	-62.01	-67.46	-12.89
Navigation	0,06	0,06	0,02	0,02	0,01	0,01	0.01	0.01	0.03	0.04	0.06	0.08	-49.69	5.98	83.77

Road transport shows steadily growing activity and consequently energy consumption and GHG emissions. After the year 2007, transport, especially fright transport, was hit by the economic crisis. However, the growing trend of transport activity is supposed to continue also in the period 2010 – 2020. On the other hand, improved efficiency of new cars causes that energy consumption will reach its peak around the year 2015 and then it will be slightly decreasing.

The projection supposes continuing growing trend of emissions in road transport until 2025. Emissions from railways are expected to decrease. The inland water transport is supposed to increase from 2025.

The projected structure of energy carriers in the transport sector is shown in the following table.

Tab. 52 Projection of final energy consumption of the transport sector

Final energy consumption in transport [PJ]	2012	2015	2020	2025	2030	2035
Brown coal	0,0	0,0	0,0	0,0	0,0	0,0
Liquid biofuels	11,5	19,7	29,1	29,1	28,1	28,1
Electricity	8,0	8,0	9,7	12,1	15,6	20,4
Gasoline	68,7	65,9	53,9	50,2	50,5	46,7
Diesel fuel	146,9	143,0	119,5	99,6	92,4	95,7
Aviation fuels	13,2	13,4	15,6	16,4	16,7	17,2
Liquefied petroleum gas	3,1	3,2	2,6	2,7	3,8	3,6
Natural gas	1,8	5,3	23,8	35,1	44,1	48,1
Hydrogen	0,0	0,0	0,0	0,0	0,0	0,0
TOTAL	**253,2**	**258,5**	**254,1**	**245,2**	**251,1**	**259,8**

The projection counts with growing shares of bio fuels (up to 2020) and natural gas. A significant increase of electric and hybrid cars is supposed to start after the year 2030.

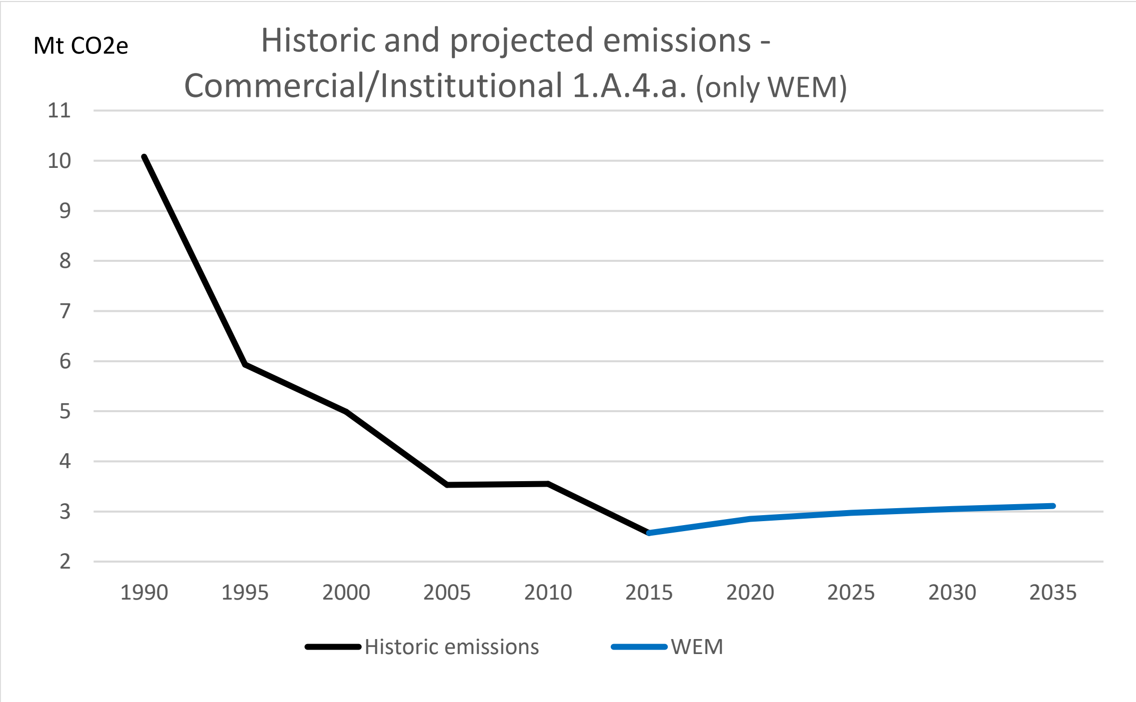
The GHG emissions from transport are expected to decline in both scenarios WEM and WAM from 2020 (see Tab. 49). This results from fuel switches in favor of fuels with lower carbon content, from obligatory improved energy efficiency of new personal cars and especially from a higher share of electric and hybrid vehicles.

Scenario with additional measures

The additional measure *Economic tax tools* and *Road toll* (see Ch. 1.6.9 and 1.6.10) will influence GHG emissions.

2.2.3.4 Commercial/Institutional sector

Fig. 20 Historic and projected emissions of GHG – Commercial/Institutional sector



Tab. 53 Historic and projected emissions of GHG – Commercial/Institutional sector [Mt CO_2 eq.]

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 - 2030(%)	2005 - 2020(%)	2005 - 2030(%)
WEM only	10,08	5,93	4,99	3,53	3,55	2,55	2,57	2,85	2,97	3,05	3,11	-71.69	-69.71	-19.11	-13.44

Tab. 54 Breakdown of historic and projected emissions of GHG by gases in commercial/institutional sector

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 - 2030(%)	2005 - 2020(%)	2005 - 2030(%)
CO2	10,02	5,90	4,97	3,51	3,54	2,54	2,55	2,84	2,96	3,04	3,09	-71.70	-69.71	-19.21	-13.51
CH4	0,03	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	-43.87	-44.14	13.85	13.29
N2O	0,03	0,02	0,01	0,00	0,00	0,00	0,002	0,002	0,002	0,003	0,003	-91.88	-91.20	-40.85	-35.95
Total	10,08	5,93	4,99	3,53	3,55	2,55	2,57	2,85	2,97	3,05	3,11	-71.69	-69.71	-19.11	-13.44

The tertiary sector is a sector with the fastest economic growth. The energy consumption driven by the economic grow may almost negate the energy efficiency improvements. The growing projection of final energy consumption presented in Tab. 20 corresponds with this assumption.

The GHG emission declined until 2014 and then a slight increase is expected.

