CZECH HYDROMETEOROLOGICAL INSTITUTE

Air Quality Control Division

NATIONAL GREENHOUSE GAS INVENTORY REPORT OF THE CZECH REPUBLIC, NIR

(REPORTED INVENTORY 2007)

NIR was compiled by the Czech GHG inventory team from institutions involved in National Inventory System, NIS:

KONEKO, CDV, CHMI, IFER, CUEC
coordinated by CHMI

National Inventory Report under the UNFCCC and the Kyoto Protocol

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CONTENT

Executive Summary

ES 1. Background Information

As a Party to the United Nations Framework Convention on Climate Change (UNFCCC), the Czech Republic is required to prepare and regularly update National Greenhouse Gas Inventories. This edition of the National Inventory Report (NIR) deals with National Greenhouse Gas Inventories for the 1990 to 2007 period with accent on the latest year 2007.

Through adopting decision 3/CP.5, the COP has undertaken to implement the UNFCCC guidelines on reporting and reviewing (FCCC/CP/1999/7). According to this decision, Parties shall submit a National Inventory Report (NIR) containing detailed and complete information on their inventories, in order to ensure the transparency of the inventory. This is the eighth version of the National Inventory Report (NIR) submitted by the Czech Republic; it is an update of the NIR submitted in 2008. This report is based on the figures submitted to the UNFCCC in the CRF 2009 submission, which contains the data for 2007 and revised data for 1990 to 2006. These data differ somewhat from last year's reported data, as some recalculations have been undertaken and some changes have been made in the methodology (e.g. lime production and LULUCF) retrospectively, to improve the accuracy of the GHG inventory. In the NIR 2004 version (last reported inventory for 2002), the authors began to employ the updated Reporting Guidelines (FCCC/CP/2008/8). In the previous submission (2008), almost all the chapters were modified and rewritten to be in accordance with above-mentioned Guidelines. The process of gradual improvement of the NIR also continues in this submission.

The Executive Summary gives an overview of the Czech GHG inventory. Chapters 1 and 2 provide general information on the inventory preparation process and summarize the overall trends in emissions. Comprehensive information on the methodologies used for estimating emissions of the national GHG inventory is presented in the Sector Analysis Chapters 3 - 8. Chapter 9 gives an overview of actions planned to further improve the inventory and of changes made previously (Recalculations).

References are also given, as well as the underlying emission data for 2007 as included in the CRF Tables Submission 2009. Furthermore, detailed information on the methodology of emission estimates for the fuel combustion sector, the CO_2 reference approach and data from the national energy balance are presented in a special Annex.

It is the intention of this NIR to help in understanding the calculation of Czech GHG emissions. More information can be found in the background literature cited here. Unfortunately, the majority of the background literature is available only in Czech.

ES 2. Summary of National Emission and Removal Related Trends

In 2007, the most important GHG in the Czech Republic was CO_2 contributing 85.9 % to total national GHG emissions and removals expressed in $CO_{2\ eq.}$, followed by CH_4, 8.0 % and N_2O, 5.0 %. PFCs, HFCs and SF_6 contributed for 1.1 % to the overall GHG emissions in the country. The energy sector accounted for 82.7 % of the total GHG emissions and removals followed by Industrial Processes and Solvent Use 10.8 %, Agriculture 5.3 % and Waste 2.4 %. Total GHG emissions and removals (with 5 *Land Use, Land-Use Change and Forestry*) amounted to 149 103 Gg $CO_{2\ eq.}$ and decreased by 21.6 % from 1990 to 2007.

Table ES 1 provides data on emissions by sectors and Table ES 2 by gas from 1990 to 2007.

Tab. ES 1 Summary of GHG emissions by sector 1990 - 2007 *[Gg $CO_{2\ eq.}$]*

	1 Energy	2 Industrial Processes	3 Solvent Use	4 Agriculture	5 LULUCF	6 Waste
1990	156 235	19 596	765	15 467	-4 565	2 650
1991	149 169	14 612	728	13 714	-10 080	3 052
1992	132 978	16 062	691	11 952	-11 870	3 057
1993	131 538	12 916	651	10 445	-10 486	3 062
1994	121 268	13 848	616	9 642	-8 136	3 152
1995	125 521	14 310	596	9 580	-8 207	3 193
1996	132 971	14 037	587	9 174	-8 650	3 167
1997	125 380	14 873	585	9 004	-7 707	3 150
1998	118 447	14 166	580	8 594	-8 044	3 180
1999	116 190	12 146	578	8 602	-8 186	3 194
2000	121 418	13 610	569	8 387	-8 573	3 250
2001	124 075	12 863	550	8 587	-8 907	3 275
2002	120 280	12 558	540	8 353	-8 674	3 344
2003	120 589	13 753	525	7 772	-6 752	3 328
2004	120 156	15 011	519	8 037	-7 211	3 337
2005	120 902	13 650	514	7 765	-7 708	3 419
2006	122 390	15 055	513	7 670	-4 452	3 479
2007	123 330	15 593	512	7 838	-1 720	3 550

Tab. ES 2 Summary of GHG emissions by gas 1990 - 2007 *[Gg $CO_{2\ eq.}$]*

	$CO_{2\ total}$ [1]	CO_2 [2]	CH_4 [1]	N_2O [1]	HFCs	PFCs	SF_6
1990	159 639	164 332	18 559	11 872	NO	NO	78
1991	144 201	154 381	16 876	10 040			77
1992	127 942	139 916	15 873	8 979			77
1993	125 253	135 854	14 880	7 916			77
1994	118 501	126 754	13 977	7 836			76
1995	123 080	131 396	13 729	8 108	1	0	75
1996	129 865	138 650	13 547	7 692	101	4	78
1997	123 984	131 833	13 117	7 842	245	1	95
1998	116 103	124 273	12 645	7 794	317	1	64
1999	112 427	120 729	12 139	7 609	268	3	77
2000	118 458	127 138	12 173	7 617	263	9	142
2001	119 702	128 719	12 331	7 836	393	12	169
2002	116 183	124 974	12 149	7 596	391	14	68
2003	119 422	126 318	11 857	7 221	590	25	101
2004	119 689	127 033	11 661	7 830	600	17	52
2005	118 541	126 375	11 753	7 557	594	10	86
2006	124 008	128 615	12 229	7 440	872	23	83
2007	128 031	129 950	11 876	7 495	1 606	20	76

[1] emissions including LULUCF sector

[2] emissions excluding LULUCF sector

Over the period 1990 - 2007 CO_2 emissions and removals decreased by 19.8 %, mainly by emissions reduction in *1 Energy*; although CO_2 emissions from *1A3 Transport* sector rapidly increased. CH_4 emissions decreased by 36.0 % during the same period mainly due to lower emissions from *1 Energy*, *4 Agriculture* and *6 Waste*; N_2O emissions decreased by 36.9 % over the same period due to emission reduction in *4 Agriculture* and despite increase from the *1A3 Transport* sector. Emissions of HFCs and PFCs increased more than 2 000 times and 165-times, respectively, whereas SF_6 emissions decreased by 2.3 % from the base year (1995) to 2007.

ES 3. Overview of Source and Sink Category Emission Estimates and Trends

In 2007, 123 330 Gg $CO_{2\ eq.}$, that are 82.7 % of national total emissions (including *5 Land Use, Land-Use Change and Forestry*) arose from *1 Energy*; 95.7 % of these emissions arise from fuel combustion activities. The most important sub sector of *1A Fuel Combustion* with 52.2 % of total sectoral emissions in 2007 is *1A1 Energy Industries*, *1A2* M*anufacturing Industries and Construction* responses for 21.3 % and *1A3 Transport* for 16.3 % of total sectoral emissions. From 1990 to 2007 emissions from *1 Energy* decreased by *21.1* %.

2 Industrial Processes is the second largest sector with 10.5 % of total GHG emissions (including *5 Land Use, Land-Use Change and Forestry*) in 2007 (15 593 Gg $CO_{2\ eq.}$); the largest sub sector is 2C *Metal Production*. From 1990 to 2007 emissions from *2 Industrial Processes* decreased by 20.4 %.

In 2007, 0.3 % of total GHG emissions (including *5 Land Use, Land-Use Change and Forestry*) in the Czech Republic (512 Gg $CO_{2\ eq.}$) arose from the sector *3 Solvent and Other Product Use*. From 1990 - 2006 emissions from *3 Solvent and Other Product Use* decreased by 33.0 %.

4 Agriculture is the third largest sector in the Czech Republic with 5.3 % of total GHG emissions (including *5 Land Use, Land-Use Change and Forestry*) in 2007 (7 838 Gg $CO_{2\ eq.}$); 59 % of emissions is coming from *4D Agricultural Soils*. From 1990 to 2007 emissions from *4 Agriculture* decreased by 59.3 %.

5 Land Use, Land-Use Change and Forestry is the only sector where removals exceed emissions. Removals from this sector decreased from 1990 to 2007 by 62.3 % to 1 583 Gg $CO_{2\ eq.}$

2.4 % of the national total GHG emissions (including *5 Land Use, Land-Use Change and Forestry*) in 2007 arose from *6 Waste.* Emissions from *6 Waste* increased from 1990 to 2007 by 34.0 % to 3 550 Gg $CO_{2\ eq.}$

ES 4. Overview of Emission Estimates and Trends of Indirect GHGs and SO_2

Emission estimates of indirect GHGs and SO_2 for the period from 1990 to 2007 are presented in Table ES 3.

Tab. ES 3 Indirect GHGs and SO_2 for 1990 - 2007 *[Gg]*

	NO_X	CO	NMVOC	SO_2
1990	742	1 071	311	1 876
1991	732	1 157	273	1 772
1992	708	1 162	257	1 559
1993	691	1 194	233	1 469
1994	451	1 075	255	1 290
1995	430	932	215	1 095
1996	447	965	265	934
1997	471	981	272	981
1998	414	812	267	442
1999	391	726	247	269
2000	397	680	244	264
2001	333	687	220	251
2002	319	587	203	237
2003	326	630	203	232
2004	334	622	198	227
2005	279	556	182	219
2006	284	540	179	211
2007	286	581	174	217
NEC[3]	286	-	220	283

Emissions of indirect greenhouse gases decreased from the period from 1990 to 2007: for NO_X by 61 %, for CO by 46 %, for NMVOC by 44 % and for SO_2 by 88 %. The most important emission source for indirect greenhouse gases and SO_2 are fuel combustion activities.

[3] NEC - National Emission Ceilings according to Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001

1 Introduction and general issues

1.1 Background

Annual monitoring of greenhouse gas emissions and removals is one of the obligations following from the *UN Framework Convention on Climate Change and its Kyoto Protocol*. In addition, as a result of membership in the European Union, the Czech Republic must also fulfil its reporting requirements concerning GHG emissions and removals following from Decision of the European Parliament and Council No. 280/2004/EC. This Decision also requires establishing a National Inventory System (NIS) pursuant to the Kyoto Protocol (Art. 5.1) from December 2005.

The *Czech Hydrometeorological Institute* (CHMI) was appointed in 1995 by the *Ministry of Environment* (ME), which is the founder and supervisor of CHMI, to be an institution responsible for compilation of GHG inventories. Thereafter CHMI is the official provider of Czech greenhouse gas emission data. The role of CHMI was improved following implementation of NIS, as CHMI was designated by ME as the coordinating institution of the official national GHG inventory.

Inventory studies have been gradually elaborated in CHMI for years since 1990: the first study was issued in 1995 for 1990 - 1993 (Fott *et al*, 1995). Following the authorization given by the *Ministry of Environment*, the results of these studies have been submitted in the prescribed format to the *Secretariat of Framework Convention* as official national information. In addition, GHG inventory results compiled by CHMI were summarized in National Communications (*Second National Communication*, 1997; *Third National Communication*, 2001; *Fourth National Communication*, 2006) for the 1990 – 1995, 1990 - 1999 and 1990-2003 periods, respectively.

This report includes GHG emission inventory in the Czech Republic for 2006 in relation to the preceding period, especially to the reference year 1990. The greatest attention is focused on direct greenhouse gases regulated by the *Kyoto Protocol* - CO_2, CH_4, N_2O, HFCs, PFCs and SF_6. In addition, the precursors of greenhouse gases and aerosols (NO_X, CO, NMVOCs, SO_2) are also reported. Similar to previous years, inventories of emissions and removals of greenhouse gases were prepared according to the IPCC methodology (*Revised 1996 IPCC Guidelines*, 1997; *Good Practice Guidance*, 2000; *Good Practice Guidance for LULUCF*, 2003); application of this general methodology on country specific circumstances will be described in following paragraphs.

This version of NIR represents the seventh volume available in English (since the 2002 submission). Previous reports were written only in Czech. The first two English issues were compiled according to the UNFCCC *Reporting Guidelines* (FCCC/CP/1997/7). A few years ago, the authors began to employ the updated *Reporting Guidelines* (FCCC/CP/2002/8 and FCCC/SBSTA/2004/8). Subsequently, the process of implementation of the updated *Reporting Guidelines* gradually proceeded and now is almost complete.

