REPORTING OF POLICIES AND MEASURES UNDER ARTICLE 3(2) OF DECISION 280/2004/EC CONCERNING PROJECTIONS AND ASSESSMENT OF POLICIES AND MEASURES

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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 (Dr. Rostislav Neveceral). Text outputs were compiled and data were calculated by the company ENVIROS, s.r.o. (Ing. 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. (Ing. Zuzana Exnerova and Doc. Ing. Emil Cienciala, Ph.D.). Mgr. 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 (Mgr. Michal Danhelka).

The presented GHG emission projections are based on “Optimized scenario” from the proposal of Update of the State Energy Conception published in September 2014. The document 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 2012. The latest year with existing inventory was 2010 as well (submission in the October 2012). The projection years are 2015, 2015, 2020, 2025, 2030 and 2035.

The following table shows the summary results of the projection.

Tab. 1 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%

For comparison, the following table shows the results from the previous projections.

Tab. 2 Summary results of the 2013 GHG emissions projections (LULUCF excluded) [Mt CO_2eq]

Scenario	1990	1995	2000	2005	2010	2015	2020	2025	2030	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
WEM	196,3	151,0	146,2	146,7	139,5	130,8	122,3	107,3	106,5	-37,7%	-45,7%	-16,6%	-27,4%
WAM	196,3	151,0	146,2	146,7	139,5	130,3	120,9	104,7	103,9	-38,4%	-47,1%	-17,6%	-29,2%

There are quite remarkable 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.
- The difference between WEM scenarios have their origin mainly in a bit lower economy growth and lower availability of domestic hard and brown coal in the new projections.
- The WAM scenario is much more ambitious in expected energy savings on the demand side in the new projections.
- Introduction of new nuclear power plants was postponed from the period 2020 – 2025 in the old projections to 2030 – 2035 in the new projections.

1 Policies and measures

1.1 Cross-cutting measures

1.1.1 EU level

1.1.1.1 Ecological Tax Reform

Characteristic: Ecological Tax Reform implements requirements of the Energy Taxation Directive 2003/96/EC into the Czech legislation. It was defined by the Act on Stabilization of Public Budgets No. 261/2007 Coll. The act stipulates consumers' tax on energy carriers more or less exactly equal to minimal levels required by the EU directive.

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

In January 2007 the Czech government agreed to start Ecological Tax Reform. Besides the first stage, implemented by the above mentioned act, it envisaged also second and third stages of the Ecological Tax Reform aiming at decrease of energy consumption and emissions. The continuation of the Ecological Tax reform was evaluated as an additional measure in the NC5 GHG emission projections. However, further deal of the reform was cancelled by the governmental resolution No. 221/2013 and so this additional measure is not evaluated within the GHG emission projections any more.

The impact of the energy taxes was evaluated in the NEEAP 3 as single-shot energy saving of 1,700 TJ in the year 2007. The corresponding CO_2 emissions decrease was calculated from CO_2 intensity of the final energy consumption.

1.1.1.2 Application of the IPPC Directive 2008/1/EC

Characteristics: Harmonization of the Czech legislation with the EU directives 96/61/EC concerning integrated pollution prevention and control, 2008/1/EC and 2010/75/EU on industrial emissions (integrated pollution prevention and control) (Recast).

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

Time framework: the law provisions are obligatory for new installations from the year 2003 and for existing installations from the year 2012

The implementation of EU legislation related to IPPC in the CR is ensured by the Act on Integrated Prevention and Pollution Control No. 76/2002 Coll. and its amendments. About 850 companies and 1400 facilities are covered by this law in the CR, of it 14 % in the energy sector, 20 % in metallurgical industry, 7 % in industry of non-metallic materials, 15 % in chemical industry, 7 % in waste treatment and 37 % in other sectors. The law is not directly dealing with emissions of greenhouse gases. The IPPC legislation has an indirect impact on GHG emissions through emission limits of

pollutants and use of best available technologies. The strengthened emission limits may have an important impact especially on coal-fired power plants and combined power and heat plants. However, it is difficult to estimate impact of this directive on GHG emissions.

1.1.1.3 Application of the Eco-design Directive

Characteristics: Harmonization of the Czech legislation with EU directives 2005/32/EC establishing a framework for the setting of eco-design requirements for energy-using products and 2009/125/EC (recast).

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

The eco-design directives are implemented into the Czech legislation in the Energy Management Act No. 406/2000 Coll. by its amendment 393/2007 Coll. Under the directive, set of regulations stipulating requirements on minimal energy efficiency of new electric appliances, were issued. The following regulations are currently implemented in the CR and reflected in the projections:

- Stand-by regulation 2008/1275/EC
- Simple Set-to boxes regulation 2009/107/EC
- Household refrigerating appliances regulation 2009/643/EC
- Televisions regulation 2009/642/EC
- Glandless standalone circulators and glandless circulators integrated in products regulation2009/641/EC
- Electric motors regulation 2009/640/EC
- External power supplies regulation 2009/278/EC
- Household lighting regulation 2009/244/EC
- Office/street lighting regulation 2009/245/EC
- Household washing machines 2010/1015/EC
- Household dish-washers 2010/1016/EC.

The expected annual energy savings were calculated in the NEEAP III [34] and amount 567 TJ in 2015 and in 2020 they should reach 1030 TJ.

1.1.1.4 EU ETS

Characteristic: The EU ETS is one of the most important economic steering methods to reduce CO_2 emissions. The administrative framework of the EU ETS deriving from directive (2003/87/EC) is defined by the Act on conditions of trade with emission allowances 694/2004 Coll. with amendments done in the act No. 164/2010 Coll.

Period of implementation: 2004 – **ongoing**

Time framework: There are stipulated three trading periods so far. The first period was under way from 2005 to 2007 and all allowances were allocated free of charge in the CR. In the second period (2008 – 2012) all allowances were allocated free of charge as well. The third period, which is currently under way, is planned from 2013 to 2020. There is a single EU-wide cap in the third trading period and allowances are allocated on the basis of harmonized rules. National allocation plans are not needed any more. Most allowances will have to be bought.

Due to low and highly non-motivating prices of emission allowances the decision was made to temporarily draw down 900 millions allowances from the market, of 400 millions in 2014. However, the CO_2 emission price remains low (currently about 6 €/r CO_2) despite this measure.

The following table shows differences between allocated allowances and verified emissions in the finished commitment periods.

Tab. 3 Comparison of allocated emission allowances and verified emissions [t CO_2]

Sector	**Emissions**	**2005 - 2007**	**2008 - 2012**
Combustion installations with a rated thermal input exceeding 20 MW	Allocation	170 539 659	257 661 847
	Verified	150 853 765	218 319 172
	Difference	19 685 894	39 342 675
Combustion of fuels	Allocation	48 057 828	70 466 635
	Verified	42 313 193	66 067 720
	Difference	5 744 635	4 398 915
Industrial plants for the production of (a) pulp from timber or other fibrous materials (b) paper and board	Allocation	359 577	469 034
	Verified	268 707	93 585
	Difference	90 870	375 449
Installations for the manufacture of glass including glass fiber	Allocation	60 147	85 012
	Verified	52 085	36 598
	Difference	8 062	48 414
Installations for the production of cement clinker in rotary kilns or lime in rotary kilns or in other furnaces	Allocation	2 274 237	2 974 425
	Verified	1 796 074	2 778 051
	Difference	478 163	196 374
Installations for the production of pig iron or steel (primary or secondary fusion) including continuous casting	Allocation	7 844 421	265 520
	Verified	6 065 281	204 689
	Difference	1 779 140	60 831
Production of paper or cardboard	Allocation	53 856	51 960
	Verified	29 488	37 246
	Difference	24 368	14 714
Production of pig iron or steel	Allocation	9 388 245	15 110 961
	Verified	8 714 767	14 349 874
	Difference	673 478	761 087
Refining of mineral oil	Allocation	810 753	994 500
	Verified	580 498	763 048
	Difference	230 255	231 452
Total	**Allocation**	**239 388 723**	**348 079 894**
	Verified	**210 673 858**	**302 649 983**
	Difference	**28 714 865**	**45 429 911**

Source: [19 – EUTL]

It is difficult to estimate the effect on emissions due to the EU ETS, because this instrument is interacting with several other instruments. Besides the measures, the companies are influenced by for example fuel and electricity prices and economic development as well.

We can conclude from the Tab. 1, that there was a big over-allocation in the first and second trading periods and the emission reduction due to this measure was rather negligible. The second trading period was strongly influenced by the economic crisis, emissions in most sectors were lower than anticipated and it is unclear, how much of the decline we can attribute to the EU ETS.

Whereas there are many other measures influencing combustion processes, EU ETS is the dominant driver for reduction of emissions from industrial technology processes.

1.1.2 National level

1.1.2.1 Existing measures

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

Objective: To create a legal framework for protection of the air and climate system of the Earth and for creation and revision of the National Program to Abate the Climate Change Impacts 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. Compensatory measures

The new legislation will ensure that in areas with poor air quality will not be put into operation a new pollution source, until they demonstrate or accept measures to balance the new pollution. Compensatory measures, which are newly included in the Act, have investment and operational character.

b. Implementation of low emission zones

Municipalities and cities will be able to set apart on their territories zones. In these zones only cars, which meet the emission limits, can ride. But municipalities must provide an alternative route along the road of the same or higher class.

c. New parameters for domestic boilers

New measures will also affect households. Small boilers (power output up to 300 kW) put on the market in the Czech Republic will have significantly lower emissions than today. The law also prohibits the burning of low-quality fuels.

Emission requirements for small combustion plants up to 300 kW are determined by performance, dosage, type and calorific value of the fuel

d. Inspection in households

The new law establishes a mandatory verification of emission sources and technical parameters of boilers with rated thermal input of 10 to 300 kW, which serves as the heat source for hot water central heating system. These inspections will be carried out by persons authorized by the Ministry of Environment. In addition to visual inspection, these entities can also help with regulation and cleaning the boiler and recommend how to use it optimally.

e. Individual assessment of large polluters

The new law also allows individual access to air polluters. Competent regional authorities can operational tighten source of emissions, which has in certain area bad influence to the air quality.

f. A simpler charges

The new law also significantly simplifies the payment of charges. The number of charged substances will be reduced from more than twenty-four to four. The charge that was previously levied on the amount of 500 CZK will now be negotiated, where the amount reaches 5000 CZK per plant. Since 2017, the charges will be increased gradually up to 2022.

The Act also allows the reduction of charges, when the operator will reduce emissions beyond the minimum legal requirements or is already below that level.

1.1.2.1.2 Act No. 695/2004 Coll., on the conditions of greenhouse gas emission allowance trading and amending some laws, as amended (amendment Act No. 212/2006 Coll., No. 315/2008 Coll., No. 227/2009 Coll., No. 292/2009 Coll., 164/2010 Coll., 85/2012 Coll., 201/2012 Coll., 383/2012 Coll.)

Objective: Creation of a legal framework for implementation of EU ETS and international emission trading (IET) according to Art. 17 of the Kyoto Protocol

Characteristics: Legislative instrument

Period of implementation: 2004 – **ongoing** (revision), **existing measure**

Time framework: not stipulated

Sector: energy production, industry including small and medium-sized enterprises, air transport

The Act transposes, into the Czech legislation, Directive 2003/87/EC establishing a scheme for trading in greenhouse gas emission allowances within the Communities. The amendment of 2006 also transposes Directive 2004/101/EC amending Directive 2003/87/EC in respect of the Kyoto Protocol's project mechanisms. In accordance with the EC legislation, the Act lays down:

a. the rights and obligations of the operators of installations and other persons in trading in allowances for greenhouse gas emissions,
b. procedures for issuing permits for discharge of greenhouse gas emissions,
c. procedures for issuing and allocating allowances for greenhouse gas emissions and the conditions for trading therein.

The installations to which the Act is related consist in energy-production installations burning fossil fuels for the purpose of production of heat and electrical energy (the sector of public and corporate energy production) and also technical installations in the sector of petro chemistry, chemistry and metallurgy (including coke production) as well as the production of cement, lime, glass, ceramics, paper and cellulose. The Act establishes a registry for emission trading and stipulates the conditions for allocation of allowances to new installations and the use of emission reduction units and certified emission reduction units from project activities.

The amendment of 2008, introduced by Act No. 315/2008 Coll., defines an allocated allowance unit (AAU) as a property value corresponding to the entitlement of the Czech Republic to release an equivalent of one ton of CO_2 emissions into the air on the basis of the Kyoto Protocol. In Section 12a, the Act stipulates that AAUs are the property of the Czech Republic, managed by the Ministry of the Environment. The legal regulations related to management of the property of the Czech Republic pursuant to Act No. 219/2000 Coll., on the property of the Czech Republic, are not applicable to management of this property.

AAUs not used by the Czech Republic for fulfilment of its commitment following from the Kyoto Protocol may be sold within the international emission trading scheme (Article 17 of the Kyoto Protocol) or used to promote projects within the joint implementation mechanism (Article 6 of the Kyoto Protocol). Funds obtained by sale of AAUs are an income for the State Environmental Fund of the Czech Republic (SEF CR) and may be used only to promote activities leading to a reduction in greenhouse gas emissions.

The amendment of 2010, introduced by Act No. 164/2010 Coll., transposes into the Czech legislation, Directive 2008/101/EC, which include aviation activities in the scheme for greenhouse gas emission allowance trading within the Community.

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

Objective: Greater effectiveness of energy management, transposition of the regulations of the European Communities.

Characteristics: Legislative instruments, requirements in the area of management of electrical energy and heat, rules for the National Program to Abate the Climate Change Impacts in the Czech Republic, etc. (coordination MIT)

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

Time framework: not stipulated

Sector: energy production, industry, services, housing sector

The Act transposes, into the Czech legislation Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings, Directive 2010/30/EU of the European Parliament and of the Council of 19 May 2010 on the indication by labelling and standard product information of the consumption of energy and other resources by energy-related products, Directive 2009/125/EC of the European Parliament and of the Council of 21 October 2009 establishing a framework for the setting of ecodesign requirements for energy-related products, Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

This Act, which has been amended several times since 2000 (original version), stipulates, amongst other things:

a. measures for increasing the economic use of energy and the obligations of natural and legal persons in management of energy,
b. rules for the creation of the State Program, Rules for the drafting of the National Energy Policy, Territorial Energy Policy, for the Promotion of Energy Conservation and the Use of Renewable Sources of Energy,
c. requirements on eco-design of energy-using products
d. energy labels,
e. energy performance of buildings,
f. energy audits and auditors.

1.1.2.1.3.1 State Energy Policy

Characteristic: The State Energy Policy is a strategic document with an outlook of 30 years expressing the objectives of the State in energy management in accordance with the needs of sustainable development.

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

Time framework: evaluation at least each 5 years

Proposal of State Energy Policy is prepared by The Ministry of Industry and Trade, which submits it to the Government for approval. The Ministry evaluates the implementation of the State Energy Policy at least once every 5 years and informs the Government of the results. The valid State Energy Policy was approved in the year 2004 and is a bit outdated now. Its update is currently under preparation, but we still do not know, whether and when it will be approved and what will be the final definition of the policy.

Since the old State Energy Policy is outdated in some respects and wording of the newly prepared document seems already quite stable, we used the “Optimized scenario” defined in the new policy as a base for modelling of energy sector for these projections.

The policy update sets three strategic priorities:

- safety of energy supplies – provision of necessary energy supplies for consumers in normal operation and under sudden changes of exogenous circumstances (outages of primary energy supplies, price variations on markets, breakdowns and attacks) in the EU context; the aim is to guarantee fast restoration of supplies in case of outages and simultaneously to guarantee supplies of all energy carriers in extent necessary for emergency operation of economy and supplies of households during crisis situations
- competitiveness – energy end user prices (electricity, gas, oil products) for industries and for households, comparable with countries of the region and other direct competitors + energy utilities able to produce economic value added in the long term prospective
- sustainability – energy sector structure, which is sustainable in the long term from the point of view of environment (preserving quality of the environment), finance and economy (financial stability of energy utilities and ability to ensure necessary investments into retrofits and development), labor forces (education), social impacts (employment) and primary sources (availability).

From the point of view of GHG emissions, there are set the following relevant indicative targets:

- Reaching 40% decrease of CO_2 emissions in 2030 in comparison with 1990 and further emissions decrease in accordance with the EU 2050 strategy of economy decarburization and economic possibilities of the Czech Republic;
- Increasing energy savings by 20 % in 2020 in comparison with the “business as usual status” reaching net final consumption of 1060 PJ (using Eurostat methodology) and further energy efficiency improvement in accordance with the EU strategy, targeted at reaching lower than EU28 average energy intensity and energy consumption per capita;
- Preserving the share of gross electricity production from domestic primary sources on the total gross electricity production at level of at least 80 % (RES, secondary energy and wastes, brown and hard coal and nuclear fuel, provided that there are sufficient reserves of it) with the target electricity generation structure in the corridors:
    - nuclear energy 46 – 58 %
    - renewable and secondary energy 18 – 25 %
    - natural gas 5 – 15 %
    - brown and hard coal 11 – 21 %
- Diversified primary energy mix with the target structure within the corridors:
    - nuclear energy 25 – 33 %
    - solid fuels 11 – 17 %
    - gaseous fuels 18 – 25 %

- liquid fuels 14 – 17 %
- renewable and secondary energy 17 – 22 %

1.1.2.1.3.2 State Program in Support of Energy Savings and the Usage of Renewable Energy Sources

The State Program in Support of Energy Savings and the Usage of Renewable Energy Sources (hereinafter the "Program") is an instrument to promote measures to increase the effectiveness of energy use, to reduce energy intensity and promote the use of renewable and secondary energy sources in accordance with the approved State Energy Policy and principles of sustainable development. The Ministry of Industry and Trade prepares the program for a period of one year and, on the basis of agreement with the Ministry of the Environment, submits it to the Government for approval.

Once annually, the Ministry of Industry and Trade and the Ministry of the Environment evaluate implementation of the Program and inform the Government of the results. The results of evaluation of the Program are taken into consideration in the draft Program for the next period.

Subsidies can be provided from the State budget for implementation of the program for:

a. energy-saving measures to increase the efficiency of energy use and reduce the energy intensity of buildings,
b. development of the use of combined production of electricity and heat and secondary energy sources,
c. modernization of energy production and distribution installations,
d. modern technology and materials for energy-saving measures,
e. development of the use of renewable and secondary energy sources,
f. development of energy recovery of municipal waste,
g. public awareness, enlightenment, education and consulting in the area of energy management,
h. science, research and development in the area of energy management, energy savings and use of renewable energy sources,
i. preparation of a territorial energy concept and instruments for its implementation,
j. introduction of energy intensity certificates for buildings and performance of energy audits,
k. incentives for medium-sized, small and very small enterprises producing energy consuming appliances to introduce new procedures leading to fulfilling of requirements on eco-design.

1.1.2.1.3.3 Other measures

The Act stipulates specific measures leading to energy savings and thus also to a reduction in CO_2 emissions, in particular:

<u>Efficiency of energy use</u>

A producer of electricity or thermal energy is obliged, in newly established installations, to provide for at least the minimum efficiency of energy use stipulated by an implementing legal regulation. This obligation also applies to installations for production of electricity or thermal energy in which a change is introduced in previously completed structures. Owners are obliged to provide regularly control of operating boilers, heat distribution and air conditioning systems.

Energy intensity of buildings

A builder, building owner or association of owners of units must provide for compliance with the requirements on the energy intensity of buildings and compliance with comparative indicators and also compliance with the requirements stipulated by the relevant technical standards. An implementing legal regulation stipulates the requirements on the energy intensity of buildings, comparison indicators, the method of calculation of the energy intensity of buildings and other details.

Buildings, which are owned by public sector has to have almost zero energy consumption since 1. January 2018.

Building energy performance certificate

Owner of the building is obliged to provide energy performance certificate when the building is new or is refurbished. Also the building has to have certificate during sale or lease.

All collective houses have to have building energy certificate since 1. January 2019.

Energy labels

Domestic producers or importers of mass-produced energy-consuming appliances, a list of which is stipulated by a Decree, are obliged to place energy labels on these appliances prior to placing them on the market. The information on the label must be accurate and in the Czech language.

Energy audit

The Act regulates conditions for the performance of the obligatory energy audit of energy management and of buildings and for the use of the results of the energy audit.

Eco-design

A producer or importer of energy-consuming appliances stipulated by a regulation for implementation is obliged, prior to placing it on the market or into use, to issue a declaration of conformity, declaring compliance with the requirements on eco-design of the energy consuming appliance stipulated in an implementing legal regulation.

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

Characteristics: Legislative instrument

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

Time framework: not stipulated

Sector: energy production, including use of RES

This Act transposes the relevant legislation of the European Communities[1], builds upon directly applicable legislation of the European Communities[2], and governs business conditions, public administration and regulation in the energy sectors, namely the electricity, gas and heat sectors, as well as the related rights and obligations of natural and legal persons.

In accordance with the legislation of the European Communities, this law regulates the conditions for operating an enterprise, performance of the state administration and non-discriminatory regulation in energy branches, consisting in electrical energy production, the gas industry and heat industry, as well as the rights and obligations of natural persons connected therewith. It provides for organization of operating an enterprise in energy branches while retaining the functioning of economic competition, satisfying consumer needs and the interests of license holders and providing for reliable, safe and stable supplies of electricity, gas and heat energy for an acceptable price.

According to Section 32 (Combined generation of electricity and heat or a facility for the generation of electricity from secondary energy) of the Act, the objective of combined

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[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.

production of electricity and heat lies in an increase in effectiveness and reduction in the production of greenhouse gases.

The producers of heat energy must examine the advantageousness of combined production of heat and electricity according to a special legal regulation. The basic condition for combined production of heat and electricity consists in supply of useful heat for further use. The criterion for assessment of combined production of electricity and heat consists in savings of primary fuel following from the difference between the overall efficiency of combined production of electricity and heat and the reference value.

Electricity from high-efficiency combined heat and power generation shall include electricity

a. generated in a common process associated with the supply of useful heat;
b. generated in a facility to which the Ministry has issued a certificate of origin of electricity from the combined generation of electricity and heat;
c. in the generation of which relative savings are achieved in fuel input required for the generation of this electricity, evaluated monthly at a minimum level of 10%; this requirement shall apply solely to a source with installed electricity power exceeding 1 MW; and
d. 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 towards the price of electricity from combined production of electricity and heat or produced from secondary energy sources, provided the producer is directly connected to the transmission system. The Energy Regulatory Office stipulates the amount of the contribution. The Ministry of Industry and Trade issues a certificate of the origin of electricity from combined production of electricity and heat or produced from secondary energy sources, which constitutes an essential precondition for placing electricity from combined production of electricity and heat on the electricity market. Traders in electricity are obliged to preferentially purchase and supply electricity offered by producers of electricity from combined production of electricity and heat or producers of electricity from secondary energy sources.

The Act 458/2000 Coll. is the document through which some articles of Directive 2006/32/EC has been implemented. The articles are aimed to stipulates specific measures leading indirectly to energy savings and thus also to a reduction in CO_2 emissions. These are for example:

- article 6, Energy distributors, distribution system operators and retail energy sales company,

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[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.

- article 7, Availability of information,

- article 10, Energy efficient tariffs and other regulations for net-bound energy,

- article 13, Metering and informative billing of energy consumption.

1.1.2.1.5 Act No. 165/2012 Coll., on supported energy resources and on the amendment to certain legislation

Objective: Creation of a legal framework for the use of renewable energy sources

Characteristics: Legislative instrument

Period of implementation: 2005 – **ongoing** (revision), **existing measure**

Time framework: not stipulated

Sector: electrical energy, especially use of RES

This Act repealed Act No. 180/2005 Coll. 2012 on the promotion of production of electricity from renewable energy sources and on amendment to some laws (Act on Promotion of Use of Renewable Energy Sources)

The Act transposes Directive 2009/28/ES of the European Parliament and of the Council on the promotion of electricity produced from renewable energy sources in the internal electricity market and repealed Directive 2001/77/EC.

The objectives are:

a. promoting the use of renewable energy sources,
b. providing for a constant increase in the contribution of renewable energy sources to the consumption of primary energy sources,
c. creating conditions for fulfilment of the indicative target for the contribution of energy produced from renewable sources to the gross final consumption of energy in the Czech Republic equal to 13% by 2020.
d. levy on electricity from solar radiation.

The Act stipulates the amount of assistance for the individual categories of installations producing energy from renewable energy sources and the rights and obligations of entities active in the energy market derived from renewable energy sources. The Decree implementing the Act stipulates the conditions for support, purchasing and records of the production of electricity from renewable energy sources and the price of this electricity, including “green bonuses”.

1.1.2.1.6 Act No. 55/2012 Coll., on Public Procurement

Objective: Creation of a legal framework for Public Procurement, definition of ecological specification to be used within tendering process and evaluation

Characteristics: Legislative instrument

Period of implementation: 2006 – **ongoing** (revision), **existing measure**

Time framework: not stipulated

Sector: Public sector

The Act stipulates that as for vehicles, a contracting authority has to determine technical specification including effect on energy consumption, emissions CO_2, NO_X, hydrocarbon and particles.

1.1.2.1.7 National Program to Abate the Climate Change Impacts in the Czech Republic

Objective of the Program: Updating of the “Strategy of Protection of the Climate System of the Earth in the Czech Republic" and adoption of new reduction targets in the period to 2020, i.e. reduction compared to 2000 by the year 2020:

a. specific CO_2 emissions per inhabitant by 30 %,
b. aggregated emissions by 25 %.

Characteristics: Cross-cutting and framework strategic document at a national level (coordination MoE)

Period of implementation: 2004 – **ongoing,** program evaluation in 2008, **existing measure**

Time framework: 2020

In March of 2004, the Government (see Government Resolution No. 187 of March 3, 2004) adopted a revision of the program part of the document “Strategy of Protection of the Climate System of the Earth in the Czech Republic", which set new tasks for the individual sectors. The National Program to Abate the Climate Change Impacts in the Czech Republic replaced the Strategy of Protection of the Climate System of the Earth in the Czech Republic (adopted in Government Resolution No. 480 of May 1999), which had the objective of compliance with the international commitments of the Czech Republic following from the UN Framework Convention on Climate Change and the Kyoto Protocol. This document did not take into account the future accession of the Czech Republic to the European Communities and thus the necessity of harmonizing the national policy and measures with the strategic and legislative framework of the EU. In 1999, when the “Strategy of Protection of the Climate System of the Earth in the Czech Republic" was adopted, the future role of the flexible Kyoto Protocol mechanisms (IET, ETS and JI/CDM) was not yet sufficiently defined.

The National Program to Abate the Climate Change Impacts in the Czech Republic (hereinafter the “National Program”) is a strategic document of the Government of the Czech Republic. The document coordinates the sectorial and cross-cutting policies at a national level and also takes into consideration the requirements of the European Climate Change Program (ECCP), which became binding for the Czech Republic on accession to the EU. The individual sectorial ministries were entrusted with implementation of the National Program.

The National Program, which was prepared according to the requirements of Council Decision 1999/296/EC, introduces both specific reduction (mitigation) measures to reduce greenhouse gas emissions and also adaptation measures permitting society

and ecosystems to adapt to climate change. The document emphasizes that this reduction in emissions will take place in connection with international agreements and with respect to sustainable development in the Czech Republic.

On the basis of Government Resolution No. 395 of April 6, 2005, an evaluation was performed in 2007 of the National Program from the standpoint of the environmental effects and economic impacts of the adopted measures, i.e. comparison of the initial state of affairs and the reduction in greenhouse gases achieved since adoption of the National Program. As the National Program was created in 2003 and climatic negotiations in the Czech Republic and globally have progressed since that time (within the European Union and at conferences of the parties to the UN Framework Convention on Climate Change and its Kyoto Protocol), this document has been updated on the basis of evaluation of the adopted measures (see the chapter on prepared policies and measures).

The document “Evaluation of the National Program to Abate the Climate Change Impacts in the Czech Republic” (April 2008), which the Ministry of the Environment submitted to the Government, points out that the positive results are related particularly to an increase in the share of renewable resources in the production of energy. Biomass (79 %) and also hydroelectricity plants (11%) corresponded to the largest parts of this production at the end of 2007. A substantial inter-annual increase in the production of electricity was recorded in the area of wind energy (increase between 2004 and 2005 of 117 %, increase between 2005 and 2006 of 130 %), biogas (increase between 2004 and 2005 of 16 %, increase between 2005 and 2006 of 9.3 %) and photovoltaic panels (increase between 2004 and 2005 of 56 %, increase between 2005 and 2006 of 39 %).

The evaluation report emphasizes the inadequacy of the absence of economic analysis of the effectiveness of the measures. The report also points out that the Czech Republic has a long-term record of unfavorable indicators of energy intensity and greenhouse gas emissions per capita. The growth in greenhouse gas emissions in the transport sector is an unfavorable factor; this increase equaled 114 % for CO_2 and 121 % for N_2O in 2006 compared to 1993. As was pointed out in the “Emission inventory” chapter, this unfavorable trend continued in the following years. Thus reduction measures must be introduced, not only in the transport sector, but especially in the other sectors and areas, where lower marginal abatement costs can be anticipated. It is necessary to continue to improve the awareness of citizens in relation to the political acceptability of the proposed measures.

A new document “Policy of Climate Protection in the Czech Republic” is under preparation and should be approved in 2015.

1.1.2.1.8 State Program in Support of Energy Savings and the Usage of Renewable Energy Sources

Objective: Introduce energy savings, increase energy effectiveness and the use of renewable energy sources

Characteristics: Cross-cutting plan at a national level, sectorial structure (coordination MIT); the target areas are the state administration and local governments, private sector, households and NGO's

Period of implementation: 2004 – 2006 MIT + 10 sectorial ministries, 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)

Government Resolution No. 1105/2004 approved the State Program in Support of Energy Savings and Usage of Renewable Energy Sources (hereinafter the "Program"). Its scope and financing are specified in Act No. 406/2000 Coll., on management of energy (as amended by Act No. 61/2000 Coll.). The Program is concerned with decreasing energy consumption and the use of renewable and secondary energy sources, in accordance with economic and social needs, sustainable development and protection of the environment. Not only the sector of the Ministry of Industry and Trade (coordination of the Program), but also an additional 10 sectors, particularly the Ministry of Transport, Ministry for Regional Development, Ministry of Agriculture and Ministry of the Environment, participated in implementation of the State Program in the period 2005 - 2006. Not all the participating sectors were able to calculate the attained effectiveness in units of savings in energy or reduction in emissions (e.g. support for consulting, research, public awareness). The greatest reductions in emissions were achieved in the sectors of energy production, protection of the environment, renewable energy sources (RES), energy savings in industry and the housing sector, which are further quantified below.

The State Program is an instrument for meeting the requirements imposed by Directive 2001/77/EC of the European Parliament and of the Council on the promotion of electricity produced from renewable energy sources in the internal electricity market and for compliance with the Energy Charter Protocol on Energy Efficiency and Related Environmental Aspects.

Its scope and financing are specified in Act No. 406/2000 Coll., on management of energy (as amended by Act No. 61/2000 Coll.). The Program is concerned with decreasing energy consumption and the use of renewable and secondary energy sources, in accordance with economic and social needs, sustainable development and protection of the environment.

Since 2007 the Program is called **Program EFEKT** implemented only by MIT. Up to now the EFEKT Programs for 2007 – 2014 were completed. EFEKT 2015 is open for calls.

The EFEKT program serves the Ministry of Industry and Trade for the influencing of energy saving and the utilization of renewable energy sources (RES), thus leading directly to a reduction in CO_2 emissions. Moreover, it focuses on educational activity,

energy planning, small-scale investment events and pilot projects. It is a supplementary program for the energy programs supported from the European Union structural funds.

The annual energy savings including substitutions by RES may be estimated to 51.7 TJ in the period 2014 – 2020. The annual budget of the program is 30 mill. CZK. The estimates are based on *[34]* and annual reports of the corresponding programs.

1.1.2.1.9 Operational Program Environment (OPE)

Characteristics: The aim of the Operational Program – Environment is the protection and improvement of the quality of the environment as a basic principle for sustainable development. The Operational Program – Environment projects are financed from the European Regional Development Fund (ERDF) and from the Cohesion Fund (CF). There is 5.2 billion Euros prepared, which is 18.4 % of the total support of European funds for the Czech Republic. The OP - Environment is the second largest operation program.

Period of implementation: 2007 – 2013, **ongoing**, **existing measure**

Time framework: Annual evaluation and budget setting (financed from the State budget)

Sectors: Energy production (RES), housing sector and services (consulting)

OPE areas of intervention are divided into eight priority axes, only two of them are directly oriented on CO_2 emission reduction. These are:

Priority axis 2 – The Improvement of Air Quality and Reduction of Emissions

To improve air quality and reduce emissions with emphasis placed on using new, environmentally friendly ways of energy production and energy savings.

2.1 The improvement of air quality,

2.2 The reduction of emissions.

Priority axis 3 – The Sustainable Use of Energy Sources

To use energy sources in a sustainable manner and to promote energy savings. To use renewable energy sources for generating electricity and producing heat and to use waste heat more efficiently.

3.1 The construction of new facilities and the modernization of the existing facilities with the aim to increase the use of renewable energy sources for heat generation, electric energy generation and for combined heat and electric energy generation

3.2 The realization of energy savings and the use of waste heat in the non-business carrying sector

Actual and planned results of the program, based on *[43435]*, are as follows:

Program indicators	2009	2010	2011	2012	2013	Planned (2015)
Increasing the capacity for producing energy from renewable sources [MW]	0,51	0,94	3,81	8,35	10,52	80,00
Reducing energy consumption [TJ/year]	0,05	134	155	193	257	2 000

These figures were used to calculate CO_2 emission savings , using average emission coefficients of the tertiary sector.

Total allocation of priority axe supporting energy efficiency and RES is 791,731 €.

1.1.2.1.10 National emission ceilings

Characteristics: Mandatory national ceilings for certain pollutants for the year 2010.

Period of implementation: from 2002, **ongoing**, **existing measure**

Mandatory emission ceilings established under the Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level ozone, and the Convention on Long-range Trans boundary Air Pollution (CLRTAP) and are valid for 2010. In the next few years, new emission ceilings for 2020 for SO_2, NOx, VOC, NH_3 and newly $PM_{2.5}$ will be set in the revision of the Gothenburg Protocol Abate Acidification, Eutrophication and Ground-level ozone and CLRTAP.

In April 2012 the Government approved document called “Potential reduction of polluting substances in the Czech Republic 2020”. Approved document sets the default position of the Czech Republic and serves for active negotiate changes in the Gothenburg Protocol and currently represents the latest concept of national emission ceilings for 2020, which are shown in following tables.