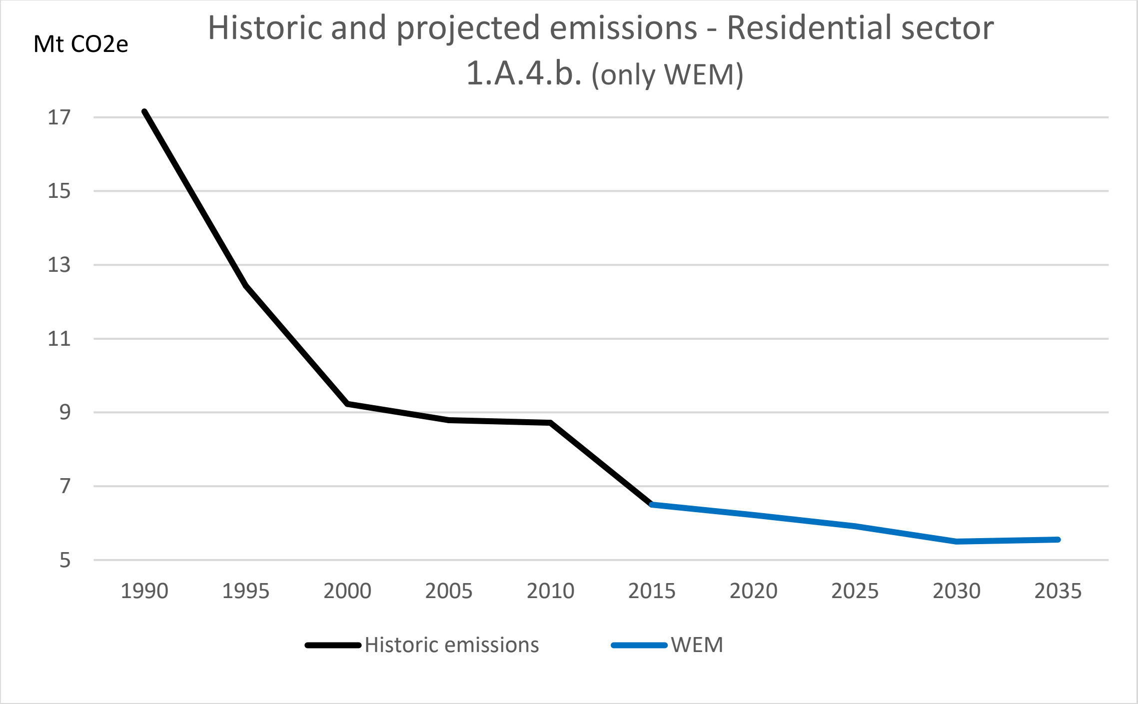
The GHG emissions from the tertiary sector decrease by 19.1% between the years 2005 and 2020 and by 13.4% between 2005 and 2030.

Scenario with additional measures

There aren´t currently additional measures in the service sector: *Operational Programme Environment 2014 – 2020* and *Operational Programme Enterprise* and *Innovation for Competitiveness,* which have started in 2014 or 2015, are included under existing measures.

2.2.3.5 Residential sector

Fig. 21 Historic and projected emissions of GHG – Residential sector



Tab. 55 Historic and projected emissions of GHG – Residential sector [Mt CO_2 eq.]

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 - 2030(%)	2005 - 2020(%)	2005 - 2030(%)
WEM (only)	17,16	12,43	9,23	8,79	8,72	6,57	6,50	6,22	5,92	5,50	5,55	-63.73	-67.92	-29.17	-37.36

Tab. 56 Breakdown of historic and projected emissions of GHG by gases in residential sector in WEM scenario

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 – 2020(%)	1990 - 2030(%)	2005 - 2020(%)	2005 - 2030(%)
CO2	15,84	11,62	8,65	8,22	8,07	5,95	5,89	5,61	5,31	4,92	4,97	-64.60	-68.95	-31.79	-40.18
CH4	1,23	0,75	0,53	0,51	0,57	0,55	0,55	0,54	0,52	0,50	0,50	-56.03	-59.00	6.27	-0.89
N2O	0,10	0,06	0,05	0,06	0,07	0,07	0,07	0,08	0,08	0,08	0,08	-18.96	-12.72	30.88	40.94
Total	17,16	12,43	9,23	8,79	8,72	6,57	6,50	6,22	5,92	5,50	5,55	-63.73	-67.92	-29.17	-37.36

Households represent the only sector where a decrease of the total energy consumption between the years 2010 and 2030 is predicted. The drop is attributed to the quickly proceeding process of thermal insulation improvement of panel living houses. Incentives financed from the sales of emission allowances started similar process even for family houses. This results in lower heat consumption. Between years 2030 – 2035 situation should be stabilized, therefore electricity consumption should be almost constant.

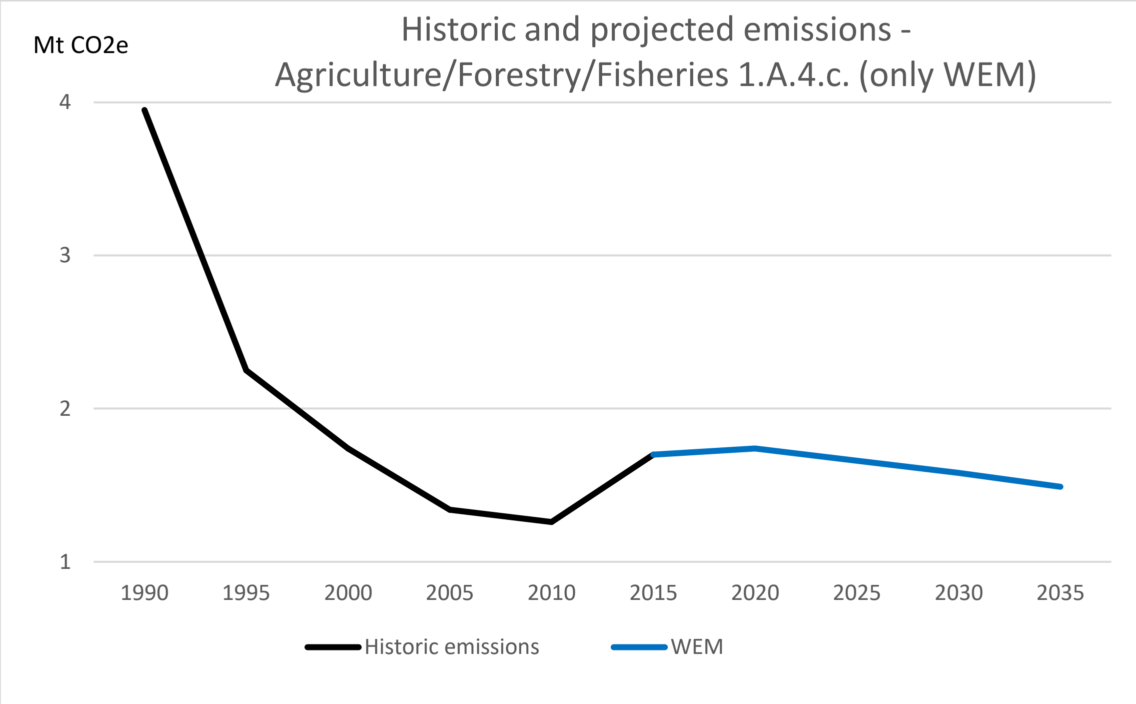
According to Tab. 56 the total drop of GHG emissions between the years 2005 and 2030 is estimated to be 37.4%.

Scenario with additional measures

There are not currently additional measures in the residential sector.

2.2.3.6 Agriculture/Forestry/Fisheries

Fig. 22 Historic and projected emissions of GHG – Agriculture/Forestry/Fisheries



Tab. 57 Historic and projected emissions of GHG – Agriculture/Forestry/Fisheries [Mt CO_2 eq.]

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020%	1990 – 2030%	2005 – 2020%	2005 – 2030%
WEM (only)	3,95	2,25	1,74	1,34	1,26	1,25	1,70	1,74	1,66	1,58	1,49	-55.98	-60.00	29.98	18.11

Tab. 58 Breakdown of historic and projected emissions of GHG by gases in agriculture/forestry/fisheries

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
CO2	3,79	2,18	1,70	1,30	1,23	1,22	1,66	1,70	1,62	1,54	1,45	-55.28	-59.36	30.15	18.26
CH4	0,14	0,05	0,02	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	-91.81	-92.56	-19.85	-27.17
N2O	0,02	0,02	0,02	0,02	0,02	0,02	0,03	0,03	0,03	0,03	0,03	32.17	20.10	51.40	37.57
Total	3,95	2,25	1,74	1,34	1,26	1,25	1,70	1,74	1,66	1,58	1,49	-55.98	-60.00	29.98	18.11

The GHG emissions in this sector increase between 2010 and 2020 and then decrease after 2020. Between 2005 and 2020 a significant growth of GHG emissions (almost 30%) is expected due to intensification and higher energy consumption in this sector.