Since submission 2000, inventory data have been reported in *Common Reporting Format. Originally, only the current year (1998) was reported, but successively also previous years have been added. The process of addition of data for previous years was often accompanied by recalculations.* In accordance with *Good Practice Guidance, 2000* and *Good Practice Guidance for LULUCF*, 2003, where possible, the necessary recalculations are undertaken as new and better underlying data and/or methodological changes and improvements become available. Some gaps and imperfections were identified in the past few years and thus it was necessary to perform the relevant recalculations. These recalculations were gradually elaborated and performed; nevertheless they were not reported in recent submissions until they were subjected to standard QA/QC procedures.

Implementation of the new reporting software - *CRF Reporter* was a good opportunity to report these recalculations in the 2006 submission (April 2006). In addition, recalculations in LULUCF were motivated by the necessity to implement the latest IPCC methodology for this sector (*Good Practice in LULUCF*, 2003).

Thus, all the recent recalculations and revisions for the 1990-2004 period were reported in the submission of April 2006. As a part of the Czech Initial Report under the Kyoto Protocol (*Czech Republic's Initial Report*, 2006), this submission was subjected to a thorough in-country review organised by UNFCCC in March, 2007. The Czech Republic was asked by the Expert Review Team (ERT) to perform extra instant revisions (during 6 weeks) to prevent possible adjustment:

- To use the country-specific emission factor for CO_2 for coals instead of the default values to be in line with the Good Practice Guidance
- To use the IPCC default emission factors for CH_4 and N_2O for stationary fuel combustion instead of the national values because of lack of transparency
- To apply the *Tier* 2 approach (FOD) instead of *Tier* 1 for CH_4 emissions from landfills to prevent possible overestimation of the base year (the amount of municipal waste land-filled has gradually increased since the 1960s).

These invitational revisions and other recommendations of ERT were taken into account in the previous (2008) submission and the relevant values were inserted in the CRF for the respective time interval (for the invitational revisions mentioned above, all the data have been inserted for the period since 1990).

The current data submission (2009) for UNFCCC and for the European Community contains all the data sets for 1990 - 2007 in the form of the official UNFCCC software called *CRF Reporter (version 3.2.1)*.

1.2 National Inventory System and Institutional Arrangement

The national inventory system (NIS), as required by the *Kyoto Protocol* (Article 5.1) and by Decision No. 280/2004/EC, is in place since 2005. As approved by the Ministry of Environment (ME), which is the single national entity with overall responsibility for the national greenhouse gas inventory, the founder of CHMI and is its superior institution, the established institutional arrangement is as follows the Czech Hydrometeorological Institute (CHMI), under the supervision of the Ministry of Environment, is designated as the coordinating and managing organization responsible for the compilation of the national GHG inventory and reporting its results. The main tasks of CHMI consist in inventory management, general and cross-cutting issues, QA/QC, communication with the relevant UN FCCC and EU bodies, etc. Sectoral inventories are prepared by sectoral compilers (sectoral experts) from sector-specialist institutions, which are coordinated and controlled by CHMI. The responsibilities for GHG inventory compilation from individual sectors are allocated in the following way:

- KONEKO MARKETING Ltd. (KONEKO), Prague, is responsible for compilation of the inventory in sector 1, Energy, for stationary sources including fugitive emissions
- Transport Research Centre (CDV), Brno, is responsible for compilation of the inventory in sector 1, Energy, for mobile sources
- Czech Hydrometeorological Institute (CHMI), Prague, is responsible for compilation of the inventory in sectors 2 and 3, Industrial Processes and Product (Solvent) Use
- Institute of Forest Ecosystem Research Ltd. (IFER), Jilové u Prahy, is responsible for compilation of the inventory in sectors 4 and 5, Agriculture and Land Use, Land Use Change and Forestry
- Charles University Environment Centre (CUEC), Prague, is responsible for compilation of the inventory in sector 6, Waste.

Official submission of the national GHG Inventory is prepared by CHMI and approved by the Ministry of Environment. Moreover, the Ministry of Environment secures contacts with other relevant governmental bodies, such as the Czech Statistical Office, the Ministry of Industry and Trade and the Ministry of Agriculture.

More detailed information about NIS is given in the Initial Report (*Czech Republic's Initial Report under the Kyoto Protocol*, 2006).

1.3 Process of Inventory Preparation

1.3.1 Activity Data Collection

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

Emissions estimates from Sector 1A *Fuel Combustion Activities* are based on the official Czech Energy Balance, compiled by the Czech Statistical Office. Data from the Czech Energy balance are processed both in the Reference Approach (TPES - primary sources data are used) and in the Sectoral Approach (data for fuel transformations and final consumptions). However, in the latter case, some additional data are required (e.g. transportation statistics data).

1.3.2 Data Processing and Storage

Data Sector *1A Fuel Combustion Activities* are processed by the system of interconnected spreadsheets, compiled in MS Excel following "Worksheets" presented in IPCC *Guidelines*, Vol. 2. *Workbook*. The system is extended by incorporating sheets with modified energy balance: these sheets represent an input data system. This system was recently a bit modified to be more transparent.

Also, in the majority of other sectors, data are processed in a similar way - by using a system of joined spreadsheets taken from the *Workbook* and slightly modified in order to respect national circumstances. The following examples of such cases of processing can be mentioned: agriculture, waste, fugitive emissions. On the other hand, in some cases, e.g. for solvent use, such a system is not as efficient and thus it is substituted by spreadsheets inspired by the CORINAIR methodology. For LULUCF, a specific spreadsheet system is used, respecting the national methodology. All spreadsheets mentioned above are stored electronically.

After calculations, all relevant data are put into the *Common Reporting Format* (CRF) to be reported and to be stored together with detailed calculation spreadsheets.

1.4 Methodology

The IPCC methodology has been prepared for the purpose to compile national inventories of anthropogenic GHG emissions and removals. Its first version was published in 1995. However, it was reviewed soon afterwards, so that the second version has been in use since 1997 (*Revised 1996 IPCC Guidelines*, 1997).

Increased compliance requirements related to the *Kyoto Protocol* were basis for further improvement of existing IPCC methodology to assure higher level of inventory quality and adequate reduction of inventory uncertainties. Therefore, the additional methodological handbook was prepared by the IPCC, entitled as *Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* (in following text it will be referred as the *Good Practice Guidance*). This methodical handbook is understood as a supplement to the *Revised 1966 IPCC Guidelines*. Its main aim is to assist Parties in preparing their inventories to assure that emission estimates are neither overestimated nor underestimated (wherever possible), and uncertainty in determining of emissions is reduced as much as possible. Implementation of *Good Practice Guidance* in preparation of national inventory improves its transparency, consistency and completeness and it is good basis for an evaluation of levels and trends in uncertainties, verifiability (QC/QA mechanisms) and inventory comparison with other Parties.

The IPCC methodology is related to greenhouse gases with direct radiation absorption effect: CO_2, CH_4, N_2O, substances with increased radiation absorption effect containing fluorine: HFCs, PFCs and

SF_6, precursors of tropospheric ozone: NO_X, NMVOCs, CO, and aerosol precursor SO_2. It highlights CO_2 emissions as the most important greenhouse gas. The only anthropogenic sources according to the IPCC methodology is fossil fuels combustion and, to some extent, also cement production, partly also limestone and other carbonate minerals decomposition (e.g. melting of glass, liming of soil, lime-based sulphur removal, etc.), unless subsequent sinks compensate these.

The combustion of fossil fuels in stationary and mobile sources usually constitutes the best-known group of sources in most countries. Two IPCC methods are prescribed for the determination of CO_2 emissions from fuel combustion; independent approaches are based to a certain degree on the national energy balance. A simpler procedure (Reference Approach**)**, basically determines the total amount of burned carbon on the basis of the balance calculation of apparent consumption of individual types of fuel (e.g. hard coal, petroleum, petrol, natural gas) for which the inventory is prepared (i.e. mining + imports - exports - change in stocks). This information is expressed in energy units (TJ) in the energy balance. The necessary emission factors for carbon (t C / TJ) for the individual kinds of fuel are listed in the methodical materials and are sufficiently accurate.

The second method (Sectoral Approach**)** is based on the actual fuel consumption in individual categories (e.g. energy production, industry, transportation). The calculation using these two methods requires different items in the energy balance. The Reference Approach is based on primary sources, while the Sectoral Approach is based on transformation processes and final consumption. Both methods also take into account that a smaller part of the fuel is utilized for purposes other than energy production (e.g. lubricating oils, asphalt). For other fuels, it is assumed that almost all the carbon is burned to form carbon dioxide and a small correction is made for unburned carbon. The Reference Approach is very transparent and thus is used especially for control purposes. On the other hand, it does not permit determination of source category of in which the emissions of carbon dioxide are generated and thus the Sectoral Approach is preferred. However, sufficiently reliable energy statistics are required for good quality inventories.

Another source, or rather sink of CO_2, is related to the sector 5 *Land Use, Land Use Change and Forestry* and it is associated, in particular, with felling or planting forests; the amount of carbon contained in felled trees is considered to correspond to emissions and, to the contrary, the amount of carbon contained in growing wood is considered as a sink. In this approach, any other CO_2 emissions formed, e.g., in burning or aerobic decay of wood or other biomass is not included in the overall emission balance.

Due to character of the most important CH_4 and N_2O sources, like coal mining, animal breeding, landfills and wastewater handling (CH_4), agricultural soils, management of animal waste, production of nitric acid, fluid-bed and local combustion, automobiles with catalysts (N_2O), the most accurate method to determine emissions (e.g. continuous direct measurement) can be used only exceptionally. Therefore, calculations are based on monitoring of the relevant statistical indicators (coal mining, number of head of farm animals, amount of nitric acid produced, amount of nitrogenous fertilizers employed, etc.) and application of relevant emission factors is a part of emission calculations. Depending on the complexity of the calculation and types of emission factors used (generally recommended - *default*, country-specific, site-specific and technology-specific), the approaches described in the IPCC methodology consist of three tiers.

The Tier 1 is typically characterized by simpler calculations, based on the basic statistical data and on the use of generally recommended emission factors (*default*) of global or continental applicability, tabulated directly in methodical manuals (*Revised 1996 IPCC Guidelines*, 1997; *Good Practice Guidance*, 2000).

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

Apparently, procedures in higher tiers should be more accurate and should better reflect the reality. However, they are more demanding in all aspects, and especially they are more expensive.

Nonetheless, the determination of emissions according to a procedure in the Tier 1 should always be carried out at least for control, because of its higher transparency.

All GHG emissions can be also expressed in terms of total (or aggregated) values, which are calculated as a sum of the emissions of the individual gases multiplied by Global Warming Potential values (GWP). GWP correspond to the factor by which the given gas is more effective in absorption of terrestrial radiation than CO_2 (1 for CO_2, 21 for CH_4 and 310 for N_2O). Total amount of F-gases is relatively small compared to CO_2, CH_4 and N_2O; nevertheless their GWP values are larger by 2-4 orders of magnitude. So, total aggregated emissions to be reduced according to the *Kyoto Protocol* are expressed as the equivalent amount of CO_2 with the same radiation absorption effect as the sum of the individual gases.

In relation to general methodological aspects, attention should be made particularly of quantification of uncertainty in the individual year and in the overall trend. Simultaneously, consideration is given to cases of uncertainties in the individual categories of sources, which is described either by the statistical parameters or at least on the basis of an expert judgment. The uncertainty in the total emissions or its trend can be determined in the Tier 1 using the method of error propagation, based on mathematical statistical relationships for calculation of the scattering of the sum or product from the corresponding scatters of the individual terms. Model methods of the Monte-Carlo type are more sophisticated and can be used for the Tier 2.

From a practical viewpoint, identification of *key categories* (*key sources)* is of great importance. These sources contribute to a decisive degree to the total amount of emissions or to its uncertainty, both in the individual year and in terms of trends. Considerably more attention should be paid to *key categories*, compared to the remaining sources or categories. This means that, where possible, more sophisticated procedures at a higher tier should be used for determining emissions from *key categories*, using site-specific or at least national emission factor values. However, this is often not possible in the absence of expenditure of financial means required to ensure carrying out suitable studies and the relevant measurements. Any means employed to improve the quality of the inventory should be expended in the most effective manner possible and should be preferentially oriented to *key categories.*

One of the most important *Good Practice* issues consists in ensuring consistent time series. In order to achieve this goal, it is necessary to ensure that the entire time series is determined in a methodologically consistent manner. In case of revision of the methodology and its further development, it is sometimes necessary to recalculate the values for previous years if the emission values for these years were determined using an older, obsolete version. Recalculation must sometimes also be carried out when an error is found in earlier calculations or in the use of an unsuitable method.

The Czech national inventory is generally based on the IPCC methodology (*Revised 1996 IPCC Guidelines*, 1997 and *Good Practice Guidance,* 2000). Results determined earlier by older version of IPCC Guidelines from 1995 (*IPCC Guidelines*, 1995) were gradually recalculated in accordance with *Good Practice (see chapter 9)*.

On the other hand, in preparing this inventory, somewhat less attention was paid to emissions of the precursors NO_X, CO, NMVOCs and SO_2, which are covered primarily by *Convention on Long-Range Transboundary Air Pollution* (CLRTAP) and are not directly related to the Kyoto Protocol. Their inventories are compiled for the purposes of CLRTAP by NFR (*New Format of Reporting*) by another team at CHMI. Since 2001, emissions of precursors in the GHG inventory (CRF) have been fully taken over and transferred from NFR to CRF. A detailed description of the methodology used to estimate emissions of *precursors* is provided in the *Czech Informative Inventory Report (IIR) 2007, Submission under the UNECE / CLRTAP Convention*, published in March 2009.