Tab. 4 National emission ceilings outlook of SO_2 emissions up to the year 2020

Emissions SO_2 [kt]	**2005**	**2010**	**2020**
1.A.1. Energy Industries	148,34	122,71	68,60
1.A.2. Manufacturing Industries and Construction	31,51	15,16	15,83
1.A.3.b. Road Transportation	0,98	0,11	0,11
1.A.4.b. Residential	32,46	30,08	10,00
2. Industrial Processes	3,17	3,56	4,48
Other	1,84	1,47	1,49
Total	**218,30**	**173,09**	**100,51**

Tab. 5 National emission ceilings outlook of NOx emissions up to the year 2020

Emissions NOx [kt]	**2005**	**2010**	**2020**
1.A.1. Energy Industries	112,63	56,36	46,67
1.A.2. Manufacturing Industries and Construction	43,39	38,65	32,80
1.A.3.b. Road Transportation	96,38	83,60	32,28
1.A.4.b. Residential	15,93	15,24	13,20
2. Industrial Processes	1,42	1,76	2,47
Other	21,19	22,48	12,49
Total	**290,94**	**218,09**	**139,91**

Tab. 6 National emission ceilings outlook of VOC emissions up to the year 2020

Emissions VOC [kt]	**2005**	**2010**	**2020**
1.A.1. Energy Industries	5,39	4,96	4,10
1.A.2. Manufacturing Industries and Construction	5,70	5,95	5,00
1.A.3.b. Road Transportation	42,21	31,89	12,61
1.A.4.b. Residential	23,15	20,40	15,06
2. Industrial Processes	11,76	11,76	11,98
3. Solvent and Other Product Use	93,40	82,70	71,86
Other	16,57	15,47	12,16
Total	**198,20**	**173,10**	**132,80**

Tab. 7 National emission ceilings outlook of NH_3 emissions up to the year 2020

Emissions NH_3 [kt]	**2005**	**2010**	**2020**
1.A.1. Energy Industries	0,06	0,67	0,3
1.A.2. Manufacturing Industries and Construction	0,1	0,21	0,2
1.A.3.b. Road Transportation	1,08	0,78	0,44
4.B. Manure Management	57,02	52,57	42,76
Other	21,67	23,63	24,25
Total	**79,93**	**77,86**	**67,95**

Tab. 8 National emission ceilings outlook of $PM_{2.5}$ emissions up to the year 2020

Emission $PM_{2.5}$ [kt]	**2005**	**2010**	**2020**
1.A.1. Energy Industries	2,93	2,23	1,92
1.A.2. Manufacturing Industries and Construction	1,79	1,33	0,68
1.A.3.b. Road Transportation	4,43	4,56	2,01
1.A.4.b. Residential	15,66	11,58	6,92
2. Industrial Processes	2,55	2,71	2,76
Other	6,86	7,1	4,82
Total	**34,22**	**29,51**	**19,11**

1.1.2.1.11 Promotion of bio fuels

Characteristic: Ensuring of minimal share of bio fuels in motor fuels used in transport.

Period of implementation: from 2006, **ongoing**, **existing measure**

Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC was adopted by the act on protection of the air 201/2012 Coll., which sets the minimal shares of biofuels in gasoline and diesel in accordance with EU directive. Government Decree 351/2012 Coll. sets sustainability criteria of biofuels.

The consumption of bio fuels in transport and other engines was 11.5 PJ in 2012 and according to the EFOM/ENV model calculations 19.7 PJ in 2015, 29.1 PJ in 2020, 29.1 PJ in 2025 and 28.1 PJ in 2030.

1.1.2.1.12 Fuel Quality Directive 2009/30/EC

Characteristic: The directive requires decrease of GHG emissions from the whole lifecycle of fuels used in transport and other engines by 10 % up to the year 2020. The directive also defines a methodology of calculation of GHG emissions from bio fuels.

Period of implementation: from 2011, **ongoing**, **existing measure**

Implementation of the Fuel Quality Directive 2009/30/EC into the Czech legislation, as regards emissions of greenhouse gases, is a part of the amendment to the act on protection of the air No. 201/2012 Coll.

This measure is considered as implemented for these GHG emissions projections. The default values of emissions from bio fuels defined in the directive were used for calculations.

1.1.2.1.13 Gains from Implementation of Recommendations of Obligatory Energy Audits

Characteristics: From the year 2001, there was an obligation to elaborate energy audits. The audits were mandatory for most entities from the public sector, owners or users of large buildings or building areas exceeding certain dimensions and for facilities with energy consumption exceeding certain limits. All public bodies and bodies, that used subsidies for audits elaboration are obliged to realize recommendations from the audits within the time period set by the law.

Period of implementation: 2001 – 2015, **ongoing**, **existing measure**

Time framework: not applicable

Sectors: all

The following table shows energy savings resulting from the realization of recommendations from obligatory energy audits as they were estimated in the NEEAP III [34]:

[TJ]	2008	2009	2010	2011	2012	2013	2014	2015	2016
Energy savings	713	713	713	475	475	475	333	333	333

The corresponding CO_2 emission savings were calculated using average emission coefficients of the total final energy consumption in the Czech Republic.

1.1.2.1.14 Obligatory Energy Certification of Buildings

Characteristics: Energy Performance Certificates serve as a motivational and informational tool for increased awareness of energy consumption of buildings and its public posting serves as a motivation to improve energy performance of buildings.

Period of implementation: from 2009 forth, **ongoing**, **existing measure**

Time framework: not applicable

Sectors**: all**

The obligation to prepare Energy Performance Certificate applies for buildings from the public sector or services sector. The obligation applies also for family and collective houses and for flats in collective houses in case of their selling or renting.

The following table shows energy savings resulting from the realization of obligatory energy certifications of buildings as they were estimated in the NEEAP III [34]:

[TJ]	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Energy savings	1,17	1,17	1,17	1,17	1,17	1,52	1,52	1,52	1,75	1,75	1,75	1,75

The corresponding CO_2 emission savings were calculated using average emission coefficients of the total final energy consumption in the Czech Republic.

1.1.2.1.15 Targeted Ecological Improvement of Pollution Sources

Characteristics: This measure supports areal gasification of areas heated form coal-fired boilers. Municipalities can obtain investment subsidies supporting areal switch from coal to gas boilers.

Period of implementation: 1995, the potential of the measure will be exhausted about 2016, **ongoing**, **existing measure**

Time framework: Annual evaluation and budget setting

Sectors: all

The main effect of this measure occurred mainly in the period 1995 – 2004. The remaining energy saving potential of this measure was estimated in the NEEAP III [34] as follows:

[TJ]	2008–2010	2011–2013	2014–2016	2017-2020
Energy savings	0.096	0.096	0.096	0

The CO_2 emission savings were calculated from amounts of coal and gas and their emission coefficients, taking into account the above mentioned energy savings..

1.1.2.2 Additional measures

1.1.2.2.1.1 Efficiency Improvement of District Heating Systems

Characteristic: The measure supports better utilization of primary energy through subsidies to introduction of combined heat and power generation (CHP) and to modernization of heat distribution systems.

Period of implementation: 2015 – 2020, **under preparation – additional measure**

Time framework: Annual evaluation and budget setting

Sectors: All

The Czech Republic operates large systems of district heating but they often do not achieve required parameters. Moreover, there exists still potential of further combined heat and power generation in systems currently fed from heat boilers. The measure has two aims:

- to achieve primary energy savings utilizing combined heat and power generation,
- modernization of heat distribution systems leading to lower heat losses.

Expected effects: Primary goal of the measure is to save energy. Expected energy savings and corresponding savings of CO_2 emissions shows the following table.

	2015	2020	2025	2030	2035
Energy savings [TJ]	1,022.0	3,578.0	0.0	0.0	0.0
Running sum of energy savings [TJ]	1,022.0	4,600.0	4,600.0	4,600.0	4,600.0
Decrease of CO_2 emissions [kt]	147.1	617.5	543.4	494.9	438.2

Source:NEEAP 3 [34], ENVIROS

1.2 Sectorial instruments

1.2.1 Energy

1.2.1.1 Industry

1.2.1.1.1 EU level

1.2.1.1.1.1 Existing measures

1.2.1.1.1.1.1 Promotion of RES in electricity production

Characteristic: Preferential feed-in tariffs, together with obligation of distribution companies to connect sources using RES and to purchase the produced electricity, serve as main tools used for promotion of RES in the CR.

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

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

This measure stipulates preferential feed-in tariffs for electricity produced from renewable energy their 15 years' guarantee from the commissioning the power plant. 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.

There exist concurrent measures supporting introduction of RES. However, at least almost all photovoltaic and wind power plants built so far can be attributed to this measure. Installed capacity of wind power plants by the end of 2011 was 218.9 MW and 1971.0 MW in photovoltaic power plants.

Delayed reaction of the Czech authorities caused an unforeseen solar boom in 2010. Therefore, the government prepared and the parliament approved a law which drastically decreases the feed-in tariffs (especially for photovoltaic and wind electricity) and moreover, introduces a special tax of 26 % for the solar electricity for the period 2011 – 2013.

For estimate of impacts of this measure we attribute to this measure all newly built photovoltaic plants, wind plants, small water plants and 50 % of biogas and biomass plants (concurrency with other measures).

1.2.1.1.1.1.2 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 Cogeneration Directive 2004/8/EC was reflected by the Energy Act No. 406/2000 Coll. and its amendments. The Directive was repealed by the Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency and the Energy Act No. 406/2000 was changed by Act No. 318/2012. 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 Authority on the annual basis.

The measure impact was calculated using the EFOM/ENV model.

1.2.1.1.1.1.3 National Renewable Energy Resources Plan

Characteristics: The Renewable Energy Directive 2009/28 requires that EU Member States will cover a specified percentage of final energy demand from renewable sources by 2020, for the Czech Republic it is 13 %, so that across the EU a target of 20% is achieved.

The aim of the RES Directive is to establish a common framework for the promotion of energy from renewable sources and the principal requirements focus on:

- 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 has required that each Member State will submit a National Renewable Energy Action Plan (NREAP) setting out how it plans to achieve its 2020 target. The Czech NREAP was submitted to EC in July 2010. The Czech NREAP was updated in July 2012. The main share of renewable energy supply is from biomass, followed by bio fuel for transportation, biogas, electricity from water power stations and photovoltaic. Very detailed measures are proposed including the amendment of legislation to create favorable environment for RES development.

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

Time framework: National Renewable Energy Action Plan will be evaluated every two years by Ministry of Industry and Trade. The results will be reported to the Czech Government and additional measures and activities are to be proposed in order to reach the target of 13 percentages.

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

Tab. 9 Share of RES on final consumption of energy (targets of Directive 2009/28/EC)

	2005	2011-2012	2013-2014	2015-2016	2017-2018	**2020**
The share of RES [PJ]	76.2	92.8	101.2	113.7	131.7	**161.7**
The share of RES [%]	6.1	7.5	8.2	9.2	10.6	**13**

Tab. 10 Share of RES on final consumption of energy (proposed scenario NREAP, July 2012)

	2005	2011	2013	2015	2017	**2020**
The share of RES [PJ]	76.2	119.8	135.4	146.6	158.2	**173.2**
The share of RES [%]	6.1	9.7	11.0	11.9	12.8	**13.9**

1.2.1.1.1.1.4 Directive 2006/32/EC of the European Parliament and the Council of 5 April 2006 on energy end use efficiency and energy service

Characteristics: The European Union (EU) has adopted a framework for energy end-use efficiency and energy services. The purpose of the Directive is to enhance the

cost-effective improvement of energy end-use efficiency in the Member States. The Directive is applied to providers of energy efficiency improvement measures, energy distributors, distribution system operators and retail energy sales companies. Energy means all forms of commercially available energy and fuels. Among other things, the Directive includes an indicative energy savings target for the Member States, obligations on national public authorities as regards energy savings and energy efficient procurement, and measures to promote energy efficiency and energy services.

Period of implementation: 2008 – 2016, **ongoing**, **existing measure**

Time framework: According to Article 14(2) of the Directive, Member States submitted their first National Energy Efficiency Action Plan (NEEAP) to the Commission by June 30, 2007. In their NEEAPs, Member States have showed how they intend to reach the 9% indicative energy savings target by 2016. The second NEEAP was submitted in August 20111. The third NEEAP shall be submitted not later than in 30 June 2014. The NEEAPs shall be assessed by the Commission from the point view achieving the national indicative target.

Sectors: The Directive is applied to all final customers with exception of undertakings under scheme for green gas emission allowances.

Tab. 11 Indicative target of the energy savings of the Czech Republic for the period 2008 – 2016

Average over five-year period 2002 – 2006 (with updated data for 2006 included)	**225,651 GWh, 100 %**
9% energy savings target at the end of 2016	**20,309 GWh**
Average annual savings over the period from 2008 to 2016	**2,257 GWh**

1.2.1.1.2 National level

1.2.1.1.2.1 Existing measures

1.2.1.1.2.1.1 Operational Program Industry and Enterprise (OPIE)

Characteristic: Operational Program Industry and Enterprise was one of programs offering subsidies from the EU Structural funds. The Measure 2.3 of the program was important for GHG emissions reduction. Two kinds of projects were supported – *energy savings* and *renewable energy sources*.

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

Time framework: Annual evaluation and budget setting.

The total subsidies offered by the program reached 424.6 MCZK. The annual energy savings after the program completion are 20.27 TJ and annual production of energy from RES is 54.91 GWh *[1]*.

1.2.1.1.2.1.2 Operational Program Enterprise and Innovation (OPEI)

Characteristic: With the framework of the Operational Program Enterprise and Innovation for the period 2007–2013, the Ministry of Industry and Trade is introducing a total of 15 aid programs, one of them is oriented on Eco-energy. Eco-energy is oriented on energy savings by means of replacing old technologies and on generation of electricity or heat from renewable resources. Funding derives in part from EU structural funds (85%) and in part from the state budget (15%). Funding is paid out in the form of non-returnable subsidies, preferential loans and guarantees. Eligible projects are those that are implemented on the territory of the Czech Republic outside the capital city of Prague.

Period of implementation: 2007 – 2013, **ongoing**, **existing measure**

Time framework: Annual evaluation and budget setting.

The aim of this program is to use grants in order to stimulate the activities of enterprises in the area of reducing the energy requirements of production and the consumption of primary energy sources, and to promote greater utilization of renewable and secondary energy sources and their sustainable growth.

The realized and expected program results, according to program annual report *[2]* are as follows:

	2009	2010	2011	2012	2013	Expected (2015)
Electricity generation from RES [GWh/year]		28,3			320	767
Heat generation from RES [TJ/year]		20,9			260	1 500
Reducing energy consumption [TJ/year]	58,6	157	399	849	2 590	11 000

These figures were used to calculate CO_2 emission savings , using average emission coefficients of the industry sector. Total allocation of priority axe supporting energy efficiency and RES is 471,475,058, €.

1.2.1.1.2.1.3 Support of voluntary commitments to energy savings

Characteristics: Tax allowances, where applicable, or possibility to draw the grants for energy end-users, who commit themselves to meet a certain improvement in energy efficiency (or absolute reduction in energy consumption or CO_2 emissions).

Period of implementation: from 2015, **planned – additional measure**

Voluntary agreements were envisaged already in NEEAP II, but they were not introduced yet. The measure is now planned for the NEEAP III.

The expected energy savings in 2015 are 725.3 TJ and about 3,262.7 TJ in 2020 *[343]*.

1.2.1.1.2.2 Additional measures

1.2.1.1.2.2.1 Operational Program Enterprise and Innovation for Competitiveness – Part Industry

Characteristic: The Program is designed to provide investment subsidies to improvement of energy efficiency in industry.

Period of implementation: 2015 – 2020, **under preparation – additional measure**

Time framework: Annual evaluation and budget setting.

Sectors: Industry.

The program will support the following activities:

- modernization or replacement of appliances generating energy for own use,
- introduction and modernization of metering and control systems,
- modernization, reconstruction and decreasing losses in electricity and heat distribution, in buildings and in production plants,
- decreasing of energy intensity of buildings (insulations, heat recovery),
- utilization of waste heat in industrial processes,
- improvement of energy efficiency of industrial processes,
- installation of renewable energy sources for own consumption,
- installation of CHP units for own consumption of industrial plants,
- subsidies to additional costs necessary for reaching near zero energy consumption of existing or new buildings.

Expected effects: Primary goal of the measure is to save energy. Expected energy savings [34] and corresponding savings of CO_2 emissions shows the following table.

	2015	**2020**	**2025**	**2030**	**2035**
Energy savings [TJ]	4,571.3	11,428.7	0.0	0.0	0.0
Running sum of energy savings [TJ]	4,571.3	16,000.0	16,000.0	16,000.0	16,000.0
Decrease of CO_2 emissions [kt]	381	1,267	1,207	1,186	1,111

The total program budget is 6 bill. CZK.

1.2.1.1.2.2.2 Efficiency Improvement of District Heating Systems

Characteristic: The measure provides investment support for increasing the efficiency of heat supply systems. The measure aims are:

- The achievement of primary energy savings through the use of low-temperature heat from electricity production, which would otherwise be lost and the introduction of combined heat and power generation (CHP) in heat supply systems, where the heat demand was satisfied from heat mono-production.
- Modernization of heat supply systems, optimizing their operation and reducing heat losses in distribution.

Period of implementation: 2014 - 2020, **under preparation**, **additional measure**

Time framework: Annual evaluation and budget setting.

Sectors: industry

Supported activities include:

- Installation of cogeneration units (with the exception of cogeneration units using biomass and biogas);
- Reconstruction of the existing facilities with a combined electricity and heat production in order to achieve primary energy savings through improved technical parameters;
- Building new and enlarging existing district heating systems including heat exchange stations in order to maximize heat recovery from high-efficiency CHPs and utilization of waste heat from industrial processes;
- Reconstruction of existing heat networks including exchange stations to reduce heat losses.

The annual energy savings were estimated to 767 TJ/year in the NEEAP III [34]. The CO_2 emissions savings were calculated from energy savings and average emissions coefficients of heat production.

1.2.1.2 Domestic sector

1.2.1.2.1 EU level

1.2.1.2.1.1 Existing measures

1.2.1.2.1.1.1 Energy labelling of household electrical appliances

Characteristic: In the course of its existence, the energy labelling within the European Union proved to be an economically very effective as well as organizationally not too complex instrument of improving the energy efficiency of household electrical appliances. Therefore, energy labelling with minimum demands for public funds brings a relatively significant effect in the form of energy savings.

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

The estimated energy savings from labelling are 2600 TJ in 2010, 4900 TJ in 2015 and 7100 TJ in 2020 *[3]*. These savings include new appliance categories introduced for labeling from the year 2011.

1.2.1.2.2 National level

1.2.1.2.2.1 Existing measures

1.2.1.2.2.1.1 The Green Savings Program, (Ministry of the Environment, Administration State Environmental Fund)

Characteristic The Green Savings program focuses on supporting environmentally sound methods for producing heat and hot water for households, reducing the energy intensity of residential buildings (comprehensive or partial thermal insulation) and constructing passive houses.

Period of implementation: 2010 – 2012, **finished**, **existing measure**

Time framework: Annual evaluation and budget setting.

The Czech Republic obtained financial resources for this program through selling 'Emission Credits' under the Kyoto Protocol on reducing greenhouse gas emissions. A total allocation of up to CZK 25 billion is envisaged for the program. Aid can be drawn until the end of 2012. Aid can be obtained by individuals, associations of flat owners, housing cooperatives, towns and municipalities including town districts, businesses and other legal entities.

The following are supported from the program:

A. Savings of energy for space heating,

B. Construction of buildings in the passive standard,

C. RES use for space and water heating.

Savings of energy for space heating (improving thermal insulation of buildings) are expected to bring the biggest effect.

The subsidy can be obtained either for a complex building insulation or a partial insulation provided that the energy saving will reach at least 20 % of the annual energy consumption for space heating. Installation of solar collectors for water and space heating are eligible in the RES support category.

The call for new applications was stopped at the beginning of the year 2011 due to surplus of applications to available budged.

The expected energy savings of the program are 1100 TJ in the year 2010 and 8700 TJ in the year 2013 *[3]*. These saving figures include energy substituted by RES as well.

Since August 2013 should start The Green Savings Program II, which should end in the year 2020.

1.2.1.2.2.1.2 New Green Savings Program 2013

Characteristic: New Green Savings Program 2013 was a subsidy program of Ministry of Environment (administrated by the State Environmental Fund) oriented to energy savings and use of renewable energy in family houses.

Period of implementation: 2013 – **finished – existing measure**.

Time framework: Annual evaluation and budget setting.

Sectors: households.

The call was oriented to insulation of family houses in combination with replacement of substandard boilers using solid fuels and installation of solar systems for water heating in family houses.

Expected effects: Primary goal of the measure is to save energy. Expected energy savings and corresponding savings of CO_2 emissions shows the following table.

	2015	2020	2025	2030	2035
Energy savings [TJ]	442.0	0.0	0.0	0.0	0.0
Running sum of energy savings [TJ]	442.0	442.0	442.0	442.0	442.0
Decrease of CO_2 emissions [kt]	32.4	29.6	27.7	26.1	22.6

Source:NEEAP 3 [34], ENVIROS

The total budget of the program is 1 bill. CZK.

1.2.1.2.2.1.3 Program PANEL/NEW PANEL/PANEL 2013+

Characteristic Program PANEL (NEW PANEL since 2009, PANEL 2013+ since 2013) supports complex refurbishments and modernizations of panel living houses leading to improvement of utility value and substantial lifetime prolongation.

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

Time framework: Annual evaluation and budget setting.

The program is based on the decree of the government No. 299/2001 Coll. 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
- community of flats owners.

Enumerated kinds of refurbishments of panel houses built from the standardized construction systems are eligible for the support. The support can have the form of

- guarantee for the bank loan,
- subsidy to the credit interest.

The support has the form of low-interest loan in the program PANEL 2013+.

The total savings for the period 2001 – 2013 were 2,358 TJ. The expected annual energy savings are 162 TJ for the period 2014 - 2020 *[334]*. The expected annual budget for the same period is 1 bill. CZK.

1.2.1.2.2.1.4 Support to housing fund modernization using the building saving

Characteristic: Building savings is a financial product with a relatively favorable interest rate, and whose appeal is enhanced by the provision of state support. Building savings is advantageous mainly because of the subsequent possibility of obtaining

loans to ensure housing needs. Loans have a fixed rate, which currently ranges from 3 % to 6 % depending on the selected Savings Bank and the loan amount.

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

Time framework: continuous

Sectors: households

The building savings are from their beginnings the most popular way of financial savings of households. Building savings is generally intended to safeguard the needs and 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 reached by this measure are as follows *[334]*:

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Annual energy savings [TJ]	842	732	626	564	465	469	425	395	365	334	304	273	243	213

1.2.1.2.2.1.5 Common Programmed for Boiler Replacements

Characteristics:

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

Period of implementation: 2013 – 2015, **ongoing**, **existing measure**

Time framework: Annual evaluation and budget setting.

Sectors: households

Common Programmed aims to support replacements of boilers in order to reduce air pollution from small boilers using fossil fuels with capacity up to 50 kW. The subject of the grant is replacement of existing manually fed solid fuel boilers by new efficient low-carbon boilers. The program is based on the principle that the same amount is contributed by the Ministry of Environment and same amount by the region. This means that if the regions manage to find more money they will also receive more money from the ministry.

The program budget was 265,4 mill. CZK in the year 2013 and 300 mill. CZK in 2014. Expected energy savings are 166 TJ in the year 2015 and 188 TJ in 2016 [34]. The saved CO2 emissions were calculated from the energy savings using average emission coefficient for households.

1.2.1.2.2.1.6 Credits of Cities and Municipalities for Modernization of Housing

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

Period of implementation: 2001 – 2016, **ongoing**, **existing measure**

Time framework: Annual evaluation and budget setting.

Sectors: Households

The program is designed for municipalities having owned apartment buildings, without distinction of construction technology (panel, brick). Provided support has form of a loan with a fixed interest rate of 3 % p.a. over the whole maturity and maturities up to 10 years. The loan can cover up to 50 % of total costs. The program is primarily focused on the complex regeneration of apartment buildings in ownership of municipalities, where the condition is to achieve a required standard of thermal and technical parameters of buildings.

According to [34], the expected energy savings are as follows:

	2011	2012	2013	2014	2015	2016
Energy saving [TJ]	5,886	1,631	1,833	2,199	2,199	2,199

The CO_2 emission savings were calculated from energy savings and average emission coefficients for households.

1.2.1.2.2.1.7 Education on Energy Savings in Heat Consumption in Households

Characteristics: The aim of the measure is organizing awareness campaigns and educational events on energy savings in households (media, leaflets, lectures etc.).

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

Time framework: Annual budget setting.

Sectors: households

The energy savings resulting from the program were estimated in [34] as follows:

	2008–2010	2011–2013	2014–2016	2017-2020
Energy savings [TJ]	0.190	0.149	0.224	0.072

The CO_2 emission savings were calculated from energy savings and average emission coefficients for households.

1.2.1.2.2.1.8 Electricity Savings in Households Lighting

Characteristics: The object 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 gradual ban on sales of incandescent and halogen bulbs.

Period of implementation: 2009 – 2016, **ongoing**, **existing measure**

Time framework: not applicable

Sectors: households

Since 2009, the main driving force of energy savings in the lighting is gradual ban on the sale of incandescent light bulbs set by the regulation (EC) no. 244/2009. Schedule ban on light bulbs according to that regulation is as follows:

- 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 in [34] as follows:

	2008–2010	**2011–2013**	**2014–2016**	**2017-2020**
Energy savings [TJ]	0.110	0.352	0.547	0.871

The CO_2 emission savings were calculated from energy savings and average emission coefficients for electricity production.

1.2.1.2.2.2 Additional measures

1.2.1.2.2.2.1 New Green Savings Program 2014 – 2020

Characteristics: This measure is a follow-up of earlier two measures Green Savings Program and New Green savings program 2013. It aims again at improvement of houses as regards energy efficiency and utilization of renewable sources.

Period of implementation: 2014 – 2020, **adopted, additional measure**

Time framework: Annual evaluation and budget setting.

Sectors: households and possibly public sector

The calls are designed for owners of family houses, for collective living houses .and likely also for public buildings. Supported activities are

- reducing energy consumption of existing buildings,
- construction of houses with very low energy consumption,
- efficient use of energy resources (biomass boilers, heat pumps, condensing gas boilers)
- replacing the heat sources using solid or liquid fossil fuels with efficient, and environment-friendly sources,
- installation of solar heating systems,
- forced ventilation systems with heat recovery.

	2015	**2020**	**2025**	**2030**	**2035**
Energy savings [TJ]	2 444,7	11 863,3	0.0	0.0	0.0
Running sum of energy savings [TJ]	2 444,7	14 308,0	14 308,0	14 308,0	14 308,0
Decrease of CO_2 emissions [kt]	179,3	958,3	897,0	844,0	730,4

Source: NEEAP 3 [34], ENVIROS

The total program budget is 27 bill. CZK.

1.2.1.2.2.2.2 Operational Program Environment 2014 – 2020 – priority axe 2

Characteristics: The aim of the Operational Program Environment 2014 – 2020 is the protection and improvement of the quality of the environment as a basic principle for sustainable development. Two priority axes relevant for GHG emissions reduction are priority axe 2 - Improvement of Air Quality in Residential Quarters and priority axe 5 – Energy Savings.

Period of implementation: 2014 – 2020, **under preparation – additional measure**

Time framework: Annual evaluation and budget setting

Sectors: households (PA 2).

Prevailing part of the priority axe 2 will support boiler replacements in households with aim to decrease air pollutions. Replacements of boilers burning solid fuels with low emission boilers using solid, liquid or gaseous fuels, heat pumps and combinations with non-combustion renewable energy will be supported.

The expected gains expressed in energy savings were evaluated in he NEEAP III [34] as follows:

	2015	**2020**	**2025**	**2030**	**2035**
Energy savings [TJ]	466.0	2 535.0	0.0	0.0	0.0
Running sum of energy savings [TJ]	466.0	3,001.0	3,001.0	3,001.0	3,001.0
Decrease of CO_2 emissions [kt]	34.2	201.0	188.1	177.0	153.2

Source: NEEAP III [34], ENVIROS

The total program budget is 10 bill. CZK.

1.2.1.2.2.2.3 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 indiscriminately legal subjectivity.

- 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, **under preparation**, **additional 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 expected annual energy savings are 28 TJ for the years 2014 – 2015 and 37 TJ for the period 2016 – 2020. The total budget amounts 0.5 bill. CZK for the period 2014 – 2015 and 2 bill. CZK for the period 2016 – 2020 [34]. Drop of CO_2 emissions was calculated using average emission coefficients for the households sector.

1.2.1.2.2.2.4 Integrated Regional Operating Programmed

Characteristics: The program is divided into the 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.

In terms of energy savings is significant 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”.

Period of implementation: 2014 – 2020, **under preparation**, **additional 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 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 1800 TJ for the period 2016 – 2020. The total budget for the period 2014 – 2020 amounts 16.9 bill. CZK [34].

1.2.1.3 Tertiary sector

1.2.1.3.1 EU level

1.2.1.3.1.1 Existing measures

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

Characteristics: ENERGY STAR (Labelling Energy Efficient Office Equipment) is a government-backed program helping businesses and individuals protect the environment and serve the energy through superior energy efficiency office equipment. 21 December 2006 EU and USA sign new Agreement on Energy Efficiency of Office Equipment. In June 2009 the EU and the USA have signed an Agreement to continue the ENERGY STAR program for office equipment for another five years. The new technical specifications as for energy efficiency for computers and imaging equipment, i.e. printers, copiers, fax machines, multifunctional devices etc. were developed together with EU Member States, the US Environmental Protection Agency and stakeholders from around the world.

The Enregy Star program lets pick 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 can be estimated to 3100TJ in 2010, 6040 TJ in 2015 and 8740 TJ in the year 2020 *[3]*.

1.2.1.3.2 National level

1.2.1.3.2.1 Existing measures

1.2.1.3.2.1.1 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 method EPC (energy performance contracting) and to prepare methodology for project preparation and implementation using EPC in government and public administration so that the EPC become the main financing method of energy savings in buildings.

Period of implementation: from 1992 forth

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. Contributory organizations may actually use this type of service but they are often afraid of errors in the accounting for these projects, because they consider this process as financing investments from operating assets. The measure aims to remove legal barriers to EPC application in state institutions.

.The NNEAP II [34] estimated energy savings gained using EPC method as follows:

[TJ]	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Energy savings	30	31,5	33,1	34,7	36,5	38,3	40,2	42,2	44,3	46,5	48,9	51,3	53,9

The CO_2 emission savings were calculated from energy savings above using average emission coefficients of tertiary sector.

1.2.1.3.2.1.2 Extension of Public Sector Role in Demonstration of New Technologies

Characteristics: The main purpose of the measure is the introduction of green procurement in the public administration. The green procurement should become mandatory for the organization under the effect of the law on public procurement.

Period of implementation: from 2010 forth

Time framework: not applicable

Sectors: public sector

At present, there is not strict legal obligation to use green procurement in the Czech Republic. Only a few ministries introduced internal regulations governing the purchasing of environmentally friendly products. We expect introduction of a legislative and administrative framework which will ensure compliance with the above requirement. The expected energy savings were calculated in the NEEAP III [34] as follows:

	2008–2010	2011–2013	2014–2016	2017-2020
Energy savings [TJ]	04	0.864	0.864	1.152

The CO_2 emission savings were calculated from energy savings above and average emission coefficients of electricity production.

1.2.1.3.2.1.3 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 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 lossy electromagnetic coils.

Period of implementation: 2009 – 2016, **ongoing**, **existing measure**

Time framework: not applicable

Sectors: tertiary sector

Since 2009, the main driving force of energy savings in the lighting is gradual ban on the sale of incandescent light bulbs set by the regulation (EC) no. 244/2009. Schedule ban on light bulbs according to that regulation is as follows:

- 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 in [34] as follows:

	2008–2010	2011–2013	2014–2016	2017-2020
Energy savings [TJ]	0.061	0.192	0.278	0.432

The CO_2 emission savings were calculated from energy savings and average emission coefficients for electricity production.

1.2.1.3.2.2 Additional measures

1.2.1.3.2.2.1 Operational Program Environment 2014 – 2020 – priority axe 5

Characteristics: The aim of the Operational Program Environment 2014 – 2020 is the protection and improvement of the quality of the environment as a basic principle for sustainable development. Two priority axes relevant for GHG emissions reduction are

priority axe 2 - Improvement of Air Quality in Residential Quarters and priority axe 5 – Energy Savings.

Period of implementation: 2014 – 2020, **under preparation – additional measure**

Time framework: Annual evaluation and budget setting

Sectors: public buildings (PA 5)

Thermal insulations, heat recovery and efficient low-emission heat sources in public buildings will be supported within the priority axe 5.

The expected gains expressed in energy savings were evaluated in the NEEAP III [34] as follows:

	2015	**2020**	**2025**	**2030**	**2035**
Energy savings [TJ]	308.0	1,675.0	0.0	0.0	0.0
Running sum of energy savings [TJ]	308.0	1,983.0	1,983.0	1,983.0	1,983.0
Decrease of CO_2 emissions [kt]	27.7	165.3	159.1	150.6	131.3

The total budget of the program is 13.4 bill. CZK.

1.2.1.3.2.2.2 Operational Programmed Enterprise and Innovation for Competitiveness – Part commercial services

Characteristic: The Program is designed to provide investment subsidies to improvement of energy efficiency in commercial services.

Period of implementation: 2015 – 2020, **under preparation – additional measure**

Time framework: Annual evaluation and budget setting.

Sectors: Commercial services.

The program will support the following activities:

- modernization or replacement of appliances generating energy for own use,
- introduction and modernization of metering and control systems,
- modernization, reconstruction and decreasing losses in electricity and heat distribution, in buildings and in production plants,
- decreasing of energy intensity of buildings (insulations, heat recovery),
- utilization of waste heat in industrial processes,
- improvement of energy efficiency of industrial processes,
- installation of renewable energy sources for own consumption,
- installation of CHP units for own consumption,
- subsidies to additional costs necessary for reaching near zero energy consumption of existing or new buildings.

Primary goal of the measure is to save energy. Expected energy savings, according to [34], and corresponding savings of CO_2 emissions shows the following table.

	2015	2020	2025	2030	2035
Energy savings [TJ]	1,142.7	2 857.3	0.0	0.0	0.0
Running sum of energy savings [TJ]	1,142.7	4,000.0	4,000.0	4,000.0	4,000.0
Decrease of CO_2 emissions [kt]	102.8	333.5	320.8	303.7	264.8

The total program budget is 4 bill. CZK.

1.2.1.3.2.2.3 Operation Programmed Prague - Pole of Growth – Part buildings

Characteristic: Support to improvement of energy efficiency of objects and technical equipment serving to operation of the city and road transport.

Period of implementation: 2014 – 2023, **under preparation – additional measure**

Time framework: Annual evaluation and budget setting.

Priority axe 2 will provide support to improvement of energy efficiency of objects serving to public city transport in the city of Prague.

Sectors: public sector.

The expected gains expressed in energy savings were evaluated in the NEEAP III [34] as follows:

	2015	2020	2025	2030	2035
Energy savings [TJ]	12.0	31.0	0.0	0.0	0.0
Running sum of energy savings [TJ]	120	43.0	43.0	43.0	43.0
Decrease of CO_2 emissions [kt]	1.1	3.6	3.4	3.3	2.8

The total program budget is1 bill. CZK

1.2.1.4 Transport

1.2.1.4.1 EU level

1.2.1.4.1.1 Emission limits and rolling stock recovery

The objective of these measures is to decrease air pollution from the transport sector. New vehicles must meet European emission standard (from September 2009 it is EURO 5 standard). A very significant contribution to reduction of the transport effects on human health has a rolling-stock recovery. According to 'the Czech Transport Policy 2005 – 2013' the public transport modernization including rolling stock recovery is supported and financed through public sources and funds. It is a WEM measure, which decreases methane emissions. Due to the lower fuel consumption by new vehicles also CO2 emissions decline.

The decommissioned vehicles are mostly old types with non-functional catalyst or without catalyst, and they tend to be replaced by new vehicles which meet stricter

emission standards. The Czech Republic uses the EURO 1-5 system of emission limits for road transport, which is used in all EU countries.