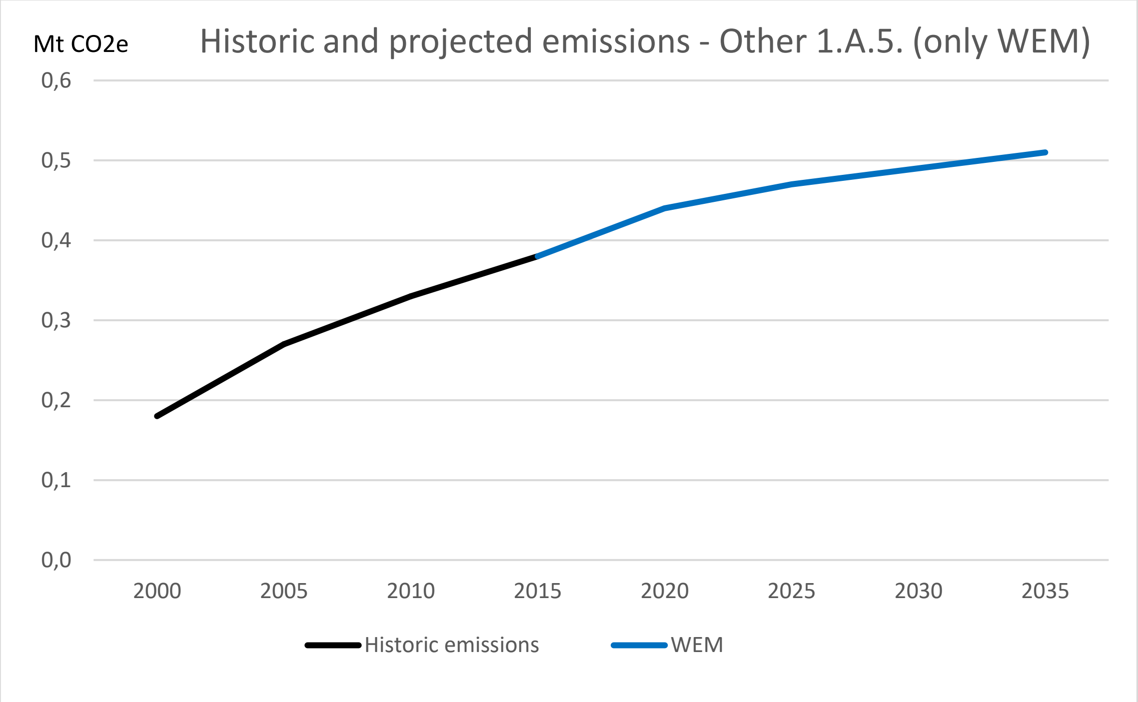
Scenario with additional measures

No additional measures were identified for this sector.

2.2.3.7 Other (1.A.5.)

Other emissions include mobile sources mainly in the agriculture/fisheries/forestry sectors.

Fig. 23 Historic and projected emissions of GHG – Other



Tab. 59 Historic and projected emissions of GHG – Other [Mt CO_2 eq.]

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020%	1990 – 2030%	2005 – 2020%	2005 – 2030%
WEM only	NO	NO	0,18	0,27	0,33	0,34	0,38	0,44	0,47	0,49	0,51			59.39	78.49

Tab. 60 Breakdown of historic and projected emissions of GHG by gases in other

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 – 2020%	1990 – 2030%	2005 – 2020%	2005 – 2030%
CO2	NO	NO	0,18	0,27	0,32	0,33	0,37	0,42	0,45	0,47	0,49			59.751	78.887
CH4	NO	NO	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00			35.556	51.772
N2O	NO	NO	0,00	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01			49.250	67.104
Total	NO	NO	0,18	0,27	0,33	0,34	0,38	0,44	0,47	0,49	0,51			59.394	78.487

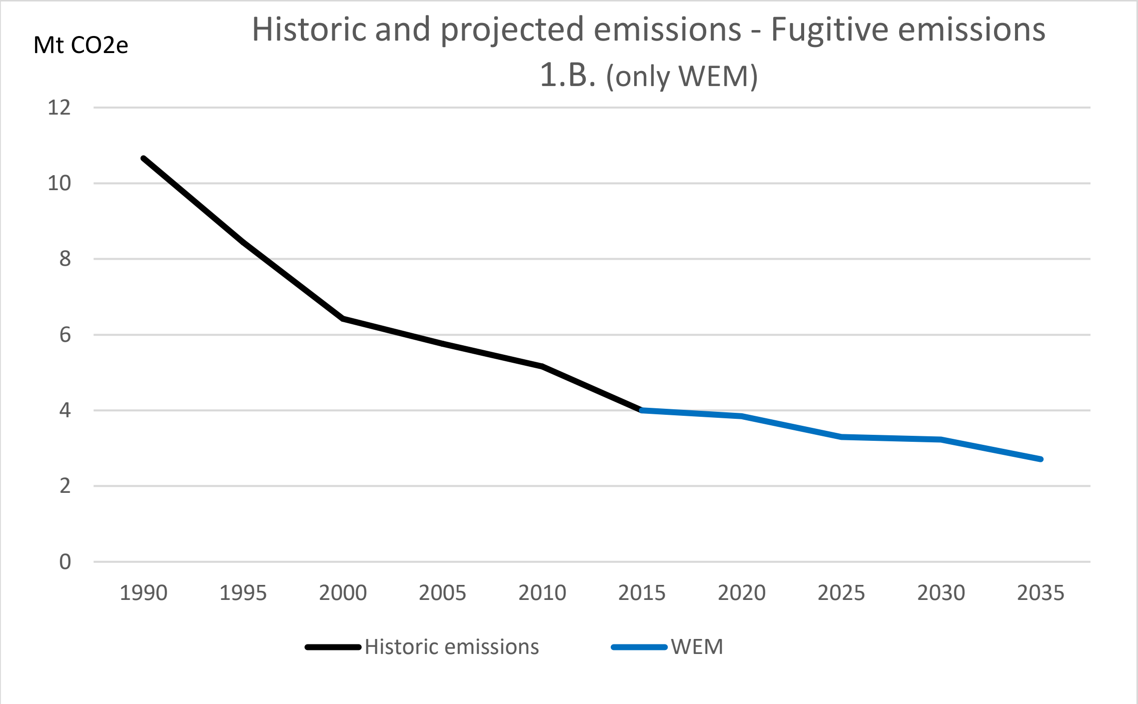
The projections of GHG are supposed to increase due to higher demand for motor fuels.

Scenario with additional measures

No additional measures were identified for this sector.

2.2.3.8 Fugitive emissions

Fig. 24 Historic and projected emissions of GHG – Fugitive emissions



Tab. 61 Historic and projected emissions of GHG – Fugitive emissions [Mt CO_2 eq.]

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 – 2020%	1990 – 2030%	2005 – 2020%	2005 – 2030%
WEM only	10,66	8,44	6,42	5,76	5,16	3,96	4,00	3,85	3,30	3,23	2,71	-63.87	-69.68	-33.18	-43.92

The projection of fugitive emissions is based on fuel quantities calculated using the MESSAGE model. The projected decline in fugitive emissions results mainly from decreasing mining of hard coal.

Scenario with additional measures

No additional measures were identified in this sector.