As for the sector of Land use, Land-use change and Forestry (LULUCF), the Czech inventory follows the new IPCC methodology presented in the *Good Practice Guidance for LULUCF, 2003. Its* implementation started since the 2006 submission, while the older submissions were based on the former methodical instructions given in the *Revised 1996 IPCC Guidelines*, 1997.

As part of the implementation of *Good Practice Guidance* and as a response to the review processes performed by UNFCCC, it was decided to re-classify emissions from the production of iron and steel. Originally, these emissions were treated under sub-category 1A2. (to be compatible with the *Reference*

Approach). These emissions were recently re-classified under 2C1. (Metal production, Production of iron and steel) and emissions from ammonia production were re-classified (from 1A2. to 2B1.) in a similar way. The corresponding recalculations and re-categorizations of the whole time series since the reference year of 1990 were presented for the first time in the 2006 *Submission*. In addition, the relevant recalculations for Agriculture were completed in 2006 and were finally given there.

To summarise what has been mentioned above concerning recalculations: In recent years, there were two important “waves” of recalculations: (i) in the 2006 submission before the Initial Report under the Kyoto Protocol (*Czech Republic’s Initial Report under the Kyoto Protocol*, 2006) and (ii) last year, in the 2008 submission, as a consequence of the “in-country” UNFCCC review that took place in March, 2007.

The Czech national inventory is regularly subjected to thorough international reviews organized by the UNFCCC authorities. The Czech team considers the comments and recommendations of the ERT international review team to be an important means of improving the quality of the national inventory.

In September of 2008, the Czech national greenhouse gas inventory was subjected to re-examination of the centralised review type. The Czech national inventory team learned of the contents of the draft of the relevant review report (ARR) relatively late (in January 2009) and was thus not able to fully take into account the comments and recommendations of the international review team (ERT) in this submission. Nonetheless, in feasible cases, the comments were taken into account in this year’s submission (e.g. lime production – the entire data series from 1990 was recalculated); in more complicated cases, the comments and recommendations will be taken into account in the 2009 submission.

1.5 QA/QC Plan

Preparation of a QA/QC plan is one of the important obligations following from NIS. Elaboration of the QA/QC plan reflects the institutional arrangements: each institution should elaborate its own system of QA/QC procedures, including designation of a responsible QA/QC expert for each sector. Sectoral QA/QC plans are integral parts of the overall NIS QA/QC plan, which is developed by the NIS coordinator.

The national GHG inventory is part of client processes provided by CHMI that are in compliance with the ISO 9001 quality standard (CHMI obtained this certificate in 2007). The processes concerning the national inventory are elaborated in the form of flowcharts (diagrams) and include the above-mentioned principles of planning inventories including QA/QC procedures.

1.5.1 Quality control procedures

QC is designed to provide routine technical checks to measure and control the quality of the inventory, to ensure consistency, integrity, correctness, and completeness of the data and to identify and address errors and omissions. Its scope covers a wide range of inventory processes, from data acquisition and handling and application of the approved procedures and methods to calculation of estimates and documentation. These procedures are performed according to the *Good Practice Guidance*, 2000

Parts of these procedures are carried out by sectoral compilers (SC) and parts by the NIS manager. SC concentrate more on activity data and the sector-specific methods employed; the NIS manager mostly checks appropriate use of methodology, carries out a trend analysis and compares data from other possible sources. Both sectoral and overall inventory compilers employ the new CRF Reporter’s automatic control. When a sectoral inventory is forwarded to CHMI, this step is accompanied by a detailed check by the NIS manager. These all procedures correspond mainly to the Tier 1 QC approach in accordance with GPG.

The Tier 2 approach has so far been used only in some special cases. It is e.g. partly used in the transport sub-sector, where activity data based on energy statistics (provided by experts from the KONECO) are combined with activity data based on transport statistics (provided by experts from CDV). Appropriate use of EFs is discussed in a similar way.

1.5.2 Quality assurance procedures

QA generally consists of independent third-party review activities to ensure that the inventory represents the best possible estimates of emissions and removals and to support the effectiveness of the QC program (GPG).

In former years, the Czech national inventory was regularly (always in December) assessed by Slovak experts, and vice versa. However, in the past two years, this tradition has been broken by the participation of Czech and Slovak experts in COP/MOP conferences. Cooperation between the two inventory teams in preparing the national inventories has been preserved; however, it is manifested in a less formal manner in mutual consultations and joint consultation workshops approximately once a year. Consequently, the Ministry of Environment has taken over the role of impartial evaluator; the outputs from the national inventory are submitted to the ME for checking and approval approximately ten days prior to the official submission.

The results of this review, together with findings of the review process performed by an international review team organized by UN FCCC, are utilized in the process of inventory planning for the coming years. Relevant findings are analysed by the NIS coordinator in co-operation with sectoral compilers to eliminate possible omissions and imperfections.

The Czech inventory team, taking into account the recommendations of the previous review, recognized that sectoral (sector-oriented) QA/QC procedures described in latest NIR should be improved. Therefore the team focused its attention on making QA/QC outputs more detailed and more specific. For instance, QA procedure of the activity data in the Energy sector will be performed by experts from the Czech Statistical Office. Similarly, the emissions from reducing agents and feedstocks reported under the Industrial processes sector will be compared and harmonized with the emissions from the Energy sector to prevent omission or double counting of the sources. The inventory of mobile sources compiled by the Centre of Transport Research will be checked by our energy experts.

Sector specific QA/QC procedures are described in the sectoral chapters.

1.6 Key Source Categories

The *Good Practice Guidance* provides two tiers of determining these *key categories (key sources)*. *Key categories* by definition contribute to ninety percent of the overall uncertainty in a level (in emissions per year) or in a trend. The procedure in the Tier 2 follows from this definition, and requires thorough analysis of the uncertainty and use of sophisticated statistical procedures and evaluation of sources in terms of the appropriate characteristics. However, it is more difficult to obtain the necessary data for this approach and this information is not yet used on the national level.

The procedure of the Tier 1 is based on the fact that ninety percent of the overall uncertainty in a level or in a trend is usually caused only by those sources whose contribution to total emissions does not exceed 95 %. This procedure is illustrated in Tab. 1.1 (determined on the basis of the level of emissions, i.e., level assessment and on the basis of trends, i.e., trend assessment). The sources or their categories are for level assessment ordered on the basis of decreasing contribution to total emissions. The *key categories* were considered to be those whose cumulative contribution is less than 95 %. For trend assessment, a similar procedure is used; with the difference that here the decisive quantity is defined as the product of the relative contribution to the total emissions (determined in the previous case) and the absolute value of the relative deviation of the individual trends from the total trend.

In previous submissions, only *key sources* identification not considering the LULUFC sector based on *Good Practice Guidance*, 2000, were performed. Starting with the 2008 submission, the *key categories* are identified according to *Good Practice Guidance for LULUCF*, 2003, which also considers categories from LULUCF. However, for the right identification of *key categories*, also assessment without consideration of the LULUCF categories was employed. It is obvious from Tab. 1.1 that no additional *key category* was identified when the LULUCF categories were not considered.

On the whole, 25 *key categories* were identified either by *level assessment* or by *trend assessment*. Of this quantity, 2 *key categories* belong to the LULUCF sector. 14 categories were identified as key in both ways. A summary of the assessed numbers concerning *key categories* is given in Tab. 1.2.

Tab. 1.1 Identification of key categories by level assessment (LA) and trend assessment (TA) for 2007 evaluated with and without LULUCF (Tier 1)

	Level Assessment (LA) with LULUCF							Trend Assessment (TA) with LULUCF				with	without*
Sec.	IPCC Source Categories	GHG	LA, %	LA*, %	Cum, %	KC	Sec.	IPCC Source Categories	GHG	Rel TA,%	NT	LULUCF	
1A	1.A Stationary Combustion - Solid Fuels	CO2	49.09	49.93	49.09	1	1A	1.A Stationary Combustion - Solid Fuels	CO2	16.13	2		LA,TA
1A	1.A.3.b Transport - Road Transportation	CO2	11.76	11.96	60.84	2	1A	1.A.3.b Transport - Road Transportation	CO2	25.39	1		LA,TA
1A	1.A Stationary Combustion - Gaseous Fuels	CO2	10.83	11.02	71.68	3	1A	1.A Stationary Combustion - Gaseous Fuels	CO2	13.53	3		LA,TA
2	2.C.1 Iron and Steel Production	CO2	5.23	5.32	76.91	4	2	2.C.1 Iron and Steel Production	CO2	2.76	7		LA,TA
1A	1.A Stationary Combustion - Liquid Fuels	CO2	3.15	3.20	80.06	5	1A	1.A Stationary Combustion - Liquid Fuels	CO2	10.19	4		LA,TA
1B	1.B.1.a Coal Mining and Handling	CH4	2.98	3.03	83.03	6	1B	1.B.1.a Coal Mining and Handling	CH4	2.24	9		LA,TA
4	4.D.1 Agricultural Soils, Direct Emissions	N2O	1.66	-	84.69	7	4	4.D.1-2 Agricultural Soils, Direct Emissions	N2O	1.72	12		LA,TA
6	6.A Solid Waste Disposal on Land	CH4	1.58	1.69	86.27	8	6	6.A Solid Waste Disposal on Land	CH4	2.18	10		LA,TA
4	4.A Enteric Fermentation	CH4	1.55	1.60	87.81	9	4	4.A Enteric Fermentation	CH4	2.48	8		LA,TA
2	2.A.1 Cement Production	CO2	1.33	1.57	89.15	10							LA
4	4.D.3 Agricultural Soils, Indirect Emissions	N2O	1.18	1.35	90.32	11	4	4.D.3 Agricultural Soils, Indirect Emissions	N2O	1.77	11		LA,TA
2	2.F.1-6 F-gases Use - ODS substitutes	F-gas	1.05	1.20	91.37	12	2	2.F.1-6 F-gases Use - ODS substitutes	F-gas	3.03	6		LA,TA
5	5.A.1 Forest Land remaining Forest Land	CO2	0.88	1.07	92.25	13	5	5.A.1 Forest Land remaining Forest Land	CO2	5.42	5		LA,TA
2	2.A.3 Limestone and Dolomite Use	CO2	0.72	0.73	92.97	14	2	2.A.3 Limestone and Dolomite Use	CO2	1.11	16		LA,TA
1A	1.A.5.b Mobile sources in Agricult. and Forestry	CO2	0.70	0.71	93.67	15							LA
2	2.A.2 Lime Production	CO2	0.52	0.53	94.19	16							LA
2	2.B.2 Nitric Acid Production	N2O	0.50	0.51	94.69	17							LA
1A	1.A.3.b Transport - Road Transportation	N2O	0.47	0.48	95.17	18	1A	1.A.3.b Transport - Road Transportation	N2O	1.26	15		LA,TA
						19	1A	1.A Stationary Combustion - Solid Fuels	CH4	1.56	13		TA
						20	5	5.B.1 Cropland remaining Cropland	CO2	1.45	14		TA
						21	6	6.C Waste Incineration	CO2	0.78	17		TA
						22	1A	1.A.3.e Transport - Other Transportation	CO2	0.56	18		TA
						23	1A	1.A Stationary Combustion - Biomass	CH4	0.52	19		TA
						24	4	4.B Manure Management	CH4	0.52	20		TA
						25	4	4.D.2 Pasture, Range and Paddock Manure	N2O	0.50	21		TA

* evaluated without LULUCF

Tab. 1.2 Figures for key categories assessed in different ways

Key categories (KC) with LULUCF	**25**	**KC assessed without LULUCF**	**22**
KC assessed by LA	18	KC assessed by LA	16
KC assessed by TA	21	KC assessed by TA	18
KC assessed by LA + TA concurrently	14	KC assessed by LA + TA concurrently	13
KC assessed by only LA	4	KC assessed by only LA	4
KC assessed by only TA	7	KC assessed by only TA	5

Of the overall number of 25 key categories, some of them are right on the 95 % borderline and thus appear only occasionally. This is particularly true of subcategories 1B1b (LA) and 5C2 (TA). Inclusion of "*6C Waste Incineration*" (TA) could be caused by the fact that these emissions were not determined in the reference year of 1990.

1.7 Uncertainty Analysis

Results of the uncertainty analysis for 2007 are given in Tab. 1.3.

Uncertainty analysis of Tier 1, which is presented in this volume of NIR, employs the same source categorization as used in *key categories* assessment. However, only sectors without LULUCF have been considered so far.

Presented results are based only on "default" uncertainty data presented in Good Practice Guidance, combined with uncertainties based on "expert judgment". To achieve more reliable results, it will be necessary to gather more relevant uncertainty data concerning both activity data and emission factors. As soon as more precise uncertainty estimates appear, they will be immediately inserted in the calculation spreadsheet.

Relatively low uncertainty in level (6 %) could be connected with a dominant contribution of CO_2 from fossil fuel combustion, which is usually more accurate compared with other sources. The value of 3 % in the trend uncertainty can be considered to be a typical result.