Since 1st January 2006 the registration, sale and commissioning of the new heavy trucks with lower emission limit than EURO 4 have been banned with the exception of vehicles intended for export to the third world countries. The registration prohibition of passenger cars and light trucks with lower emission limit than EURO 4 has also been in force since 1st January 2006. New stricter EURO 5 emission limits will be valid in all EU countries for new vehicles which have been produced since 1st January 2009.

They will concern mainly vehicles with diesel engines. The EURO 5 limits mainly reduce the emissions of solid particles - five times more compared to currently valid EURO 4 standard. This limit could be met by car producers only when introducing effective micro filters. The EURO 5 standard sets stricter limit for the sum of hydrocarbons and NOx by passenger diesel cars, which simultaneously reduces methane emissions.

The transport emissions in the Czech Republic are generally subjected to Law 56/2001 on rules for vehicle traffic and to Decree 283/2009 amending Decree 341/2002 concerning road vehicle technical standards. Regulation 2007/715/EC regarding Euro 5 and 6 standards was transposed into Czech legislation by this Decree 283/2009. The EURO 6 standard should be in force in September 2014.

Tab. 12 EURO Emission limits of the passenger cars with ignition engine

Limit	Year	CO (g. km^{-1})	HC+NOx (g. km^{-1})	HC (g. km^{-1})	NOx (g. km^{-1})	PM (g. km^{-1})
EURO I	1992	2.72	0.97	-	-	-
EURO II	1996	2.2	0.5	-	-	-
EURO III	2000	2.30	-	0.2	0.15	-
EURO IV	2005	1	-	0.1	0.08	-
EURO V	2009	1	-	0.1	0.06	0.005
EURO VI	2014	1	-	0.1	0.06	0.005

Tab. 13 EURO Emission limits of the passenger cars with diesel engines

Limit	Year	CO (g. km^{-1})	HC+NOx (g. km^{-1})	HC (g. km^{-1})	NOx (g. km^{-1})	PM (g. km^{-1})
EURO I	1992	2.72	0.97	-		0.14
EURO II	1996	1	0.7	-		0.08
EURO III	2000	0.64	0.56	-	0.5	0.05
EURO IV	2005	0.5	0.30	-	0.25	0.025
EURO V	2009	0.5	0.23	-	0.18	0.005
EURO VI	2014	0.5	0.17	-	0.08	0.005

Tab. 14 EURO Emission limits of the heavy trucks with diesel engines

Limit	Year	CO (g. kWh^{-1})	HC (g. kWh^{-1})	NOx (g. kWh^{-1})	PM (g. kWh^{-1})
EURO I	1992	4.5	1.1	8	0.36
EURO II	1996	4	1.1	7	0.25
	1998	4	1.1	7	0.15
EURO III	2000	2.1	0.66	5	0.1
EURO IV	2005	1.5	0.46	3.5	0.02
EURO V	2008	1.5	0.46	2	0.02

1.2.1.4.1.2 EU regulation on CO_2 from light-commercial vehicles (vans) (WAM)

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.

The main objective of the vans Regulation is to cut CO_2 emissions from vans to 175 grams of CO_2 per kilometer by 2017, phasing in the reduction from 2014, 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 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.

1.2.1.4.2 National level

1.2.1.4.2.1 Existing measures

1.2.1.4.2.1.1 Measures on vehicles - devices for gas adjustment.

The objective of this measure is to decrease air pollution from transport. This measure involves: 3-way controlled catalytic converters, oxidation catalysts, exhaust gas recirculation and particulate catcher. Governmental support of the development of these catalytic systems helps to fulfil strict emission legislation, e.g. Euro 5 (see above).

1.2.1.4.2.1.2 Exhaust gas treatment equipment

Reduction of vehicle emissions is being reached through catalytic converter, combustion engine improvement and through other equipment for exhaust gas treatment. First vehicles with catalytic converters started to emerge on roads in 1975. Currently, petrol vehicles are equipped with three-way catalytic converters containing an oxidation and a reduction part. Diesel vehicles are only equipped with the oxidation catalytic converter (two-way converter).

Producers of heavy trucks were forced by the strict NO_X limit to develop a new device for the exhaust gas treatment. There are currently two types of heavy trucks on the

market using either the EGR system (exhaust gases recirculation; currently used for Euro 4).

The EGR is a system of exhaust gas recirculation. In order to reach lower combustion temperature which will reduce emissions of nitrogen oxides on the required level, the exhaust gas quantity is regulated, 18 % by EURO 4 and 25 % by EURO 5, are cooling off in EGR cooler and return back to the engine.

Emissions of solid particles (PM) are reduced by high pressured injection system. The current situation and trends in the use of catalytic converters in the Czech Republic are apparent from the following table.

The SCR system (selective catalytic reduction) should meet the Euro 5 emission limits. This technology uses an additive called AdBlue (pure colorless 32.5 % urea solution), which is injected into exhaust gases before they go through the SCR catalytic converter. In the catalytic converter there are nitrogen oxides transformed to nitrogen and water vapor. The advantage of the method using SCR is a fact that it could be modified so that it could be compatible with the EURO 5 and EURO 6 requirements. For example in case of EURO 5 engines, more of the AdBlue additive is injected in order to reduce the nitrogen oxide content. In case of EURO 4 level, the additive quantity is approximately 3-4% of the fuel quantity and on the EURO 5 level approximately 5 – 7 %.

Tab. 15 **Number of motor vehicles per emission category EURO I-V**

Type of vehicle	2011				
	EURO I	EURO II	EURO III	EURO IV	EURO V
Passenger cars and LDV	397,2	1133,9	1234,7	916,8	538,8
Goods vehicles	9,7	12,2	36,9	29,6	29,5
Buses	1,00	1,87	5,57	2,85	3,89
Total	407,97	1148,00	1277,18	949,24	572,19

From the viewpoint of road transport impact on air quality, the number of cars meeting EURO 5 standards is gradually increasing, what is very positive. This measures belongs to the existing measures (WEM), because new emissions limit are valid for new cars.

Tab. 16 Number of vehicles in the Czech Republic equipped with catalytic converters

	Year												
	1993	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Number	183	280	436	517	670	842	981	1,181	1,306	1,517	1,759	1,994	2,244
%	6.8	9.5	14	17.5	20.6	24.1	26.6	32.02	37.1	41.6	47.5	52.3	56.8

The classification of vehicles according to catalytic converter equipment comes from the statistics of the Central Vehicle Register. Depending on the pace of the rolling-stock modification, the number of vehicles equipped by the catalytic converters is still rising. However, the vehicles with catalytic converters drive considerably more kilometers than older vehicles without them. Currently, 95 % of vehicles are equipped with catalytic converters.

1.2.1.4.2.1.3 Economic and tax tools

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), 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 following measures are supported by the Transport policy (2005-2013) through governmental subsidies and investments:

The new Transport Policy for 2014 – 2020 with the perspective to 2050 year was approved by the government of the Czech Republic, in the 12th June, 2013. In the field of transport impact on the environment, the new policy contains following measures:

To minimize negative impacts of traffic emissions and noise by appropriate measures on transport infrastructure.

To promote measures for the increase of the share of low emissions freight transport.

Gradually eliminate the environmental burden caused by the existing infrastructure, to implement measures to protect against noise and vibrations, preferably in densely populated areas with excessive hygienic noise limits.

Minimize the negative impacts of transport on public health, ecosystem stability.

in the landscape, their structure, function and binding.

Gradually increase the throughput of transport infrastructure for wildlife, organisms and humans. The construction and reconstruction of traffic structures use technical and other solutions to provide functional permeability for animals and ensure crossing the current transport structures in sections with demonstrated significant due to fragmentation.

Take into account the traffic problems in transport development plans of regions and cities and municipalities to achieve values, e.g. building bypasses and establishment low emission zones.

Preferably strengthen the capacity of existing transport corridors before building concurrent communications with similar transport capacity serving the same territory. Transport corridors and construction plan, design and implement with respect requirement to provide connectivity to wildlife populations and ensuring their migratory sufficient permeability.

Reduce the dependence of the transport energy based on fossil fuels.

The preparation and implementation of transport infrastructure development projects to minimize impacts on individual components of the environment and public health.

Implement measures to minimize conflicts with game (throughput traffic infrastructure, odor fences etc.)..

Implement measures to adhering to speed limits on motorways and expressways (higher speeds mean more energy consumption and higher reduction of harmful substances).

In addition, several non environmental measures, adopted by this new Transport Policy, will influence the production of greenhouse gas emissions as well. The freight transport as a part of logistic process is one of the key issues. In European countries logistics is gradually moving from a purely commercial sphere to the area of public services. This trend in the development of logistics in Europe, also in relation to the links to the European transport policy, must be not only taken into account but also developed in a systematic way in the Czech Republic, having regard to the following:

– Modal shift from road to those modes of transport which have less impact on the environment, without the entities operating in road transport losing their business, in the form of a service for road operators4,

– Use of multimodal transport systems to reduce the performance of road transport in favor of those modes of transport which have less impact on the environment, minimizing the costs of the change of the mode of transport and optimizing the time of transport, to avoid accumulation of logistics stock during circulation.

The following measures was adopted in this field:

- Seek effective and sustainable logistics solutions using the principle of co-modality with the view to supporting multimodal nature of transport, optimize the capacity of the transport infrastructure and use of energy and also make logistics services available to small and middle-sized businesses in industry, trade and agriculture.

Responsible: MoT in cooperation with the regional and local authorities; deadline continuous, check date 2017; funding: co-financing from European funds through Operational Programmed for the Transport sector

- Create an access to competitive multimodal transport chains for companies, using the railway and possibly waterborne transport with the objectives of:
    - improving capacity utilization of the means of transport and reducing empty rides
    - reduction of heavy road transport (in the form of a service for road operators)
    - better cooperation and coordination among companies in the area of transport
    - support of small and middle-sized enterprises

- reduction of negative impacts on the environment, public health and transport safety

Responsible: MoT in cooperation with the regional and local authorities; deadline continuous, check date 2017.

The perception of public transport as a public serve is another key issue of the new transport policy. Within this field, the following measures were adopted.

- Provide for regular and competitive clock-face public transport among all important conurbations in the Czech Republic.
- Based on national and regional economic possibilities, provide for integration of public transport on all the territory of the regions; the integration must include the connecting of timetables in all segments of public transport on the basis of a backbone and distribution system and the integration in terms of tariffs and information.
- Provide for interconnection of public passenger transport with non-motorized and private transport (serving sparsely populated areas).
- Provide for overlapping of public transport services of different regions – at the horizontal (the citizens have important transport needs leading to neighboring regions), as well as the vertical level (linking national, regional and communal demand). For this purpose, a national coordinator will be appointed

to methodically guide the individual independent contracting authorities. An important element will be the coordination of the creation of public transport plans, which must be comparable in different regions and at different levels and must serve as one of important foundations for the decision making regarding the scope and modernization of rail infrastructure.

- Ensure, through authorities contracting public passenger transport services and through public transport plans, that on the backbone lines there is service in appropriate intervals all day long and every day in the week. The use of different lines during the day depends on this concept. There will always be the negative element that outside peak times, the rate of utilization of services will not be sufficient.
- Public passenger transport services to be contracted gradually on the basis of a clear schedule in accordance with the principles of the EU White Paper, i.e., in particular in open public tenders.
- Ensure appropriate protection of public services in the opening transport market environment in both the rail and road transport.

Responsible for all the above measures: MoT, the regional and local authorities; deadline: by the end of 2020; check date: 2017.

1.2.1.4.2.1.4 Supporting of environmentally friendly transport

One of the important tools to mitigate negative transport impacts is the change to more ecological types of transportation (e.g. rail, public and non-motor transportation). The public transport should be sufficiently attractive in order to motivate the population to the more frequent use of this type of transport. There is a range of possibilities how to raise the attractiveness; however, not all of them are always suitable for concrete situations. It is necessary to combine these ways sensitively in relation to local conditions.

1.2.1.4.2.1.5 Increasing the attractiveness of public transport (WEM)

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). In the Czech Republic there are 13 IDS systems currently being operated with different integration rate. Among the greatest and most elaborated systems there are Pražský, Ostravský a Jihomoravský regional IDS.

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.

c) Preference of public transport vehicles

The speed of public transport vehicles in cities is mainly decreased due to cars. This results in prolonged travel time. To increase the attractiveness of public transport sufficient travel speed is necessary. Therefore, an introduction of extra lanes for buses and trolleybuses in exposed places and the preference of the urban public transport in the light controlled intersections are supported by the Czech Transport Policy.

1.2.1.4.2.1.6 Introduction of the "Park and Ride" and "Bike and Ride" systems (WEM)

a) “Park and Ride” system (WEM)

"Park and Ride" (P&R) system means that the driver goes by car a part of his journey from a place of residence to intercepting car park where they change to public transport vehicle in which they continue their destination. This system should be combined with increasing rates of parking fees in the localities which have to be calmed down (mainly city centers), possibly with the introduction of entrance fees for these localities. The necessary assumption for the realization of this system is a construction of parking houses or intercepting car parks. The intercepting car parks in external zones of towns and cities are recommended to be built, at places of major interchanges of the urban public transport. In outside urban areas it is recommended to build the intercepting car parks close to the important rail line stops leading to stream city of particular region. The parking policy should prevent the drivers from entering the city centers for example by increasing the rates and motivating them to multi-modal realization of the journey, which means to go partially by car and partially by urban public transport.

In the implementation of P&R system it is necessary to assure clear guidance traffic signs (parking signs with symbols of “P&R“) and to strengthen the urban public transport connections at the inclined localities. The parking fee should be reflected in the price of fare. In order to assure the maximum usage of the intercepting car parks, the localities should be chosen on the basis of socio-economic researches concerning the transport behavior and demand for P&R system and subsequent modelling of the wider transport relations of particular area.

Mental nature of the car drivers who are usually used to getting directly to the destination this may represent a certain obstacle in the realization (efficiency) of this measure. It will probably last some time until at least some of them would be willing to leave their vehicle, though on a supervised car park, and continue to their target place by public transport. The drivers should have a financial motivation for this measure, such as merging the parking ticket with the urban public transport ticket.

b) “Bike and Ride” system (WEM)

This system is more specified in the National strategy for the development of cycling (www.cyklostrategie.cz). Law 361/2000 and its amendments on road traffic set rules also for cycling.

"Bike and Ride" (B&R) system is similar to the "P&R" system only a bicycle is used instead of a car, in a part of journey from the source (place of residence) to an intercepting car park or to an object for bicycle storing. The cyclist changes for the public transport vehicle and continues to their destination after bicycle parking. Whereas there are no obstacles for car drivers which would prevent them from parking their car at the suitable place and continue to the targeted destination by public transport, cyclists usually do not have an opportunity to leave the bicycle without supervision at a stop of urban public transport. This system should secure the storage

and safe bicycle parking mainly at end stations and important public transport interchanges nodes.

The existing parking areas or public places in the city ownership should be used in the first place. The objects for bicycle storage and parking could have for example the form of a "cage" or special stands with fencing and lockable doors to which the access could be solved with help of a card or coin. These measures should make the bicycle transport more attractive also to people who are less physically capable, who would like to use bicycle for commuting to work, but for whom the passing of the whole route from the residential place to their workplace on the bicycle means a huge physical burden. Another option is a combination of B&R system and P&R system in those localities where there is a concurrence of these options. The bicycle depository should be in this case located directly on the car park premises.

1.2.1.4.2.1.7 Systems of combined freight transport (WEM)

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.

1.2.1.4.2.1.8 Support of bicycle transport (WEM)

This system is more specified in the National strategy for the development of cycling (www.cyklostrategie.cz).

This measure aims to build a comprehensive network of bike trails which guarantees relatively quick and safe connection of the important sources and targets of the journey, not only recreational, but mainly from a residential place to a workplace. The actual design of the concrete bike trails should be preceded by the processing

development plan (possibly a study) of the bike trail network. The General plan determines the proportional rate of investments in the bicycle infrastructure considering the cyclist’s needs. The proposed and gradually implemented network of the bicycle trail should meet these basic principles: network integrity, interconnection of the sources and goals and attractiveness of the paths in terms of length, safety and overall transparency. Within latitude organization of each road or trail a suitable bicycle path is designed and suitable way of guiding recommended. The bicycle trails should be conveniently separated from the motorized transport: for example by the guide lane, green dividing strip, curb, handrail or safety fence. It is suitable to use routing along the existing watercourses and the so called "greenways" in vegetation. Then in the cities the bicycle infrastructure should be completed with objects for bicycle storage and safe parking.

1.2.1.4.2.1.9 Mobility management (WEM)

Currently discussed mobility management is an approach focused primarily on demand in the passenger and freight transport; therefore it is sometimes translated into Czech as transport demand management. It tries to change the approaches and behavior of the population towards sustainable types of transport. The tools of the management mobility are based on information, communication, organization and coordination. Management mobility is defined to "traffic system management", which is on the contrary, an approach focused on supply which is trying to optimize the traffic corridor capacity by the telematics methods with price systems etc. However, some tools could be similar in both approaches; management of the traffic system is more focused on the final approach solution ("end of pipe approach"), whereas management mobility precedes this approach so it is more preventive and systemic. The influence of human transport options before people decide how, where and whether they will travel is particularly important for mobility management.

The constitution of the mobility management responded to the need of such approaches in the solution of the oppressive problem of considerably increasing mobility demand which simply do not rely on new road construction or introduction of the advanced technologies. Out of these "hard" measures an urgent need of "softer" measures has to be dealt with which will provide a wide range of service addressing the user’s needs and influencing them to change their transport habits towards sustainable transport. Management mobility concretely consists of providing information and consultation including bicycle maps, freight maps, itineraries of the organizations, availability schemes of the schools, companies and other organizations, information about the possibility of transfers within public transport, transport schedules and further information. It further deals with consultative activity in the sense of analysis of the availability and proposes the alternatives and recommendations such as transport plans for the organizations or comparison of various types of transportation in terms of transport time, costs and environmental effects.

1.2.1.4.2.1.10 Environmental education and awareness (WEM)

Law 123/1998 Col. on the right for environmental information sets the duty of the Ministry of Environment and the Ministry of Education to support “ecological” transportation, which indirect decreases emission of GHGs.

Changes of the transport system, which should mitigate the health and environmental effects, are not viable unless they have broad public support. Furthermore, these changes have to be proposed on a high professional level and therefore the transport experts have to be educated appropriately and motivated in the area of environment. The political support of such projects is necessary. These three groups - public, experts and political representation - are crucial for the enforcement of these desirable changes.

Environmental education must begin with children to have a significant chance for success. Ecological education has been already established as a subject at primary schools. Unfortunately, it is still rather a marginal subject and its content is often still inadequate to the issue which should be solved. It is caused by the fact that there is no sufficient education of the ecological subjects at faculties of education, where the so called environmental minimum has failed to be enforced. Education of the environmental minimum would assure that the graduates of the faculties will master basic principles of environmental education in their subjects. As far as the integration to the education of the transport, health and environmental issues is concerned, the situation is even less favorable. An example of the integration of environmental and human transport aspect of education could be a Methodical guideline "Transport and environment designed for primary and secondary schools", published by the Club of Ecological Education (CEE), on whose establishment the workers of the Transport Research Centre (TRC) participated. Besides the school’s environmental education the highest attention is paid to environmental education by non-state non-profit organizations (NNO), which are though not able to encompass the entire population’s interest in the whole range of the issue.

Within researches carried out among primary school students it was found out that the ability to act ecologically friendly according to the knowledge gained within the environmental enlightenment is missing almost entirely. There is a competition between old and new values, in case of students, whereas environmental values in the fight with the competitive ones are losing clearly. The transport behavior is motivated by transport speed, comfort and attractiveness, not by the sustainable transport pursuit and meeting fundamental principles of the sustainable development.

1.2.1.4.2.1.11 Public involvement

Law 100/2001 Col. on environmental impact assessment sets rules for the inclusion of the public in planning processes (e.g. transport connections), which should decrease the impact on environment and indirectly also the emissions of GHGs.

It is necessary for the public to be integrated in the process of transport planning and decision-making. In this respect, the transport planning area has limited historical

experience. The planning processes are largely restricted especially to transport experts, politicians and the government officials. It is valid mainly for states with short democratic duration, among which there is also the Czech Republic. The decision-making in the environment of the so called young democracy is often characterized by the technical rationality, decision-making guided "from above" and is often linked to protracted bureaucratic procedures. This model of decision-making is possible to be named as democratic elitism. The key decisions tend to be made by a narrow group of officials and politicians and if some participatory techniques are used during the decision-making process, they are selected and implemented in such a way that they ensure the official support form of the project and eliminate opposing views.

The opposite of the democratic elitism is a model called participative democracy. An important characteristic of this model is a necessity of the direct public integration in the decision-making process. In this case, the public has a direct influence on the final form of a project because differences between expert and lay opinions are minimized. The decision-making process is based on availability, cooperation, negotiation and interactivity. Among a significant number of examples in the practice it is apparent that thoroughly planned and realized public participation could considerably contribute to make better decisions. The early public integration in the evaluation of the transport needs and alternatives of transport decisions leads to the fact that the population is accepting the decisions "as their own ones", they tolerate them easily and accept the negative aspects of the realized transport projects better.

According to law, the citizens have an opportunity to integrate in the decision-making in the approbation process of the ground plan and its changes. However, this opportunity is not very often used by the public. In case of the extensive projects (including not only them, of course) it is a necessity to plan and implement public participation in form of extra work in the creation phase of the variants, for example in form of round-table meetings, workshops, discussions, planning weekends etc. The citizen should be understood as an equal partner and the public opinions should be reflected during the whole project. Lack of opportunities to be engaged in the transport plan negotiations could even lead up to public effort to list a referendum about the given construction (for example in case of a planned transfer of a railway junction in Brno). The similar initiatives represent a clear message that citizens want to co-decide about the form of the city in which they live.

1.2.1.4.2.1.12 Eco-driving (WEM)

"Eco-driving" or "ecological management" is a kind of management which reduces the fuel consumption, emissions of the greenhouse gases and number of the traffic accidents as well, which brings benefit not only to the environment but mainly to drivers of motor vehicles. Driving the vehicle in accordance with the "eco-driving" principles reduces the fuel consumption by 10% or even more. Among these fundamental elements of this management there are: maintaining the constant speed of the vehicle, forecast of the transport congestions and finding the alternative "free" route, gradual acceleration and braking and frequent checks of tire pressure. To enforce the principles

of "eco-driving" in practice an international campaign is planned and is coordinated by the ECODRIVEN project on the European level. The campaign goal is to stimulate at least 2.5 million drivers of the passenger and freight vehicles in Europe to drive safely and in an energetically effective way and reduce the CO_2 emissions by 0.5 million tons in 2010.

1.2.1.4.2.1.13 Territorial planning measures (WEM)

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.).

1.2.1.4.2.1.14 Operational Program Transport

Characteristic: The program provides support for the 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 in particular transport aspects and strategic objectives of the National Development Plan. It is focused on modernization of railway and road networks. The main program indicators include reduction of the accident rate, increase of transport capacity, time savings and greenhouse gases emissions reduction.

Basic overview of priority axes and areas of intervention:

- 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

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 232 TJ/year in the NEEAP III [34].

1.2.1.4.2.2 Additional measures

1.2.1.4.2.2.1 Operation Program Prague - Pole of Growth – Part transport

Characteristic: Support to improvement of energy efficiency of objects and technical equipment serving to operation of the city and road transport.

Period of implementation: 2014 – 2023, **under preparation – additional measure**

Time framework: Annual evaluation and budget setting.

Priority axe 2 will provide support to improvement of energy efficiency of objects serving to public city transport in the city of Prague.

Sectors: transport

The expected gains expressed in energy savings were evaluated in the NEEAP III [34] as follows:

	2008-2010	2011-2013	2014-2016	2017-2020
Energy savings [TJ]	0	0	39	52

The CO_2 emission savings were calculated from saved energy and emission coefficients of motor fuels in road transport. The total budget of the program is 1 bill. CZK

1.2.1.4.2.2.2 National Strategy of Cycling Transport Development

Characteristic: The measure introduces support to the construction of cycling infrastructure. It is financed mainly from the State Transport Infrastructure Fund, which supports the following measures:

- construction and maintenance of cycling infrastructure,
- connection of with public transport,
- use existing roads also for the needs of cyclists,
- construction new and reconstruction of cycling lanes, paths, walkways and underpasses.

Period of implementation: 2014 – 2020, **adopted**, **additional measure**

Time framework: Annual evaluation and budget setting

Sectors: Transport

The program is primarily focused on the construction and maintenance of cycling paths. Cycling can very well compete vehicular traffic in urban and suburban areas and thus lead to energy savings.

The annual energy savings were estimated in [34] to 45 TJ/year with the annual budget of 150 mill. CZK. CO_2 emission savings were calculated from energy savings and emission coefficients of motor fuels in road transport.

1.2.1.5 Agriculture

1.2.1.5.1 National level

1.2.1.5.1.1 Existing measures

1.2.1.5.1.1.1 Complex of Measures Increasing Energy Efficiency of Agricultural Facilities

Characteristic: The measure targets at reducing energy consumption in agricultural production and support the use of RES. The measure includes a combination of legislative instruments and grant funds in agricultural production.

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

Time framework: Annual evaluation and budget setting

Sectors: Agriculture

Thea NEEAP III [34] estimated the energy savings of the measure as follows:

[PJ]	2008–2010	2011–2013	2014–2016	2017-2020
Energy savings	0,210	0,300	0,420	0,560

The savings of CO_2 emissions were calculated from the energy savings above and average emission coefficients of agriculture.

1.2.2 Industrial processes

1.2.2.1 EU level

1.2.2.1.1 Regulations on emissions of fluorinated gases

The European Parliament and Council approved two documents setting rules for treatment of fluorinated gases:

- Regulation (EC) No 842/2006 of the European Parliament and of the Council of 17 May 2006 on certain fluorinated greenhouse;
- Directive 2006/40/EC of the European Parliament and of the Council of 17 May 2006 relating to emissions from air conditioning systems in motor vehicles and amending Council Directive 70/156/EEC.

Both documents became part of the Czech legislation as they are.

All limitations and bans resulting from these regulations were incorporated into the scenario “with existing measures”.

1.2.2.1.2 Regulation (EU) No 517/2014 of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006

The European Parliament and Council approved In April 2014 new “Regulation (EU) No 517/2014 of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006” setting strict bans on use of fluorinated gases with high global warming potentials for certain purposes. The document became part of the Czech legislation as is. All limitations and bans resulting from this regulation were incorporated into the scenario “with existing measures”.

1.2.3 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.

Together with the implemented measures and policies, it is necessary to provide progressive knowledge and a material base and proposals for improvement of the state administration and municipal control activities in the agrarian sector.

1.2.3.1 EU level

1.2.3.1.1 Common Agricultural Policy (CAP)

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.

Since 2004, the Czech Republic has applied the Single Area Payment Scheme (SAPS) and “phasing in” module, according to Council Regulation (EC) No. 1782/2003 of 29 September 2003, establishing common rules for direct support schemes under the common agricultural policy and establishing certain support schemes for farmers. In 2010, the EU subsidies for CR attained 70 % of the EU 15 level. By the end of 2010, more than CZK 186 billion had been paid to the beneficiaries within this program (SAIF, 2011).

In the future, the EC intends to keep the two-pillar structure of the CAP with a greener and more equitably distributed first pillar and a second pillar that is more focused on competitiveness and innovation, climate change and the environment. It intends to introduce the following changes: greening of direct payments; convergence of payments and capping the level of direct payments. The Commission proposes to allocate: EUR 281.8 billion to the first pillar of the CAP; EUR 89.9 billion to rural development. In addition, an amount of EUR 15.2 billion will be distributed between the following sectors: research and innovation, food safety, food support, new reserve for possible crises in the agricultural sector and European Globalization Fund.

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.

1.2.3.1.2 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.

Since 2010, farmers are required to comply with 10 standards of GAEC (Good agricultural and environmental condition) that are more complex and more responsible agricultural practices.

In 2012, the scientists from Research Institute of Agricultural Engineering published an invention (new agro-environmental measure incl. in WAM scenario) related to litter production of manure. Thanks to a special composting technology working with

biological heat can you get rid of pathogenic microorganisms in the separated slurry, from which it is made of plastic litter for cattle. Litter is just as comfortable as straw, but the animals are cleaner and there is no contamination of their illness or milk. Introducing a new technology will increase food safety and competitiveness of Czech farmers. In addition, it transmits and saving money. Increased milk production and changes in manure management affects the balance of N2O emissions.

In May 2013, the material describing a Good Agriculture and Environmental condition for Czech Republic was elaborated and published.

1.2.3.1.3 The Nitrates Directive (91/676/EEC)

The 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).

1.2.3.2 National level

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

1.2.3.2.1 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.

1.2.3.2.2 Rural development and Multifunctional Agriculture (OP)

The program includes and specifies measures jointly financed by the guidance section of the European Agricultural Guidance and Guarantee Fund (EAGGF) and jointly financed by Financial Instrument for Fisheries Guidance (FIFG). It covers the area of the Czech Republic. The purpose of processing the Agriculture OP is to support agricultural primary production and the processing of agricultural products, to support forest and water management and to ensure the continually sustainable development of the countryside. The program also ensures i) Development and modernization of agricultural holdings, ii) Support of young farmers and iii) Diversification into non-agricultural activities.

1.2.3.2.3 Horizontal Rural Development Plan of the Czech Republic

The program was commenced in 2004 following approval by the European Commission. The main objective of the program was to ensure sustainable development of agriculture, the countryside and its natural resources. The program objectives included i) preservation and support of agricultural systems with low inputs, ii) protection and support of sustainable agriculture meeting environmental demands and iii) preservation and strengthening of a viable social structure in rural areas. The most important share in the total allocation was represented by agro-environmental measures related to support for less-favored areas. By the end of 2010, more than CZK 25 billion had been paid to the beneficiaries within this program.

The implementation of the rural development program can affect the trend of GHG emissions from agriculture (methane and nitrous oxide emissions) in both directions (up or down) depending on specific implemented measures, practices and policies.

The allocation for the whole program period of 2004-2006 amounted to EUR 678,500,000 of which the sum of EUR 542,800,000 came from the European Agricultural Guidance and Guarantee Fund (80% supplementary funding). By the end of 2007, approx. 99.37% of this allocated amount had been applied for. By the end of 2008 more than CZK 18 billion was paid to the beneficiaries within this program (Annual report of HRDP, 2008, 2009).

1.2.3.2.4 Organic farming

Organic farming is an integral part of the agricultural policy of the Czech Republic. Its importance lies not only in the production of good-quality bio-foodstuffs but also in the farming methods that, through their environmentally friendly influence on nature, contribute substantially to the preservation of the rural character of the countryside, 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.

- **Decree 79/2007** defines the conditions for implementation of agro-environmental measures. These measures include
    - environmentally friendly subordinate processes, which are divided into organic farming and integrated production,
    - management of grassland
    - the landscape, which is divided into i) conversion to grassland, ii) growing crops and iii) bio-corridors.
- **Act No. 242/2000** concerns ecological agriculture. This act administers and describes the activities of agro-environmental programs (implementation of new technologies, procedures in protected areas, landscape cultivation, etc.).

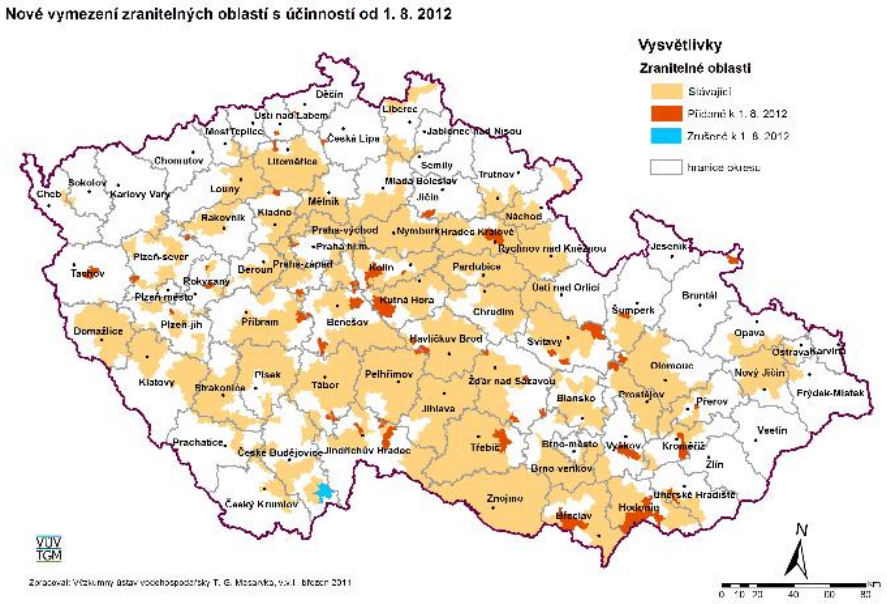
Directives 834/2007 and 889/2008 have been adopted and implemented in the Czech Republic.

1.2.3.2.5 Nitrate Directive

Action Program No. 103/2003 is closely linked to the Nitrates Directive (91/676/EEC). The program consists in a system of compulsory measures in vulnerable areas to reduce the risk of nitrogen leaching into surface waters and ground waters. Endangered and protected areas were delimited in the Czech Republic in 2003. Since 2004, Action Plans have been implemented in these areas.

The list of endangered and protected areas was updated in December 2012, when the Third Action Plan has been implemented (incl. in WAM scenario). The limit of 170 kg N/ha for application of organic fertilizers is presented, thereby reducing the amount of N in the soil and emissions of N_2O. The Third Action Plan brings new rules: i) period of prohibition of fertilization, ii) manure storage rules, iii) balancing fertilization, iv) an application of fertilization on sloping, wet, frozen and snow covered land, in vulnerable areas. Good Agricultural Practices, applied in ecological farms, include BAT technologies and techniques as: reduction of waste nitrogen by phase diets in feed, reduction of ammonia emission by adding enzyme substances to feed, partly grated floor, plastic and concrete grids with vacuum system removes manure, steel manure storage tanks etc.

Fig. 1 New definition of vulnerable areas (orange and read)in Czech Republic



Good Agricultural Practices, applied in ecological farms, include BAT technologies and techniques as: reduction of waste nitrogen by phase diets in feed, reduction of ammonia emission by adding enzyme substances to feed, partly grated floor, plastic and concrete grids with vacuum system removes manure, steel manure storage tanks etc.

1.2.3.3 Additional measures and policies

1.2.3.3.1 EU level

1.2.3.3.1.1 Reform of the Common Agricultural Policy and Transition Rules for 2014

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

1.2.3.3.1.2 *Cross Compliance, incl. GAEC*

New cross-compliance conditions, including GAEC, are reflected as 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.

1.2.3.3.2 National level

1.2.3.3.2.1 Czech Rural Development Program (2014-2020)

On July 2014 document submitted to the European Commission for comments. An adoption of the Rural Development Program for the period 2014-2020 by the EC is expected in the first quarter of 2015. Project RDP measures will be implemented as in the current period through government regulation or rules. The general part of the specific rules for certain measures of the RDP 2014-2020 will be published early in the spring of 2015. Publication of the government for individual measures depends on the date of approval of the RDP. The preliminary schedule assumes an adoption of the detailed conditions for individual measures within government regulations, preparation of guidelines approved by government regulation and in autumn 2015 1st round start receiving applications (probably investment measures in agriculture).

1.2.3.3.2.2 Strategy for growth

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.