2.2.3.9 Sensitivity analysis

2.2.3.9.1 Sensitivity analysis of combustion processes on GDP

The sensitivity analysis was conducted for CO2 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.

Tab. 62 Sensitivity analysis of combustion processes (1.A.) on GDP (WEM scenario)

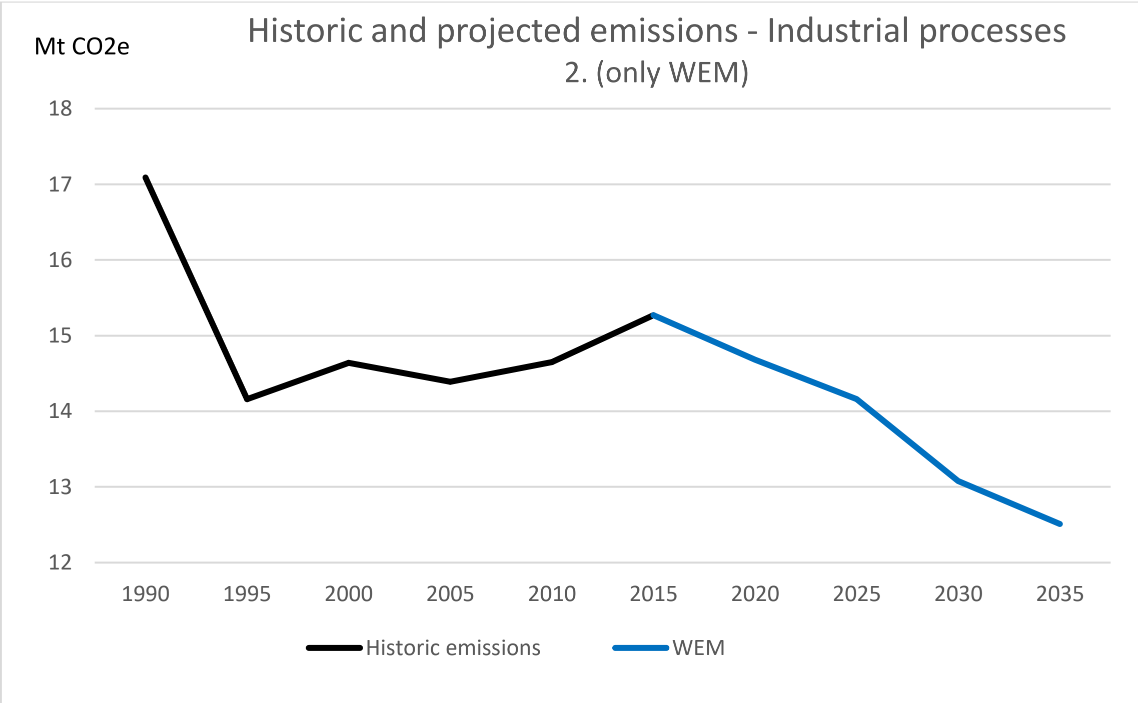
	CO2 (Mt)	CO2 in Mt (GDP +5%)	CO2 in Mt (GDP -5%)	Emission difference in % (GDP +5%)	Emission difference in % (GDP -5%)
2014	89,4	89,4	89,4	0	0
2015	90,3	95,9	83,5	+ 6,2	-7,5
2020	88,5	93,2	81,7	+ 5,3	-7,7
2025	80,5	85,8	75,7	+ 6,6	- 6,0
2030	76,9	79,8	73.4	+3,8	-4,6
2035	71,5	73,54	69,0	+ 2,9	-3,5

2.2.3.9.2 Sensitivity analysis of combustion processes on coal price

In this analysis the price of coal 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.

2.2.4 Industrial processes (incl. fluorinated gases)

Fig. 25 Historic and projected emissions of GHG – Industrial processes



Tab. 63 Historic and projected emissions of GHG – Industrial processes [Mt CO_2 eq.]

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
WEM only	17,09	14,16	14,64	14,39	14,65	15,28	15,27	14,68	14,16	13,08	12,51	-14.11	-23.43	2.00	-9.07

Tab. 64 Breakdown of historic and projected emissions of GHG by gases in industrial processes

[Mt CO2eq]	1990	1995	2000	2005	2010	2014	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
CO2	15,62	12,77	13,02	12,33	11,53	11,23	11,22	11,20	11,14	11,08	11,03	-28.33	-29.05	-9.22	-10.13
CH4	0,05	0,05	0,05	0,06	0,41	0,57	0,57	0,57	0,57	0,57	0,56	1009.60	1008.07	796.95	795.71
N2O	1,33	1,25	1,25	1,17	0,62	0,55	0,56	0,56	0,56	0,55	0,55	-58.19	-58.42	-52.34	-52.61
Total	17,09	14,16	14,64	14,39	14,65	15,28	15,27	14,68	14,16	13,08	12,51	-14.11	-23.43	2.00	-9.07

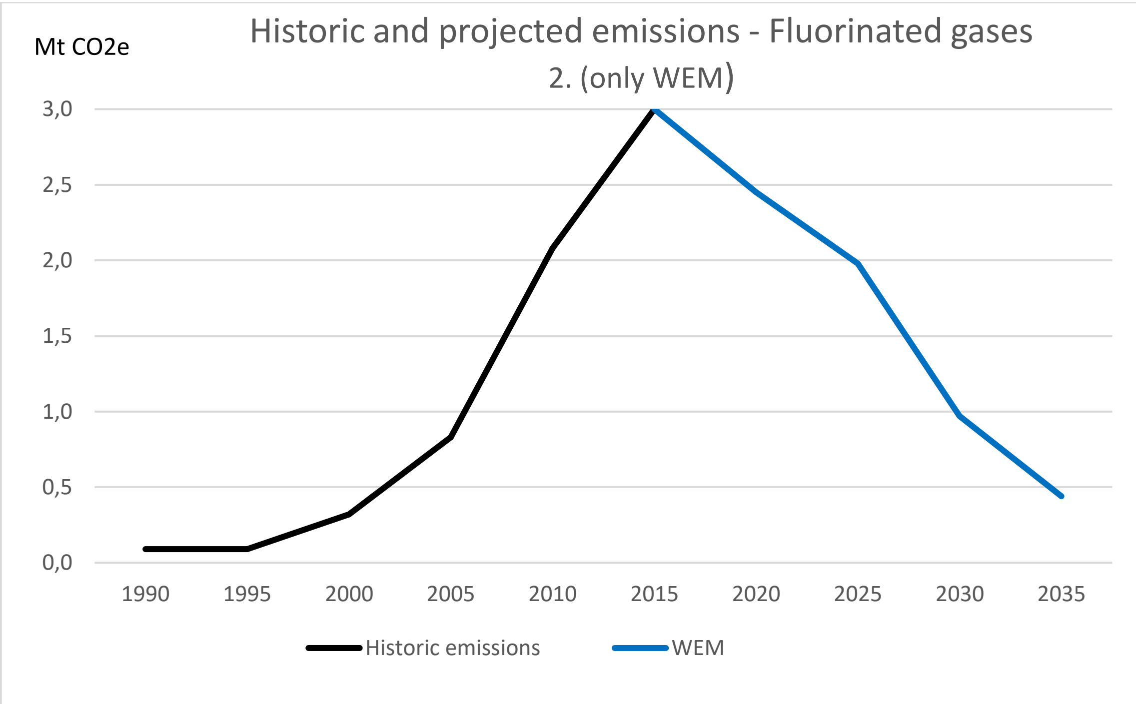
All assumptions related to the projection of industrial processes are indicated in the chapter 2.1.5.

Scenario with additional measures

No additional measures were identified for this sector.