The same source categories used in key sources assessment have also been used even in uncertainty analysis. In this way, the uncertainty analysis result will be used later for Tier 2 key source analysis, which might be more suitable.

Tab. 1.3 Uncertainty analysis in level and trend assessments for 2007 (Tier 1)

Input DATA						Uncertainty in Level		Uncert. in trend
IPCC Source Category	Gas	Base year emissions (1990)	Year emissions (2006)	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in 2007	Uncertainty introduced into the trend in total national emissions
		[Gg $CO_{2\ eq.}$]		[%]	[%]	[%]	[%]	[%]
1.A Stationary Combustion - Solid Fuels	CO2	110 713	75 313	4.0	4.0	5.66	2.83	2.20
1.A Stationary Combustion - Gaseous Fuels	CO2	12 438	16 618	4.0	3.0	5.00	0.55	0.49
1.A Stationary Combustion - Liquid Fuels	CO2	13 518	4 828	4.0	3.0	5.00	0.16	0.16
1.A.3.a Transport - Civil Aviation	CO2	149	32	4.0	3.0	5.00	0.00	0.00
1.A.3.b Transport - Road Transportation	CO2	5 995	18 039	4.0	3.0	5.00	0.60	0.56
1.A.3.c Transport - Railways	CO2	647	298	4.0	3.0	5.00	0.01	0.01
1.A.3.d Transport - Navigation	CO2	56	16	4.0	3.0	5.00	0.00	0.00
1.A.3.e Transport - Other Transportation	CO2	494	76	4.0	3.0	5.00	0.00	0.01
1.A.5.b Mobile sources in Agriculture and Forestry	CO2	1 601	1 078	4.0	3.0	5.00	0.04	0.03
2.A.1 Cement Production	CO2	2 489	2 043	5.0	10.0	11.18	0.15	0.07
2.A.2 Lime Production	CO2	1 337	794	5.0	10.0	11.18	0.06	0.03
2.A.3 Limestone and Dolomite Use	CO2	678	1 106	5.0	10.0	11.18	0.08	0.05
2.A.7 Glass, Bricks and Ceramics	CO2	326	424	5.0	10.0	11.18	0.03	0.02
2.B.1 Ammonia Production	CO2	807	544	5.0	3.0	5.83	0.02	0.02
2.C.1 Iron and Steel Production	CO2	12 533	8 030	7.0	5.0	8.60	0.46	0.41
3 Solvents and Other Product Use	CO2	550	298	5.0	5.0	7.07	0.01	0.01
6.C Waste Incineration	CO2	0	413	20.0	5.0	20.62	0.06	0.06
1.A Stationary Combustion - Solid Fuels	CH4	1 335	180	4.0	50.0	50.16	0.06	0.22
1.A Stationary Combustion - Gaseous Fuels	CH4	21	28	4.0	50.0	50.16	0.01	0.00
1.A Stationary Combustion - Liquid Fuels	CH4	14	3	4.0	50.0	50.16	0.00	0.00
1.A Stationary Combustion - Biomass	CH4	56	320	4.0	50.0	50.16	0.11	0.07

Tab. 1.3 Uncertainty analysis in levels and trend assessments for 2007 (Tier 1), continuation

Input DATA						Uncertainty in Level		Uncert. in trend
IPCC Source Category	Gas	Base year emissions (1990)	Year emissions (2006)	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in 2007	Uncertainty introduced into the trend in total national emissions
		[Gg CO2 eq.]		[%]	[%]	[%]	[%]	[%]
1.A.3.a Transport - Civil Aviation	CH4	0	0	20.0	50.0	53.85	0.00	0.00
1.A.3.b Transport - Road Transportation	CH4	25	32	7.0	50.0	50.49	0.01	0.00
1.A.3.c Transport - Railways	CH4	1	0	10.0	50.0	50.99	0.00	0.00
1.A.3.d Transport - Navigation	CH4	0	0	10.0	50.0	50.99	0.00	0.00
1.A.3.e Transport - Other Transportation	CH4	0	0	10.0	50.0	50.99	0.00	0.00
1.A.5.b Mobile sources in Agriculture and Forestry	CH4	7	1	20.0	50.0	53.85	0.00	0.00
1.B.1.a Coal Mining and Handling	CH4	7 600	4 567	5.0	40.0	40.31	1.22	0.32
1.B.2 Fugitive Emission from Oil, Natural Gas, etc.	CH4	896	692	5.0	30.0	30.41	0.14	0.03
2.A.7 Glass, Bricks and Ceramics	CH4	3	5	5.0	50.0	50.25	0.00	0.00
2.B.5 Other	CH4	8	9	5.0	50.0	50.25	0.00	0.00
2.C.1 Iron and Steel Production	CH4	127	70	7.0	50.0	50.49	0.02	0.01
4.A Enteric Fermentation	CH4	4 869	2 372	7.0	30.0	30.81	0.48	0.25
4.B Manure Management	CH4	1 009	490	7.0	60.0	60.41	0.20	0.09
6.A Solid Waste Disposal on Land	CH4	1 663	2 417	25.0	40.0	47.17	0.76	0.50
6.B Wastewater Handling	CH4	825	514	30.0	40.0	50.00	0.17	0.11
1.A Stationary Combustion - Solid Fuels	N2O	495	343	4.0	80.0	80.10	0.18	0.02
1.A Stationary Combustion - Gaseous Fuels	N2O	7	9	4.0	80.0	80.10	0.00	0.00
1.A Stationary Combustion - Liquid Fuels	N2O	34	12	4.0	80.0	80.10	0.01	0.01
1.A Stationary Combustion - Biomass	N2O	27	93	4.0	80.0	80.10	0.05	0.03

Tab. 1.3 Uncertainty analysis in levels and trend assessments for 2007 (Tier 1), continuation

Input DATA						Uncertainty in Level		Uncert. in trend
IPCC Source Category	Gas	Base year emissions (1990)	Year emissions (2006)	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in 2007	Uncertainty introduced into the trend in total national emissions
		[Gg $CO_{2\ eq.}$]		[%]	[%]	[%]	[%]	[%]
1.A.3.a Transport - Civil Aviation	N2O	4	1	20.0	70.0	72.80	0.00	0.00
1.A.3.b Transport - Road Transportation	N2O	71	722	7.0	70.0	70.35	0.34	0.24
1.A.3.c Transport - Railways	N2O	8	5	10.0	70.0	70.71	0.00	0.00
1.A.3.d Transport - Navigation	N2O	1	0	10.0	70.0	70.71	0.00	0.00
1.A.3.e Transport - Other Transportation	N2O	0	0	10.0	70.0	70.71	0.00	0.00
1.A.5.b Mobile sources in Agriculture and Forestry	N2O	20	21	20.0	70.0	72.80	0.01	0.00
2.B.2 Nitric Acid Production	N2O	1 127	773	10.0	25.0	26.93	0.14	0.06
2.B.5 Other	N2O	84	94	5.0	70.0	70.18	0.04	0.01
3 Solvents and Other Product Use	N2O	215	215	5.0	70.0	70.18	0.10	0.02
4.B Manure Management	N2O	690	351	7.0	250.0	250.10	0.58	0.24
4.D.1 Agricultural Soils, Direct Emissions	N2O	4 573	2 550	15.0	250.0	250.45	4.24	1.30
4.D.2 Pasture, Range and Padock Manure	N2O	706	271	15.0	250.0	250.45	0.45	0.35
4.D.3 Agricultural Soils, Indirect Emissions	N2O	3 620	1 803	15.0	250.0	250.45	3.00	1.30
6.B Wastewater Handling	N2O	162	201	20.0	50.0	53.85	0.07	0.04
6.C Waste Incineration	N2O	0	4	15.0	70.0	71.59	0.00	0.00
2.F.1-6 F-gases Use - ODS substitutes	F-gas	0	1 612	20.0	20.0	28.28	0.30	0.29
2.F.7 F-gases Use - Semiconductore Manufacture	F-gas	0	16	20.0	20.0	28.28	0.00	0.00
2.F.8 F-gases Use - Electrical Equipment	F-gas	78	65	20.0	20.0	28.28	0.01	0.01
2.F.9 F-gases Use - Other SF6	F-gas	0	9	20.0	20.0	28.28	0.00	0.00
	Total	**194 712**	**150 823**				**6.25**	**3.13**
							Level uncertainty	**Trend uncertainty**

2 Trend in Total Emissions

According to the Kyoto Protocol, Czech national GHG emissions have to be 8 % below base year emissions during the five-year commitment period from 2008 to 2012. The Czech Republic is in a good direction to meet its goal, despite of the fact that emissions are slightly increasing in recent years.

2.1 Emission Trends of Aggregated GHG Emissions

Tab. 2.1 presents a summary of GHG emissions excl. bunkers for the period from 1990 to 2007. For CO_2, CH_4 and N_2O the base year is 1990; for F-gases the base year is 1995.

Tab. 2.1 GHG emissions from 1990 - 2007 excl. bunkers *[Gg $CO_{2\ eq.}$]*

	$CO_{2\ total}$ [4]	CO_2 [5]	CH_4	N_2O	HFCs	PFCs	SF_6	Total emissions	
								incl. LULUCF	excl. LULUCF
1990	159 639	164 332	18 559	11 872	NO	NO	78	190 148	194 712
1991	144 201	154 381	16 876	10 040			77	171 195	181 275
1992	127 942	139 916	15 873	8 979			77	152 871	164 741
1993	125 253	135 854	14 880	7 916			77	148 125	158 611
1994	118 501	126 754	13 977	7 836			76	140 390	148 526
1995	123 080	131 396	13 729	8 108	1	0	75	144 993	153 200
1996	129 865	138 650	13 547	7 692	101	4	78	151 286	159 936
1997	123 984	131 833	13 117	7 842	245	1	95	145 284	152 991
1998	116 103	124 273	12 645	7 794	317	1	64	136 924	144 968
1999	112 427	120 729	12 139	7 609	268	3	77	132 522	140 709
2000	118 458	127 138	12 173	7 617	263	9	142	138 661	147 234
2001	119 702	128 719	12 331	7 836	393	12	169	140 443	149 350
2002	116 183	124 974	12 149	7 596	391	14	68	136 401	145 075
2003	119 422	126 318	11 857	7 221	590	25	101	139 215	145 967
2004	119 689	127 033	11 661	7 830	600	17	52	139 849	147 061
2005	118 541	126 375	11 753	7 557	594	10	86	138 541	146 249
2006	124 008	128 615	12 229	7 440	872	23	83	144 654	149 107
2007	128 031	129 950	11 876	7 495	1 606	20	76	149 103	150 823
% [6]	-19.8	-20.9	-36.0	-36.9	2 186 - times	165 - times	-2.3	-21.6	-22.5

Note: Global warming potentials (GWPs) used (100 years time horizon): CO_2 = 1; CH_4 = 21; N_2O = 310; SF_6 = 23 900; HFCs and PFCs consist of different substances, therefore GWPs have to be calculated individually depending on substances

GHG emissions in have been fluctuating since 1993; nevertheless the overall trend in the period of 1990 to 2002 has been decreasing (see Fig. 2.1) by 28.3 %. From 2002 to 2007 the total GHG emissions (incl. *LULUCF*) increased by 9.3 % mainly in the last two years.

[4] CO_2 emissions including LULUCF sector

[5] CO_2 emissions excluding LULUCF sector

[6] relative to base year.

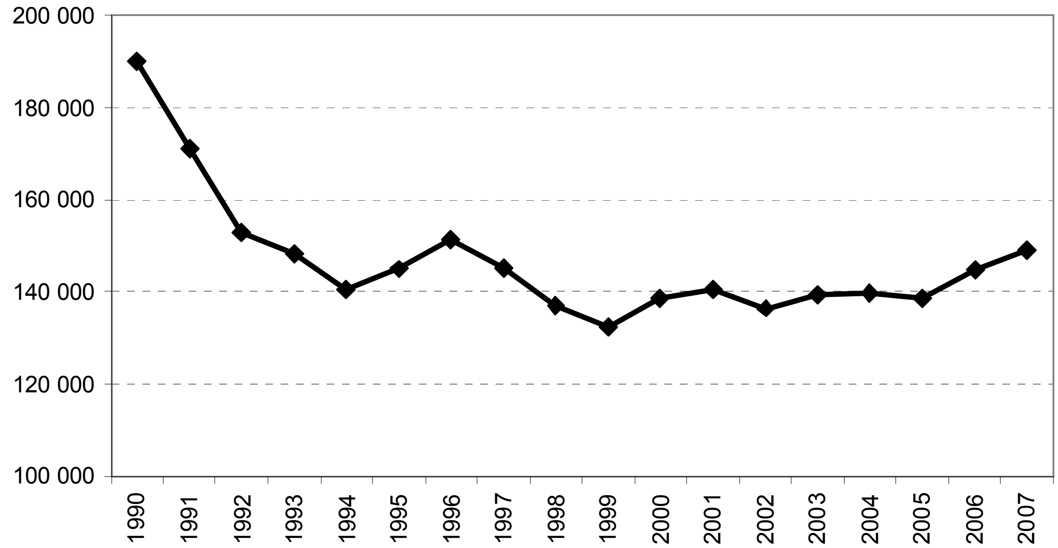

Fig. 2.1 Total GHG emissions (incl. LULUCF) for the period from 1990 - 2007 ***[Gg $CO_{2\ eq.}$]***

As can be seen from Fig. 2.1 there has been a strong decrease in total (incl. *LULUCF*) emissions and removals from 1990 to 1994 (26.2 %), followed by some fluctuations in the following years, but the overall trends has been decreasing (30.3 %) between 1990 and 1999. In the period from 1999 to 2007 emissions and removals has been fluctuating but with overall increasing trend. From 2006 to 2007 emissions and removals increased by 3.0 %, resulting in total emissions of 149 103 Gg $CO_{2\ eq.}$ in 2007 (incl. *LULUCF*). The increase was caused mainly by CO_2, N_2O and F-gases emission increase by 3.2 %; 0.7 % and 74.0 % respectively and CH_4 emission decrease by 2.9 % compared to previous year. The total GHG emissions in 2007 were 21.6 % below the base year level including *LULUCF* and 22.6 %, when excluding *LULUCF*.