1.2.3.3.2.3 Action Plan for biomass in 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.

Agriculture Law no. 179/2014 Coll., Amending Act no. 252/1997 Coll., and other related laws. Effective from 1 January 2015. Topics: Grants and support structural policy, crop production and rural development.

Government Regulation no.117/2014 Coll., determining of vulnerable areas and Action Program. Effective from 1 July 2014. Topics: Vulnerable areas, action program, the use of nitrogen fertilizers, the prohibition period fertilization, limiting the use of organic nitrogen storage of nitrogen fertilizing substances in vulnerable areas, crop rotation in vulnerable areas, farming on sloping agricultural land, the limits of each crop fertilization.

1.2.4 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 1.2.2.1.2 are partly common for the two 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.

1.2.4.1 EU level

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.

1.2.4.2 National level

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, varied species composition and variability of silvicultural approaches, reflecting the current international treaties, agreements, conventions and EU directives.

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 (Cienciala 2013), which are directly aimed at reducing the impacts of global climate change and extreme weather events.

The essence of the key measures recommended by the above material is included in the "with additional measures" (WAM) scenario, which is described in the methodological section for the LULUCF sector below (Chapter 2.1.8).

1.2.5 Waste

Greenhouse gas emissions generated by the waste sector in Czech Republic have been growing due to organic carbon that is accumulated in landfills, increasing amount of produced MSW and unfavorable mix of MSW (municipal solid waste) treatment options. Recently trend started to turn and we observe mild stagnation of emissions from landfills (a key source of this sector in the CZ). The slowing we observe is mainly due to increased LFG (landfill gas) capturing. There is an additional potential for CZ 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.

1.2.5.1 EU level

The Czech waste legislation is largely based on EC legislation. EC legislation with direct impact on GHG emissions from waste includes Landfill Directive (1999/31/EC) and Waste Directive (2006/12/EC). While second one creates more framework for waste management in the country the first one sets up a system of operating permits for landfill sites, standards and requirements that influence landfill performance. There are several policies from other sectors that already have or will have impact on GHG emissions from waste. Most of them are mentioned in cross sectorial section in this

report but above all is worthy to mention ETS, Climate & Energy Package, Energy Tax Directive which provide direct and indirect support on LFG recovery and therefore significantly influencing landfill emissions.

1.2.5.2 National level

The most important instrument on the national level is waste management plan (WMP). The current WMP adopted in 2003 and valid till 2013 and is recently being reworked with certain shifts in waste management practice (e.g. more weight on waste incineration). However, for the projection we will refer to the old plan that is in power because new one is still in inter-ministerial evaluation. Most of the targets and measures is reflection of obligatory EU legislation and will be likely also included in a new WMP which is under preparation. Since adoption of WMP there were several programs that aimed for projects that should lead to fulfilling goals of WMP. Main one that is still active is Operational Programmed 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, Systems for separating and picking-up waste and separating bio waste, Systems to separate hazardous municipal waste and medical waste, Waste use facilities, especially for waste sorting and recycling, Waste separators with linked technologies, Facilities for the use of medical waste for power engineering, Composting plants and biogas stations for bio waste processing. It is too early to assess its effects of its project on GHG emissions however. The current WMP includes several targets and measures that have direct effect on GHG emission. Fact is that many of the targets don't reflect reality in the country and therefore they won't be reached:

- increasing recovery of wastes with preference given to recycling, with a statutory target of 55% of all waste produced by year 2012;
- increase recovery of municipal waste to 50 % by 2010
- 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.
- Prefer 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.

Because waste sector is end sector for nearly all economical activities (all production and consumption becomes waste at some point in time) there are also a lot of cross-sectorial policies indirectly influencing GHG emissions from waste. One with significant influence on emissions from landfills and incineration is law no. 180/2005 Sb., about support of electricity production from renewables (with annual decisions of Energy Regulatory Office about energy prices). It is in power for several years and it seems it significantly influences utilization of LFG (trend is visible from last seven years where utilization of LFG in 2013 was so far all-time high and there is still a potential for growth) and therefore reducing total emissions of methane from landfills.

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 employed for preparation of projections for the Third to Fifth National Communications which, amongst other things, permits them to be compared. The methodology includes 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 is available for 2012 (submission 2014). Total greenhouse gas emissions recalculated to CO_{2eq} for 2012 were calculated as 124,214.14 thousand t including sinks and 131,466.12 excluding sinks.

The results of greenhouse gas inventories indicate that CO_2 emissions, produced by the combustion of fossil fuels (91.5 %), make the largest contribution to greenhouse gas emissions (84.3 %). The largest amount of CO_2 emissions comes from the energy production sector (54.9 %), followed by industry including corporate energy production (15.8 %), households, agriculture and the tertiary sector (10.0 %). Transport currently contributes 15.6 % 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 2012 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 2030 was selected as the

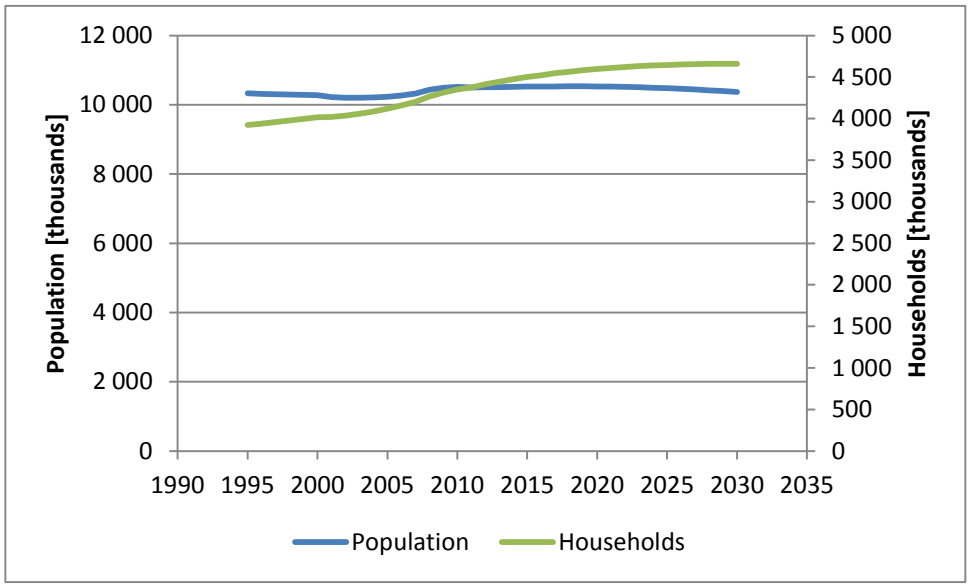
final year for projections of greenhouse gases emissions, in accordance with the recommendations of the European Commission. The years 2012, 2015, 2020, 2025 and 2030 were selected as cross-cutting years for preparing the projections. Measures introduced before 1st January 2015 are considered as existing 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) [32]; 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. 2 Demographic projection (thousand)

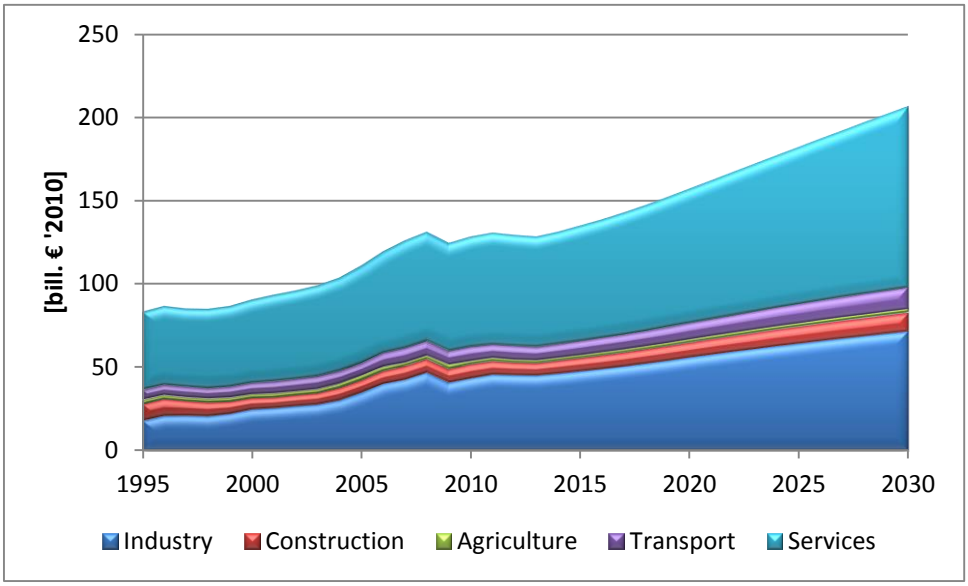


Source: CSO, EGÚ Brno, a. s.

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 April 2014. These projections are made two times a year and approved by a group of experts organized by the OTE.

Fig. 3 Projection of trends in gross added value (constant prices[4] of 2010) in bill. €



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 2015 (*Final after consultation, 17 June 2014*)".

Tab. 17 Global prices of fuels (€/GJ, constant prices of 2010)

€ (2010)/GJ	2010	2015	2020	2025	2030	2035
oil	9.3	11.9	13.7	13.8	14.4	14.8
gas	5.9	7.7	9.5	9.1	10.0	10.2
coal	2.5	2.3	3.5	3.7	3.7	3.9

Source: Recommended parameters for reporting on GHG projections in 2015

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

The prices of imported primary energy sources will be 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

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

fuel in the market compared to competitive energy sources. Solid fuels, especially brown coal, will continue to be a decisive domestic primary energy source to 2020.

The purchase prices of electrical energy from renewable energy sources and from sources with combined heat and electricity production of are currently stipulated by a Decree of the Energy Regulation Authority[5]. The current legislation[6] guarantees favorable purchase prices for a period of 15 years from bringing the source into operation. The Energy Regulatory Office can reduce these prices by up to 5% annually compared to the previous year. The projections assume maintenance of current purchase prices for the entire period.

During 2010 dramatically decreased investment costs of photovoltaic panels and arose an extreme boom of new solar installations. The installed capacity of photovoltaic power plants tripled and reached 1800 MW by the end of 2010. Since there were was a high preferential feed-in tariff for electricity from photovoltaic it would have led to a substantial increase of electricity prices. Therefore, 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 an 2010 was introduced.

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. 18 gives trends in the capacities of mining. It is not expected that environmental limits for mining brown coal will be relaxed 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 the brown coal price will reach about 75 % of hard coal price.

There is a substantial cut in hard coal production in comparison with the previous projections. The domestic hard coal mining is not competitive any more with current coal prices and the company decided to shorten the lifetime of the mines. The projection of brown coal mining is lower as well, but not so dramatically.

Tab. 18 Projections of domestic coal mining

Category of coal (company – mine)	Maximum mining (units)	2013	2015	2020	2025	2030	2035
Hard coking coal	PJ	142.0	127.1	64.8	0.0	0.0	0.0
	thousand t	5,400	4,800	2,400	0	0	0
Hard steam coal	PJ	94.7	84.7	43.2	0.0	0.0	0.0

[5] ERA Price Decision No. 1/2014, stipulating the subsidies to supported energy sources (http://www.eru.cz/cs/-/cenove-rozhodnuti-c-1-2014, in Czech)

[6] Act No. 180/2005 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)

Category of coal (company – mine)	Maximum mining (units)	2013	2015	2020	2025	2030	2035
	thousand t	3,600	3,200	1,600	0	0	0
Brown steam coal (SD – Libouš)	PJ	159.6	166.8	115.0	92.0	69.0	69.0
	thousand t	13,880	14,500	10,000	8,000	6,000	6,000
Brown steam coal (SD – Bílina)	PJ	138.3	134.0	111.5	96.0	90.3	90.3
	thousand t	9,800	9,500	7,900	6,800	6,400	6,400
Brown steam coal (CC - Vršanská uhelná)	PJ	71.3	72.8	63.9	63.9	63.9	63.9
	thousand t	6,850	7,000	6,140	6,140	6,140	6,140
Brown steam coal (Severní energetická)	PJ	61.7	59.0	64.8	0.0	0.0	0.0
	thousand t	3,430	3,280	3,600	0	0	0
Brown steam coal (SU – total)	PJ	77.8	67.0	65.8	59.8	59.8	59.8
	thousand t	6,500	5,600	5,500	5,000	5,000	5,000

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 2010):

€2010/tCO_2	2015	2020	2025	2030	2035
EU ETS carbon price	7	10	14	35	57

Source: Recommended parameters for reporting on GHG projections in 2015

2.1.3.7 Energy production scenario

Since the long lasting process of updating the State Energy Concept seems soon to end in the final version of the document [33], the energy consumption and production scenario of these projections tries to be as close as possible to the "Optimized scenario" proposed in the document [33]. The scenarios evaluated in the frame of the Update of the State Energy Concept were based on three priorities: safety – sustainability – competitiveness. There were set corridors limiting acceptable development of the primary energy mix and electricity generation and various scenarios within these corridors were analyzed. The "Optimized scenario" represents the most advisable way of energy system development.

Following the most influencing assumptions were employed for model calculation of greenhouse gas emissions from energy-production processes:

a. The Temelín nuclear power plant will remain in normal operation for the whole monitored period (2000 – 2030).

b. The operation license of the Dukovany nuclear power plant will be prolonged and will be 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 2033.

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 EFOM/ENV energy production linear optimization model was used for projections of CO_2, CH_4 a N_2O emissions from combustion processes. The model underwent an upgrade from the time of previous projections. The old model version used, due to historical reasons, energy balances in format of the Czech Statistical Office (CSO), which is not compatible with the Eurostat/IEA format. The main difference is in balancing heat in industry, where CSO balances all produced heat, whereas Eurostat balances only heat sold outside the companies. There are also incompatibilities in balanced energy carriers and some other more subtle incompatibilities. The new model version strictly follows the structure of energy balances produced by Eurostat (sectors, energy carriers, transformations, energy uses). The new model version should provide outputs better comparable with other EU countries.

The 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 and mobile sources.

2.1.4.1 Fuel Combustion

Calculation of GHG emissions from fuel combustion is based on energy balances obtained from the scenarios developed by the model EFOM/ENV. The main model outputs are presented in the following paragraphs.

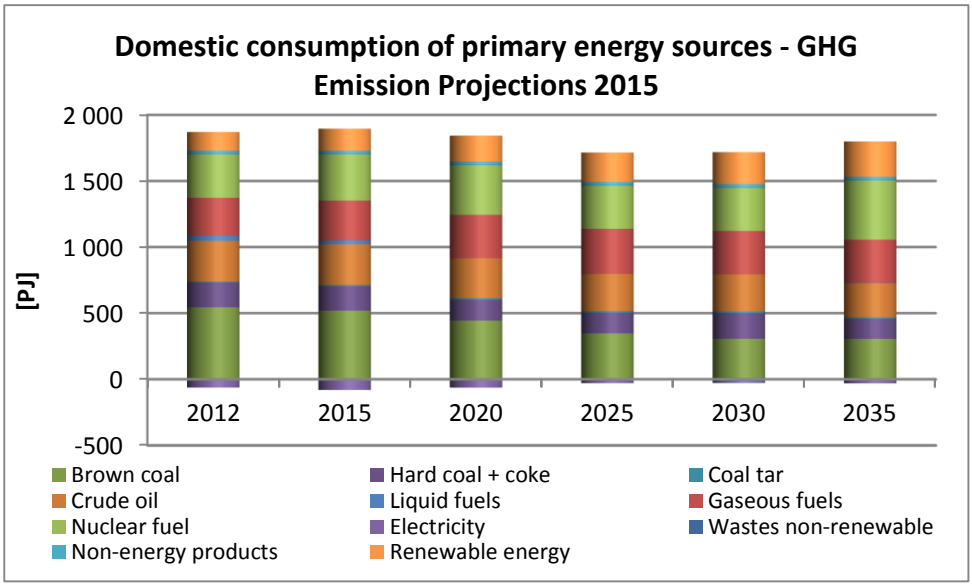
2.1.4.1.1 Domestic consumption of primary energy sources

Tab. 19 Domestic consumption of primary energy sources

Domestic consumption of primary energy sources [PJ]	2012	2015	2020	2025	2030	2035
Brown coal	544	519	444	347	306	306
Hard coal + coke	188	185	158	157	195	151
Coal tar	9	11	12	12	12	12
Crude oil	306	306	301	280	280	255
Liquid fuels	39	29	-3	-6	-15	6
Gaseous fuels	287	302	328	342	329	325
Nuclear fuel	328	350	376	327	327	449
Electricity	-62	-80	-59	-22	-12	-30
Wastes non-renewable	2	3	3	3	3	3
Non-energy products	25	23	24	25	24	25
Renewable energy	141	167	196	222	242	266
TOTAL	**1,808**	**1,815**	**1,780**	**1,687**	**1,691**	**1,769**

Source: ENVIROS, s. r. o.

Fig. 4 Domestic consumption of primary energy sources



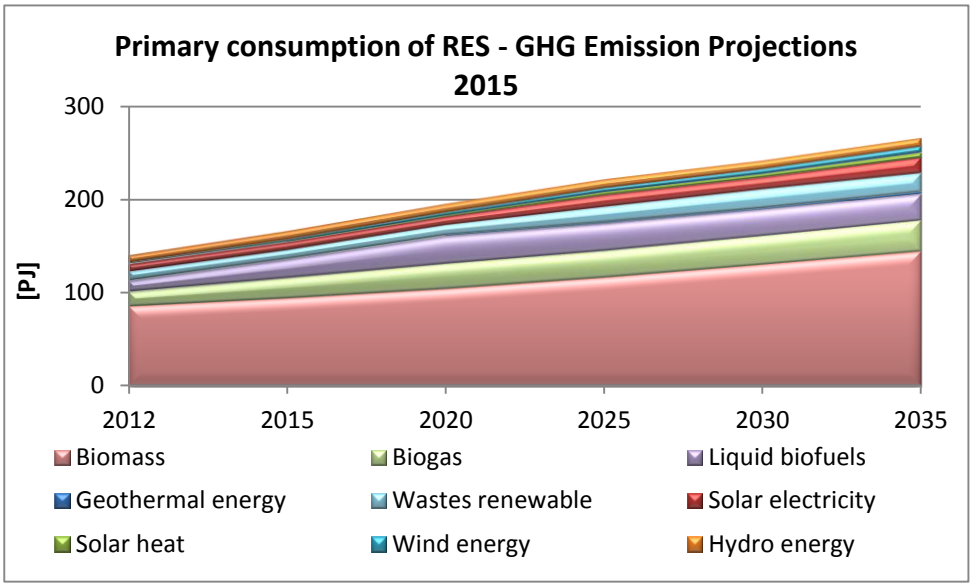
Source: ENVIROS, s. r. o.

Tab. 20 Domestic consumption of renewable energy sources

Domestic consumption of renewable energy sources [PJ]	2012	2015	2020	2025	2030	2035
Biomass	86.1	94.6	104.7	116.6	130.4	144.6
Biogas	15.7	22.1	27.1	28.8	31.1	33.5
Liquid biofuels	11.5	19.7	29.1	29.1	28.1	28.1
Geothermal energy	0.0	0.0	0.7	1.0	1.2	1.7
Wastes renewable	10.6	10.4	11.7	16.9	20.3	20.3
Solar electricity	7.7	8.2	8.7	12.8	12.8	17.0
Solar heat	0.6	0.8	1.4	3.0	3.5	5.0
Wind energy	1.4	2.3	3.6	4.8	5.8	7.0
Hydro energy	7.7	8.9	9.1	9.1	9.1	9.1
TOTAL	**141.3**	**167.0**	**196.1**	**222.1**	**242.3**	**266.3**

Source: ENVIROS, s. r. o.

Fig. 5 Domestic consumption of renewable energy sources



Source: ENVIROS, s. r. o.

Since we expect economic recovery after the recession period, the total domestic consumption of primary energy sources (PES) will increase between years 2012 and 2015. The energy saving tendency will overweight 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 proposed Update of the State Energy Concept [33]. The biggest role among RES plays and will play biomass.

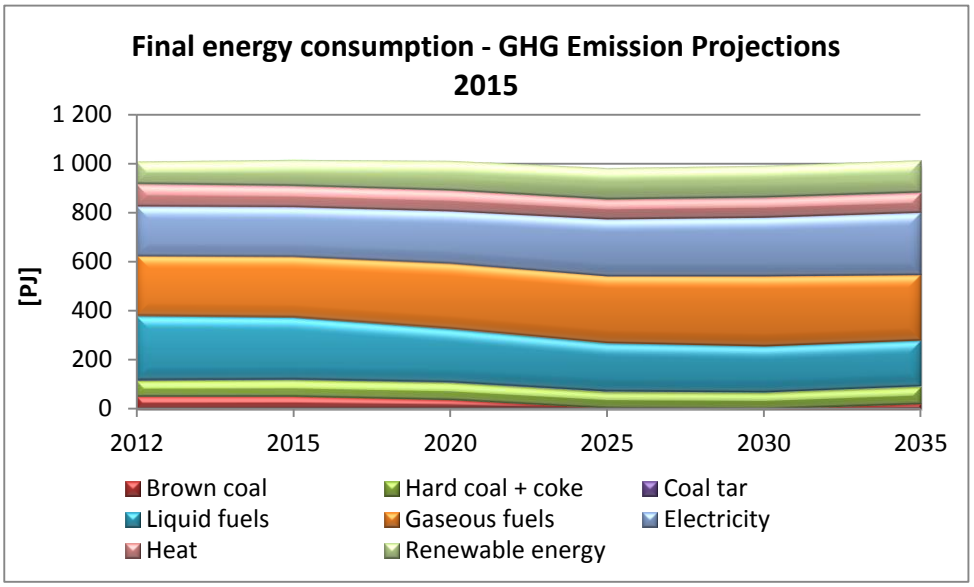
2.1.4.1.2 Final energy consumption

Tab. 21 Final energy consumption

Final energy consumption [PJ]	2012	2015	2020	2025	2030	2035
Brown coal	51	51	38	5	6	22
Hard coal + coke	64	66	69	66	66	70
Coal tar	3	3	2	1	1	2
Liquid fuels	261	252	217	196	188	186
Gaseous fuels	246	250	268	277	281	268
Electricity	204	204	215	232	242	255
Heat	89	84	83	80	80	80
Wastes non-renewable	1	1	1	1	1	1
Renewable energy	89	103	118	123	126	128
TOTAL	**1,007**	**1,014**	**1,010**	**980**	**990**	**1,013**

Source: ENVIROS, s. r. o.

Fig. 6 Final energy consumption



Source: ENVIROS, s. r. o.

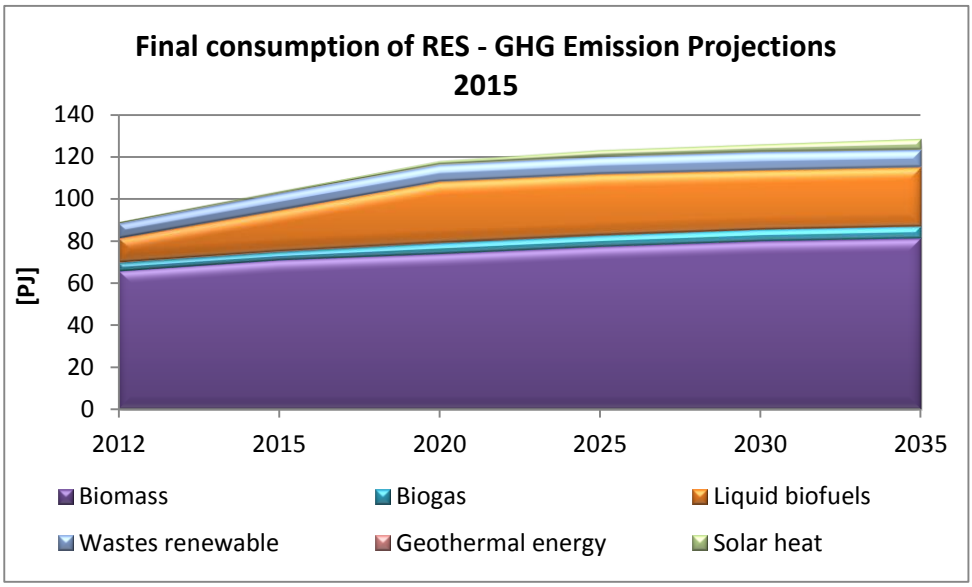
The final energy consumption was strongly influenced by the economical recession starting in the year 2008. Therefore, we expect that the improving energy efficiency will be compensated by the economic revival, start of which we observe now in 2014. The likely small energy consumption growth in tertiary and industrial sectors will partially offset a decline in the energy consumption in households sector, as shown in the following paragraphs. The resulting figure exhibits more or less stable final energy consumption.

Tab. 22 Final consumption of renewable energy

Final consumption of RES [PJ]	2012	2015	2020	2025	2030	2035
Biomass	65.8	71.0	73.9	77.2	79.8	81.2
Biogas	4.2	4.1	5.2	5.5	5.6	5.8
Liquid biofuels	11.5	19.7	29.1	29.1	28.1	28.1
Wastes renewable	7.0	7.9	8.0	8.1	8.5	8.1
Solar heat	0.6	0.8	1.4	3.0	3.5	5.0
TOTAL	**89.1**	**103.4**	**117.6**	**122.8**	**125.5**	**128.1**

Source: ENVIROS, s. r. o.

Fig. 7 Final consumption of renewable energy



Source: ENVIROS, s. r. o.

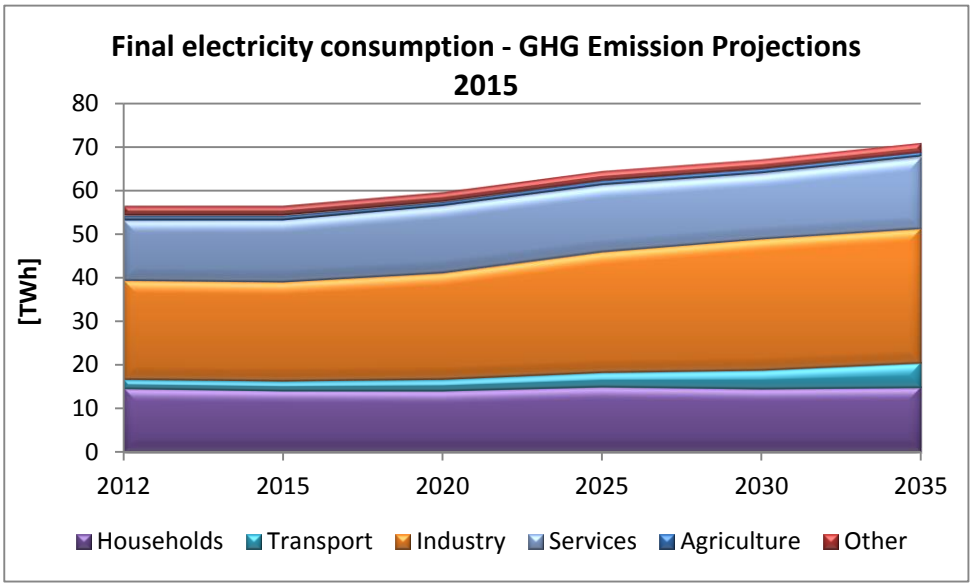
As regards RES, we see an increased use of liquid biofuels in transport in the period 2012 – 2020. Steady but slow growth we can observe in final consumption of biomass and solar heat.

Tab. 23 Final consumption of electricity

Final electricity consumption [TWh]	2012	2015	2020	2025	2030	2035
Households	14.6	14.2	14.1	15.0	14.5	14.8
Transport	2.2	2.2	2.7	3.4	4.3	5.7
Industry	22.7	22.7	24.4	27.7	30.1	30.8
Services	13.9	14.3	15.4	15.3	15.0	16.4
Agriculture	1.0	0.9	0.9	1.0	1.0	1.0
Other	2.2	2.2	2.2	2.2	2.2	2.2
TOTAL	**54.4**	**54.4**	**57.6**	**62.3**	**65.0**	**68.7**

Source: ENVIROS, s. r. o.

Fig. 8 Final consumption of electricity



Source: ENVIROS, s. r. o.

Electricity consumption is expected to grow in almost all sectors after the temporary decline caused by the economical crisis. The Czech Republic has a lower share of electricity in both the economy and households in comparison with more developed countries and electricity consumption will grow despite the improving energy efficiency.

Tab. 24 Final energy consumption of households

Final energy consumption in households [PJ]	2012	2015	2020	2025	2030	2035
Brown coal	18.9	16.8	9.8	1.4	1.0	1.9
Hard coal	3.6	3.7	3.9	4.3	3.6	2.2
Coke	0.6	0.9	0.9	0.9	0.8	0.5
Liquefied petroleum gas	0.2	0.1	0.1	0.0	0.0	0.0
Natural gas	84.7	85.2	84.5	74.8	67.2	62.9
Electricity	52.5	51.2	50.8	53.9	52.4	53.3
Heat	43.5	40.3	38.3	38.1	37.5	36.8
Biomass	47.8	51.6	53.4	56.4	58.3	59.4
Solar heat	0.4	0.5	0.9	1.5	2.5	4.0
TOTAL	**252.1**	**250.3**	**242.4**	**231.3**	**223.3**	**221.1**

Source: ENVIROS, s. r. o.

Households represent a sector with the strongest decline of final energy consumption. The main cause of this tendency is rapid insulation and revitalization of panel and other collective houses. With the current tempo we may expect this insulation process will be finished between years 2015 – 2020. After 2015 the new building standards will drive further decline of energy consumption in households. About 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 despite increasing efficiency of appliances supposed to grow because of lower appliances ownership ratios in comparison with more developed countries.

Tab. 25 Final energy consumption of industry

Final energy consumption in industry [PJ]	2012	2015	2020	2025	2030	2035
Brown coal	30.5	32.9	27.8	3.4	5.0	19.6
Hard coal	16.7	16.3	17.3	13.0	12.7	17.4
Coke	42.7	44.3	46.1	46.7	47.9	49.0
Coal tar	2.7	3.0	2.0	1.1	1.1	1.8
Diesel fuel	2.7	2.8	2.9	3.1	3.3	3.3
Fuel oils	1.9	3.7	4.0	3.7	4.2	3.3
Liquefied petroleum gas	1.1	0.6	0.3	2.3	0.0	0.0
Other liquid fuels	7.8	4.5	2.8	2.8	0.6	0.0
Natural gas	84.9	84.5	87.4	98.3	95.5	83.3
Coke oven gas	4.8	4.6	5.1	5.0	4.9	4.8
Blast furnace gas	10.3	10.5	8.9	7.0	6.1	5.2
Other gaseous fuels	1.1	1.1	0.7	0.4	0.2	0.0
Electricity	81.7	81.8	87.9	99.7	108.2	111.0
Heat	26.9	24.8	25.6	22.8	23.4	23.8
Biomass	17.2	18.4	19.6	19.7	20.0	20.2
Biogas	0.1	0.2	0.2	0.2	0.2	0.2
Wastes renewable	6.0	6.7	6.8	6.8	6.7	6.2
Solar heat	0.0	0.0	0.0	0.4	0.4	0.4
TOTAL	**339.1**	**340.6**	**345.3**	**336.3**	**340.4**	**349.4**

Source: ENVIROS, s. r. o.

Tab. 26 Final energy consumption of services

Final energy consumption in services [PJ]	2012	2015	2020	2025	2030	2035
Brown coal	0,8	0,9	0,3	0,0	0,0	0,1
Hard coal	0,1	0,2	0,2	0,2	0,2	0,2
Coke	0,2	0,3	0,4	0,5	0,5	0,5
Diesel fuel	0,3	0,4	0,3	0,1	0,5	0,0
Fuel oils	0,1	0,0	0,0	0,0	0,0	0,4
Natural gas	54,0	54,2	54,1	52,6	59,7	59,9
Electricity	50,1	51,5	55,5	55,0	54,0	59,0
Heat	18,2	18,0	18,1	18,3	18,2	19,0
Biomass	0,5	0,6	0,5	0,7	0,9	1,0
Biogas	1,0	1,1	1,2	1,1	1,0	1,1
Wastes renewable	1,0	1,2	1,2	1,3	1,8	1,9
Wastes non-renewable	0,6	0,5	0,8	0,5	0,8	1,2
Solar heat	0,1	0,3	0,5	1,0	0,5	0,9
TOTAL	**127,1**	**129,3**	**133,0**	**131,3**	**138,3**	**144,9**

Source: ENVIROS, s. r. o.

As services have the highest expected economic growth, the final energy consumption is likely to increase. The use of fossil fuels will rather stagnate and the increase will occur mainly in electricity use.

Tab. 27 Final energy consumption of agriculture

Final energy consumption in agriculture [PJ]	2012	2015	2020	2025	2030	2035
Brown coal	0.3	0.3	0.1	0.0	0.0	0.0
Hard coal	0.1	0.1	0.0	0.0	0.0	0.0
Coke	0.1	0.8	0.4	0.4	0.4	0.1
Diesel fuel	13.8	13.3	13.9	14.6	14.9	15.2
Fuel oils	0.1	0.1	0.0	0.0	0.0	0.0
Liquefied petroleum gas	0.1	0.1	0.1	0.0	0.0	0.0
Natural gas	2.1	1.9	1.4	1.1	1.1	1.2
Electricity	3.6	3.4	3.4	3.6	3.6	3.7
Heat	0.5	0.4	0.5	0.5	0.5	0.5
Biomass	0.4	0.3	0.4	0.4	0.7	0.7
Biogas	3.1	2.8	3.9	4.2	4.3	4.6
Solar heat	0.0	0.0	0.0	0.1	0.1	0.1
TOTAL	**24.2**	**23.5**	**24.1**	**24.9**	**25.5**	**25.9**

Source: ENVIROS, s. r. o.

The final energy consumption of stationary facilities in agriculture is expected to slightly decline. The consumption of mobile sources will likely grow with expected introduction of planting energy biomass.

Tab. 28 Final energy consumption of transport

Final energy consumption in transport [PJ]	2012	2015	2020	2025	2030	2035
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
TOTAL	**253.2**	**258.5**	**254.1**	**245.2**	**251.1**	**259.8**

Source: ENVIROS, s. r. o.

The final energy consumption of transport will more or less stagnate as a result of trade-off between increasing mobility and improving energy efficiency of transport means.

2.1.4.1.3 Electricity generation

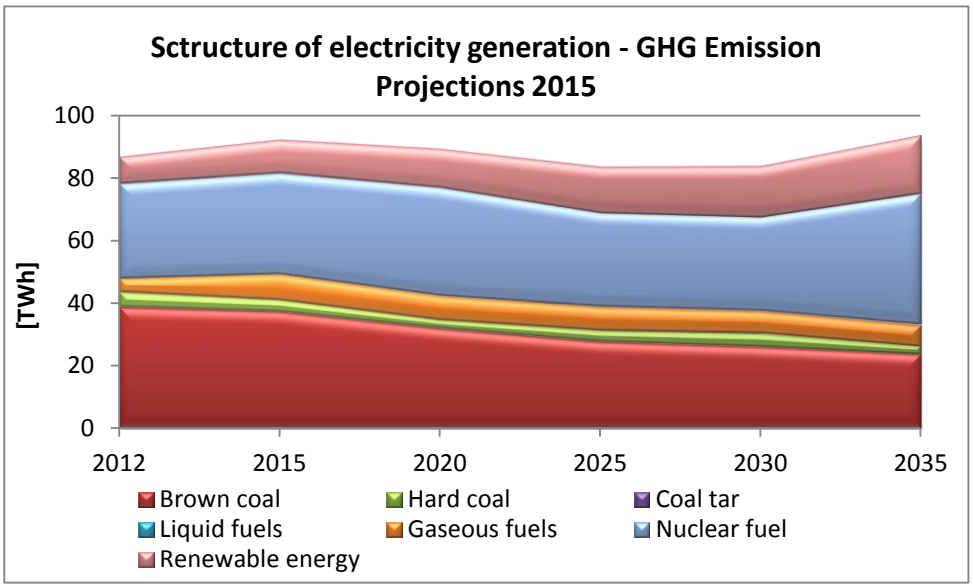
Tab. 29 Structure of electricity generation

Structure of electricity generation [TWh]	2012	2015	2020	2025	2030	2035
Brown coal	38.77	37.30	31.94	27.76	26.08	23.74
Hard coal	4.75	3.76	2.89	3.67	4.41	2.79
Coal tar	0.00	0.00	0.00	0.14	0.23	0.00
Liquid fuels	0.13	0.03	0.03	0.02	0.02	0.01
Gaseous fuels	4.24	8.22	7.64	7.37	6.89	6.73
Nuclear fuel	30.33	32.29	34.55	30.03	30.03	41.93
Wastes non-renewable	0.05	0.06	0.04	0.06	0.05	0.03
Renewable energy	8.58	10.58	12.21	14.69	16.22	18.41
TOTAL	**86.85**	**92.24**	**89.31**	**83.74**	**83.93**	**93.64**

Source: ENVIROS, s. r. o.