2.2.4.1 Fluorinated gases

Fig. 26 Historic and projected emissions of GHG – Fluorinated gases



Tab. 65 Historic and projected emissions of GHG – Fluorinated gases [Mt CO_2 eq.]

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
WEM	0,09	0,09	0,32	0,83	2,08	2,93	3,00	2,45	1,98	0,97	0,44	2769.93	1036.75	196.14	17.30
WAM	0,09	0,09	0,32	0,83	2,08	2,93	3,00	2,45	1,98	0,97	0,44	2769.93	1036.75	196.14	17.30

Tab. 66 Breakdown of historic and projected emissions of GHG by gases in fluorinated gases

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
PFCs	NO	0,00	0,00	0,01	0,05	0,01	0,01	0,00	0,00	0,00	0,00			-70.41	-72.15
HFCs	NO	0,00	0,20	0,70	1,95	2,83	2,90	2,33	1,87	0,86	0,34			233.03	22.48
SF6	0,09	0,09	0,11	0,11	0,08	0,10	0,09	0,11	0,10	0,10	0,09	23.82	22.36	-6.06	-7.17
NF3	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00				
Total	0,09	0,09	0,31	0,83	2,08	2,93	3,00	2,45	1,98	0,97	0,44	2769.93	1036.75	196.14	17.30

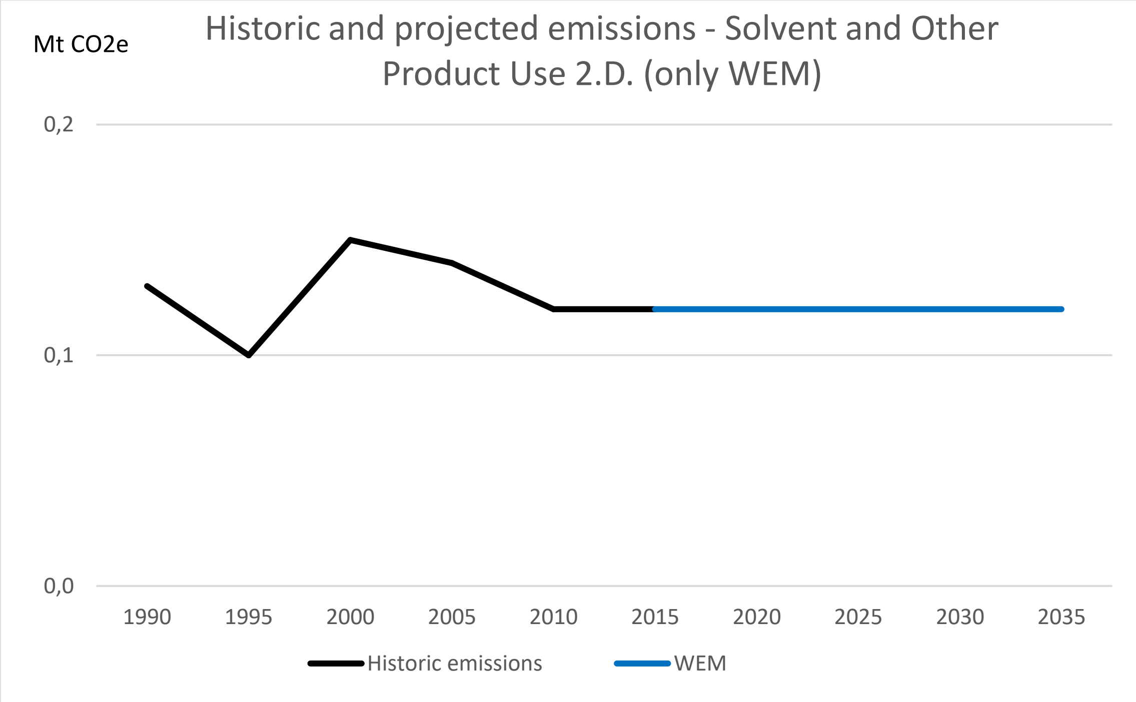
The emissions of fluorinated gases are strongly impacted by the Regulation (EU) No 517/2014 of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006. Especially cooling and freezing appliances for households are mostly using coolants with high GWPs, which should be replaced by other coolants. Since we expect refrigerators lifetime of 15 years, the GHG emissions will significantly drop in the next 15 years. Temporary increase of SF_6 emissions is caused by expected life end of soundproof windows installed during past two decades.

Scenario with additional measures

No additional measures were identified for this sector.

2.2.5 Solvent and Other Product Use

Fig. 27 Historic and projected emissions of GHG – Solvent and Other Product Use



Tab. 67 Historic and projected emissions of GHG – Solvent and Other Product Use [Mt CO_2 eq.]

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
WEM	0,13	0,10	0,15	0,14	0,12	0,12	0,12	0,12	0,12	0,12	0,12	-7.10	-7.10	-14.38	-14.38
WAM	0,13	0,10	0,15	0,14	0,12	0,12	0,12	0,12	0,12	0,12	0,12	-7.10	-7.10	-14.38	-14.38

Tab. 68 Breakdown of historic and projected emissions of GHG by gases in solvent and other product use

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
CO2	0,13	0,10	0,15	0,14	0,12	0,12	0,12	0,12	0,12	0,12	0,12	-7.10	-7.10	-14.38	-14.38
CH4	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO				
N2O	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO	NA, NO				
Total	0,13	0,10	0,15	0,14	0,12	0,12	0,12	0,12	0,12	0,12	0,12	-7.10	-7.10	-14.38	-14.38

All assumptions related to the projection of solvent and other product use were indicated in the chapter 2.2.5.

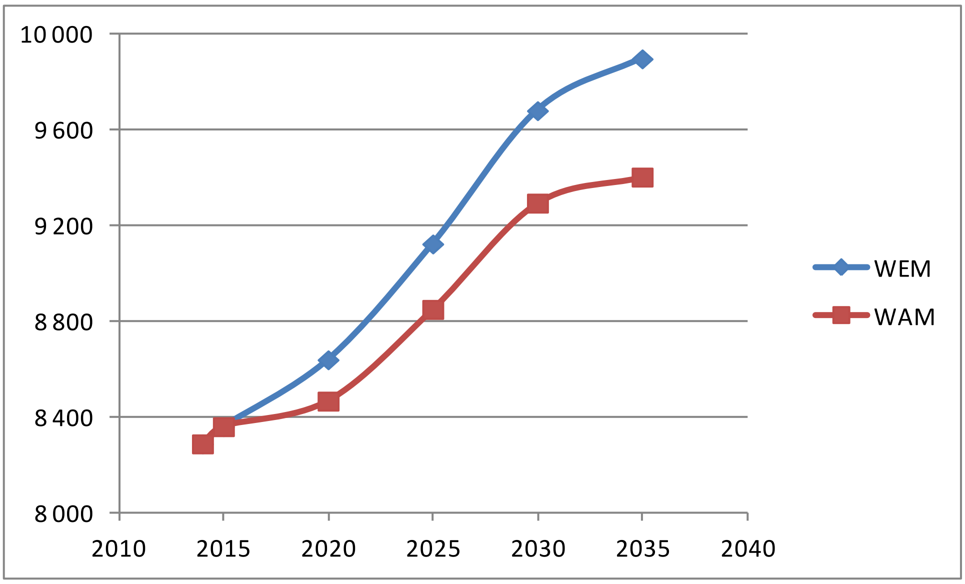
Scenario with additional measures

No additional measures were identified for this sector.