2.2 Emission Trends by Gas

Tab. 2.2 presents the GHG emissions of the base year and 2007 and their share in total.

Tab. 2.2 GHG emissions by gas in the base year and in 2007

	Base year	2007	Base year	2007
	[Gg $CO_{2\ eq.}$]		*[%]*	
$CO_{2\ emissions}$	164 332	129 950	86.4%	87.2%
$CO_{2\ removals}$	-4 693	-1 919	-2.5%	-1.3%
$CO_{2\ Total}$	159 639	128 031	84.0%	85.9%
CH_4	18 559	11 876	9.8%	8.0%
N_2O	11 872	7 495	6.2%	5.0%
F-gases	76	1 702	0.04%	1.1%
Total (incl. LULUCF)	190 146	149 103	100.0	100.0

The major greenhouse gas in the Czech Republic is CO_2, which represents 85.9 % of total GHG emissions and removals in 2007, compared to 84.0 % in the base year. It is followed by CH_4 (8.0 % in 2007, 9.8 % in the base year), N_2O (5.0 % in 2007, 6.2 % in the base year) and F-gases (1.1 % in 2007, 0.04 % in the base year).

The trend of individual gas emissions is presented in Fig. 2.2 and Fig. 2.3 relative to emissions in the respective base years [7].

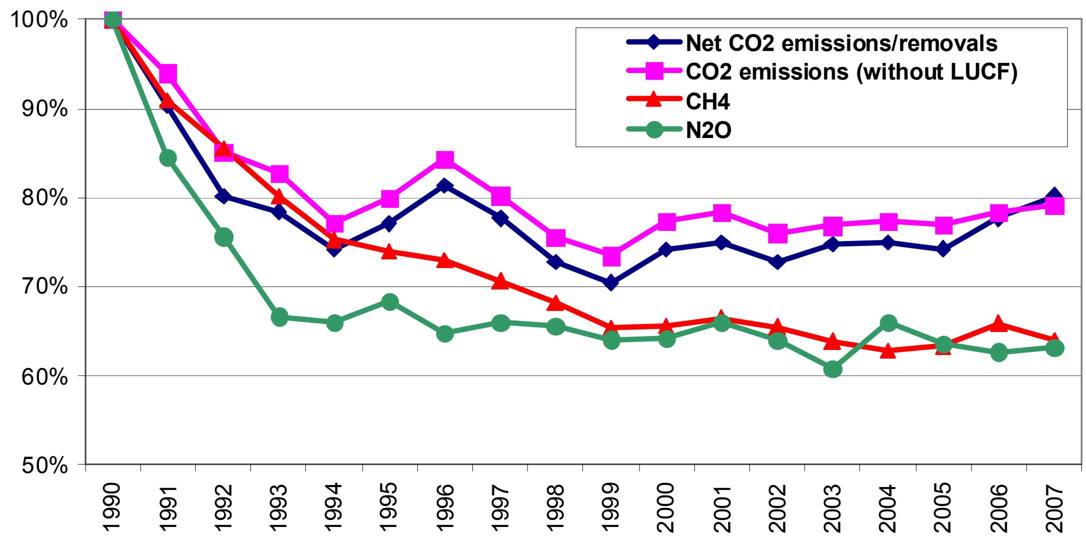

Fig. 2.2 Trend in CO_2, CH_4 and N_2O emissions 1990 - 2007 in index form (base year = 100 %)

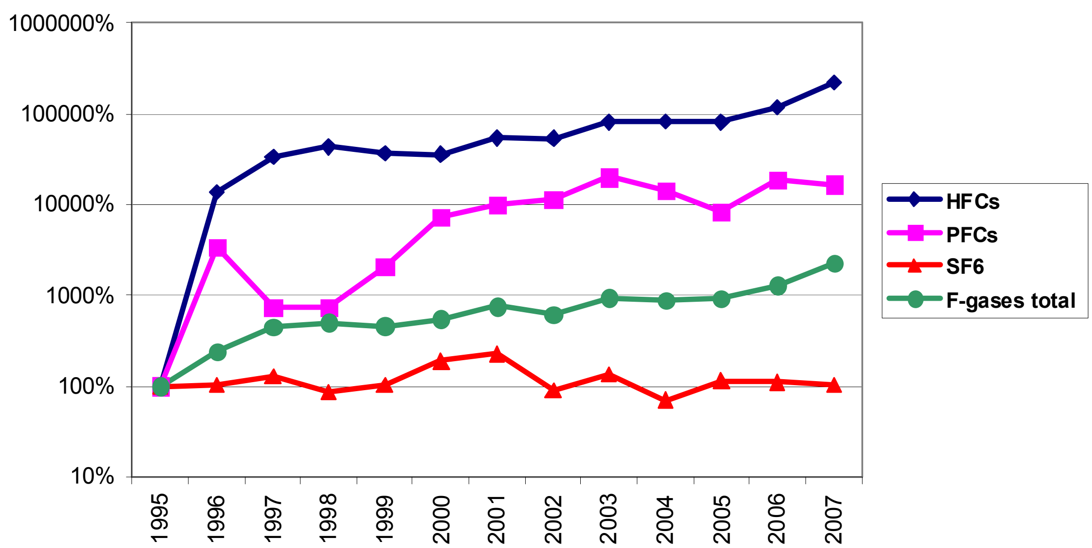

Fig. 2.3 Trend in HFCs, PFCs and SF_6 emissions 1995 - 2007 in index form (base year = 100 %)

CO_2

CO_2 emissions have been strongly decreasing in the beginning of 90's, followed by small inter-annual fluctuations and increase after the year 2000. Increase in CO_2 emissions (excl. *LULUCF*) from 2006 to 2007 by 1.0 % lower the total decrease to 20.9 % from 1990 to 2007 (19.8 % decrease incl. *LULUCF*). Quoting in absolute figures, CO_2 emissions and removals decreased from 159 639 to 128 031 Gg $CO_{2\,eq.}$ in the period from 1990 to 2007, mainly due to lower emissions from the *1 Energy* sector

[7] (index form: 1990 = 100 for CO_2, CH_4 and N_2O and 1995 = 100 for HFCs, PFCs and SF_6)

(mainly *1A2 Manufacturing Industries & Construction*, *1A4A Commercial / Institutional and 1A4B Residential*).

The main source of CO_2 emissions is fossil fuel combustion; within the *1A Fuel Combustion* sector, *1A1 Energy Industry* and *1A2 Manufacturing Industries & Construction* sub sectors are the most important. CO_2 emissions increased remarkably between 1990 and 2007 from the *1A3 Transport* sector from 7 342 to 18 461 Gg CO_2.

CH_4

CH_4 emissions decreased almost steadily during the period from 1990 to 2004, slightly increase from 2004 to 2006 and decrease by 2.9 % between 2006 and 2007 (see Tab. 2.2). In 2007 CH_4 emissions were 36.0 % below the base year level, mainly due to lower contribution of *1B Fugitive Emissions from Fuels* and emissions from *4 Agriculture* and despite increase from the *6 Waste* sector.

The main sources of CH_4 emissions are *1B Fugitive Emissions from Fuels* (solid fuel), *4 Agriculture* (*4A Enteric Fermentation* and *4B Manure Management*) and *6 Waste* (*6A Solid Waste Disposal on Land* and *6B Waste-water Handling*).

N_2O

N_2O emissions strongly decreased from 1990 to 1994 by 34.0 % over this period and than shows slow decreasing trend with inter-annual fluctuation. N_2O emissions decreased between 1990 and 2007 from 11 872 to 7 495 Gg $CO_{2\ eq.}$ In 2007 N_2O emissions were 36.9 % below the base year level, mainly due to lower emissions from *4 Agriculture* and despite increase from the *1A3 Transport* sector.

The main source of N_2O emission is sector *4D Agricultural Soils* (others less important sources are *2 Industrial Processes - 2B Chemical Industry* and *1A Fossil Fuel Combustion*).

HFCs

HFCs actual emissions increased remarkably between 1995 and 2007 from 0.7 to 1 606 Gg $CO_{2\ eq.}$. Emissions of HFCs have been increasing since the base year 1995, when they were started to use. In 2007, HFCs emissions are approximately 2 200 times higher than in the base year 1995.

The main sources of HFCs emissions are *Refrigeration* and *Air Conditioning Equipment*.

PFCs

PFCs actual emissions show very similar trend as HFCs emissions to the year 2007 as they increased remarkably between 1995 and 2007 from 0.12 to 20 Gg $CO_{2\ eq.}$ In 2007, PFCs emissions are 165 times higher than in the base year 1995.

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

SF_6

SF_6 actual emissions in 1995 amounted for 75 Gg $CO_{2\ eq.}$ Between 1995 and 2007 they inter annually fluctuated with maximum of 169 Gg $CO_{2\ eq.}$ in 2001 and minimum of 52 Gg $CO_{2\ eq.}$ in 2004. In 2007, they were by 2.3 % below the base year level.

The main sources of SF_6 emissions are *Electrical Equipment*; *Semiconductor Manufacture* and *Filling of Insulate Glasses*.

2.3 Emission Trends by Sources

Tab. 2.3 presents a summary of GHG emissions by sectors for the period from 1990 to 2007:

Sector 1. Energy
Sector 2. Industrial Processes
Sector 3. Solvent and Other Product Use
Sector 4. Agriculture
Sector 5. Land Use, Land-Use Change and Forestry
Sector 6. Waste

Tab. 2.3 Summary of GHG emissions by sector 1990-2007 ***[Gg $CO_{2\ eq.}$]***

	1 Energy	2 Industrial Processes	3 Solvent Use	4 Agriculture	5 LULUCF	6 Waste
1990	156 235	19 596	765	15 467	-4 565	2 650
1991	149 169	14 612	728	13 714	-10 080	3 052
1992	132 978	16 062	691	11 952	-11 870	3 057
1993	131 538	12 916	651	10 445	-10 486	3 062
1994	121 268	13 848	616	9 642	-8 136	3 152
1995	125 521	14 310	596	9 580	-8 207	3 193
1996	132 971	14 037	587	9 174	-8 650	3 167
1997	125 380	14 873	585	9 004	-7 707	3 150
1998	118 447	14 166	580	8 594	-8 044	3 180
1999	116 190	12 146	578	8 602	-8 186	3 194
2000	121 418	13 610	569	8 387	-8 573	3 250
2001	124 075	12 863	550	8 587	-8 907	3 275
2002	120 280	12 558	540	8 353	-8 674	3 344
2003	120 589	13 753	525	7 772	-6 752	3 328
2004	120 156	15 011	519	8 037	-7 211	3 337
2005	120 902	13 650	514	7 765	-7 708	3 419
2006	122 390	15 055	513	7 670	-4 452	3 479
2007	123 330	15 593	512	7 838	-1 720	3 550

The dominant sector is the *1 Energy* sector, which caused for 81.8 % of total GHG emissions in 2007 (80.2 % in 1990) excluding LULUCF, followed by the sectors *2 Industrial Processes* and *4 Agriculture*, which caused for 10.3 % and 5.2 % of total GHG emissions in 2007, resp. (10.1 % and 7.9 % in 1990, resp.) *6 Waste* sector covered 2.4 %, *3 Solvent and Other Product Use* 0.3 % and *5 LULUCF* sector removed in 2007 1 720 Gg $CO_{2eq.}$.

The trend of GHG emissions by sectors is presented in Fig. 2.4 (relative to the base year).