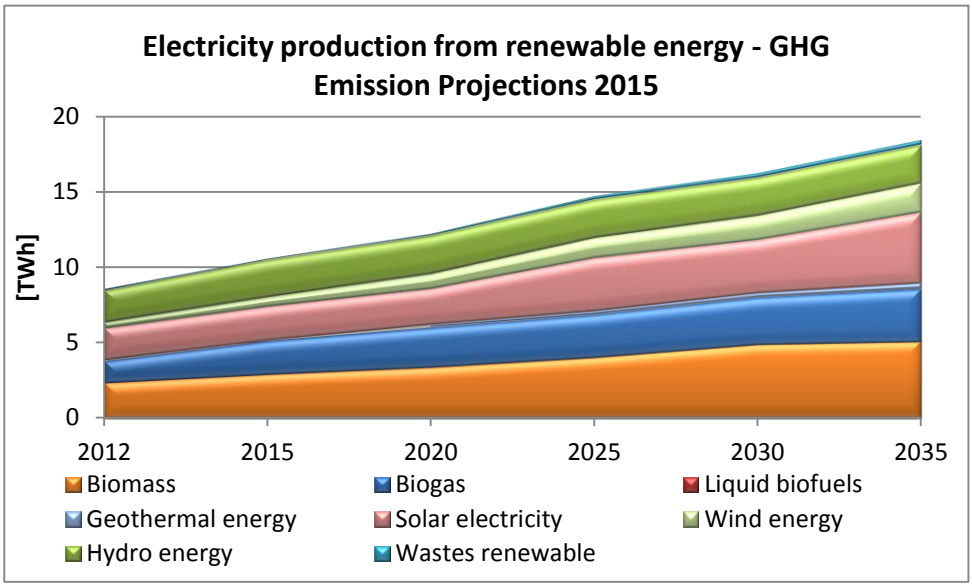
The total electricity generation does not copy the growing shape of final electricity consumption due to fluctuations of electricity exports (see Tab. 33). Currently, there is a generation overcapacity utilized for electricity exports. The decreasing coal production and severe emission legislation will cause decommissioning or modernization of many coal units and fluctuations and decrease of electricity exports. 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. There is a temporary increase of electricity generation in nuclear power plants due to partial overlap of introduction of new units and decommissioning the old ones about the year 2035.

Fig. 9 Structure of electricity generation



Source: ENVIROS, s. r. o.

Fig. 10 Electricity generation from renewable energy



Source: ENVIROS, s. r. o.

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 grows of photovoltaic power plants caused a big 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" from the draft of Update of the State Energy Concept [33].

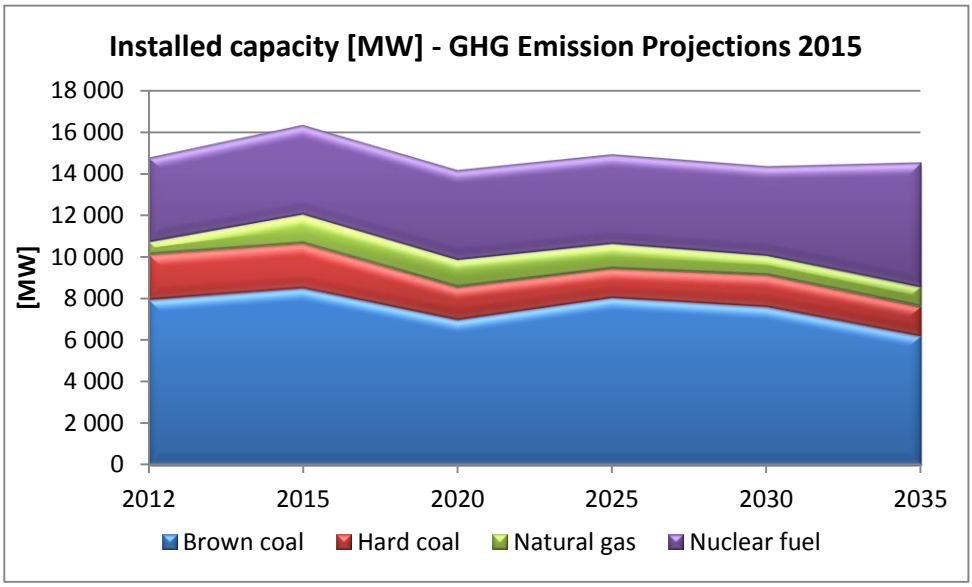
Tab. 30 Installed capacities in public and industrial power plants

Capacity [MW]	2012	2015	2020	2025	2030	2035
Brown coal	7,927	8,487	6,981	8,033	7,592	6,188
Hard coal	2,182	2,162	1,578	1,410	1,544	1,439
Natural gas	626	1,410	1,335	1,209	948	948
Nuclear fuel	4,040	4,290	4,290	4,290	4,290	5,990

Source: ENVIROS, s. r. o

The installed capacities for electricity generation shown on two following figures correspond with the electricity production described above.

Fig. 11 Installed capacities in public and industrial power plants



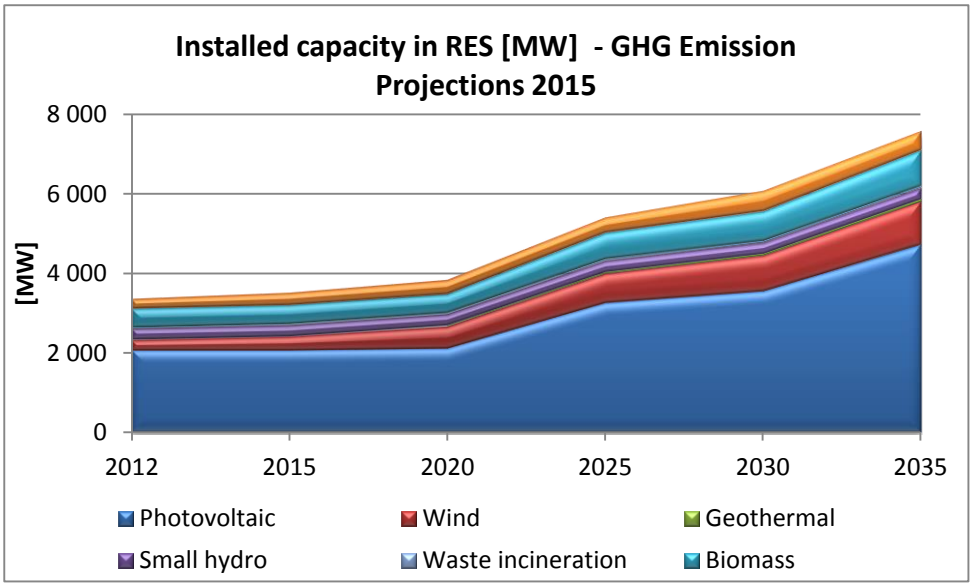
Source: ENVIROS, s. r. o.

Tab. 31 Installed capacity of power plants using renewable energy

Capacity [MW]	2012	2015	2020	2025	2030	2035
Photovoltaic	2,086	2,086	2,130	3,270	3,558	4,726
Wind	263	350	550	736	896	1,081
Geothermal	0	0	28	40	48	67
Small hydro	281	281	281	281	281	281
Waste incineration	20	20	21	36	43	43
Biomass	480	480	480	666	741	905
Biogas	238	306	359	384	515	474

Source: ENVIROS, s. r. o.

Fig. 12 Installed capacity of power plants using renewable energy



Source: ENVIROS, s. r. o.

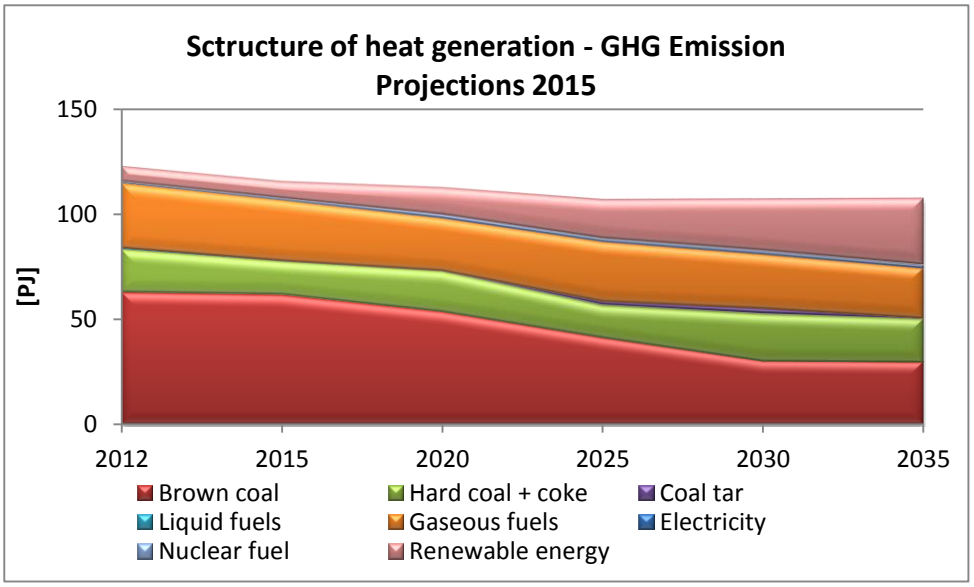
2.1.4.1.4 District heat generation

Tab. 32 Structure of district heat generation

Structure of heat generation [PJ]	2012	2015	2020	2025	2030	2035
Brown coal	62.9	61.7	53.7	41.5	30.5	30.0
Hard coal + coke	20.2	15.8	19.2	15.5	22.4	20.7
Coal tar	0.0	0.0	0.0	1.5	2.4	0.0
Liquid fuels	0.9	0.4	0.3	0.2	0.0	0.0
Gaseous fuels	30.7	28.9	25.1	28.5	25.9	24.0
Nuclear fuel	1.0	1.0	1.9	1.7	1.7	1.7
Wastes non-renewable	0.9	1.2	1.3	1.0	0.8	1.1
Renewable energy	7.4	8.0	12.9	18.6	24.7	31.7
TOTAL	**124.0**	**117.1**	**114.4**	**108.4**	**108.5**	**109.1**

Source: ENVIROS, s. r. o.

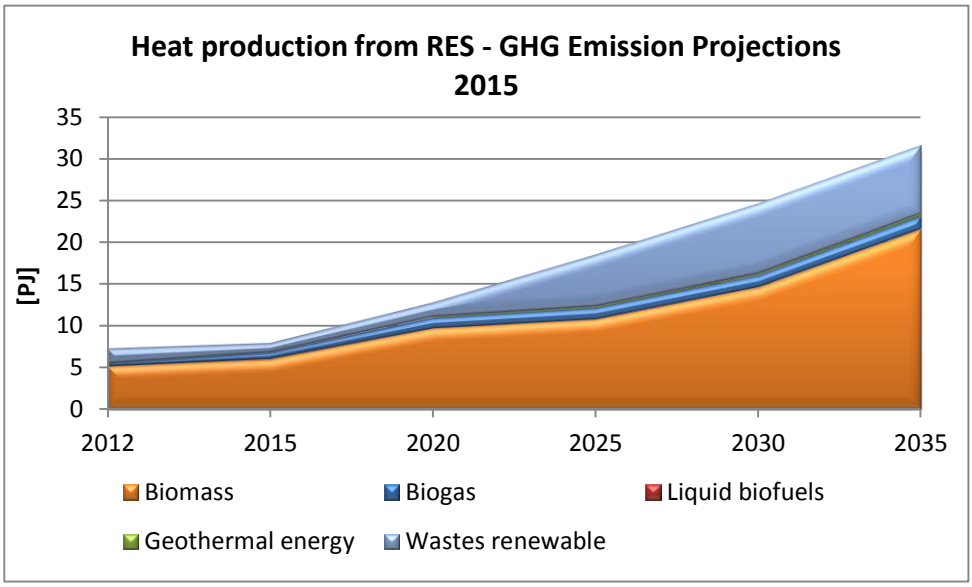
Fig. 13 Structure of district heat generation



Source: ENVIROS, s. r. o.

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

Fig. 14 District heat generation from renewable energy



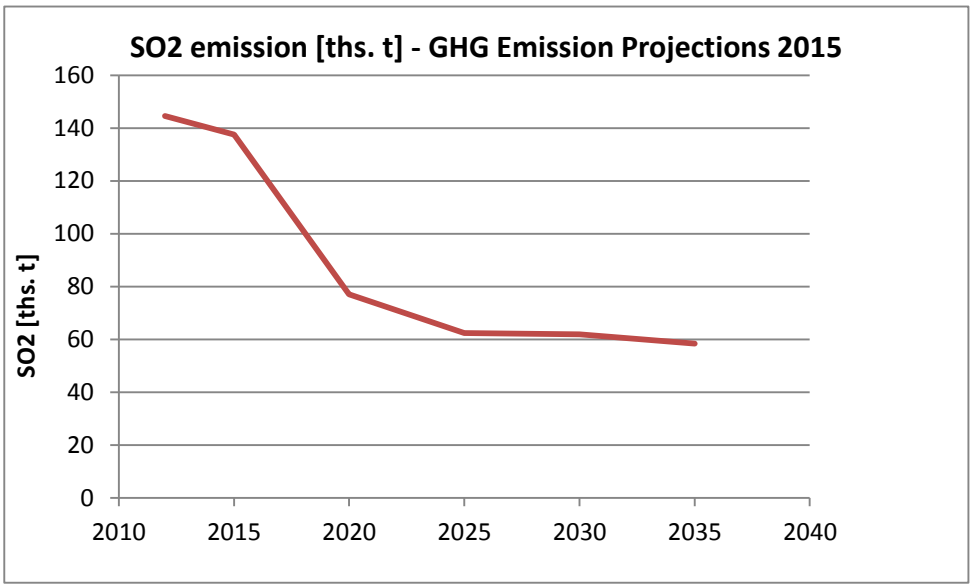
Source: ENVIROS, s. r. o.

Contrary to electricity generation, the RES share in heat generation has the fastest growth after the year 2020 with biomass being the main driver. The increasing amount of biomass will likely be covered by energy crops and plants.

2.1.4.1.5 Emissions of SO_2 and NO_X

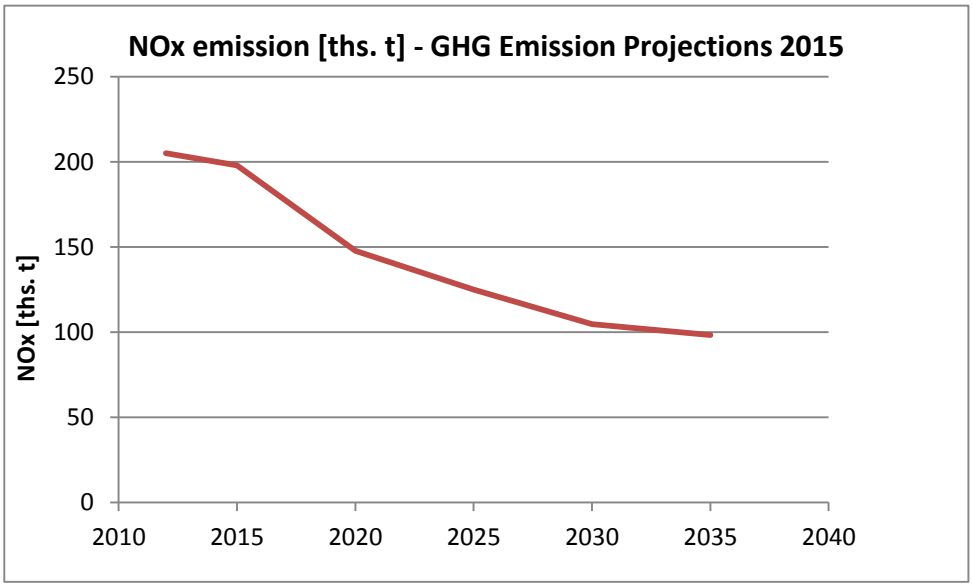
Emissions of both SO_2 and NO_X are influenced by two factors – decreasing share of coal and fossil fuels in the energy mix and new strong regulations resulting from the recast of the IPPC directive.

Fig. 15 Emissions of SO_2



Source: ENVIROS, s. r. o.

Fig. 16 Emissions of NO_X



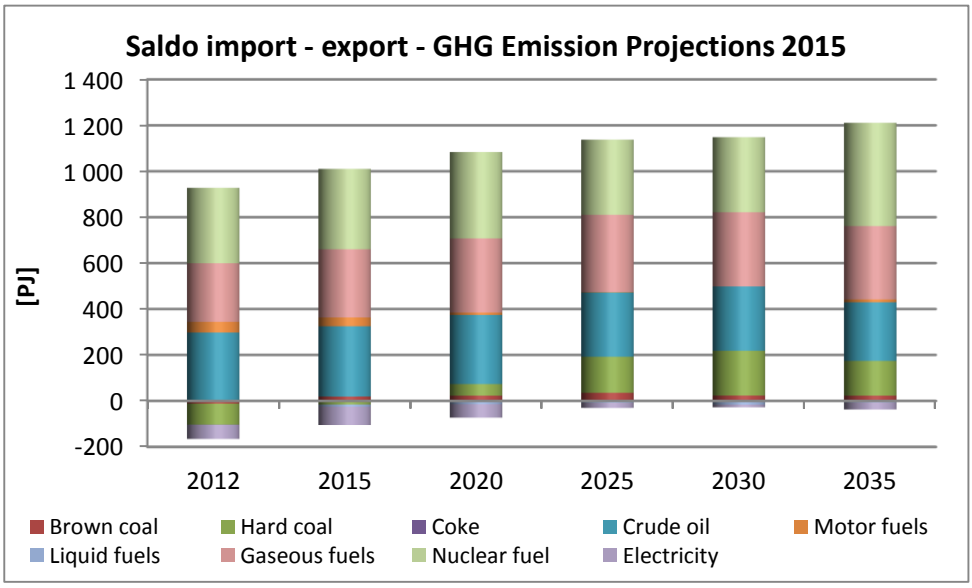
Source: ENVIROS, s. r. o.

Tab. 33 Net energy imports

Saldo import - export [PJ]	2012	2015	2020	2025	2030	2035
Brown coal	-11	19	23	35	23	23
Hard coal	-92	-15	50	157	195	151
Coke	0	0	0	0	0	0
Coal tar	9	11	12	12	12	12
Crude oil	298	306	301	280	280	255
Motor fuels	46	39	10	2	-3	12
Liquid fuels	0	-9	-14	-8	-12	-7
Non-energy products	9	13	14	15	14	15
Gaseous fuels	255	296	323	336	323	320
Nuclear fuel	328	350	376	327	327	449
Electricity	-61,6	-80,1	-58,9	-22,3	-11,9	-29,9
Heat	-0,1	0,0	0,0	0,0	0,0	0,0
Biomass	-8,0	0,0	0,0	0,0	0,0	0,0
Liquid biofuels	-2,0	0,0	0,0	0,0	0,0	0,0
TOTAL	**771**	**930**	**1,037**	**1,135**	**1,147**	**1,201**

Source: ENVIROS, s. r. o.

Fig. 17 Net energy imports



Source: ENVIROS, s. r. o.

The import energy dependence of the Czech Republic will increase as the diminishing coal is the only important domestic non-renewable energy source. Current exports of coal will cease and there will remain small exports of oil products and electricity.

2.1.4.2 Fugitive Emissions

The calculation of fugitive emissions is based on results of the EFOM/ENV 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 coefficients from the latest GHG inventory were used and they are as follows:

Tab. 34 Emission coefficients for calculation of fugitive emissions

Category	Coefficient	Unit
Deep hard coal mines – CO_2	22.68	kg/t
Deep hard coal mines – CH_4	10.39	kg/t
Open brown coal mines – CH_4	0.84	kg/t
Crude oil mining – CO_2	30.00	kg/PJ
Crude oil cracking – CO_2	7,305	kg/PJ
Crude oil transmission – CO_2	0.00	kg/PJ
Crude oil mining – CH_4	13.26	kg/PJ
Crude oil cracking – CH_4	5,288	kg/PJ
Crude oil transmission – CH_4	1,150	kg/PJ
Natural gas mining – CO_2	146	kg/PJ
Natural gas transmission – CO_2	15.39	kg/PJ
Natural gas distribution – CO_2	26.76	kg/PJ
Natural gas leakages in heat and power plants – CO_2	450.89	kg/PJ

Category	Coefficient	Unit
Natural gas mining – CH_4	30,94	kg/PJ
Natural gas transmission – CH_4	38,649	kg/PJ
Natural gas distribution – CH_4	6,720	kg/PJ
Natural gas leakages in heat and power plants – CH_4	113,216	kg/PJ

Source: CRF table 2012

2.1.5 Industrial processes (sector 2)

A combined procedure with the EFOM/ENV model and a table processor was used for projections of trends in greenhouse gases emissions from industrial processes. The projection was concerned only with activities and emissions with a major contribution to greenhouse gas emissions. Other emissions and activities with a minor contribution to greenhouse gas emissions 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.

The main component of emissions from industrial processes, i.e. the metallurgy of ferrous metals, is dealt with directly in the EFOM/ENV optimization model.

Tab. 35 Projection of activity data for industrial processes

[kt]	2009	2010	2011	2012	2015	2020	2025	2030	2035
Clinker production	2,923	2,748	3,132	2,838	2,900	3,000	3,100	3,200	3,200
Lime production	853	915	943	830	850	850	850	850	850
Lime use	2,168	2,344	2,642	2,537	2,339	2,028	1,756	1,661	1,457
Soda Ash Use	0,995	2,073	2,559	2,620	2,600	2,600	2,600	2,600	2,600
Road Paving with Asphalt	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800	4,800
Glass production	1,329	1,023	1,381	1,058	1,100	1,200	1,200	1,200	1,200
Bricks an ceramics production	1,180	1,117	1,140	993	1,100	1,200	1,300	1,400	1,400
Ammonia production	264	257	230	239	250	250	250	250	250
Nitric acid production	505	442	562	550	550	550	550	550	550
Carbon black	0,30	0,30	0,30	0,30	0,30	0,30	0,30	0,30	0,30
Ethylene production	416	455	412	441	440	440	440	440	440
Dichlorethylene production	144	136	122	116	120	120	120	120	120
Styrene production	150	170	170	170	170	170	170	170	170
Kaprolaktam *)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Steel production	4,663	5,274	5,678	5,164	5,400	5,400	5,400	5,400	5,400
Pig iron production	3,490	3,987	4,137	3,935	4,100	4,100	4,100	4,100	4,100
Sinter production	4,309	4,628	5,148	5,089	4,800	4,800	4,800	4,800	4,800
Metallurgic coke	2,295	2,548	2,586	2,467	2,860	2,255	2,335	2,970	2,166

[kt]	2009	2010	2011	2012	2015	2020	2025	2030	2035
production									

Source: CRF tables 2009 – 2012, Czech Statistical Office, ENVIROS, s. r. o.

*) Only total N_2O emissions are available from the CRF tables.

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

Tab. 36 Emission coefficients for industrial processes

[t/t]	emission coefficient		
	CO_2	CH_4	N_2O
Clinker production	0.53462		
Lime production	0.73321		
Lime use	0.43584		
Soda Ash Use	0.41500		
Road Paving with Asphalt			
Glass production	0.14000		
Bricks an ceramics production	0.10718	0.00014	
Ammonia production	2.40219		
Nitric acid production			0.00250
Carbon black		0.01100	
Ethylene production		0.00100	
Dichlorethylene production		0.00040	
Styrene production		0.00400	
Kaprolaktam			N/A
Steel production	1.01667		
Pig iron production		0.00018	
Sinter production		0.00012	
Metallurgic coke production		0.00050	

Source: CRF table 2012

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 CR. 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. 37 Projection of use of fluorinated gases [t]

Gas	Usage	2005	2010	2012	2015	2020	2025	2030	2035
C2F6	Domestic Refrigeration	0,016	0,033	0,031	0,044	0,062	0,049	0,031	0,019
C3F8	Domestic Refrigeration	0,765	0,949	0,742	0,263	0,026	0,002	0,000	0,000
C6F14	Domestic Refrigeration	0,025	0,034	0,019	0,006	0,001	0,000	0,000	0,000
HFC-125	Domestic Refrigeration	35,1	200,2	256,9	247,2	183,5	126,7	88,0	61,8

Gas	Usage	2005	2010	2012	2015	2020	2025	2030	2035
HFC-134a	Domestic Refrigeration	134,0	197,7	206,6	190,3	134,6	93,0	64,7	45,0
HFC-143a	Domestic Refrigeration	32,15	61,86	70,83	72,11	48,66	41,82	31,37	22,94
HFC-152a	Domestic Refrigeration	2,108	1,243	0,838	0,459	0,120	0,031	0,001	0,001
HFC-227ea	Domestic Refrigeration	0,006	0,082	0,215	0,145	0,024	0,013	0,000	0,000
HFC-23	Domestic Refrigeration	0,244	0,327	0,349	0,385	0,261	0,242	0,189	0,161
HFC-245ca	Domestic Refrigeration	0,000	0,073	0,281	0,322	0,283	0,323	0,308	0,300
HFC-32	Domestic Refrigeration	4,5	139,0	184,6	201,0	140,6	99,6	68,6	47,8
HFC-125	Mobile Air-Conditioning	0,119	2,653	5,248	6,165	5,435	3,852	2,703	1,875
HFC-134a	Mobile Air-Conditioning	130,0	356,2	473,4	458,8	446,0	315,7	220,8	153,5
HFC-143a	Mobile Air-Conditioning	0,00	4,92	7,85	10,07	10,12	10,18	10,22	10,22
HFC-23	Mobile Air-Conditioning	0,000	0,004	0,004	0,005	0,000	0,000	0,000	0,000
HFC-32	Mobile Air-Conditioning	0,047	0,947	1,016	1,005	0,963	0,703	0,477	0,333
HFC-134a	Hard Foam	2,626	2,035	1,856	1,617	1,284	1,020	0,810	0,644
HFC-227ea	Hard Foam	0,005	0,032	0,029	0,025	0,020	0,016	0,013	0,010
HFC-245ca	Hard Foam	0,050	0,016	0,015	0,013	0,010	0,008	0,006	0,005
C3F8	Fire Extinguishers	0,004	0,004	0,004	0,003	0,003	0,002	0,002	0,001
HFC-227ea	Fire Extinguishers	0,229	1,835	2,268	2,259	2,891	3,210	3,266	3,310
HFC-236fa	Fire Extinguishers	1,601	2,936	3,313	3,669	4,312	4,414	4,426	4,436
HFC-134a	Metered Dose Inhalers	7,600	6,150	2,388	6,250	6,250	6,250	6,250	6,250
HFC-134a	Solvents	0,438	0,000	0,525	0,000	0,000	0,000	0,000	0,000
C2F6	Semiconductor Manufacture	0,439	3,199	0,100	0,955	0,955	0,955	0,955	0,955
SF6	Electrical Equipment	3,210	2,772	3,739	3,330	3,330	3,330	3,330	3,330
SF6	Sound-proof windows	0,700	0,147	0,144	0,140	0,133	1,405	0,905	0,000

Source: CRF tables 2005 – 2012 ENVIROS, s. r. o.

2.1.6 Solvent and Other Product Use (sector 3)

We can observe a remarkable decrease of solvents use in “Degreasing and Dry cleaning” and continuous decrease in “Paint application” and “Chemical Products, Manufacture and Processing”. We expect further decrease of solvents use in all three mentioned applications. As regards N_2O use for anesthesia and in aerosol cans, we forecast keeping the today’s figures.

Tab. 38 Projection of activity data for production and use of solvents and paints

[kt]	2010	2011	2012	2015	2020	2025	2030	2035
A. Paint Application	33.52	30.85	30.87	30.91	26.85	22.72	18.59	14.47
B. Degreasing and Dry Cleaning	13.91	8.89	8.38	7.87	7.36	6.85	6.33	5.82
C. Chemical Products, Manufacture and Processing	13.30	14.33	12.20	12.90	12.28	11.67	11.05	10.43
D. Other								
1. Use of N_2O for Anesthesia	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
2. N_2O from Fire Extinguishers								
3. N_2O from Aerosol Cans	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
4. Other Use of N_2O								

Source: CRF tables 2000 – 2012, ENVIROS, s. r. o.

The implied emission coefficient of 3.14286 kg/t 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. The political and economical changes also brought about changes in Czech farming. During time period 1990-2012 emission decreased by almost 50 % [25].

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 annual harvest production.

The projections of emissions in Agriculture retain the trend in emissions from the 1990-2012 period [25], 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).

2012, for which the last emission inventory is available, was chosen as the base year. The projection years are 2015, 2020, 2025 and 2030. The scenario with measures includes the measures implemented in the 2000-2012 period.

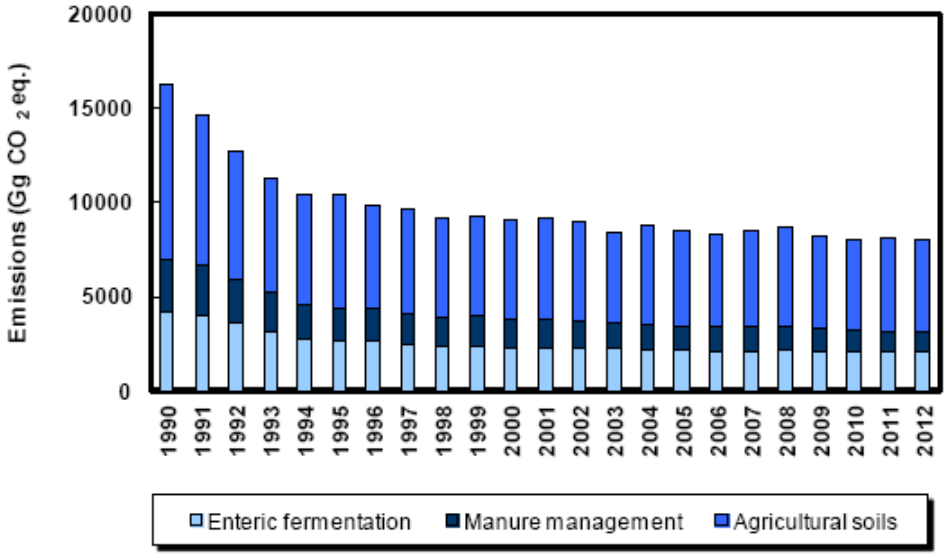
Definition of scenario WEM: Existing policies are those which have been either adopted or implemented as of 2012 and are assumed to continue in the WEM scenario.

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. After adoption, these policies and measures would generate impacts which are additional to the impacts already reflected in the WEM scenario. The scenario with additional measures includes the measures and policies planned for implementation after 2012. For example, new practices implemented within the CAP EU (Strategy Europe 2020), new conceptual material Strategy for Growth (Czech agriculture after 2013) and new rules related to Nitrates Directives etc.

Expert judgments of MA and IFER experts 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 reports “Vision of Czech agriculture up to 2010” and mainly new material “Strategy for growth”, which formulates common and specified 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. 18 The emission trend in agricultural sector during reporting period 1990-2012



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 1990-2012 period (cattle by more than 60 %), in the future, we can expect an increase in this emission source. An increase of dairy and suckler cows is expected. The persistent decline in swine numbers is induced and sustained by import, this trend would be changed. Foreign trade has a great effect on home production and swine farming and

management (major imports of pork). Also moderate increase in goat, sheep and horse breeding is expected. The growth of animal population is recommended by conceptual material of Ministry of Agriculture (Strategy for growth, 2014), the main objective is to ensure food self-sufficiency of Czech Republic.

The following table gives the reported (1990, 2012) and forecast (2015, 2020, 2025, 2030) 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 GPG IPCC methodology (1996, 2000 and 2007) and the emission categories are linked to the CRF format.

Tab. 39 Activity data – animal population (thous. of heads)

	1990	**2012**	**2015**	**2020**	**2025**	**2030**
Cattle	3 532	1 354	1 380	1 450	1 500	1 600
Swine	4 790	1 579	1 650	2 000	2 600	3 200
Sheep	430	221	225	250	280	300
Goats	41	24	28	30	35	35
Horses	27	33	36	40	42	45
Poultry	31 971	20 691	24 000	25 000	27 000	27 000

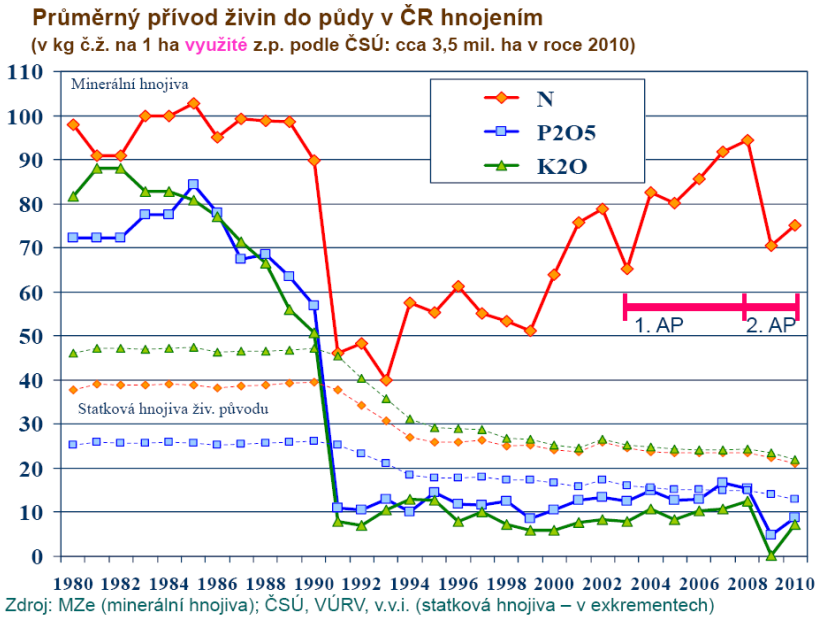
Source: 1990, 2012 – CSO data; 2015, 2020, 2025 and 2030 – estimated by MA

2.1.7.2 Nitrous oxide emissions

The total emissions from agricultural soils decreased by 45 % in the 1990-2012 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).