2.2.6 Agriculture

This chapter describes how each policy and measure described in the text above is included in the two employed scenarios: i) with existing measures (WEM) and ii) with additional measures (WAM). The policies and measures described in Ch. 1.7.1 are included in projected emissions.

Fig. 28 ***Current and projected emissions of GHG in Agriculture under WEM (blue line) and WAM (red line) scenarios (in Gg CO_2 eq.) in period 2014-2035***



Tab. 69 ***Projected total GHG emissions in sector of Agriculture [Gg CO_2 eq.]***

Scenario	2014	2015	2020	2025	2030	2035	2014 - 2035
WEM	8 287	8 359	8 639	9 124	9 682	9 899	**+ 19 %**
WAM	8 287	8 359	8 466	8 850	9 295	9 404	**+ 13 %**

2.2.6.1 With measures (WEM) scenario

WEM (with existing measures) scenario takes into account the policies and measures adopted and implemented until June 2016 presented in Ch. 1.7.1. The breakdown of historical and projected (WEM scenario) emissions by individual categories is shown in Tab. 70 and 71.

The breakdown of emissions by individual gases shows that the decisive share of changes in emissions in Agriculture is determined by methane.

The GWP (Global Warming Potential) coefficients to recalculate of greenhouse gas emissions to CO_2 equivalent is 25 for CH_4 and 298 for N_2O.

Tab. 70   Methane emission projections in scenario WEM (in kt CH4)

Category	**2014**	**2015**	**2020**	**2025**	**2030**	**2035**	**2014 -2035**
Enteric Ferm.	112.69	115.84	123.68	130.93	139.50	143.31	+27 %
Manure Man.	30.73	30.86	33.49	36.42	38.93	40.15	+31 %
Total CH_4	143.42	146.70	157.18	167.35	178.44	183.46	+28 %

Tab. 71   Nitrous oxide emission projections in scenario WEM (in kt NO_2)

Category	**2014**	**2015**	**2020**	**2025**	**2030**	**2035**	**2014 -2035**
Manure Man.	4.40	4.15	4.64	4.71	4.98	5.12	-1 %
Managed soils	10.70	10.88	10.43	11.14	11.82	11.98	+21 %
Total N_2O	15.08	15.03	15.08	15.85	16.79	17.10	+13 %

Tab. 72   Emissions in WEM scenario by gas

Gas	**2014**	**2015**	**2020**	**2025**	**2030**	**2035**	**2014 -2035**
	Gg CO_2 eq.						
CH_4	3585.47	3667.41	3929.44	4183.64	4460.98	4586.49	+28%
N_2O	4494.37	4479.62	4492.49	4723.38	5004.36	5095.97	+13%
CO_2	207.32	212.13	217.00	217.00	217.00	217.00	+5%
Total	8287.16	8359.16	8638.93	9124.02	9682.33	9899.46	+19%

2.2.6.2 With additional measures (WAM) scenario

WAM scenario takes into account the policies and measures implemented after June 2016 within The Fourth Action Plan of Nitrate Directives.

The main WAM PaM´s were proposed:

1. The revision of fertilizer regulations
2. More areas of organic farming

Application of agro-environmental measures should lead to a slower increase in emissions in agricultural sector. There are not known measured effects, then the expert estimate of emission reduction was assessed under WAM is 5% in 2035 (related to the WEM scenario). The total emission increase by WAM scenario about 15%, related to reference year 2014 (see Table 78).

Tab. 73 Emissions in WAM scenario by gas

Gas	2014	2015	2020	2025	2030	2035	2014 -2035
	Gg CO_2 eq.						
CH_4	3585.47	3667.41	3929.44	4183.64	4460.98	4586.49	+28%
N_2O	4494.37	4319.71	4449.66	4617.06	4601.00	4693.48	+4%
CO_2	207.32	212.13	217.00	217.00	217.00	217.00	+5%
Total	8287.16	8199.24	8596.11	9017.70	9278.97	9496.98	+15%

Trends in the Agriculture sector

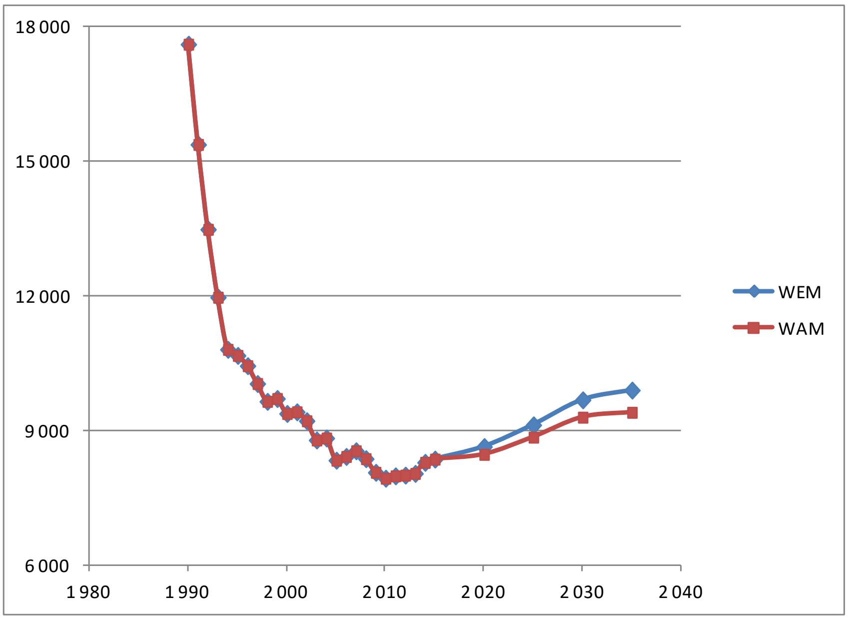
The current economic and financial situation entails considerable uncertainties in predicting the long-term emission trends in the Agriculture sector. Due to relatively small contribution of Agriculture (6 %) to total GHG emissions in the Czech Republic, the impact of emission changes is not significant for the total emission trend. The specific PaMs need to be translated into changes in activity data via assumptions. However, the great emission changes should be caused by changes of activity data. Mainly predicted growing animal production has the strong effect on the GHG emissions in agriculture sector.

The question is whether a strategic material (MA 2016) reflects a real growth potential in animal production growth (esp. swine). There is a high uncertainty in the effects. The biological effects are not as easy to model as physical effects.

Quantification of implemented policies and measures

The WEM and WAM scenarios include corresponding policies and measures described in Chapter 1.2.3. and 2.1.7. We can say, that the majority of policies and measures, including objectives of conceptual strategy, is contained in the individual tasks of the Rural Development Program for period 2014-2020. A strong increasing trend in the production of greenhouse gases in Agriculture is expected, according to WEM scenario and the emissions should be approximately 19 % above the 2014 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 1990-2014 by 53 % is sufficient to cover increase of emissions by 19 % in the period 2014-2035. The resulting effect of WEM scenario for period 1990-2035 presents a decrease of emissions about 44 % in agriculture sector.