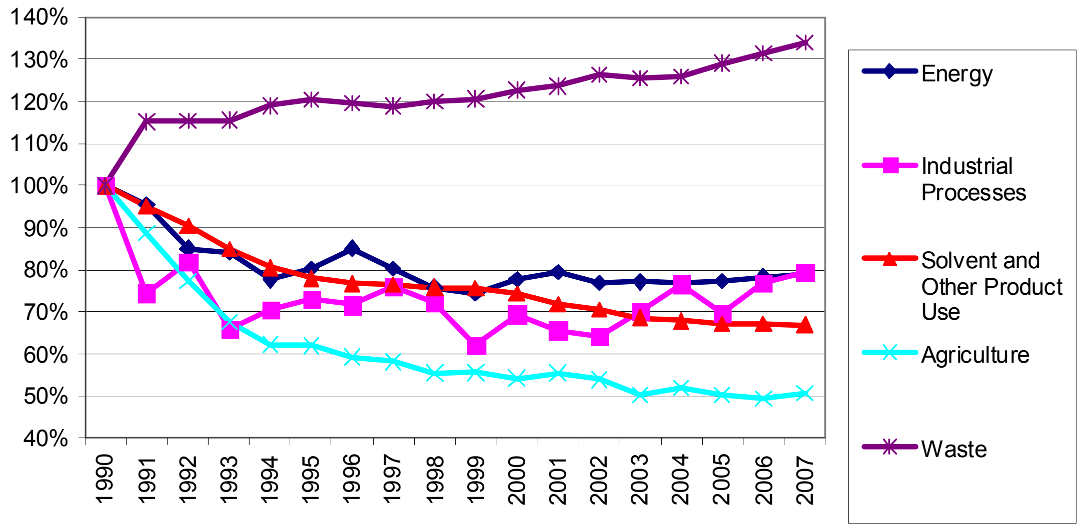

Fig. 2.4 Emission trends in 1990 - 2007 by sectors in index form (base year = 100)

Tab. 2.4 GHG emissions by sectors in the base year and in 2007

	Base year	**2007**	**Base year**	**2007**
	[Gg $CO_{2\ eq.}$]		*[%]*	
1 Energy	156 235	123 330	82.2 %	82.7 %
2 Industry	19 596	15 593	10.3 %	10.5 %
3 Solvent	765	512	0.4 %	0.3 %
4 Agriculture	15 467	7 838	8.1 %	5.3 %
5 LULUCF	-4 565	-1 720	-2.4 %	-1.2 %
6 Waste	2 650	3 550	1.4 %	2.4 %
Total	190 148	149 103	100.0 %	100.0 %

Energy (IPCC Category 1)

The trend for GHG emissions from *1 Energy* sector shows decreasing trend of emissions. They strongly decreased from 1990 to 1995 and than fluctuated by 2007. In the period 1995 – 2007 emissions varied from around 125 000 Gg $CO_{2\ eq.}$ (total decrease between 1990 and 2007 is 21.7 %).

From the total 118 071 Gg $CO_{2\ eq.}$ in 2007 - 95.7 % comes from *1A Fuel Combustion*, the rest are *1B Fugitive Emissions from Fuels* (mainly solid fuels). *1B Fugitive Emissions from Fuels* is the largest source for CH_4, which represented 44.3 % of all CH_4 emissions in 2007. 49.0 % of all CH_4 emissions in 2006 originated from *Energy* sector.

CO_2 emission from fossil fuel combustion (sector *1 Energy*) is the main source of emissions in CR inventory with a share of 78.0 % in national total emissions (incl. *LULUCF*) or 77.1 % excl. *LULUCF* in 2007. CO_2 contributes for 94.3 % to total GHG emissions from *1 Energy* sector, CH_4 for 4.7 % and N_2O for 1.0 % in 2007.

Industrial Processes (IPCC Category 2)

GHG emissions from the *2 Industrial Processes* sector fluctuated during the period 1990 to 2007. In early 90's emissions decreased very rapidly, then fluctuated with minimum in 1999 and subsequently increased. Between 1990 and 2007 emissions from this sector decreased by 20.4 %. In 2007 emissions amounted for 15 593 Gg $CO_{2\ eq.}$.

The main categories in the *2 Industrial Processes* sector are *2C Metal Production* (51.9 %), *2A Mineral Products* (28.0 %), *2F Consumption of Halocarbons and* SF_6 (10.9 %) and *2B Chemical Industry* (9.1 %) of the sectoral emissions in 2007.

The most important GHG of the *2 Industrial Processes* sector was CO_2 with 83.0 % of sectoral emissions, followed by HFCs (10.3 %), N_2O (5.6 %), CH_4 (0.5 %), SF_6 (0.5 %) and PFCs (0.1 %).

Solvent and Other Product Use (IPCC Category 3)

In 2007, 0.3 % of total GHG emissions (512.2 Gg $CO_{2\ eq.}$) arose from the *3 Solvent and Other Product Use* sector. Emissions generally decreased in the period from 1990 to 2007 (in recent years the decrease was slowed). In 2007 GHG emissions from *3 Solvent and Other Product Use* were 33.0 % below the base year level. 58.1 % of these emissions were CO_2, N_2O emissions contributed by 41.9 %.

Agriculture (IPCC Category 4)

GHG emissions from the sector *4 Agriculture* decreased near over the all period from 1990 to 2006 and slightly increased between 2006 and 2007; in 2007 emissions were by 49.3 % below the base year level.

They amounted for 7 838 Gg $CO_{2\ eq.}$ in 2007, which corresponds to the 5.2 % of national total emissions (excluding LULUCF). The most important sub sector agricultural soils (N_2O emissions) contributed by 59.0 % to sectoral total in 2007, followed by the enteric fermentation (CH_4 emissions, 30.3 %) and manure management (CH_4 and N_2O emissions, 6.3 % and 4.5 % resp.).

4 Agriculture is the largest source for N_2O and second largest source for CH_4 emissions: 66.4 % of all N_2O emissions and 24.1 % of all CH_4 emissions in 2007 originated from this sector. N_2O emissions amounted for 4 975.7 Gg $CO_{2\ eq.}$, which corresponds to 63.5 % of sectoral emissions, CH_4 contributed by 36.5 % (2 862.0 Gg $CO_{2\ eq.}$) in 2007.

Land Use, Land-Use Change and Forestry (IPCC Category 5)

GHG removals from the *5 Land Use, Land-Use Change and Forestry* sector vary through the whole time series with minimum of 1 720 Gg $CO_{2\ eq.}$ in 2007 and maximum 11 870 $CO_{2\ eq.}$ in 1992. In 2007 removals were by 62.3 % below the base year level.

Removals amounted to 1 720 Gg $CO_{2\ eq.}$ in 2007, which corresponds to - 1.2 % to national total emissions and removals. Emissions and removals are calculated from the all categories and according to GPG for LULUCF; IPCC 2003.

LULUCF category is the largest sink for CO_2. CO_2 removals from this sector amounted to 1 919.1 Gg in 2007, CH_4 emissions amounted for 174.6 Gg $CO_{2\ eq.}$, N_2O to 24.6 Gg $CO_{2\ eq.}$

Waste (IPCC Category 6)

GHG emissions from *6 Waste* category slowly increased during the whole period. In 2007 emissions amounted for 3 550 Gg $CO_{2\ eq.}$, which is 34.0 % above the base year level. The increase of emissions is mainly due to higher emissions of CH_4 from *6A Solid Waste Disposal on Land* (and partly due to increase N_2O emissions from *6B Waste-water Handling*), which is the most important category. As a result of CH_4 recovery systems installed in *6B Waste-water Handling* emissions decreased in this category by 37.7% compared to the base year. The share of this category in total emissions was 2.4 % in 2007 (excluding LULUCF).

The main source is solid *6A Solid Waste Disposal on Land*, which caused for 68.1 % of sectoral emissions in 2007, followed by *6B Waste-water Handling* (CH_4 - 14.5 % and N_2O 5.7 %) and 6C Waste Incineration (11.8 %).

82.6 % of all emissions from *Waste* sector are CH_4 emissions; CO_2 contributes by 11.6 % and N_2O by 5.8 %.

2.4 Emission Trends of Indirect GHGs and SO_2

Emission estimates for NO_X, CO, NMVOC and SO_2 are also reported in the CRF. The following chapter summarizes the trends for these gases.

A detailed description of the methodology used to estimate these emissions was provided in the *Czech Informative Inventory Report (IIR) 2007, Submission under the UNECE / CLRTAP Convention*, which was published in March 2009.

Tab. 2.5 presents a summary of emission estimates for indirect GHGs and SO_2 for the period from 1990 to 2007. The National Emission Ceilings (NEC) as set out in the 1999 *Gothenburg Protocol to Abate Acidification, Eutrophication and Ground-level Ozone*. These reduction targets should be met by 2010 by Parties to the UNECE / CLRTAP Convention signed this Protocol.

Emissions of indirect greenhouse gases decreased from the period from 1990 to 2007 (NMVOCs by 44.1 %, CO by 45.7 % and NO_X by 61.5 %). SO_2 emissions decreased by 88.4 % compared to 1990 level.

Tab. 2.5 Emissions of indirect GHGs and SO_2 1990 - 2007 *[Gg]*

	NO_X	CO	NMVOC	SO_2
1990	742	1 071	311	1 876
1991	732	1 157	273	1 772
1992	708	1 162	257	1 559
1993	691	1 194	233	1 469
1994	451	1 075	255	1 290
1995	430	932	215	1 095
1996	447	965	265	934
1997	471	981	272	981
1998	414	812	267	442
1999	391	726	247	269
2000	397	680	244	264
2001	333	687	220	251
2002	319	587	203	237
2003	326	630	203	232
2004	334	622	198	227
2005	279	556	182	219
2006	284	540	179	211
2007	286	581	174	217
NEC[8]	286	-	220	283

NO_X

NO_X emissions decreased from 742 to 286 Gg during the period from 1990 to 2007. In 2007 NO_X emissions were 61.5 % below the 1990 level. Nearly 99 % of NO_X emissions originate from *1 Energy,* mainly subsectors *1A1 Energy Industries, 1A3 Transport* (road), *1A2 Manufacturing Industries and Construction* and *1A5 Other*.

CO

CO emissions decreased from 1 071 to 581 Gg during the period from 1990 to 2007. In 2007 CO emissions were 45.7 % below the 1990 level. In 2006, more than 85 % of total CO emissions

[8] NEC - National Emission Ceilings according to Directive 2001/81/EC of the European Parliament and of the Council of 23 October 2001. Emissions targets for NO_X, NMVOC and SO_2 should be met by 2010

originated from *1 Energy* (subsectors *1A3 Transport, 1A2 Manufacturing Industries and Construction* and *1A4 Other Sectors (Commercial / Institutional, Residential, Agriculture / Forestry / Fisheries)*), followed by *5A Forest land* (12.5 %).

NMVOC

NMVOC emissions decreased from 311 to 174 during the period from 1990 to 2007. In 2007 NMVOC emissions were 44.1 % below the 1990 level. There are two main emission source categories, first is *3 Solvent and Other Product Use* (54.4 % of the national total) and second is *1 Energy* (44.8 % - mainly subsectors *1A3 Transport (23.0 %),* and *1A4 Other Sectors* (*Commercial / Institutional, Residential, Agriculture / Forestry / Fisheries*) 11.9 %).

SO_2

SO_2 emissions decreased from 1 876 to 217 Gg during the period from 1990 to 2007. In 2007 SO_2 emissions were 88.4 % below the 1990 level. In 2007, 98.4 % of total SO_2 emissions originated from *1 Energy* mainly subsectors *1A1 Energy Industies, 1A2 Manufacturing Industries and Construction* and *1A4 Other Sectors (Commercial / Institutional, Residential, Agriculture / Forestry / Fisheries)*).

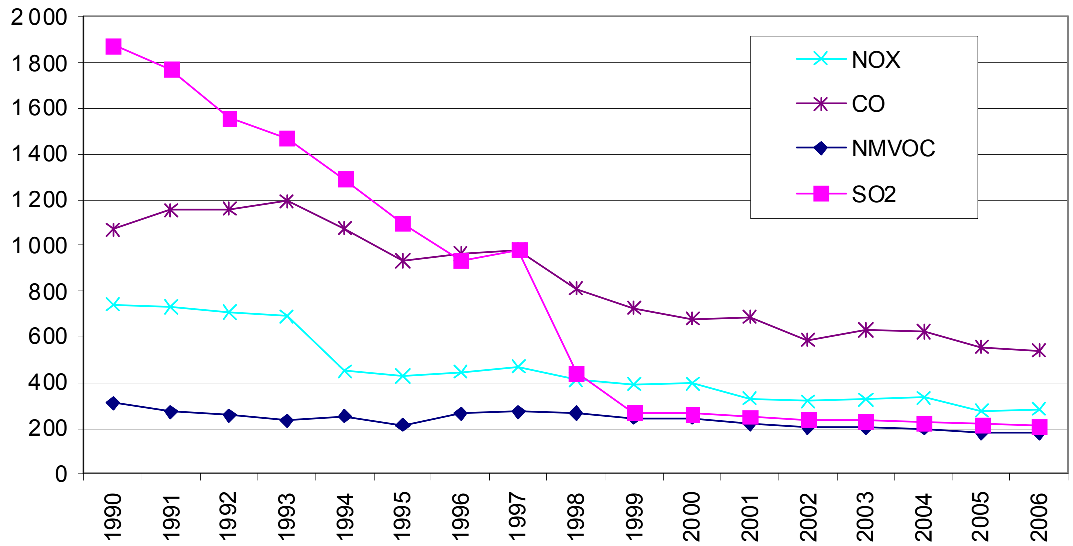

Fig. 2.5 Emissions of indirect GHGs and SO_2 1990 - 2007

3 Energy (CRF Sector 1)

3.1 Energy - Combustion processes (1A)

3.1.1 Overview of Sector 1A

Combustion processes included in category 1A make a decisive contribution to total emissions of greenhouse gases. Almost all emissions of carbon dioxide, with the exception of decomposition of carbonate materials, occurring, e.g., in cement production, are derived from the combustion of fossil fuels in stationary and mobile sources. Consequently, the greatest attention is paid in the IPCC Guidelines (*Revised 1996 IPCC Guidelines, 1997*) to inventories of emissions from these categories.