Fig. 19 ***Application of fertilizers in Czech Republic. Nitrogen fertilizers are marked by red line. Red line segments present the First and Second Action Plans.***



The areas vulnerable in relation to nitrogen covered 49 % of agricultural land in 2011. A decrease in indirect N_2O emissions from nutrient leaching can be anticipated following the implementation of appropriate policies and measures (GAEC and the Nitrates Directive 91/676/EEC and Czech Regulation No.103/2003).

The following tables give the reported (1990, 2012) and forecast (2015, 2020, 2025 and-2030) 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 GPG IPCC methodology (1996, 2000 and 2007) and the emission categories are linked to the CRF format.

Tab. 40 Activity data – application of fertilizers (t)

	1990	2012	2015	2020	2025	2030
Fertilizer application (t)	418 144	248 024	240 000	230 000	215 000	200 000

Tab. 41 Activity data – annual harvests (kt)

	1990	2012	2015	2020	2025	2030
Crops (cereals)	8947	6595	7000	6500	6000	6000
Pulses	152	39	40	45	50	50
Soya	41672	13	14	15	20	20
Potatoes	1755	662	600	650	700	700
Sugar beet	4026	3869	3800	3900	4000	4000
Clover	1344	320	330	350	400	400
Alfalfa	1088	405	440	450	500	500

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 (IPCC 2003, IPCC 2006). 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 actual development of six major IPCC land use categories as reported in the Czech emission inventory (NIR 2014) for the reporting period since 1990 to 2012. The projections beyond 2012 are based are on the observed trends and anticipation of gradually less intensive land use changes until 2030. The historical and projected land use areas are shown in and Fig. 20 below. No dramatic changes are foreseen. There is a slight increase of forest, grassland and wetland land use categories, while the area of cropland would decrease. That particular change 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 between the reference year 2015 and 2030, the end year of the projection period. During that time, the area share of cropland would decrease from 41.2 % to 40.6 % (Fig. 21), which means a loss of 45 th. hectares 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 2030 (Fig. 20).

Tab. 42 Land use areas (all in kha): reported until 2012, projected until 2030

			Year									
Land use category	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2015**	**2020**	**2025**	**2030**
Forest Land	2647	2649	2651	2653	2655	2657	2660	2662	2665	2669	2671	2671
Cropland	974	976	978	980	983	986	989	992	1002	1022	1043	1063
Grassland	3286	3278	3271	3264	3256	3248	3240	3233	3213	3187	3165	3144
Wetlands	161	161	162	163	163	163	163	164	165	166	166	166
Settlements	712	714	717	720	722	725	727	729	734	735	735	736
Other Land	107	107	107	107	107	107	107	107	107	107	107	107

Source: NIR 2012, IFER

Fig. 20 Actual areas of the major IPCC land use categories in the Czech Republic for the period 1970 to 2012 and the projected trends shown for the period until 2030

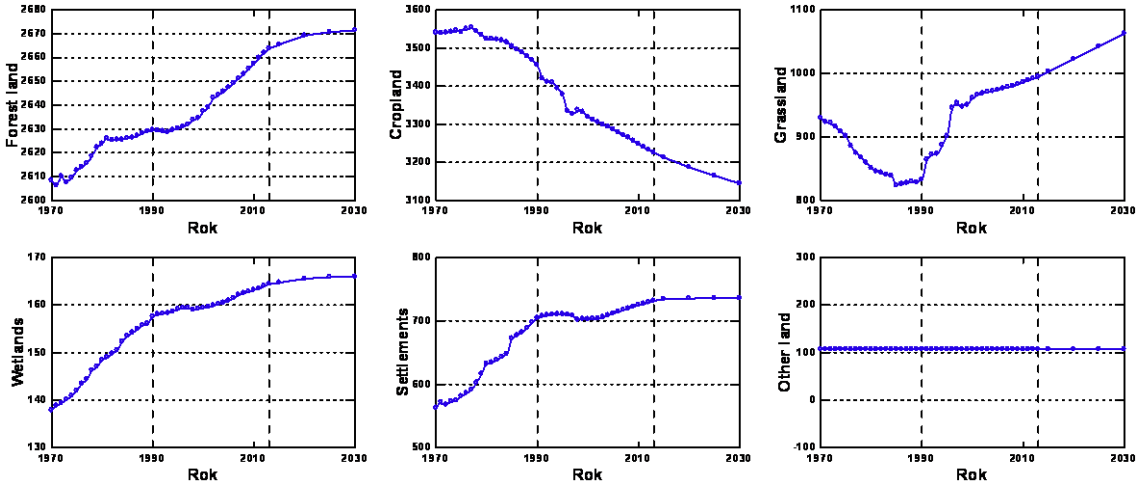
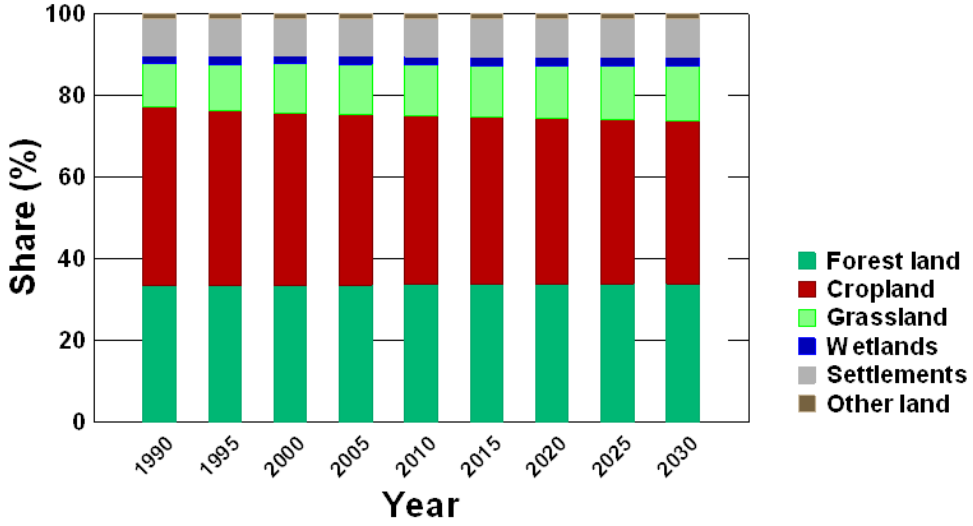


Fig. 21 Share of areas for the six IPCC land use categories in 5-year intervals since 1990 to 2030, using the actual data until 2012 (until year 2010 in graph) and projections until 2030.



2.1.8.2 Projection of emission estimates

Secondarily, following the setup of land use areas, the projection of emission estimates is prepared. The specific attention is given to forest land, which always represents one of the key emission categories in the Czech emission inventory. For this reason, the projections related to forestry are elaborated on the basis of scenario modelling using EFISCEN – the European Forest Information Scenario Model [28 – Sallnas 1990, 29 – Pussinen et al. 2001, 30 – Schelhaas et al. 2007] and 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 estimated emissions for the reference year linked exclusively to the corresponding land areas for the predicted years.

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 [OC10003; 31 – Cienciala 2012]. 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. The model EFISCEN, ver. 3.3 [30 – Schelhaas et al. 2007] was applied on matrices on 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 last known 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 [31 – Cienciala (2012)].

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. 42 and Fig. 20. That development of land areas and land use changes drives the emissions of the reference year (2012) in response to the projected are change for the individual land use categories with exception of CO_2 emissions from Forest Land. 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.

The WAM (With Additional Measures) scenario is similar to WEM. It differs in the applied EFISCEN model scenario for Forest Land and CO_2 emissions. 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. The proposed species change is driven by the actual management groups and by altitude of their locations. This is the essence of the recommendations of the currently elaborated 2nd National Forest Program (Key Action 6 - Cienciala, 2013).

2.1.9 Waste (sector 6)

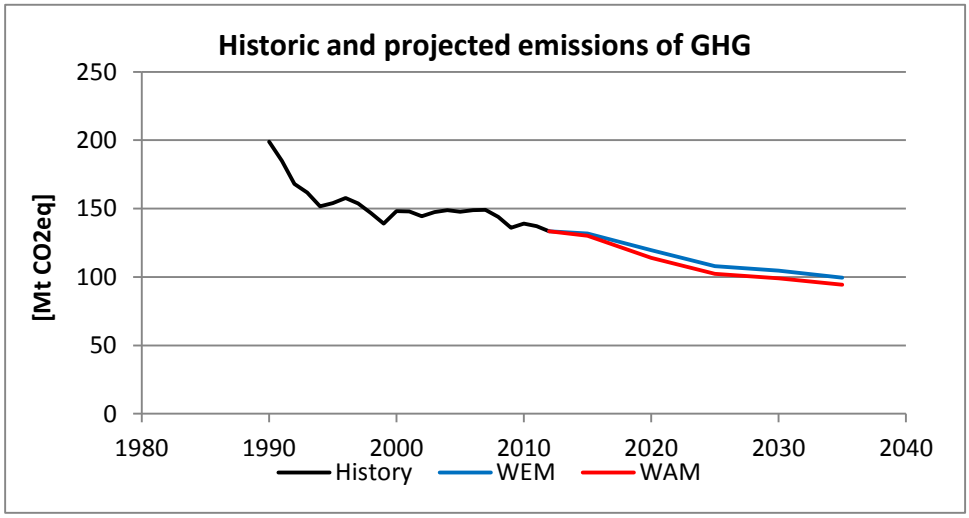
A waste sector projection contains four source categories - emissions from landfills, emissions from wastewater handling and emissions from waste incineration and emissions from biological treatment. For the landfill estimation we used first order decay model, for the other three sectors we used tier 1 methodology for the particular source sectors.

Activity data for the projections are various. Main socioeconomic drivers used for quantifications (population and GDP) are taken from the Czech statistical office. Subsequent activity data (e.g. capacity of incinerated waste, amount of captured LFG) are estimated in accordance with scenarios description and particular policy goals for the field.

2.2 Projections

2.2.1 Summary projections

Fig. 22 Historic and projected emissions of GHG (LULUCF excluded)



Tab. 43 Historic and projected emissions of GHG (LULUCF excluded) [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	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%

The projected decrease of GHG emissions between years 1990 and 2020 reaches 39.9 % in the scenario without measures. Implementation of additional measures would add another 3.0 % to this decrease. Between the years 2005 – 2030, the decrease amounts 28.0 % in the WEM scenario and 32.3 % in the WAM scenario.

Carbon dioxide is the dominant greenhouse gas and its share in the total GHG emissions was 83.4 % in 2012. 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, then they quite rapidly drop..

Tab. 44 Breakdown of historic and projected emissions of GHG by gases (LULUCF excluded) – 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	164,7	128,9	126,1	126,2	117,1	111,3	108,4	97,5	87,3	85,2	80,6	-40,8%	-48,3%	-22,7%	-32,4%
CH4	21,3	16,0	13,3	12,6	12,3	12,2	13,4	12,7	11,8	11,0	10,8	-40,6%	-48,5%	0,8%	-12,7%
N2O	13,0	9,0	8,4	8,2	7,4	7,4	7,5	7,4	7,3	7,3	7,3	-43,1%	-43,3%	-9,9%	-10,4%
HFC	0,00	0,00	0,20	0,68	1,95	2,42	2,38	1,92	1,41	1,03	0,75			180,6%	50,1%
PFC	0,00	0,00	0,00	0,01	0,05	0,01	0,01	0,01	0,01	0,01	0,01			0,7%	-4,3%
SF6	0,08	0,08	0,08	0,09	0,07	0,09	0,08	0,08	0,11	0,10	0,08	4,5%	27,8%	-11,4%	8,3%
Total	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%

Tab. 45 Breakdown of historic and projected emissions of GHG by gases (LULUCF excluded) – 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	164,7	128,9	126,1	126,2	117,1	111,3	107,3	93,0	83,1	81,2	77,0	-43,5%	-50,7%	-26,3%	-35,6%
CH4	21,3	16,0	13,3	12,6	12,3	12,2	13,0	12,0	10,9	9,8	9,6	-43,9%	-54,0%	-4,8%	-22,0%
N2O	13,0	9,0	8,4	8,2	7,4	7,4	7,3	7,1	6,9	6,8	6,8	-45,5%	-47,4%	-13,8%	-16,8%
HFC	0,00	0,00	0,20	0,68	1,95	2,42	2,38	1,92	1,41	1,03	0,75			180,6%	50,1%
PFC	0,00	0,00	0,00	0,01	0,05	0,01	0,01	0,01	0,01	0,01	0,01			0,7%	-4,3%
SF6	0,08	0,08	0,08	0,09	0,07	0,09	0,08	0,08	0,11	0,10	0,08	4,5%	27,8%	-11,4%	8,3%
Total	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%

The deciding amount of greenhouse gases is emitted from energy producing and consuming activities – 85.5 % in the year 2012. 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.

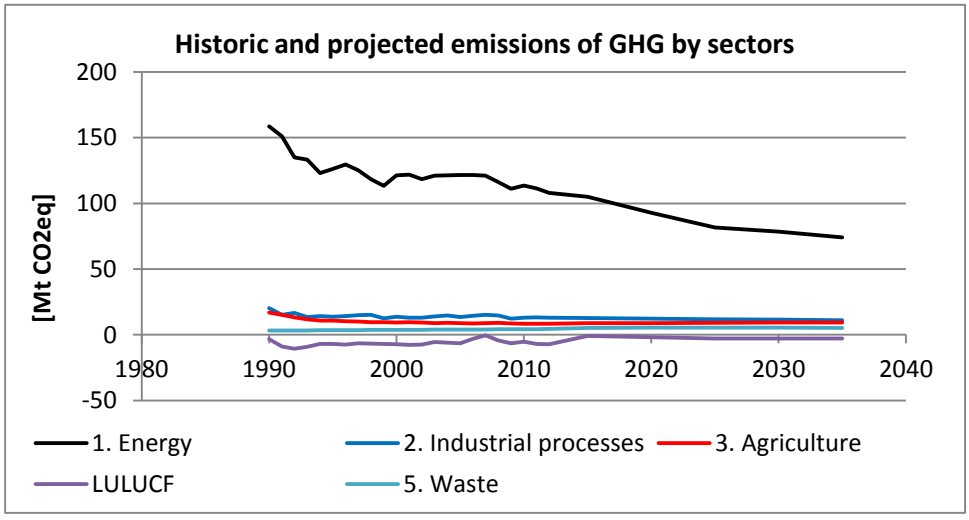
Tab. 46 Breakdown of historic and projected emissions of GHG by sectors – scenario with existing measures

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
1. Energy	158,6	126,1	121,2	121,5	113,4	107,9	105,0	92,9	81,7	78,5	74,0	-41,4%	-50,5%	-23,5%	-35,4%
2. Industrial processes	20,2	13,6	13,8	13,4	12,9	12,9	12,8	12,3	11,8	11,4	11,0	-39,0%	-43,6%	-8,1%	-15,0%
3. Agriculture	16,9	10,7	9,4	8,8	8,3	8,3	8,8	8,9	9,1	9,4	9,4	-47,2%	-44,5%	1,5%	6,7%
4. LULUCF	-3,4	-6,9	-7,3	-6,4	-5,2	-7,2	-0,9	-1,9	-2,9	-2,9	-2,9	-44,1%	-14,3%	-70,1%	-54,2%
5. Waste	3,3	3,5	3,6	3,9	4,3	4,4	5,2	5,4	5,4	5,4	5,3	63,4%	63,9%	36,6%	37,0%
Total including LULUCF	195,6	147,0	140,8	141,3	133,8	126,2	130,9	117,6	105,1	101,7	96,7	-39,9%	-48,0%	-16,7%	-28,0%

Tab. 47 Breakdown of historic and projected emissions of GHG by sectors – 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
1. Energy	158,6	126,1	121,2	121,5	113,4	107,9	103,9	88,3	77,4	74,4	70,3	-44,3%	-53,1%	-27,3%	-38,8%
2. Industrial processes	20,2	13,6	13,8	13,4	12,9	12,9	12,8	12,3	11,8	11,4	11,0	-39,0%	-43,6%	-8,1%	-15,0%
3. Agriculture	16,9	10,7	9,4	8,8	8,3	8,3	8,7	8,6	8,5	8,4	8,4	-49,1%	-50,2%	-2,0%	-4,3%
4. LULUCF	-3,4	-6,9	-7,3	-6,4	-5,2	-7,2	-1,0	-2,4	-3,5	-3,3	-3,3	-30,7%	-2,8%	-63,0%	-48,1%
5. Waste	3,3	3,5	3,6	3,9	4,3	4,4	4,6	4,7	4,8	4,7	4,6	44,3%	44,5%	20,6%	20,8%
Total including LULUCF	195,6	147,0	140,8	141,3	133,8	126,2	129,1	111,7	98,9	95,6	91,0	-42,9%	-51,1%	-21,0%	-32,3%

Fig. 23 Historic and projected emissions of GHG by sectors



2.2.2 Split of projections between EU-ETS and ESD sectors

Tab. 48 Split of projected ETS and ESD emissions in the WEM scenario

[Mt CO2eq]	2005	2006	2007	2008	2009	2010	2011	2012	2015	2020	2025	2030	2035	2005 - 2020	2005 - 2030
EU-ETS	82,45	83,62	87,83	80,40	73,79	75,58	75,34	70,27	67,95	59,57	53,30	51,83	46,71	-27,8%	-37,1%
ESD	65,23	65,20	61,20	63,60	62,22	63,37	61,89	63,18	63,83	59,99	54,71	52,83	52,90	-8,0%	-19,0%
Total	**147,69**	**148,83**	**149,03**	**144,00**	**136,01**	**138,95**	**137,23**	**133,46**	**131,78**	**119,56**	**108,02**	**104,66**	**99,61**	**-19,0%**	**-29,1%**

Tab. 49 Split of projected ETS and ESD emissions in the WAM scenario

[Mt CO2eq]	2005	2006	2007	2008	2009	2010	2011	2012	2015	2020	2025	2030	2035	2005 - 2020	2005 - 2030
EU-ETS	82,45	83,62	87,83	80,40	73,78	75,58	74,19	69,32	67,62	58,28	52,12	50,70	45,68	-29,3%	-38,5%
ESD	65,23	65,20	61,20	63,60	62,22	63,36	63,05	64,14	62,48	55,75	50,29	48,24	48,64	-14,5%	-26,1%
Total	**147,69**	**148,83**	**149,03**	**144,00**	**136,01**	**138,95**	**137,23**	**133,46**	**130,10**	**114,03**	**102,41**	**98,94**	**94,32**	**-22,8%**	**-33,0%**

Fig. 24 Historic and projected emissions of EU-ETS sectors

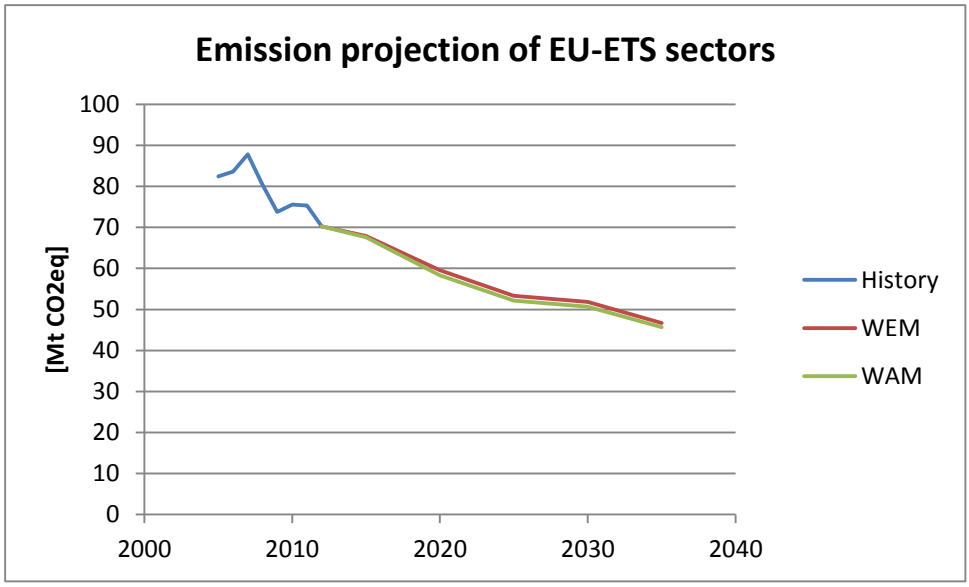
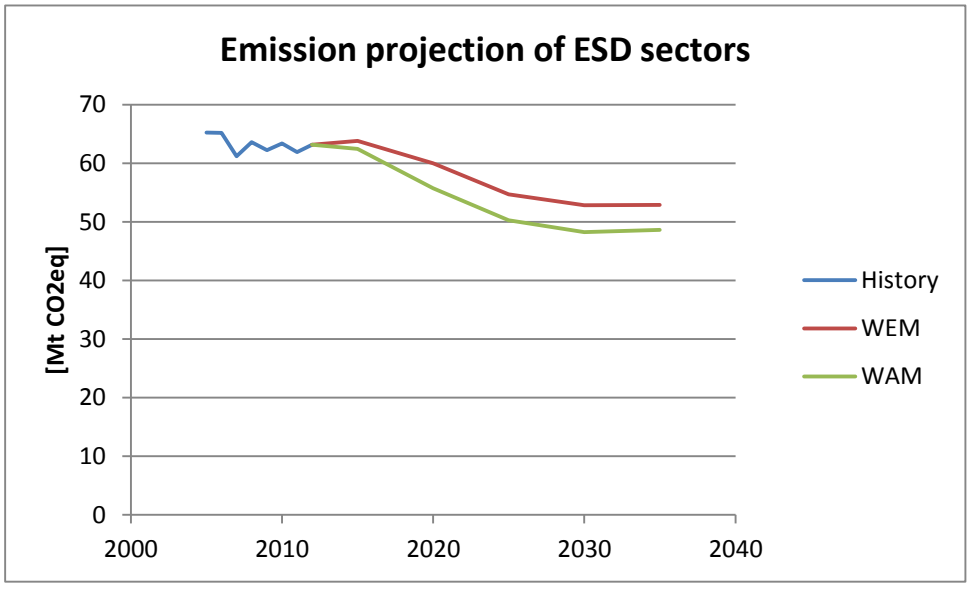


Fig. 25 Historic and projected emissions of ESD sectors

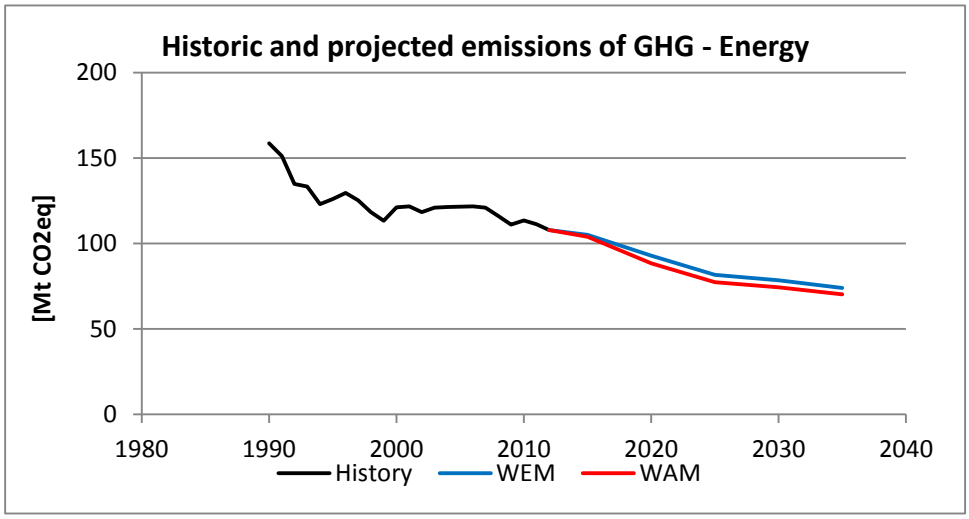


The drop of GHG emissions in the EU-ETS sectors reaches 27.8 % for the WAM scenario in the period 2005 – 2020. The drop increases to 29.3 % in the WAM scenario. Similar figures for the period 2005 – 2030 are 37.1 % (WEM) and 38.5 % (WAM).

Emissions of greenhouse gases in the ESD sectors will drop by 8 % in the WEM scenario and by 14.5 % in the WAM scenario during the period 2005 – 2020. The drops in the period 2005 – 2030 are estimated to 19 % for the WEM scenario and 26.1 % for the WAM scenario.

2.2.3 Energy

Fig. 26 Historic and projected emissions of GHG – Energy



Tab. 50 Historic and projected emissions of GHG – Energy [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	158,6	126,1	121,2	121,5	113,4	107,9	105,0	92,9	81,7	78,5	74,0	-41,4%	-50,5%	-23,5%	-35,4%
WAM	158,6	126,1	121,2	121,5	113,4	107,9	103,9	88,3	77,4	74,4	70,3	-44,3%	-53,1%	-27,3%	-38,8%

The expected drop of GHG emissions in the WEM scenario in the energy sector is 41.4 % between years 1990 and 2020. Realization of additional measures would increase the drop to 44.3 %. The drop between years 2005 and 2030 equals to 35.2 % for the WEM scenario and 38.6 % for the WAM scenario.

Tab. 51 Breakdown of historic and projected emissions of GHG by gases in energy sector – scenario with existing measures

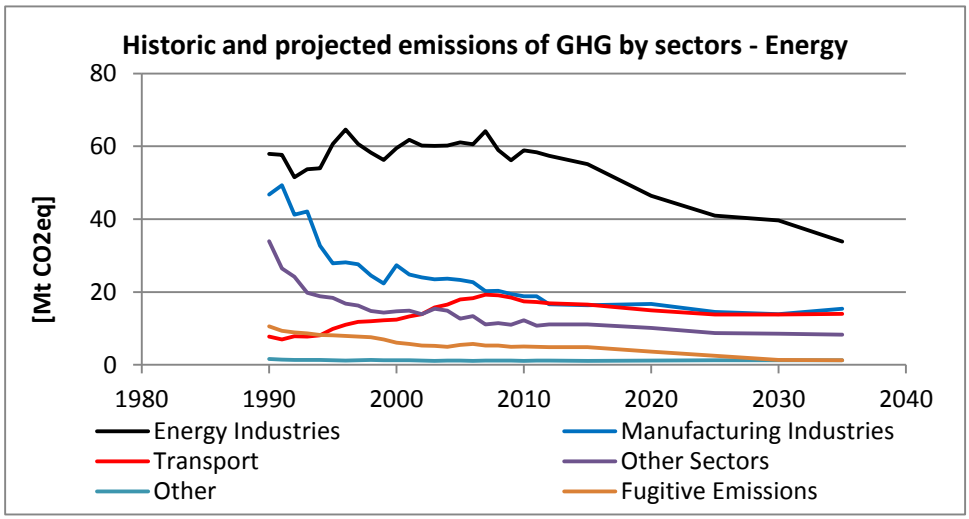
[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
CO2	146,1	116,7	113,9	114,7	106,9	101,6	98,6	87,8	77,7	75,6	71,1	-39,9%	-48,3%	-23,4%	-34,1%
CH4	11,9	8,7	6,4	5,8	5,4	5,2	5,3	4,1	3,1	2,0	1,9	-65,2%	-83,5%	-28,5%	-66,2%
N2O	0,7	0,7	0,9	1,1	1,1	1,1	1,1	1,0	0,9	1,0	1,0	43,5%	36,4%	-9,2%	-13,7%
Total	158,6	126,1	121,2	121,5	113,4	107,9	105,0	92,9	81,7	78,5	74,0	-41,4%	-50,5%	-23,5%	-35,4%

Tab. 52 Breakdown of historic and projected emissions of GHG by gases in energy sector – 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	146,1	116,7	113,9	114,7	106,9	101,6	97,6	83,3	73,4	71,6	67,5	-43,0%	-51,0%	-27,4%	-37,6%
CH4	11,9	8,7	6,4	5,8	5,4	5,2	5,3	4,1	3,0	1,9	1,9	-65,7%	-84,1%	-29,6%	-67,3%
N2O	0,7	0,7	0,9	1,1	1,1	1,1	1,1	1,0	0,9	0,9	0,9	39,7%	32,3%	-11,6%	-16,3%
Total	158,6	126,1	121,2	121,5	113,4	107,9	103,9	88,3	77,4	74,4	70,3	-44,3%	-53,1%	-27,3%	-38,8%

Carbon dioxide with its share of 94.2 % in the year 2012 is the decisive greenhouse gas produced in the energy sector. Methane is released mainly as a result of coal mining and its share was 4.8 % in 2012.

Fig. 27 Breakdown of historic and projected emissions of GHG by sectors – Energy

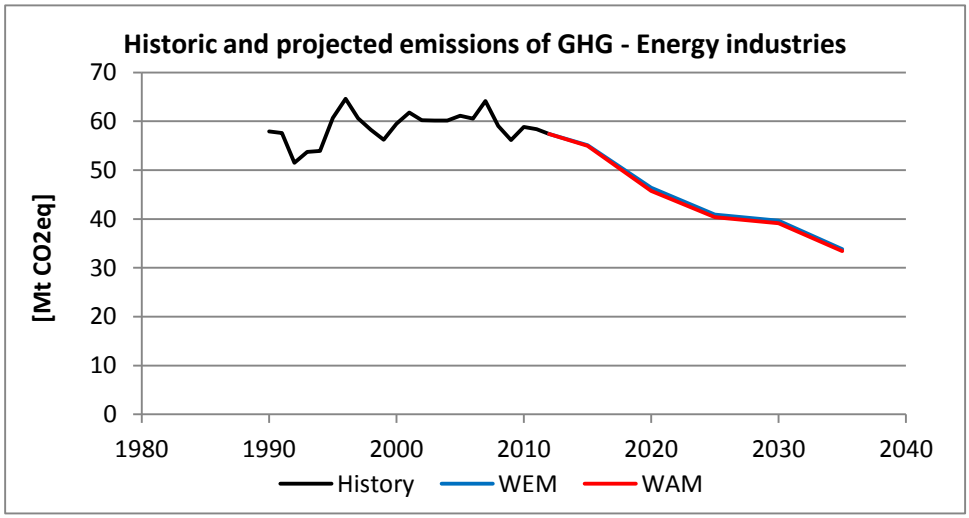


From the point of view of sectors, the dominant GHG emissions source is represented by energy industries (53.2 %), followed by transport (15.7 %), manufacturing industries (15.4 %), and other sectors (10.3 %). Fugitive emissions constituted about 3.8 % in the year 2012. We can observe a big reduction of GHG emission in manufacturing industries and others sectors in the past years which resulted mainly from switch from domestic coal to other fuels, mainly gas. As easily accessible domestic reserves of brown coal are getting near depletion we predict similar tendency for energy industries for the future.

Since energy sector is the most important one, individual subsectors are dealt with in the following sections.

2.2.3.1 Energy industries

Fig. 28 Historic and projected emissions of GHG – Energy industries



Tab. 53 Historic and projected emissions of GHG – Energy industries [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	57,9	60,7	59,5	61,1	58,8	57,4	55,1	46,4	40,9	39,7	33,8	-19,9%	-31,6%	-24,1%	-35,1%
WAM	57,9	60,7	59,5	61,1	58,8	57,4	55,0	45,8	40,4	39,2	33,4	-21,0%	-32,4%	-25,1%	-35,9%

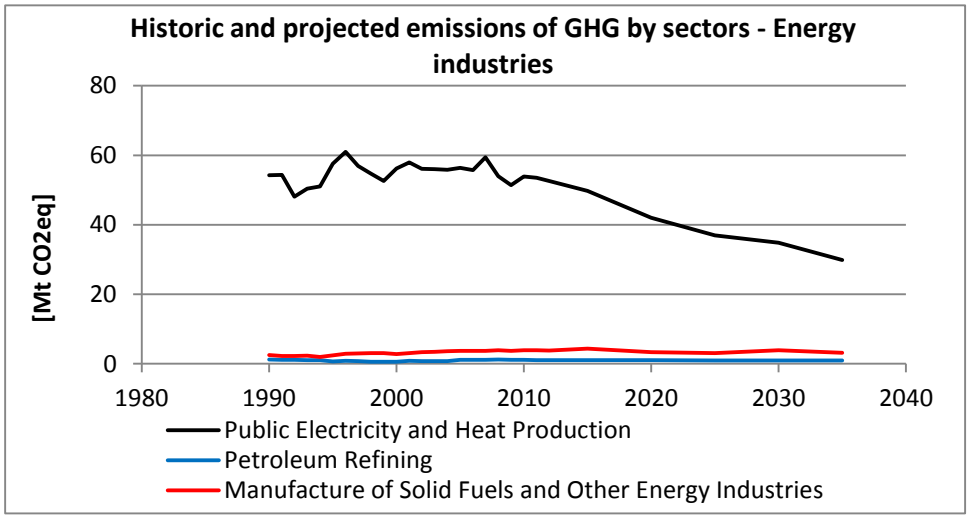
Tab. 54 Breakdown of historic and projected emissions of GHG by gases in energy industries – scenario with existing measures

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
CO2	57,7	60,4	59,2	60,8	58,6	57,1	54,8	46,1	40,7	39,4	33,6	-20,0%	-31,7%	-24,2%	-35,3%
CH4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	86,1%	149,5%	54,5%	107,2%
N2O	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,2	0,2	0,2	0,2	-4,3%	-5,0%	-12,4%	-13,0%
Total	57,9	60,7	59,5	61,1	58,8	57,4	55,1	46,4	40,9	39,7	33,8	-19,9%	-31,6%	-24,1%	-35,1%

Tab. 55 Breakdown of historic and projected emissions of GHG by gases in energy industries – 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	57,7	60,4	59,2	60,8	58,6	57,1	54,7	45,5	40,1	38,9	33,1	-21,1%	-32,6%	-25,2%	-36,1%
CH4	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	83,0%	145,1%	52,0%	103,5%
N2O	0,3	0,3	0,3	0,3	0,3	0,3	0,3	0,2	0,2	0,2	0,2	-5,7%	-6,4%	-13,6%	-14,3%
Total	57,9	60,7	59,5	61,1	58,8	57,4	55,0	45,8	40,4	39,2	33,4	-21,0%	-32,4%	-25,1%	-35,9%

Fig. 29 Breakdown of historic and projected emissions of GHG by sectors – Energy industries



The emissions projection of public electricity and heat production exhibits a break in the trend after the year 2010. This sudden change happens in electricity generation as 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. Introduction of new nuclear units was postponed by 10 years in comparison with the previous projection and now is expected about the year 2035.

Other driving forces are increasing electricity generation and decreasing heat generation which more or less mutually compensate (see Fig. 9 and Fig. 13). Decrease of GHG emissions is bound to increased use of RES in electricity and heat generation (see Fig. 10 and Fig. 14) as well.

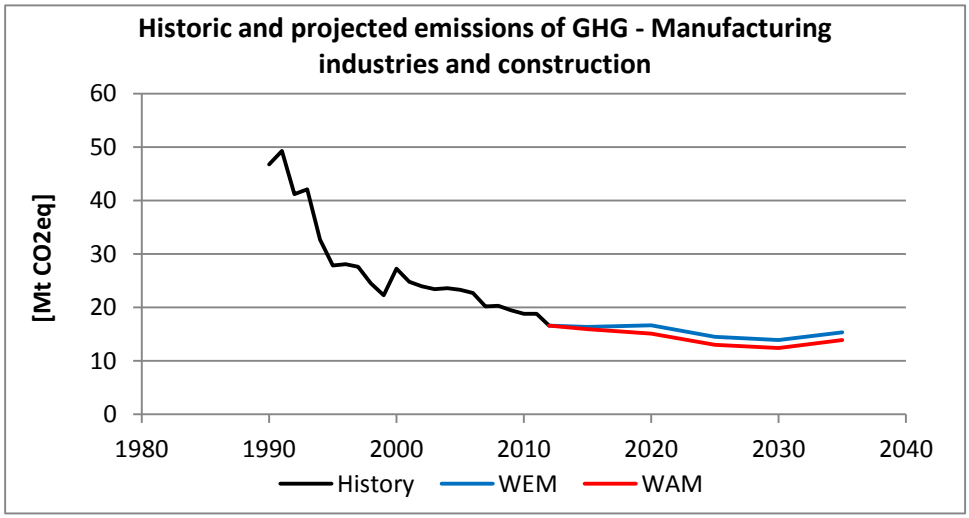
Scenario with additional measures

The projected drop of GHG emissions of scenario WEM between years 1990 and 2020 is 19.9 %. The same figure for the WAM scenario is 21.0 %.