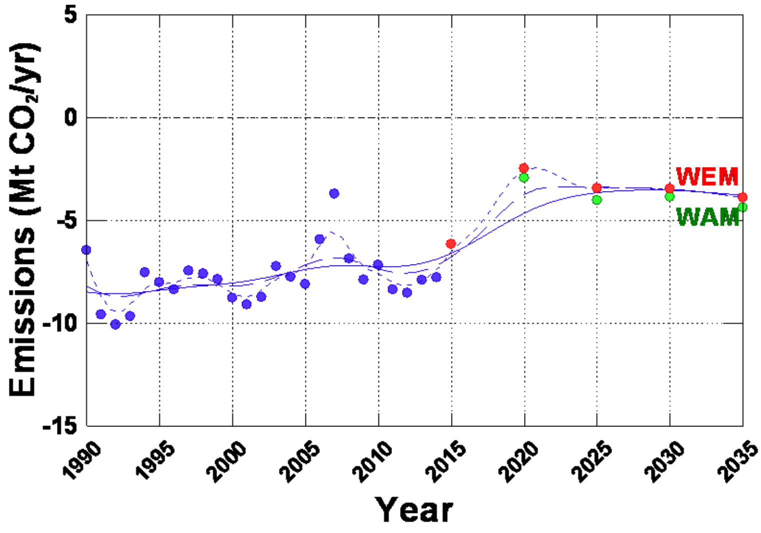
Fig. 29 Historic and projected emissions of GHG in sector Agriculture under WEM and WAM scenarios in period 1990-2035 (Gg CO_2 eq.)



2.2.7 LULUCF

The historical data and projections using the WEM and WAM scenarios are shown in Fig. 30. 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 (see Tab. 74). 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. Although the net positive effect of WAM scenario is only about 6%, it should be noted that there are additional benefits associated with WAM. Specifically, the WAM scenario should result in more resilient and stable forest stands, which is essential for long-term sustainability of forest production and wide spectrum of services that forests provide.

Fig. 30 Historic and projected (scenarios WEM and WAM) emissions of GHG for the LULUCF sector. The historic data (blue) and the WEM scenarios are accompanied by a least square smooth lines using different tension values that determine the local flex.



Tab. 74 Historic and projected emissions of GHG for the LULUCF sector [Mt CO_2 eq.]

Scenario	1990	2014	2015	2020	2025	2030	2035	2014- 2035
Historic data and WEM	-6.468	-7.793	-6.172	-2.494	-3.453	-3.483	-3.912	+50%
Historic data and WAM	-6.468	-7.793	-6.172	-2.953	-4.038	-3.878	-4.400	+44%

Tab. 75 Breakdown of historic and projected emissions of GHG by gases in LULUCF for historic data and WEM and WAM scenario

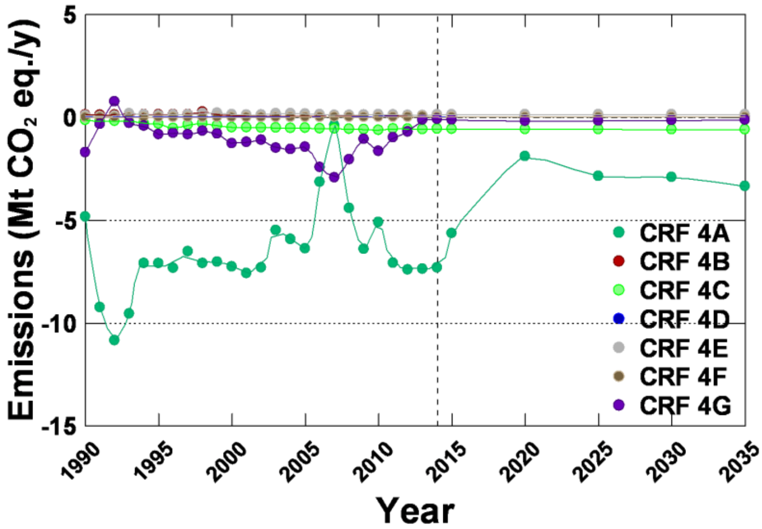
Gas [Mt CO_2eq]	1990	2014	2015	2020	2025	2030	2035	2014-2035
WEM scenario								
CO_2	-6.606	-7.878	-6,265	-2,579	-3.538	-3.568	-3.996	+49%
CH_4	0.118	0.073	0.082	0.074	0.074	0.074	0.074	+1%
N_2O	0.021	0.012	0.012	0.011	0.011	0.011	0.011	-8%
Total (Mt CO_2 eq.)	-6.468	-7.793	-6.172	-2.494	-3.453	-3.483	-3.912	+50%
WAM scenario								
CO_2	-6.606	-7.878	-6.265	-3.037	-4.122	-3.963	-4.484	+43%
CH_4	0.118	0.073	0.082	0.074	0.074	0.074	0.074	+1%
N_2O	0.021	0.012	0.012	0.011	0.011	0.011	0.011	-8%
Total (Mt CO_2 eq.)	-6.468	-7.793	-6.172	-2.953	-4.038	-3.878	-4.400	+44%

The numeric values for the trends by WEM and WAM scenarios are shown in Tab. 74. 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 2014, the sink of emissions would decrease by about 50 and 44% in 2035 of that observed in 2014 for the WEM and WAM scenarios, respectively.

The breakdown of emissions by individual gases (Tab.) shows that the decisive share of emissions and changes in emissions in LULUCF is determined by CO_2.

The breakdown of historical and projected (WEM scenario) emissions by individual land use categories is shown in Fig. 31 and numerically in Tab. 76, including the individual LULUCF categories. The emissions in the LULUCF sector are mostly determined by carbon stock changes in the category 4A Forest Land and partly by the newly reported contribution of HWP.

Fig. 31 ***Breakdown of historic and projected (WEM scenario) emissions of GHG by land categories within LULUCF, namely Forest Land (CRF 4A), Cropland (CRF 4B), Grassland (CRF 4C), Wetlands (CRF 4D), Settlements (CRF 4E), Other land (CRF 4F), plus the quantified HWP contribution (CRF 4G).***



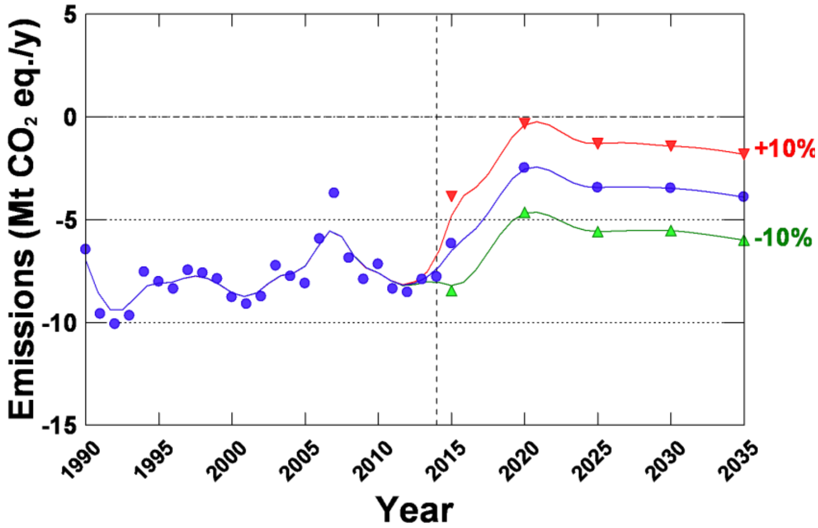
Tab. 76 ***Breakdown of historic and projected emissions of GHG by the major sub-categories of the LULUCF sector for WEM and WAM scenario***