On the whole, 7 key sources have been identified in sector 1A, the most important of which are the first 3 in Tab. 3.1. This group of sources contributes 77.0 % to total greenhouse gas emissions (without LULUCF).

Tab. 3.1 Overview of key categories in Sector 1A (2007)

Category		Character of category	Gas	% of total GHG*
1A	Stationary Combustion - Solid Fuels	KC (LA, TA, LA*, TA*)	CO_2	49.9
1A3b	Transport - Road Transportation	KC (LA, TA, LA*, TA*)	CO_2	12.0
1A	Stationary Combustion - Gaseous Fuels	KC (LA, TA, LA*, TA*)	CO_2	11.0
1A	Stationary Combustion - Liquid Fuels	KC (LA, TA, LA*, TA*)	CO_2	3.2
1A5b	Mobile sources in Agriculture and Forestry and Other	KC (LA, LA*)	CO_2	0.7
1A3b	Transport - Road Transportation	KC (LA, TA, TA*)	N_2O	0.5
1A	Stationary Combustion - Biomass	KC (TA, TA*)	CH_4	0.2

* assessed without considering LULUCF

KC: key category,LA, LA*: identified by level assessment with and without considering LULUCF, respectively

TA, TA*: identified by trend assessment with and without considering LULUCF, respectively

It is apparent from the table that the first three categories are of fundamental importance for the level of greenhouse gas emissions in the Czech Republic and, of these, the combustion of solid fuels constitutes a decisive source. This consists primarily in the combustion of solid fuels for the production of electricity and supply of heat. Another important category consists in the combustion of liquid fuels in the transport sector and the combustion of natural gas has approximately the same importance. This corresponds mostly to the direct production of heat for buildings in the private and public sector and for households. Consequently, increased attention is paid to it.

The results of the inventory, including the activity data, are submitted in the standard CRF format. For direct greenhouse gases, the consumption of fuels and "implied" emission factors are also given. However, for stationary sources, the fuel consumption is given in the CRF format in aggregated structure, i.e. as solid, liquid and gaseous fuels according to IPCC definition. All the CRF tables in sector 1A were appropriately completed for the entire required time interval of 1990 to 2007; only aggregate values were filled in for sector 1A2 for the 1990 and 2002 periods, i.e. without division into subsectors 1A2a - 1A2f. The currently available energy production statistics do not provide the necessary activity data in this period for division of this category into the individual branches of industry.

On the request of the Expert Review Team (ERT) from 2007 the inventories in this submission were newly performed for 1996 – 2005 on the basis of the final energy balance of the Czech Statistical

Office (CSO) and this is thus an important recalculation performed to refine the inventory. The data from the final energy balance for 1990 – 1995 were used in previous submissions.

In this submission, the preliminary data for 2006 were replaced by the CSO data from the final energy balance, which is regularly published on the official web site (*Czech Statistical Office: Energy Balance of the Czech Republic in 2004, 2005, 2006,* Prague, 2008). Data on the consumption of the individual kinds of fuel for 2007 were taken from the official CSO reports for IEA - EUROSTAT – UNECE. This step represents substantial progress in refinement of activity data. Closer cooperation with CSO was established in 2008 and will continue in the coming years.

The CSO reports represent the official reports of the Czech Republic, for international purposes, on the consumption of the individual kinds of fuel. They consist in a set of data on liquid, solid and gaseous fuels in independent datasets. They contain source and consumption parts of the energy balance in a structure that permits processing of activity data in the CRF structure. The use of these reports is advantageous especially because they provide a very similar data structure to CRF. The transition from the final CSO balance to the use of these reports does not affect the consistency of the time series, as the same data are involved.

In contrast to the national energy balance, in processing data from these databases, it is necessary to work with natural units and the calorific values of the individual kinds of fuel. This should lead to greater transparency in the approach to processing the activity data.

The following table gives the basic input data forming the foundation for construction of the activity data.

Tab. 3.2 Source part of the balance of the individual kinds of fuels in the Czech Republic in 2007

	[kt/year 2007]					
	Production	Imports	Exports	International bunkers	Stock Change	Apparent Consumption
Coking Coal	7 674	1 064	4 781		-142	4 099
Other Bituminous Coal	5 220	1 444	2 024		-979	5 619
Lignite (Brown Coal)	49 295	0	1 194		1 652	46 449
Brown Coal Briquettes		0	114		0	-114
Coke Owen Coke		735	807		-75	3
Crude Oil (Refinery Intake)	246	7 276	17		20	7 485
Naphtha		102	25		7	70
Gasoline		695	194		-43	544
Aviation Gasoline		2				2
Kerosene		244	2	334	13	-105
Gas / Diesel Oil		1 588	299		84	1 205
Residual Fuel Oil		118	146		1	-29
LPG		96	121		1	-26
Lubricants		106	52		3	47
Bitumen		250	150		1	99
Petroleum coke		6	3			3
Other Oil		13	10		7	-4
	[mil. m^3/year 2007]					
Natural gas	178	8 628	402		-375	8 779

The fact that only CSO data were employed constitutes a substantial improvement in the methodology of processing activity data. The data of other institutions and organizations were used for control. These consisted in documents of the Ministry of Industry and Trade (MIT), the Czech Association of the Petroleum Industry – CAPPO, Czech Gas Association and other organizations.

3.1.2 Stationary combustion

3.1.2.1 Source category description

Stationary combustion sources are divided into 4 basic categories in the Sectoral approach:

- 1A1 Energy industries
- 1A2 Manufacturing Industries and Construction
- 1A3e Other transportation (combustion of part of natural gas during its transport in compressors)
- 1A4 Other sectors (with the exception of mobile sources in subcategory 1A4c)

In the Sectoral approach, CO_2 emissions are derived from the consumption of the individual kinds of fuel in the individual subcategories using emission and oxidation factors.

The following text gives a description of the individual subcategories and evaluates their specific features in the Czech Republic.

1A1a Public electricity and heat production

This category encompasses all facilities that produce electrical energy and heat supplies, where this production is their main activity and they supply their products to the public mains. Examples include the power plants of the ČEZ, a.s. company, DALKIA, a.s. power plants and heating plants, ENERGY UNITED, a.s. and a number of others in the individual regions and larger cities in the Czech Republic.

In the final energy balance of CSO, the consumption of the individual kinds of fuels in this sector is reported under the items:

- Public electricity
- Public heat – major heating plants
- Public heat – local heating plants

1A1b Petroleum refining

This category encompasses all facilities that process raw petroleum imported into this country as their primary raw material. Domestic petroleum constitutes approx. 3.5 % of the total amount. All fuels used in the internal refinery processes, internal consumption for production of electricity and heat and heat supplied to the public mains are included in emission calculations in this subcategory. This corresponds primarily to the Česká rafinérská, a.s. company in the Czech Republic.

In the final energy balance of CSO, the consumption of the individual kinds of fuels in this sector is reported under the item:

Operational (internal) consumption – refinery.

Further consumption for heat production is calculated from CSO data on production of heat supplies for refineries using the average efficiency of industrial major and local heating plants.

1A1c Manufacture of solid fuels and other energy industries

This category includes all facilities that process solid fuels from mining through coking processes to the production of secondary fuels, such as brown-coal briquettes, coke-oven gas or generator gas. It also includes fuels for the production of electrical energy and heat for internal consumption.

There are a number of companies in the Czech Republic that belong in this category. These are mainly companies performing deep and surface mining of coal and its subsequent processing, located in the vicinity of coal deposits. The category also includes coke plants and the production of generator gas. Other energy industries, such as facilities for extraction of natural gas and petroleum are of minor interest in the Czech Republic.

In the final energy balance of CSO, the consumption of the individual kinds of fuels in this sector is reported under the items:

- Operational (internal) consumption – mining
- Operational (internal) consumption – coke plants
- Operational (internal) consumption – briquette plants
- Operational (internal) consumption – pressure gasworks

1A2 Manufacturing Industries and Construction

This category includes all stationary combustion emission sources that are not included in categories 1A1 and 1A4. NACE (Nomenclature classification of economic activities – Nomenclature des activités économiques) categorization is employed in the CR for statistical purposes. Category 1A2 includes all companies and enterprises whose main economic activity is denoted in the 12000 – 36000 range in the NACE system. As CSO does not currently give, in the energy balance, detailed classification of fuel consumption according to the individual NACE, it is necessary to derive energy consumption in this category from the overall final consumption by subtracting the consumption in the other categories. Up to 2003, the consumption of fuel was summarily included in category 1A2f. Since 2003, fuel consumption has been divided into the following subcategories:

- 1A2a Iron and steel (NACE 271 – 273, 275);
- 1A2b Non-ferrous metals (NACE 274 a 2754);
- 1A2c Chemicals (NACE 24);
- 1A2d Pulp, paper and print (NACE 20 – 21);
- 1A2e Food processing, beverages and tobacco (NACE 15 – 16);
- 1A2f Other.

The fuel consumption in these subcategories is directly available in the CSO reports. However, it should be stated that it is very difficult to exactly separate the fuels in this category and that this apparently contains the greatest uncertainty in the whole balance. The data were controlled using the documents of the individual trade federations, MIT and the monthly statements available at the CSO web site. According to these indicators, fuel consumption is divided into the individual subcategories. Simultaneously, the rule is followed that no emission may be counted more than once and that none may be missing in the overall balance. This is ensured by comparing the overall reported fuel consumption in all the sectors (combustion and others) with the overall consumption of the individual kinds of fuel used in the given year.

An improvement could be brought about in the future by the use of data directly from places of operation, e.g. from the national emission database “REZZO”. All enterprises with a total output of energy-production equipment over 5 MW report fuel consumption for this database. Since 2008, they have also been obliged to mention the category in the CRF (NFR) nomenclature. In addition, we expect greater use of data from the emission trading system in allowances for greenhouse gas emissions (EU ETS).

1A4 Other sectors

This category includes all the combustion processes in the subcategories described below. They can be generally defined as heat production processes for internal consumption.

1A4a Commercial/Institutional

This subcategory includes all combustion sources that utilize heat combustion for heating production halls and operational buildings in institutions, commercial facilities, services and trade.

In the final energy balance of CSO, the consumption of the individual kinds of fuels in this sector is reported under the item:

Other branches.

1A4b Residential

Fuel consumption in households is determined on the basis of the results of the statistical study “Energy consumption in households”, published in 1997 and 2004 by the *Czech Statistical Office* according to the PHARE/EUROSTAT method. In the final energy balance, CSO reports the consumption of the individual kinds of fuels in this sector under the item:

Households.

1A4c Agriculture/Forestry/Fisheries

This subcategory contains combustion sources at stationary facilities for heating buildings, breeding and other operational facilities. The subcategory does not include fuel consumption for powering off-road means of transport and machinery. They are reported in category A5b Mobile - Agriculture, Forestry and Fishing.

In the final energy balance of CSO, the consumption of the individual kinds of fuels in this sector is reported under the item:

Agriculture (NACE 01, 02, 03).

1A3e Other transportation

The consumption of natural gas for powering compressors for the transit gas pipeline is included in a separate subcategory under stationary combustion sources. This consumption is reported in the REZZO 1 national inventory database and is subtracted in sector 1A2f Other in the overall balance.

3.1.2.2 Methodological issues

According to IPCC methodology (Revised 1996 IPCC Guidelines, 1997), carbon dioxide emissions are calculated in two ways:

1. The **Reference Approach**, i.e. on the basis of total domestic consumption of the individual fuels. This relatively simple method is based on the assumption that almost all the fuel consumed is burned in combustion processes in energy production. It does not require a large amount of input activity data and the basic values of the sources included in the national energy balance and some supplementary data are sufficient. It provides information only on total emissions without any further classification in the consumer sector. The emission factors are related to those kinds of fuel that enter domestic consumption at the level of sources, without regard to specific kinds of fuel burned in the consumer part of the energy balance. Thus, for liquid fuels, this means that the emissions are determined practically only on the basis of domestic petroleum (crude oil) consumption.
2. The **Sectoral Approach**. This method is considerably more demanding in relation to input data and requires information on fuel consumption according to kind in the individual consumer sectors. It has an advantage in the possibility of analyzing the structure of the origin of emissions. As the emission factors employed are specific for each kind of fuel burned, calculations using this method should be more exact. However, it follows from the discussion below that the differences in the overall results from the two methods should not be very significant.

The resultant emissions are determined by the Sectoral approach (SA), while the Reference approach (RA) is used for control.

To determine the amounts of fuels used (in TJ) and CO_2 emissions, the average net calorific values, emission and oxidation factors given in Tab. 3.3 were used. The net calorific values of liquid fuels were officially obtained from experts at CSO. The net calorific values of solid fuels and natural gas were obtained by calculation from the values tabulated in the CSO reports for IEA/EUROSTAT as the weighted average for production, exports and imports. Recalculation of volume units to mass units for natural gas was performed using the density 0.69 kg/m^3 (t = 15 ^{o}C, p = 101.3 kPa). The experimentally determined country-specific values of the emission factors were used for coal and lignite (Fott, 1999); for the other fuels, the default emission factors from the IPCC methodology (*Revised 1996 Guidelines,* 1997) were used. Oxidation factors used in the national inventory are the default values taken from the IPCC methodology (*Revised 1996 Guidelines,* 1997).