None of the selected additional measures is supposed to influence directly the energy industries. The GHG emissions reduction is induced by energy savings in energy consuming sectors.

2.2.3.2 Manufacturing industries and construction

Fig. 30 Historic and projected emissions of GHG – Manufacturing industries and construction



Tab. 56 Historic and projected emissions of GHG – Manufacturing industries and construction [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	46,8	27,9	27,3	23,3	18,8	16,6	16,4	16,7	14,5	13,9	15,3	-64,3%	-70,2%	-28,4%	-40,3%
WAM	46,8	27,9	27,3	23,3	18,8	16,6	15,9	15,1	13,0	12,4	13,9	-67,7%	-73,4%	-35,2%	-46,7%

Tab. 57 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	46,5	27,7	27,1	23,2	18,7	16,5	16,2	16,5	14,4	13,8	15,2	-64,4%	-70,3%	-28,6%	-40,4%
CH4	0,1	0,1	0,1	0,1	0,0	0,0	0,1	0,1	0,0	0,0	0,1	-41,3%	-47,6%	-1,5%	-12,1%
N2O	0,2	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	-45,7%	-53,8%	0,3%	-14,7%
Total	46,8	27,9	27,3	23,3	18,8	16,6	16,4	16,7	14,5	13,9	15,3	-64,3%	-70,2%	-28,4%	-40,3%

Tab. 58 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	46,5	27,7	27,1	23,2	18,7	16,5	15,8	15,0	12,9	12,3	13,8	-67,8%	-73,5%	-35,4%	-46,8%
CH4	0,1	0,1	0,1	0,1	0,0	0,0	0,1	0,1	0,0	0,0	0,0	-44,6%	-50,8%	-7,1%	-17,6%
N2O	0,2	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	-50,0%	-58,1%	-7,6%	-22,7%
Total	46,8	27,9	27,3	23,3	18,8	16,6	15,9	15,1	13,0	12,4	13,9	-67,7%	-73,4%	-35,2%	-46,7%

The GHG emission projections in manufacturing industries and construction are based on the expected final energy consumption shown in the following table.

Tab. 59 Projection of final energy consumption in manufacturing industries and construction

Final energy consumption in industry [PJ]	2012	2015	2020	2025	2030	2035
Brown coal	30,5	32,9	27,8	3,4	5,0	19,6
Hard coal	16,7	16,3	17,3	13,0	12,7	17,4
Coke	42,7	44,3	46,1	46,7	47,9	49,0
Coal tar	2,7	3,0	2,0	1,1	1,1	1,8
Diesel fuel	2,7	2,8	2,9	3,1	3,3	3,3
Fuel oils	1,9	3,7	4,0	3,7	4,2	3,3
Liquefied petroleum gas	1,1	0,6	0,3	2,3	0,0	0,0
Other liquid fuels	7,8	4,5	2,8	2,8	0,6	0,0
Natural gas	84,9	84,5	87,4	98,3	95,5	83,7
Coke oven gas	4,8	4,6	5,1	5,0	4,9	4,8
Blast furnace gas	10,3	10,5	8,9	7,0	6,1	5,2
Other gaseous fuels	1,1	1,1	0,7	0,4	0,2	0,0
Electricity	81,7	81,8	87,9	99,7	108,2	111,0
Heat	26,9	24,8	25,6	22,8	23,4	23,8
Biomass	17,2	18,4	19,6	19,7	20,0	20,2
Biogas	0,1	0,2	0,2	0,2	0,2	0,2
Wastes renewable	6,0	6,7	6,8	6,8	6,7	6,2
TOTAL	**339,1**	**340,6**	**345,3**	**336,3**	**340,4**	**349,4**

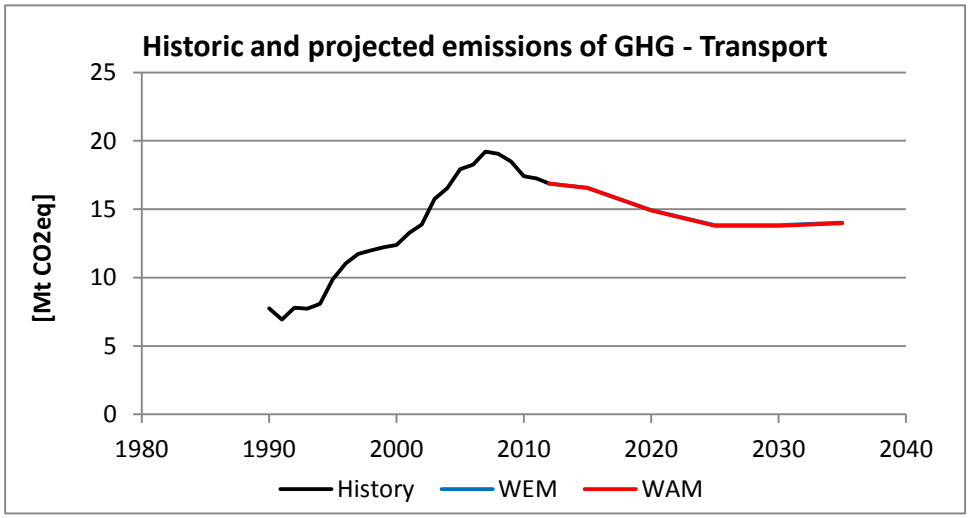
The final energy consumption in this sector is more or less stagnating. The electricity consumption is, after the crisis related drop in 2010, growing and the share of fossil fuels is decreasing. The drop of GHG emission is 64.3 % in the period 1990 – 2020 and 40.3 % between the years 2005 and 2030.

Scenario with additional measures

The WAM scenario is influenced by two additional measures - *Support of voluntary commitments to energy savings and Operational Programmed Enterprise and Innovation for Competitiveness* – in the manufacturing sector. The supposed energy savings are 20 PJ in the year 2020 according to the third National Action Plan for Energy Efficiency. These energy savings lead to additional drop CO_2 emissions by 3.4 % between the years 1990 and 2020.

2.2.3.3 Transport

Fig. 31 Historic and projected emissions of GHG – Transport



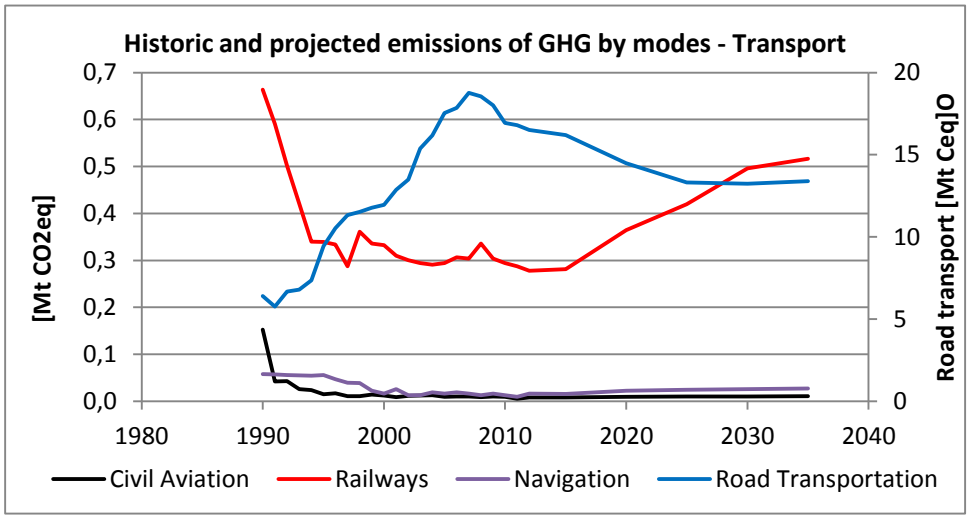
Tab. 60 Historic and projected emissions of GHG – Transport [Mt CO_2 eq.]

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
WEM	7,8	9,9	12,4	17,9	17,4	16,9	16,6	14,9	13,8	13,8	14,0	92,7%	78,4%	-16,7%	-22,9%
WAM	7,8	9,9	12,4	17,9	17,4	16,9	16,5	14,9	13,8	13,8	14,0	92,2%	77,8%	-16,9%	-23,1%

Tab. 61 Breakdown of historic and projected emissions of GHG by gases in transport – 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	7,58	9,62	11,93	17,22	16,73	16,23	15,91	14,34	13,27	13,27	13,47	89,2%	75,1%	-16,7%	-23,0%
CH4	0,03	0,04	0,03	0,03	0,02	0,02	0,02	0,02	0,02	0,02	0,02	-37,5%	-37,9%	-45,1%	-45,4%
N2O	0,15	0,24	0,42	0,70	0,68	0,66	0,66	0,61	0,57	0,57	0,55	302,8%	274,7%	-12,9%	-19,0%
Total	7,76	9,89	12,38	17,93	17,41	16,89	16,57	14,94	13,83	13,83	14,02	92,7%	78,4%	-16,7%	-22,9%

Fig. 32 Breakdown of historic and projected emissions of GHG by modes – Transport



Tab. 62 Breakdown of historic and projected emissions of GHG by modes in transport

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
Civil Aviation	0,15	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	0,01	-93,8%	-93,4%	-2,2%	4,6%
Road Transportation	6,4	9,4	12,0	17,5	16,9	16,5	16,2	14,5	13,3	13,2	13,4	126,3%	106,8%	-17,5%	-24,6%
Railways	0,66	0,34	0,33	0,29	0,29	0,28	0,28	0,36	0,42	0,50	0,52	-45,1%	-25,3%	24,0%	68,6%
Navigation	0,06	0,06	0,02	0,02	0,01	0,02	0,02	0,02	0,02	0,03	0,03	-61,2%	-55,7%	39,4%	59,2%

Transport is a sector with 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 about the year 2015 and then it will be slightly decreasing.

The projection supposes continuing growing trend of road transport and civil aviation. Improving quality of railways will likely attract more customers. The inland water transport is supposed rather to stagnate.

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

Tab. 63 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. Gradual introduction of electric and hybrid cars is supposed to start after the year 2015.

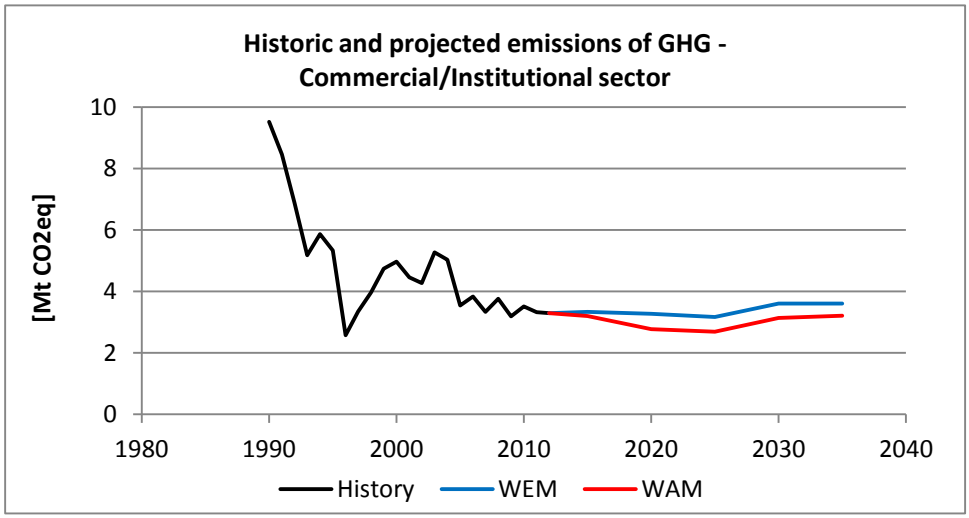
The GHG emissions from transport will be dropping to the year 2025, then they will stagnate. That results from fuel switches in favor of fuels with lower carbon content and obligatory improved energy efficiency of new personal cars.

Scenario with additional measures

Two additional measures will influence GHG emissions - *National Strategy of Cycling* and *Operation Programmed Prague - Pole of Growth*. They will bring about 0,5 % of additional emission drop in the period 1990 – 2020 and 0,6 % in the period 1990 – 2030.

2.2.3.4 Commercial/Institutional sector

Fig. 33 Historic and projected emissions of GHG – Commercial/Institutional sector



Tab. 64 Historic and projected emissions of GHG – Commercial/Institutional 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	9,5	5,3	5,0	3,5	3,5	3,3	3,3	3,3	3,2	3,6	3,6	-65,6%	-62,2%	-7,6%	1,7%
WAM	9,5	5,3	5,0	3,5	3,5	3,3	3,2	2,8	2,7	3,1	3,2	-70,9%	-67,0%	-21,8%	-11,3%

Tab. 65 Breakdown of historic and projected emissions of GHG by gases in commercial/institutional sector

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
CO2	9,5	5,3	4,9	3,5	3,5	3,3	3,3	3,3	3,1	3,6	3,6	-65,6%	-62,2%	-7,6%	1,5%
CH4	0,026	0,011	0,010	0,015	0,014	0,015	0,017	0,016	0,017	0,020	0,021	-39,7%	-21,9%	2,7%	33,0%
N2O	0,036	0,016	0,011	0,005	0,004	0,004	0,005	0,004	0,004	0,005	0,005	-88,4%	-85,9%	-20,4%	-2,8%
Total	9,5	5,3	5,0	3,5	3,5	3,3	3,3	3,3	3,2	3,6	3,6	-65,6%	-62,2%	-7,6%	1,7%

The tertiary sector is a sector with the fastest economic growth. We suppose the energy consumption driven by the economic grow may almost negate the energy efficiency improvement. The growing projection of final energy consumption presented in Tab. 66 corresponds with this assumption.

Tab. 66 Projection of final energy consumption of the commercial/institutional sector

Final energy consumption in services [PJ]	2012	2015	2020	2025	2030	2035
Brown coal	0,8	0,9	0,3	0,0	0,0	0,1
Hard coal	0,1	0,2	0,2	0,2	0,2	0,2
Coke	0,2	0,3	0,4	0,5	0,5	0,5
Diesel fuel	0,3	0,4	0,3	0,1	0,5	0,0
Fuel oils	0,1	0,0	0,0	0,0	0,0	0,4
Natural gas	54,0	54,2	54,1	52,6	59,7	59,9
Electricity	50,1	51,5	55,5	55,0	54,0	59,0
Heat	18,2	18,0	18,1	18,3	18,2	19,0
Biomass	0,5	0,6	0,5	0,7	0,9	1,0
Biogas	1,0	1,1	1,2	1,1	1,0	1,1
Wastes renewable	1,0	1,2	1,2	1,3	1,8	1,9

Final energy consumption in services [PJ]	2012	2015	2020	2025	2030	2035
Wastes non-renewable	0,6	0,5	0,8	0,5	0,8	1,2
Solar heat	0,1	0,3	0,5	1,0	0,5	0,9
TOTAL	**127,1**	**129,3**	**133,0**	**131,3**	**138,3**	**144,9**

As regards mixture of energy carriers, electricity consumption grows with a higher tempo than other carriers.

The GHG emission will decline a bit between the years 2010 and 2025, then may occur a slight increase.

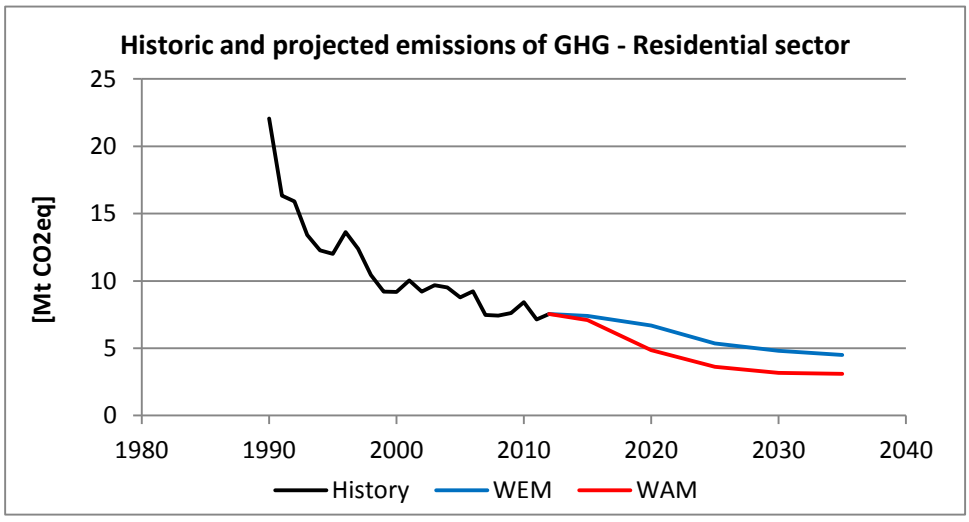
The GHG emissions from the tertiary sector decrease by 65.6 % between the years 1990 and 2020 and only by 62.2 % between 1990 – 2030.

Scenario with additional measures

There are three additional measures acting in the service sector: *Operational Programmed Environment 2014 – 2020*, *Operational Programmed Enterprise* and *Innovation for Competitiveness* and *Operation Programmed Prague - Pole of Growth*. The energy savings reached by these measures were estimated to 6 PJ in the third National Energy Efficiency Action Plan for the year 2020. These measure add 5.3 % to the sector's GHG emission drop in the period 1990 – 2020.

2.2.3.5 Residential sector

Fig. 34 Historic and projected emissions of GHG – Residential sector



Tab. 67 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	22,1	12,0	9,2	8,8	8,4	7,5	7,4	6,7	5,4	4,8	4,5	-69,7%	-78,2%	-23,8%	-45,3%
WAM	22,1	12,0	9,2	8,8	8,4	7,5	7,1	4,9	3,6	3,2	3,1	-78,0%	-85,6%	-44,6%	-63,8%

Tab. 68 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	20,6	11,2	8,6	8,2	7,8	6,9	6,8	6,1	4,8	4,2	3,9	-70,3%	-79,4%	-25,7%	-48,3%
CH4	1,2	0,6	0,4	0,4	0,5	0,5	0,5	0,4	0,4	0,4	0,4	-63,3%	-66,1%	2,2%	-5,7%
N2O	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	0,1	-14,6%	-12,3%	22,9%	26,2%
Total	22,1	12,0	9,2	8,8	8,4	7,5	7,4	6,7	5,4	4,8	4,5	-69,7%	-78,2%	-23,8%	-45,3%

Households represent the only sector where we predict a remarkable decrease of energy consumption between the years 2010 and 2030. The drop is attributed to the quickly proceeding process of thermal insulation improvement of panel living houses. Massive incentives financed from sold emission allowances started similar process even for family houses. Due to lower equipment of Czech households with electrical appliances in comparison with more developed countries we expect stagnation or even a slight grows of electricity consumption in households.

As follows from Tab. 69 the development of energy carriers structure is also favorable – the share of fossil fuels decreases.

Tab. 69 Projection of final energy consumption of the residential sector

Final energy consumption in households [PJ]	2012	2015	2020	2025	2030	2035
Brown coal	18.9	16.8	9.8	1.4	1.0	1.9
Hard coal	3.6	3.7	3.9	4.3	3.6	2.2
Coke	0.6	0.9	0.9	0.9	0.8	0.5
Liquefied petroleum gas	0.2	0.1	0.1	0.0	0.0	0.0
Natural gas	84.7	85.2	84.5	74.8	67.2	62.9
Electricity	52.5	51.2	50.8	53.9	52.4	53.3
Heat	43.5	40.3	38.3	38.1	37.5	36.8
Biomass	47.8	51.6	53.4	56.4	58.3	59.4
Solar heat	0.4	0.5	0.9	1.5	2.5	4.0
TOTAL	**252.1**	**250.3**	**242.4**	**231.3**	**223.3**	**221.1**

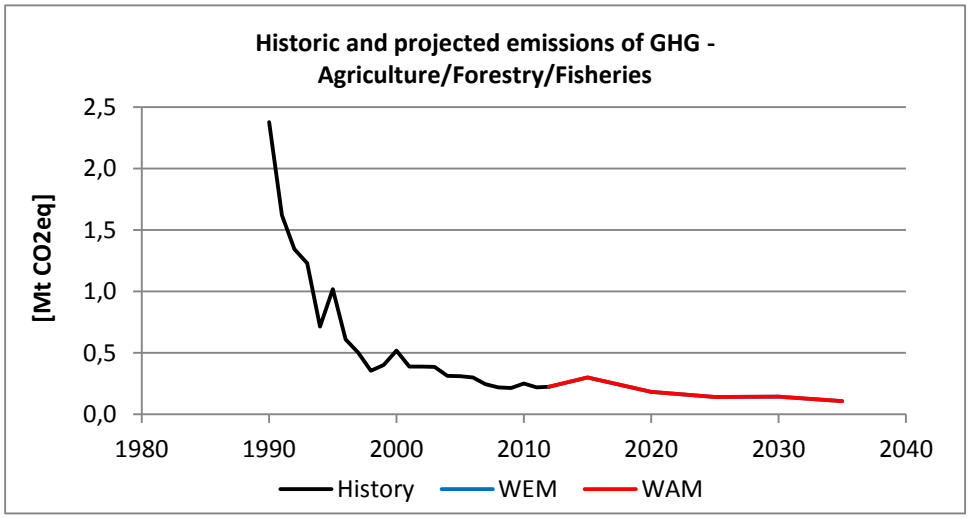
The total drop of GHG emissions between the years 1990 and 2020 is estimated to 69.7 %.

Scenario with additional measures

There are three additional measures influencing GHG emissions from residential sector: *New Green savings program 2014 – 2020*, *Integrated Regional Operating Programmed* and *Operational Programmed Environment 2014 – 2020*. These measures should bring energy savings 26.3 PJ to the year 2020 and increase GHG emissions drop from 69.7 % to 78 % between the years 1990 – 2020 and from 45.3 % to 65.8 % in the period 2002 – 2030.

2.2.3.6 Agriculture/Forestry/Fisheries

Fig. 35 Historic and projected emissions of GHG – Agriculture/Forestry/Fisheries



Tab. 70 Historic and projected emissions of GHG – Agriculture/Forestry/Fisheries [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	2,4	1,0	0,5	0,3	0,3	0,2	0,3	0,2	0,1	0,1	0,1	-92,3%	-93,9%	-41,1%	-53,6%
WAM	2,4	1,0	0,5	0,3	0,3	0,2	0,3	0,2	0,1	0,1	0,1	-92,3%	-93,9%	-41,1%	-53,6%

Tab. 71 Breakdown of historic and projected emissions of GHG by gases in agriculture/forestry/fisheries

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
CO2	2,241	0,963	0,502	0,297	0,231	0,190	0,246	0,146	0,110	0,103	0,076	-93,5%	-95,4%	-50,8%	-65,4%
CH4	0,107	0,044	0,014	0,010	0,015	0,025	0,041	0,027	0,024	0,030	0,023	-74,9%	-72,4%	160,6%	185,6%
N2O	0,009	0,003	0,001	0,002	0,003	0,005	0,006	0,005	0,005	0,006	0,006	-48,5%	-32,3%	211,2%	309,3%
Total	2,377	1,018	0,520	0,310	0,251	0,224	0,301	0,183	0,143	0,144	0,109	-92,3%	-93,9%	-41,1%	-53,6%

The projection of final energy consumption in the agricultural sector counts with a slight decrease and unimportant changes in the fuel mixture. The GHG emission projection so copies the shape of final energy consumption in the period 2012 – 2035. Possible increased planting of energy biomass will lead to a slight increase of energy demand in agriculture after the year 2020.

Tab. 72 Projection of final energy consumption of agriculture/forestry/fisheries

Final energy consumption in agriculture [PJ]	2012	2015	2020	2025	2030	2035
Brown coal	0.3	0.3	0.1	0.0	0.0	0.0
Hard coal	0.1	0.1	0.0	0.0	0.0	0.0
Coke	0.1	0.8	0.4	0.4	0.4	0.1
Diesel fuel	13.8	13.3	13.9	14.6	14.9	15.2
Fuel oils	0.1	0.1	0.0	0.0	0.0	0.0
Liquefied petroleum gas	0.1	0.1	0.1	0.0	0.0	0.0
Natural gas	2.1	1.9	1.4	1.1	1.1	1.2
Electricity	3.6	3.4	3.4	3.6	3.6	3.7
Heat	0.5	0.4	0.5	0.5	0.5	0.5
Biomass	0.4	0.3	0.4	0.4	0.7	0.7

Final energy consumption in agriculture [PJ]	2012	2015	2020	2025	2030	2035
Biogas	3.1	2.8	3.9	4.2	4.3	4.6
Solar heat	0.0	0.0	0.0	0.1	0.1	0.1
TOTAL	**24.2**	**23.5**	**24.1**	**24.9**	**25.5**	**25.9**

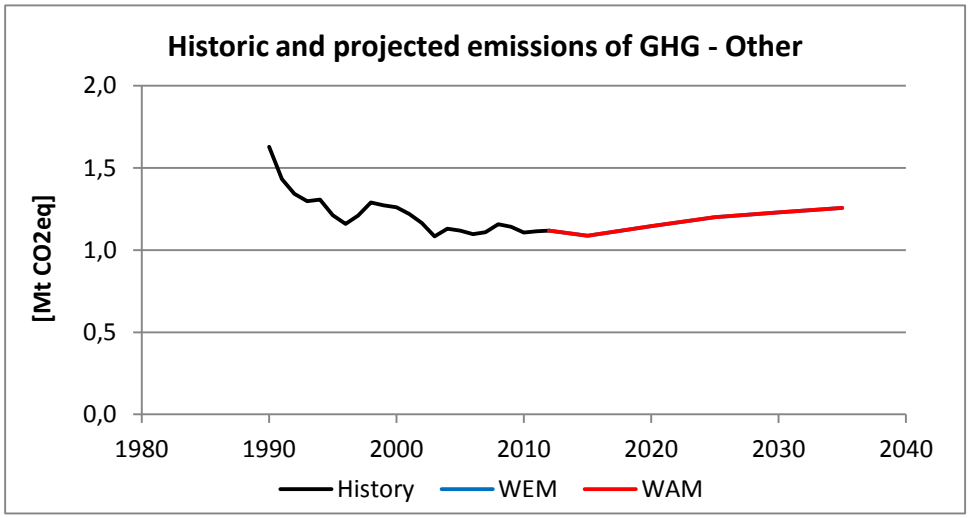
Scenario with additional measures

No additional measures were identified for this sector.

2.2.3.7 Other

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

Fig. 36 Historic and projected emissions of GHG – Other



Tab. 73 Historic and projected emissions of GHG – Other [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	1,6	1,2	1,3	1,1	1,1	1,1	1,1	1,1	1,2	1,2	1,3	-29,6%	-24,5%	2,5%	9,9%
WAM	1,6	1,2	1,3	1,1	1,1	1,1	1,1	1,1	1,2	1,2	1,3	-29,6%	-24,5%	2,5%	9,9%

Tab. 74 Breakdown of historic and projected emissions of GHG by gases in other

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
CO2	1,6	1,2	1,2	1,1	1,1	1,1	1,1	1,1	1,2	1,2	1,2	-30,0%	-24,9%	2,5%	9,9%
CH4	0,01	0,01	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-77,1%	-75,7%	-1,4%	4,6%
N2O	0,02	0,01	0,03	0,02	0,02	0,02	0,02	0,02	0,02	0,03	0,03	20,2%	29,9%	1,4%	9,6%
Total	1,6	1,2	1,3	1,1	1,1	1,1	1,1	1,1	1,2	1,2	1,3	-29,6%	-24,5%	2,5%	9,9%

The projection of final energy consumption of mobile sources supposes increasing planting of energy biomass accompanied with an increased demand for motor fuels.

Tab. 75 Projection of final energy consumption of other

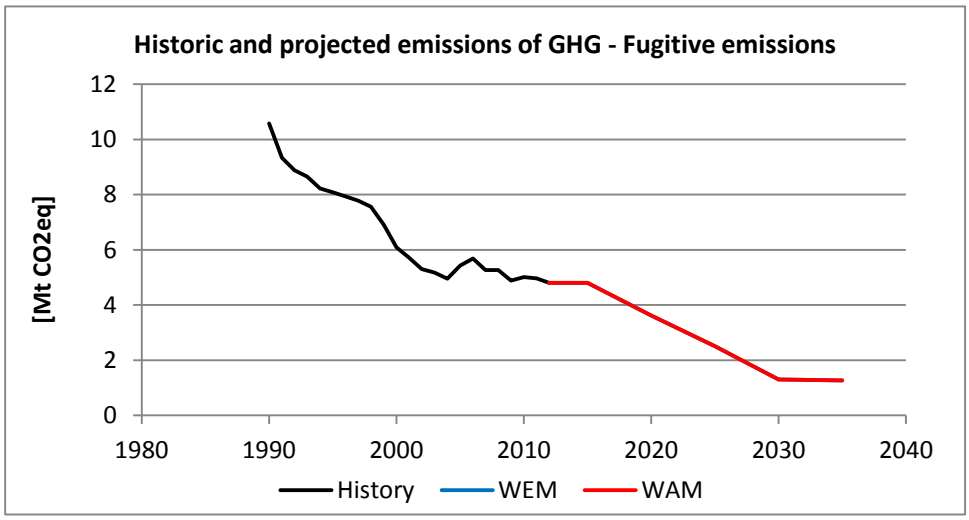
Final energy consumption other [PJ]	2012	2015	2020	2025	2030	2035
Motor fuels	16,6	16,1	16,9	17,6	18,2	18,5

Scenario with additional measures

No additional measures were identified for this sector.

2.2.3.8 Fugitive emissions

Fig. 37 Historic and projected emissions of GHG – Fugitive emissions



Tab. 76 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	10,6	8,1	6,1	5,4	5,0	4,8	4,8	3,6	2,5	1,3	1,3	-65,8%	-87,7%	-33,4%	-76,0%
WAM	10,6	8,1	6,1	5,4	5,0	4,8	4,8	3,6	2,5	1,3	1,3	-65,8%	-87,7%	-33,4%	-76,0%

The projection of fugitive emissions is based on fuel quantities calculated using the EFOM/ENV model as indicated in the following table.

Tab. 77 Projection of activities for calculation of fugitive emissions

	2012	2015	2020	2025	2030	2035
Hard coal mining [Mt]	11,7	7,6	4,0	0,0	0,0	0,0
Brown coal mining [Mt]	43,2	41,6	34,6	29,0	26,6	26,5
Crude oil mining [PJ]	6,6	0,0	0,0	0,0	0,0	0,0
Oil cracking [PJ]	306,0	306,0	300,9	280,0	280,0	255,0
Natural gas mining [PJ]	9,0	5,5	5,5	5,5	5,5	5,5
Natural gas transit [PJ]	1 350	1 350	1 350	1 350	1 350	1 350
Natural gas distribution [PJ]	115,0	116,8	126,8	132,3	137,6	129,1
Natural gas losses in power and heat generation	90,9	109,8	109,7	117,6	113,5	100,7

The projected decline of fugitive emissions results mainly from decreasing mining of hard coal.

Scenario with additional measures

No additional measures were identified directly in this sector, but energy savings in other sectors lead to decrease of fugitive emissions as well. The difference between WEM and WAM scenarios is attributed mainly to decreased power and heat generation from coal leading to lower production of coal mines.

2.2.3.9 Sensitivity analysis

2.2.3.9.1 Sensitivity analysis of combustion processes on price of emission allowances

In this test we changed the price of emission allowances by 50 % in both directions in the years 2015 and forth. Not surprisingly, the calculations have revealed that the model solution is almost insensitive to these price changes. The biggest emission change was only 0.1 Mt of CO_2 equivalent in the year 2020. Solutions of all three models were practically identical. There are two main causes of this insensitivity:

- Limited available sources of RES (for growing price of CO_2);
- Almost 100% utilization of cheap domestic brown coal (for decreasing price of CO_2).

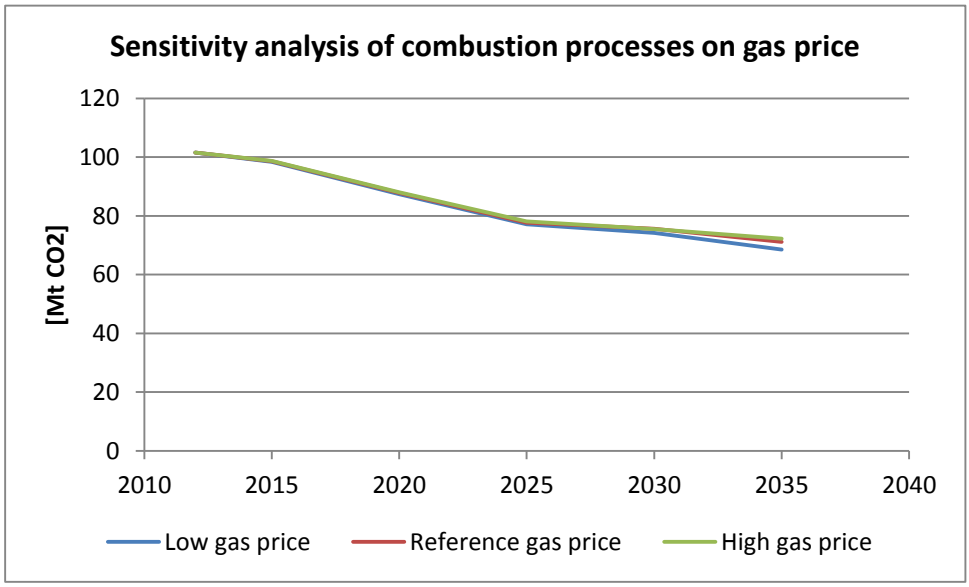
2.2.3.9.2 Sensitivity analysis of combustion processes on gas price

In this analysis we changed the price of imported natural gas by 50 % in both directions in the years 2015 and forth. From this analysis we got the following table and figure:

Tab. 78 Sensitivity analysis of combustion processes on gas price

	2005	2012	2015	2020	2025	2030	2035	2005-2020	2005-2030
Low gas price	114,7	101,6	98,4	87,4	77,2	74,2	68,5	-23,8%	-35,3%
Reference gas price	114,7	101,6	98,6	87,8	77,7	75,6	71,1	-23,4%	-34,1%
High gas price	114,7	101,6	98,7	88,0	78,2	75,5	72,2	-23,3%	-34,2%

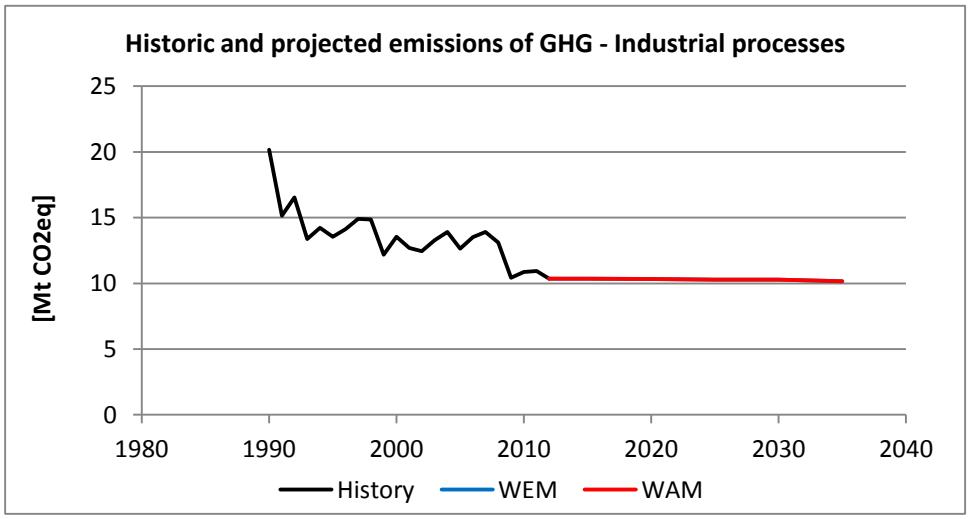
Fig. 38 Sensitivity analysis of combustion processes on gas price



The analysis reveals that the sensitivity is higher when gas price becomes lower. Increase of gas price by 50 % would increase CO_2 emissions of the sector by 0.1 % in the period 2005 – 2020 and by 0.1 % in the period 2005 – 2030. Decrease of gas price by 50 % would decrease CO_2 emissions from combustion processes by 0.4 % in the period 2005 – 2020 and by 1.2 % in the period 2005 – 2030.