Gas [Mt CO_2eq]	1990	2014	2015	2020	2025	2030	2035	2014/2035
	WEM scenario							
4A Forest Land	-4.84	-7.31	-5.64	-1.90	-2.87	-2.91	-3.36	54%
4B Cropland	0.12	0.02	0.02	0.02	0.02	0.02	0.02	3%
4C Grassland	-0.15	-0.57	-0.58	-0.59	-0.59	-0.60	-0.60	-6%
4D Wetlands	0.02	0.03	0.03	0.03	0.03	0.03	0.03	-2%
4E Settlements	0.09	0.13	0.13	0.06	0.04	0.04	0.03	77%
4F Other land	0.00	0.01	0.01	0.01	0.01	0.01	0.01	-21%
4G HWP	-1.71	-0.09	-0.13	-0.19	-0.18	-0.16	-0.14	-45%
	WAM scenario							
4A Forest Land	-4.84	-7.31	-5.64	-2.36	-3.45	-3.31	-3.84	47%
4B Cropland	0.12	0.02	0.02	0.02	0.02	0.02	0.02	3%
4C Grassland	-0.15	-0.57	-0.58	-0.59	-0.59	-0.60	-0.60	-6%
4D Wetlands	0.02	0.03	0.03	0.03	0.03	0.03	0.03	-2%
4E Settlements	0.09	0.13	0.13	0.05	0.03	0.03	0.02	86%
4F Other land	0.00	0.01	0.01	0.01	0.01	0.01	0.01	-21%
4G HWP	-1.71	-0.09	-0.13	-0.19	-0.18	-0.16	-0.14	-45%

Sensitivity analysis

The key category of the Czech emission inventory is biomass carbon stock change in the emission sub-category 4.A.1 Land remaining Forest Land. This basically represents the forest management and its effect on growing stock volume. Here, the loss is determined by harvest demand including thinning and final felling. This is to be offset by annual woody increment. Therefore, harvest regime is the most prominent factor affecting carbon balance in the sector. Its role is demonstrated on the sensitivity analysis using smaller or larger overall harvest demand by 10% with respect to the selected baseline (17.29 mil. m^3 annually) using the EFISCEN model (see also section 2.1.7 above). The outcome for the WEM scenario is shown in Fig. . It is apparent that a relatively small change in harvest demand would indeed have significant effect on emissions from the LULUCF sector. A smaller harvest demand would result in continuous carbon sink in forestry, while a larger felling would increase the change of changing the LULUCF sector from sink into a source category. It should also be noted that harvest demand is a more powerful short-term factor affecting emissions as compared to the management measures that distinguish WEM and WAM scenarios.

Fig. 32 ***Sensitivity analysis using variable harvest demand and its effect on emissions in LULUCF under WEM scenario***



2.2.8 Waste

Emissions estimated up to year 2035 are based on assumptions and forecasted scenario in the Waste Management Plan (WMP) (see methodology and key assumptions). Forecasted scenario in WMP does not work with variants. Scenario in WMP 2014 fulfils description of WEM, however the document is taking 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 Tab. 77.

Tab. 77 Projections from waste sector (Gg CO_2ekv), 2014-2035

	2014	2015	2020	2025	2030	2035
WEM scenario	5054	5136	4895	4606	4064	3266
WAM scenario	5054	5136	4895	4655	3789	2374

Historical development of the main emission category 5A – solid waste disposal, with projected scenarios is shown in Fig. 33.

Fig. 33 Historical and projected development of the 5A category, Gg CH_4

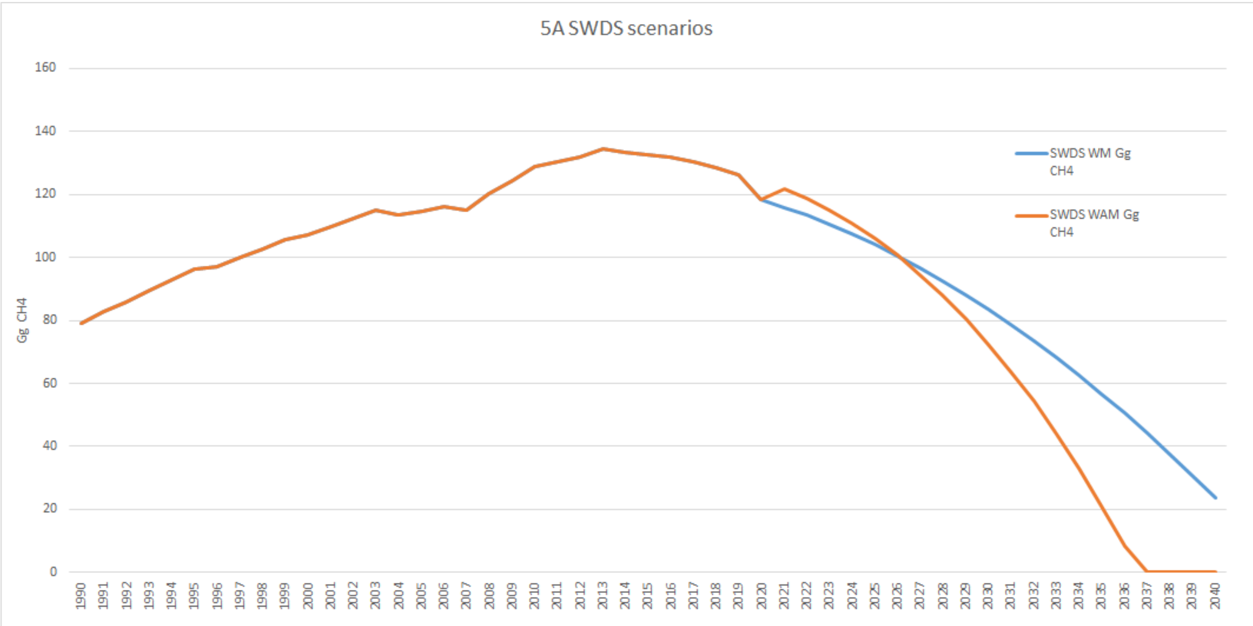
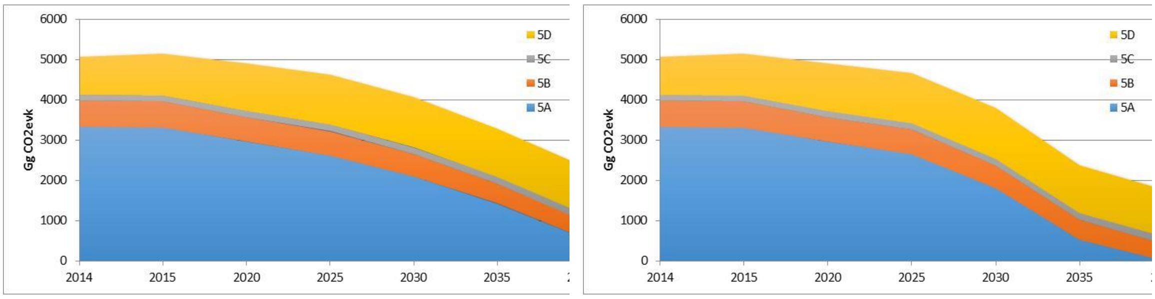


Fig. 34 WEM (left) and WAM (right) scenarios for waste sector



2.2.8.1 WEM Scenario

Development of the 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. Detailed breakdown of the emissions is shown in Tab. 78.

Tab. 78 WEM scenario emissions; Gg CO_2ekv.

	2014	2015	2020	2025	2030	2035
5A Solid waste disposal	3331	3307	2956	2601	2089	1419
5B- Bilogical treatment	654	660	605	609	549	487
5C –Waste incineration	134	135	155	162	168	174
5D – Wastewater treatment	935	1034	1179	1234	1258	1186

2.2.8.2 WAM Scenario

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. Breakdown by source categories is shown in Tab. 79.

Tab. 79 WAM scenario emissions; Gg CO2ekv.

	2014	2015	2020	2025	2030	2035
5A Solid waste disposal	3331	3307	2956	2650	1813	527
5B- Bilogical treatment	654	660	605	609	549	487
5C –Waste incineration	134	135	155	162	168	174
5D – Wastewater treatment	935	1034	1179	1234	1258	1186

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