2.2.4 Industrial processes (incl. fluorinated gases)

Fig. 39 Historic and projected emissions of GHG – Industrial processes



Tab. 79 Historic and projected emissions of GHG – Industrial processes [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	20,2	13,5	13,5	12,6	10,9	10,4	10,4	10,3	10,3	10,3	10,2	-48,7%	-49,0%	-18,3%	-18,7%
WAM	20,2	13,5	13,5	12,6	10,9	10,4	10,4	10,3	10,3	10,3	10,2	-48,7%	-49,0%	-18,3%	-18,7%

Tab. 80 Breakdown of historic and projected emissions of GHG by gases in industrial processes

[Mt CO2eq]	1990	1995	2000	2005	2010	2012	2015	2020	2025	2030	2035	1990 - 2020	1990 - 2030	2005 - 2020	2005 - 2030
CO2	18,6	12,1	12,1	11,3	10,1	9,5	9,5	9,5	9,5	9,4	9,4	-48,9%	-49,3%	-16,0%	-16,6%
CH4	0,15	0,11	0,09	0,10	0,08	0,08	0,09	0,08	0,08	0,09	0,08	-45,2%	-39,7%	-18,2%	-9,9%
N2O	1,42	1,34	1,34	1,25	0,70	0,75	0,75	0,75	0,75	0,75	0,75	-47,1%	-47,1%	-39,9%	-39,9%
Total	20,2	13,5	13,5	12,6	10,9	10,4	10,4	10,3	10,3	10,3	10,2	-48,7%	-49,0%	-18,3%	-18,7%

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

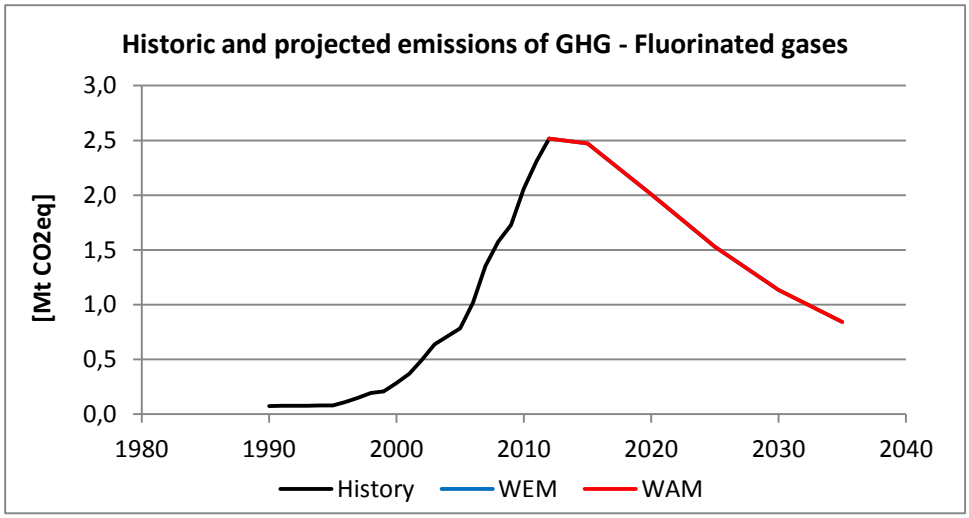
The economic crisis caused serious problems to some industries (mainly metallurgy and construction). Currently, it is very difficult to forecast production of tracked products.

Scenario with additional measures

No additional measures were identified for this sector.

2.2.4.1 Fluorinated gases

Fig. 40 Historic and projected emissions of GHG – Fluorinated gases



Tab. 81 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	0,1	0,1	0,3	0,8	2,1	2,5	2,5	2,0	1,5	1,1	0,8	2558,8%	1401,4%	155,9%	44,5%
WAM	0,1	0,1	0,3	0,8	2,1	2,5	2,5	2,0	1,5	1,1	0,8	2558,8%	1401,4%	155,9%	44,5%

Tab. 82 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	0,000	0,000	0,001	0,013	0,048	0,008	0,015	0,013	0,012	0,012	0,012			0,7%	-4,3%
HFCs	0,00	0,00	0,20	0,68	1,95	2,42	2,38	1,92	1,41	1,03	0,75			180,6%	50,1%
SF6	1 805	1 908	2 022	2 130	1 590	2 116	1 890	1 886	2 579	2 307	1 814	4,5%	27,8%	-11,4%	8,3%
Total	0,08	0,08	0,29	0,78	2,06	2,52	2,47	2,01	1,53	1,13	0,84	2558,8%	1401,4%	155,9%	44,5%

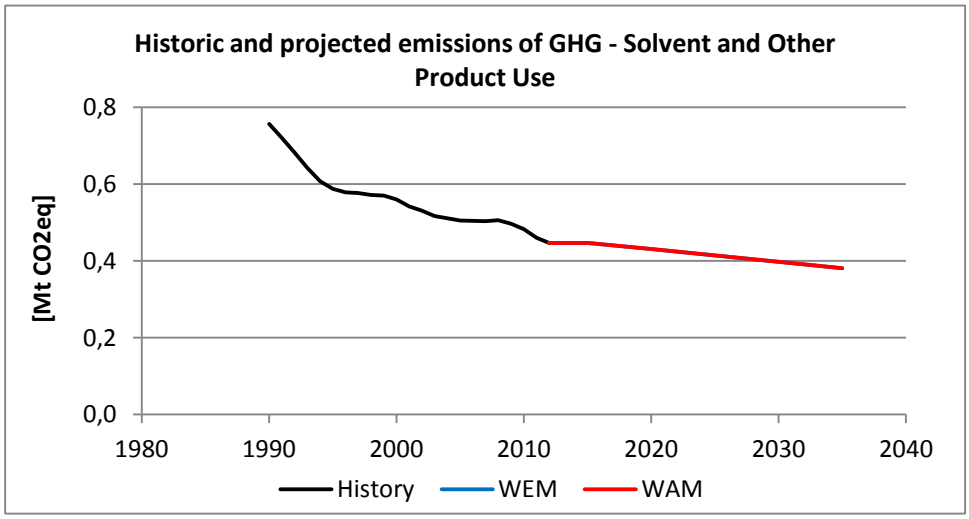
The emissions of fluorinated gases are strongly impacted by the Regulation (EU) No 517/2014 of 16 April 2014 on fluorinated greenhouse gases and repealing Regulation (EC) No 842/2006. Especially cooling and freezing appliances for households are mostly using coolants with high GWPs, which should replaced 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. 41 Historic and projected emissions of GHG – Solvent and Other Product Use



Tab. 83 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	0,76	0,59	0,56	0,51	0,48	0,45	0,45	0,43	0,41	0,40	0,38	-43,0%	-47,4%	-14,8%	-21,3%
WAM	0,76	0,59	0,56	0,51	0,48	0,45	0,45	0,43	0,41	0,40	0,38	-43,0%	-47,4%	-14,8%	-21,3%

Tab. 84 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	18,6	12,1	12,1	11,3	10,1	9,5	9,5	9,5	9,5	9,4	9,4	-48,9%	-49,3%	-16,0%	-16,6%
CH4	0,15	0,11	0,09	0,10	0,08	0,08	0,09	0,08	0,08	0,09	0,08	-45,2%	-39,7%	-18,2%	-9,9%
N2O	1,42	1,34	1,34	1,25	0,70	0,75	0,75	0,75	0,75	0,75	0,75	-47,1%	-47,1%	-39,9%	-39,9%
Total	20,2	13,5	13,5	12,6	10,9	10,4	10,4	10,3	10,3	10,3	10,2	-48,7%	-49,0%	-18,3%	-18,7%

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

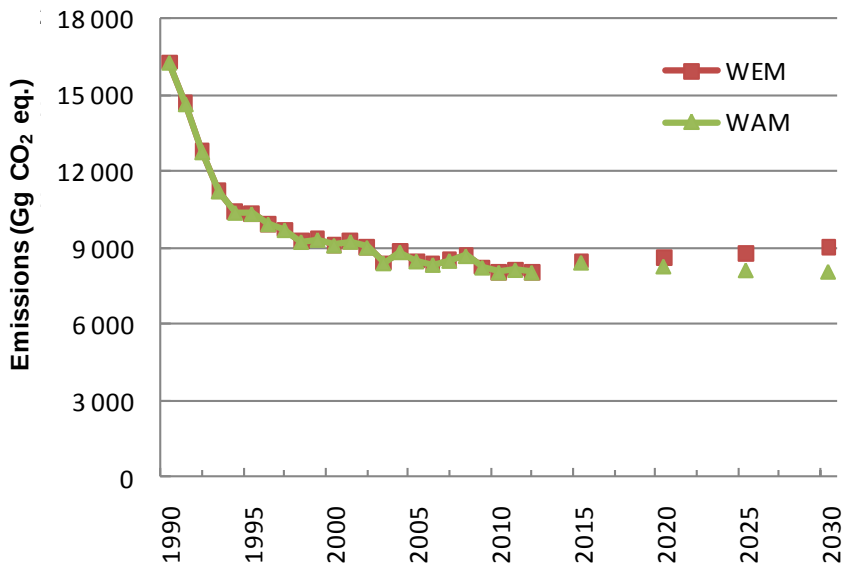
Scenario with additional measures

No additional measures were identified for this sector.

2.2.6 Agriculture

This chapter describes how each policy and measure (from Chapter 1.2.2.1.21.2.2.1.2) is included in the two employed scenarios: i) with measures (WEM) and ii) with additional measures (WAM). The policies and measures described in the chapter 1.2.2.1.2 are included to projected emissions.

Fig. 42 Historic and projected emissions of GHG in sector Agriculture under WEM (red line) and WAM (green line) scenarios.



Tab. 85 Projected total GHG emissions in sector of Agriculture [Gg CO_2 eq.]

Scenario	1990	2012	2015	2020	2025	2030	1990 - 2030	2012 - 2030
WEM	16 307	8 058	8 498	8 616	8 782	9 005	**- 44.8 %**	**+ 11.8 %**
WAM	16 307	8 058	8 450	8 300	8 150	8 093	**- 50.3 %**	**+ 0.5 %**

2.2.6.1 With measures (WEM) scenario

WEM (with existing measures) scenario takes into account the policies and measures implemented until 2012, there are presented in the chapter 1.2.2.1.2. The breakdown of historical and projected (WEM scenario) emissions by individual land use categories is shown in Tab. 86 and Tab. 81. The breakdown of emissions by individual gases shows that the decisive share of emissions and changes in emissions in Agriculture is determined by N_2O.

The GWP (Global Warming Potential) coefficients to recalculate of greenhouse gas emissions to CO_2 equivalent is 21 for CH_4 and 310 for N_2O.

Tab. 86 Methane emission projections in scenario WEM (in kt CH_4)

Category	1990	2012	2015	2020	2025	2030	1990 - 2030	2012 - 2030
Enteric Ferm.	200.92	96.52	99.44	105.37	110.38	117.7	-41.42 %	21.94 %
Manure Man.	51.19	22.36	23.55	25.32	27 .95	30.9	-39.64 %	38.19 %
Total CH_4	252.11	118.88	122.99	130.69	138.33	148.6	-41.06 %	25.00 %

Tab. 87 Nitrous oxide emission projections in scenario WEM (in kt NO_2)

Category	1990	2012	2015	2020	2025	2030	1990 - 2030	2012 - 2030
Manure Manag.	5.51	2.13	2.40	2.46	2.57	2.67	-51.5 %	25.4 %
Direct emis.	17.69	9.15	9.48	9.28	9.16	9.09	-48.6 %	-0.7 %
Pasture manure	1.02	0.83	1.07	1.10	1.11	1.13	10.8 %	36.1 %
Indirect emis.	11.30	5.83	6.13	6.10	6.11	6.09	-46.1 %	4.5 %
Total N_2O	35.52	17.94	19.08	18.94	18.96	18.98	-46.6 %	5.8 %

Tab. 88 Emissions in WEM scenario by gas

Category	1990	2012	2015	2020	2025	2030	1990 - 2030	2012 - 2030
CH_4 (Gg CH_4)	252.11	118.88	122.99	130.69	138.33	148.6	-41.1 %	25.0 %
N_2O (Gg N_2O)	35.52	17.94	19.08	18.94	18.96	18.98	-46.6 %	5.8 %
Gg CO_2 eq.								
CH_4	5 294	2 496	2 583	2 745	2 905	3 121	-41.0 %	25.0 %
N_2O	11 013	5 562	5 915	5 871	5 877	5 884	-46.6 %	5.8 %
Total	16 307	8 058	8 498	8 616	8 782	9 005	-44,8 %	11,8 %

2.2.6.2 With additional measures (WAM) scenario

WAM scenario takes into account the policies and measures implemented in the conceptual documents (Strategy for growth - Czech agriculture after 2013), in particular the Nitrate Directives and Action Plan for Organic Farming (agro-environmental measures and ecological management, Good Agricultural Practices etc.).

Application of agro-environmental measures should lead to a slow decline of emissions in agricultural sector. Expert estimate of emission reduction by WAM is 12 % in 2030 (related to WEM scenario). The total emission reduction of emissions by WAM scenario is ca. 0.4 %, related to reference year 2012.

Tab. 89 Methane emission projections in scenario WAM (in kt CH_4)

Category	1990	2012	2015	2020	2025	2030	1990 -2030	2012 -2030
Enteric Ferm.	200.92	96.52	103.82	104.83	106.44	110	- 45.3 %	+ 14.0
Manure Man.	51.19	22.36	24.75	25.17	22.13	20	- 51.2 %	+ 11.8
Total CH_4	252.11	118.88	128.57	130.00	128.57	130	- 46.5 %	+ 13.6

Tab. 90 Nitrous oxide emission projections in scenario WAM (in kt NO_2)

Category	1990	2012	2015	2020	2025	2030	1990 -2030	2012 -2030
MM	5.51	2.13	2.20	2.12	2.03	2.00	-63.7 %	-6.1 %
Direct emissions	17.69	9.15	9.32	9.13	9.04	8.90	-49.7 %	-2.7 %
Pasture manure	1.02	0.83	1.05	1.02	0.98	0.90	-11.8 %	8.4 %
Indir. emissions	11.30	5.83	5.98	5.70	5.53	5.50	-51.3 %	-5.7 %
Total N_2O	35.52	17.94	18.55	17.97	17.58	17.30	-51.3 %	-3.6 %

Tab. 91 Emissions in WAM scenario by gas

Category	1990	2012	2015	2020	2025	2030	1990 - 2030	2012 - 2030
CH_4 (Gg CH_4)	252.11	118.88	128.57	130.00	128.57	130	-48.4 %	9.4 %
N_2O (Gg N_2O)	35.52	17.94	18.55	17.97	17.58	17.30	-51.3 %	-3.6 %
Gg CO_2 eq.								
CH_4	5 294	2 496	2 700	2 730	2 700	2 730	-48.4 %	9.4 %
N_2O	11 013	5 562	5 750	5 570	5 450	5 363	-51.3 %	-3.6 %
Total	16 307	8 058	8 450	8 300	8 150	8 093	-50.4 %	0.4 %

Sensitivity analysis

The current economic and financial situation entails considerable uncertainties in predicting the long-term emission trends in the Agriculture sector. Related to the small contribution of Agriculture (6 %) to total GHG emissions in the Czech Republic, the impact of small changes of emissions is negligible. The trend of emissions will correspond to the GDP; as the GDP increases, larger amounts of funds will also be available for innovations and new technologies in the agrarian sector. It should also be noted that a fluctuation of activity data as animal population, amount of applying fertilizers or annual harvest production, has the same effect as implemented measures and policies.

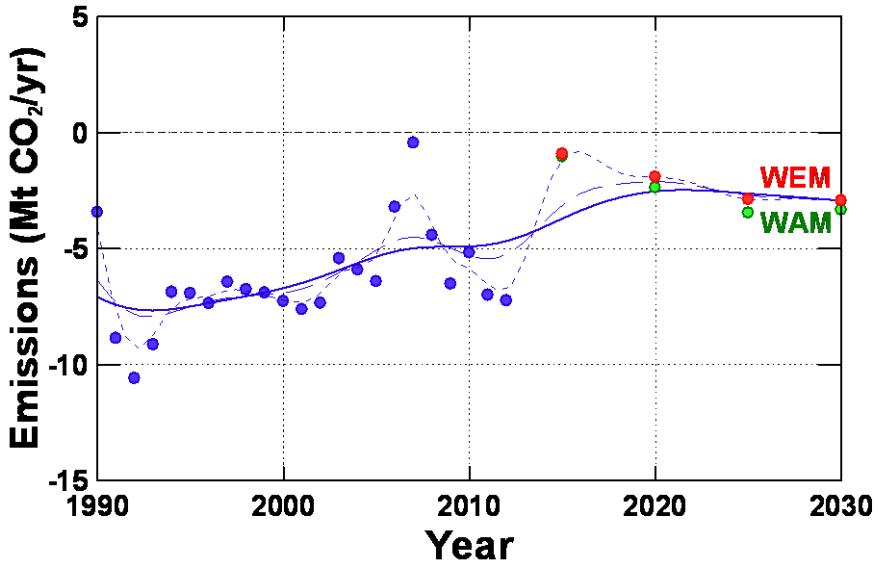
Quantification of implemented policies and measures

The WEM and WAM scenarios include all the introduced, implemented and planned policies and measures described in Chapter 1.2.2.1.2 and 2.1.7. We can say, that the majority of additional planned policies and measures, including objectives of conceptual strategy, is contained in the individual tasks of the Rural Development Program for period 2014-2020. A slight increasing trend in the production of greenhouse gases in Agriculture is expected, according to WEM scenario the growth of emissions would be about 12 % in period 2012-2030. Whereas the potential of the implemented measures is able to maintain the trend and amounts of emissions at slightly increasing trend, the potential of planned and newly implemented measures (WAM) could keep the current level of emission.

2.2.7 LULUCF

The historical data and projections using the WEM and WAM scenarios are shown in Fig. 43. It can be observed that for the nearest decades, the LULUCF sector remains to act as a sink of emissions under the current harvest demand remain for both WEM and WAM scenario. The difference between the WEM and WAM scenarios is insignificant in relation to both the overall trend and annual fluctuations of emissions in this sector. For the period predicted period until 2030, the emissions under the WAM scenario tend to be somewhat lower as compared to WEM (Tab. 92). Although the net effect of WAM scenario is only 5 %, 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. 43 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. 92 Historic and projected emissions of GHG for the LULUCF sector [Mt CO_2 eq.]

Scenario	1990	2012	2015	2020	2025	2030	2012- 2030
Historic data and WEM	-3.44	-7.25	-0,92	-1.92	-2.89	-2.94	59.4 %
Historic data and WAM	-3.44	-7.25	-1.05	-2.38	-3.47	-3.34	54.0 %

Tab. 93 Breakdown of historic and projected emissions of GHG by gases in LULUCF for historic data and WEM and WAM scenario

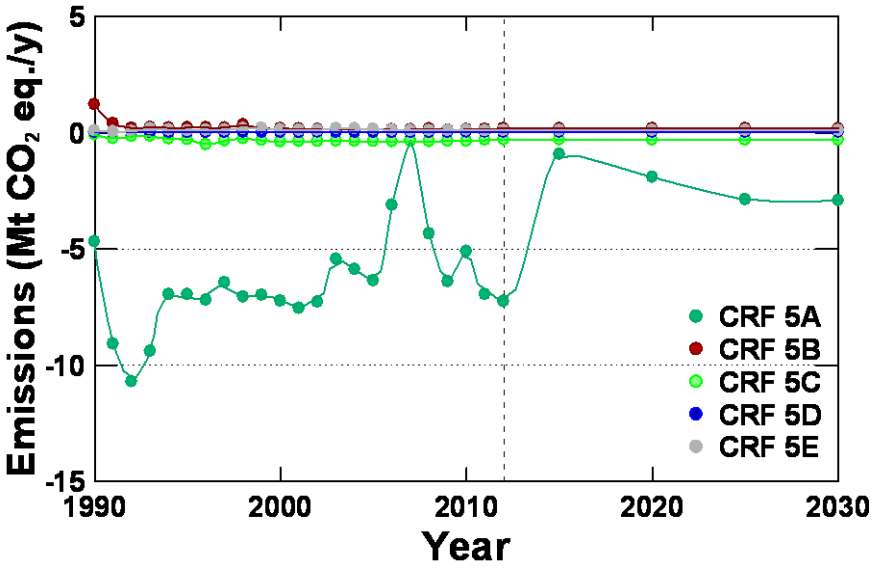
Gas [Mt CO_2eq]	1990	2012	2015	2020	2025	2030	2012- 2030
WEM scenario							
CO_2	-3.555	-7.323	-1.002	-1.995	-2.962	-3.013	58.9 %
CH_4	0.096	0.058	0.058	0.059	0.059	0.059	0.4 %
N_2O	0.021	0.012	0.012	0.012	0.012	0.012	-1,3 %
Total (Mt CO_2 eq.)	-3.437	-7.252	-0,921	-1.924	-2.891	-2.942	59.4 %
WAM scenario							
CO_2	-3.555	-7.323	-1.118	-2.453	-3.545	-3.406	53,5%
CH_4	0.096	0.058	0.059	0.059	0.059	0.059	0,4%
N_2O	0.021	0.012	0.012	0.012	0.012	0.012	-1,3%
Total (Mt CO_2 eq.)	-3.437	-7.252	-1.048	-2.382	-3.474	-3.335	54,0%

The numeric values for the trends by WEM and WAM scenarios are shown by decades in Tab. 92. It can be seen that the sink of CO_2 observed in LULUCF for the previous decades to a large extent diminishes. In relation to the base year of 2012, the sink of emissions would decrease by about 59 and 54 % in 2030 of that observed in 2012 for the WEM and WAM scenarios, respectively.

The breakdown of emissions by individual gases (Tab. 93) 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 are shown in Fig. 44 and numerically in Tab. 94 (here also including the categories 5F Other Land and 5F Other). The emissions in the LULUCF sector are mostly determined by carbon stock changes in the category 5A Forest Land.

Fig. 44 Breakdown of historic and projected (WEM scenario) emissions of GHG by land categories within LULUCF, namely Forest Land (CRF 5A), Cropland (CRF 5B), Grassland (CRF 5C), Wetlands (CRF 5D) and Settlements (CRF 5E)



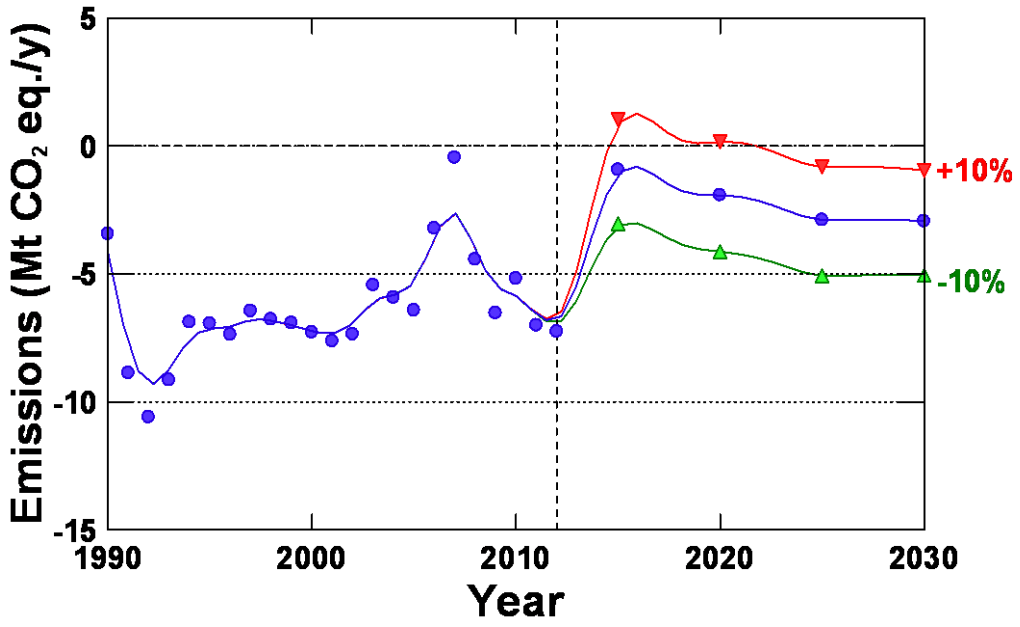
Tab. 94 Breakdown of historic and projected emissions of GHG by the major sub-categories of the LULUCF sector for WEM and WAM scenario

Gas [Mt CO_2eq]	1990	2012	2015	2020	2025	2030	2012- 2030
WEM scenario							
5A Forest Land	-4.68	-7.26	-0.93	-1.92	-2.88	-2.92	59.8 %
5B Cropland	1.21	0.18	0.18	0.18	0.18	0.18	-2.7 %
5C Grassland	-0.08	-0.30	-0.31	-0.31	-0.32	-0.32	-7.2%
5D Wetlands	0.02	0.02	0.02	0.02	0.02	0.02	1.2%
5E Settlements	0.08	0.10	0.10	0.10	0.10	0.10	0.9%
5F Other land	NO	0.0	0.0	0.0	0.0	0.0	NA
5G Other	0.01	0.0	0.0	0.0	0.0	0.0	0.4%
WAM scenario							
5A Forest Land	-4.68	-7.26	-1.05	-2.37	-3.46	-3.31	54.6 %
5B Cropland	1. 21	0.18	0.18	0.18	0.18	0.18	-2.7 %
5C Grassland	-0.08	-0.30	-0.31	-0.31	-0.32	-0.32	-7.2%
5D Wetlands	0.02	0.02	0.02	0.02	0.02	0.02	1.2%
5E Settlements	0.08	0.10	0.10	0.10	0.10	0.10	0.9%
5F Other land	NO	0.0	0.0	0.0	0.0	0.0	NA
5G Other	0.01	0.0	0.01	0.01	0.01	0.01	0.4%

Sensitivity analysis

The key category of the Czech emission inventory is biomass carbon stock change in the emission sub-category 5.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. 45. 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. 45 Sensitivity analysis using variable harvest demand and its effect on emissions in LULUCF under WEM scenario

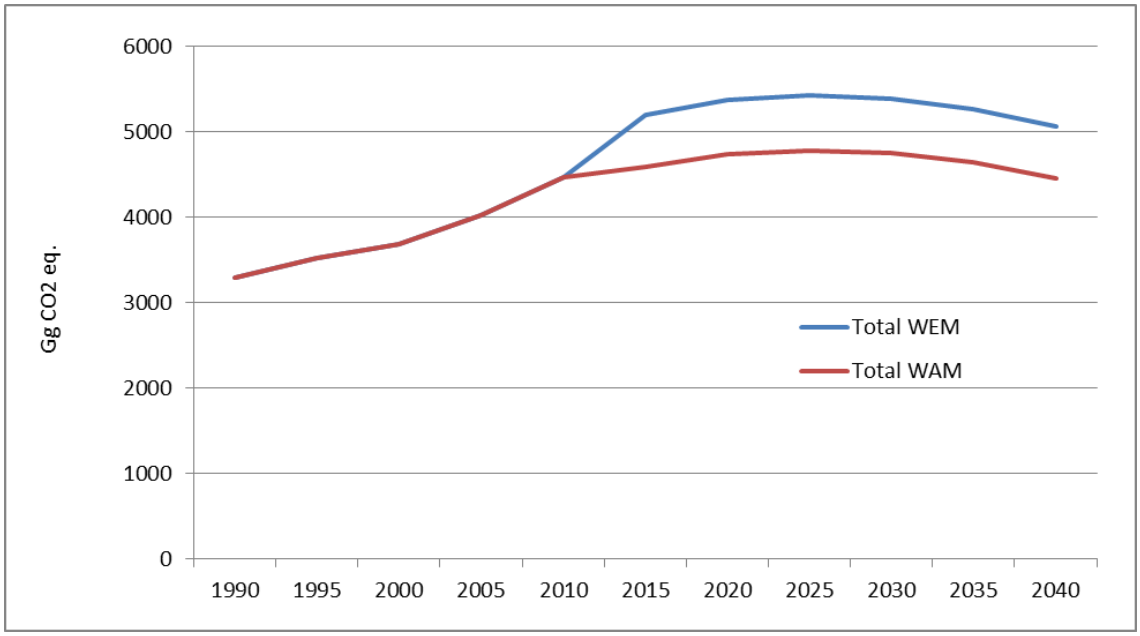


2.2.8 Waste

Changing emissions from waste sector in the Czech Republic is difficult. Even with adoption of new measures emissions changes slowly. This is due to amount of waste that is presently deposited in the landfills and will influence emissions in upcoming decades. Also there is technology lock-in between landfilling and incineration that is hard to overcome. From point of GHG emission reduction there is certain need to address also those past burdens.

Greenhouse gas emission projections from waste sector emissions from four source categories – 4A – Solid waste disposal sites, 4B biological treatment of waste – mainly composting and anaerobic digestion of organic waste, 4C – waste incineration, although this category include only emissions from waste not incinerated for energy purposes – hazardous, clinical and industrial waste, waste incinerated for energy generation is located in 1A category. Last category is 4D emissions from waste water management.

Fig. 46 Historic and projected emissions of GHG – Waste



Tab. 95 Historic and projected emissions of GHG – Waste [Gg CO_2 eq.]

	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
Total WEM	3285	3520	3685	4025	4469	5191	5370	5420	5385	5265	5062
Total WAM	3285	3520	3685	4025	4469	4582	4740	4783	4748	4638	4452

Tab. 96 Breakdown of historic and projected emissions of GHG by source categories in waste: WEM - scenario with existing measures [Gg CO_2 eq.]

	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
4A - SWDS	1979	2405	2682	2899	3224	3590	3800	3880	3875	3784	3607
4B - Biological treatment	0	0	0	64	179	561	561	561	561	561	561
4C - Waste incineration	24	72	64	178	183	200	200	200	200	200	200
4D - Wastewater treatment	1283	1043	939	884	883	840	809	779	749	721	694

Fig. 47 Breakdown of projected emissions of GHG by gasses in scenario with existing measures – waste

DELETED – table above instead

Narration of “with existing measures” scenario

4A solid waste disposal sites: Production rate of waste remains on the present level. Dematerialization, separation of selected waste compounds, present economical incentives and legislation - all those tools and measures are enough to compensate further increase of MSW. As most of MSW is still landfilled (new landfill capacity is created) newly build landfills are equipped with gas recovery system and the efficiency of LFG collection is generally high and increasing in time. Waste composition changes

with time; there is a decrease of plastics and biologically degradable waste (influencing both landfill and waste incineration). Key assumptions for this source category is amount of waste, and methane recovery that effectively cuts GHG emissions.

4B biological treatment of waste: This category is new in the inventory and we have limited knowledge about its possible development. In recent 5 years it boomed from almost zero to substantive part of the waste inventory. Behind this boom is support for renewable energy from anaerobic digestion. In WEM scenario we assume this support will last at present levels increasing current volume slightly in following years. Key assumption for this source category is amount of anaerobic digestion facility and their efficiency in capturing produced methane. Current assumption based on IPCC 2006 methodology assumes losses amounting 5% of production.

4C waste incineration: Most of this category is unaffected by measures as main bulk of waste is incinerated in 1A public energetics. WEM assumes slight increase of this source category mainly due to economic growth, but there is limited space for new capacities for industrial/hazardous/clinical waste incineration. Development is expected in municipal waste incineration thou.

4D waste water treatment: Waste water treatment is gradually producing less GHG, this is due to more favorable mix of aerobic and anaerobic technologies (with capture) Also the share of people connected to wastewater treatment plants increases. Key assumption here is decreasing IEF (implied emission factor) and population as well as steady nutrition habit of projected population as nitrous oxide production is influenced by protein availability in food.

Scenario with additional measures

Tab. 97 Breakdown of historic and projected emissions of GHG by gases in waste – scenario with additional measures

	1990	1995	2000	2005	2010	2015	2020	2025	2030	2035	2040
4A - SWDS	1979	2405	2682	2899	3224	3231	3420	3492	3487	3405	3246
4B - Biological treatment	0	0	0	64	179	312	312	312	312	312	312
4C - Waste incineration	24	72	64	178	183	200	200	200	200	200	200
4D - Wastewater treatment	1283	1043	939	884	883	840	809	779	749	721	694

Fig. 48 Breakdown of projected emissions of GHG by source categories in scenario with additional measures – waste

DELETED see table above

Narration of “with existing measures” scenario

4A solid waste disposal sites: Production rate of waste remains on the present levels. Dematerialization, separation of selected waste compounds, present economic incentives and legislation - all those tools and measures are enough to compensate further increase of MSW. As most of MSW is still landfilled (new landfill capacity is

created) newly build landfills are equipped with gas recovery system and the efficiency of LFG collection is higher than WEM scenario and increasing in time. Waste composition changes with time; there is a decrease of plastics and biologically degradable waste (influencing both landfill and waste incineration) in comparison with WEM scenario this decrease is sharper. Key assumptions for this source category are amount of waste, and methane recovery that effectively cuts GHG emissions.

4B biological treatment of waste: This category is new in the inventory and we have limited knowledge about its possible development. In recent 5 years it boomed from almost zero to substantive part of the waste inventory. Behind this boom is support for renewable energy from anaerobic digestion. In WAM scenario we assume this support will last at present levels increasing current volume slightly in following years. Key assumption for this source category is amount of anaerobic digestion facilities and their efficiency in capturing produced methane. In WAM scenario we assume that there will be additional pressure to maintain technological quality of the installations. WAM assumption based on IPCC 2006 methodology assumes losses amounting 2.5 % of production.

4C waste incineration: Most of this category is unaffected by measures as main bulk of waste is incinerated in 1A public energetics. WAM scenario assumes identical assumptions as WEM.

4D waste water treatment: Waste water treatment is gradually producing less GHG, this is due to more favorable mix of aerobic and anaerobic technologies (with capture) also the share of people connected to wastewater treatment plants increases. Key assumption here is decreasing IEF (implied emission factor) and population as well as steady nutrition habit of projected population as nitrous oxide production is influenced by protein availability in food.

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