Tab. 3.3 Net caloricic values (NCV), CO_2 emission factors and oxidation factors used in the Czech GHG inventory

Fuel (IPCC 1996 Guidelines definitions)	NCV [TJ/Gg]	CO_2 EF a) [t CO_2/TJ]	Oxidation factor	CO_2 EF b) [t CO_2/TJ]
Crude Oil	42.25	73.33	0.99	72.60
Gas / Diesel Oil	42.71	74.07	0.99	73.33
Residual Fuel Oil	40.56	77.37	0.99	76.59
LPG	45.80	63.07	0.995	62.75
Naphtha	43.94	73.33	0.99	72.60
Bitumen	40.19	80.67	0.99	79.86
Lubricants	40.19	73.33	0.99	72.60
Petroleum Coke	30.98	100.83	0.98	99.83
Other Oil	39.30	73.33	0.99	72.60
Coking Coal d)	29.29	93.24	0.98	91.38
Other Bituminous Coal d)	25.64	93.24	0.98	91.38
Lignite (Brown Coal) d)	12.83	99.99	0.98	97.99
Brown Coal Briquettes	23.43	94.60	0.98	92.71
Coke Owen Coke	27.81	108.17	0.98	106.00
Coke Owen Gas (TJ/mill. m^3)	15.62 c)	47.67	0.995	47.43
Natural Gas (TJ/Gg)	49.41	56.10	0.995	55.82
Natural Gas (TJ/mill. m^3)	34.09 c)	56.10	0.995	55.82

a) Emission factor without oxidation factor
b) Resulting emission factor with oxidation factor
c) TJ/mill. m^3, t=15 ^oC, p=101.3 kPa
d) Country specific values of CO_2 EFs

3.1.2.2.1 Provision for data inputs

The data for drawing up the balance in the structure required in the IPCC methodology was obtained each year to 2006 from the publication of the *Czech Statistical Office* (*last edition: Energy Balance of the Czech Republic in 2003, 2004, 2005, Prague, 2007*). Beginning in 2007, the data were obtained from the official reports of the *Czech Statistical Office* for IEA/EUROSTAT.

Some special data were obtained from the REZZO national emission database, where, for example, information can be obtained on the natural gas consumption in the transit pipeline compressor stations. In cases of doubt, consultations are held with the employees of the CSO. In 2008, intensively consultations were held on the aspect of the sources and consumption of liquid fuels on stationary sources and in the transport sector 1A3. On this occasion, data were refined on gasoline consumption in households (in sub-sector 1A4b Residential) and in agriculture (in sub-sector 1A4c Agriculture/Forestry/Fisheries) for non-road machinery. However, they are reported in CRF under 1A5b for better distinguishing between stationary and mobile sources. New data were also obtained on consumption of liquid fuels in the army in 1998 – 2007. In this submission, this consumption is reported in category 1A5b Other.

In order to increase clarity and taking into account the recalculation required by the ERT ("in-country" review in 2007), tables were prepared in EXCEL, in which data can be stored for entire time series (similar to CRF Reporter), and controls can be performed of the reported data, required recalculations and new calculations. The practice employed to date, where interconnected spreadsheets were employed each year in drawing up the fuel balance and in the subsequent emission calculations, was found to be insufficiently transparent for longer time series.

All the relevant recalculated data for performance of the QA/QC procedures were converted to the official data output (CRF Reporter).

Simultaneously, a method was elaborated permitting graphical depiction of the fuel balance and simple control that the sector approach includes all fuels used in the country and that none is counted twice. The diagrams for the individual kinds of fuels are filed by the responsible worker; here, only summary diagrams are given for solid and liquid fuels for illustration.

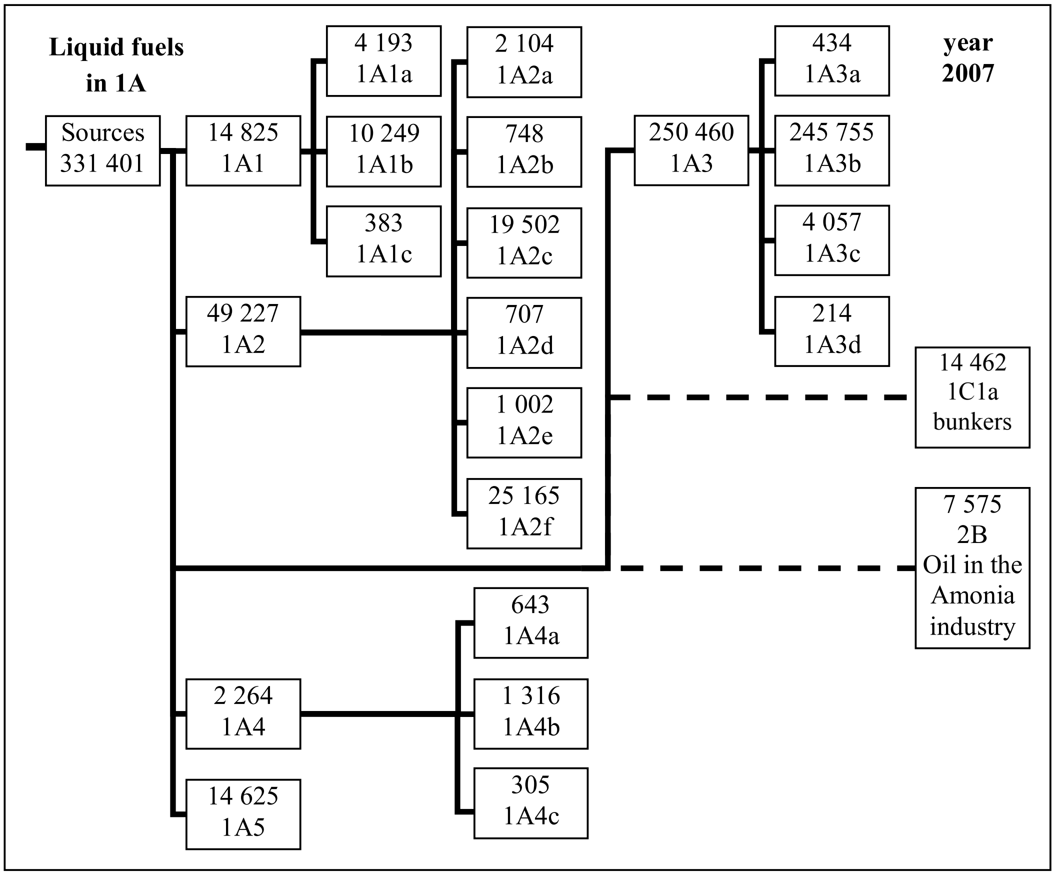

Fig. 3.1 Block scheme of the consumption of liquid fuels in sector 1A

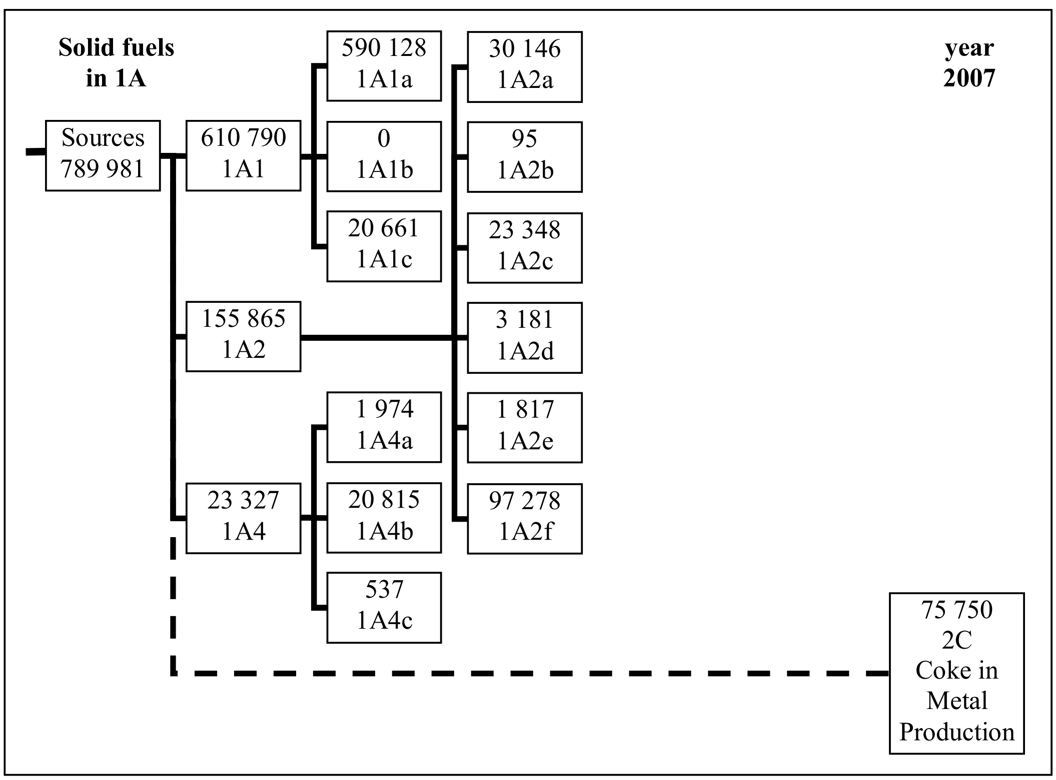

Fig. 3.2 Block scheme of the balance of consumption of solid fuels in sector 1A

It is apparent from the diagram that part of the consumption of liquid and solid fuels is shifted from sector *1A Fuel Combustion* to sector *2 Industry*. This is because of the requirement that carbon that is converted in non-energy use to CO_2 be calculated only once. Carbon dioxide formed in the production of hydrogen used primarily for subsequent synthesis of ammonia is just such an example. Under the conditions in this country, this consists in gasification of mazout by oxygen and water vapour and subsequent catalytic conversion. Similarly, the use of coke in metallurgical processes cannot be considered to be fuel used to produce heat, but rather as an additive (reductant) for modifying the properties of the final product.

A considerable part of the non-energy consumption consists in non-energy consumption of petroleum (lubricating and special oils, asphalt and particular petrochemical raw materials used for the production of plastic materials, etc.). Non-energy products formed from bituminous coal in coke plants and from brown coal in the production of coal gas (historical) and energy gas (fuel for the combined steam-gas cycle) are also important.

In this context, emphasis is placed on the correct determination of the fraction of stored (fixed) carbon in the non-energy use of fossil fuels. Calculation of its amount is based on the assumption that a certain amount of the carbon contained non-energy raw materials remains fixed in the long term and is not released as CO_2. In the CR balance, this consists in:

- petrochemical raw materials (Naphtha) mainly used for the production of plastic materials;
- lubricating oils (Lubricants);
- Coal Tars from coking of bituminous coal and from gasification of brown coal;
- asphalt (Bitumen).

Part of the intermediate products from pyrolysis of petrochemical raw materials is used directly as heating gases and oils, part of the final products (plastic materials) are also burned after use in municipal waste incinerators, but part ends up in land-fills. Thus, a considerable part of the input carbon remains bonded for a longer time in plastic materials. As plastic materials are being increasingly recycled, the fraction of carbon stored in plastics has been gradually increased from 50% to 80% between 2003 and 2006 (in period 1990 - 2002 this fraction was considered constant, 50%).

In addition, most lubricating and special oils are finally used as heating oils or are burned during their use (lubricating oils for combustion motors). Part of the oils is used for production of alternative fuels and part is burned in incinerators, but at least half remains permanently anchored in lubricants. Consequently, a fraction of stored carbon of 50% is used in the balance.

Coal tars have a similar fate and are also used for impregnation of roofing materials and for soot (additive in the production of rubber). Consequently, a value of stored carbon fraction of 75 % is used.

Practically one hundred percent fixation is assumed for asphalt.

An overall summary of fuel consumption, trends and structure in sector 1A – Energy is provided by the following tables and graphs.

Tab. 3.4 Trends in fuel consumption in 1990 – 2007 in sectors 1A1, 1A2 and 1A4

	1A1 Energy industries [TJ/year]	1A2 Manufacturing Industries and Construction [TJ/year]	1A4 Other sectors [TJ/year]	Total 1A1 + 1A2 + 1A4 [TJ/year]
1990	614 776	556 483	392 426	1 563 685
1991	621 211	607 384	311 891	1 540 486
1992	556 088	521 046	282 840	1 359 974
1993	578 060	534 905	243 283	1 356 248
1994	575 331	422 518	241 745	1 239 594
1995	615 980	435 200	241 959	1 293 139
1996	646 921	496 037	247 765	1 390 723
1997	644 214	403 596	247 746	1 295 556
1998	608 795	397 841	214 980	1 221 617
1999	576 715	416 961	214 641	1 208 317
2000	647 061	394 476	209 752	1 251 289
2001	638 275	410 664	227 892	1 276 831
2002	620 061	397 054	216 874	1 233 989
2003	632 159	383 605	233 046	1 248 810
2004	629 436	382 175	235 580	1 247 190
2005	621 775	400 252	223 451	1 245 478
2006	647 030	353 312	239 209	1 239 551
2007	670 213	342 169	219 412	1 231 794

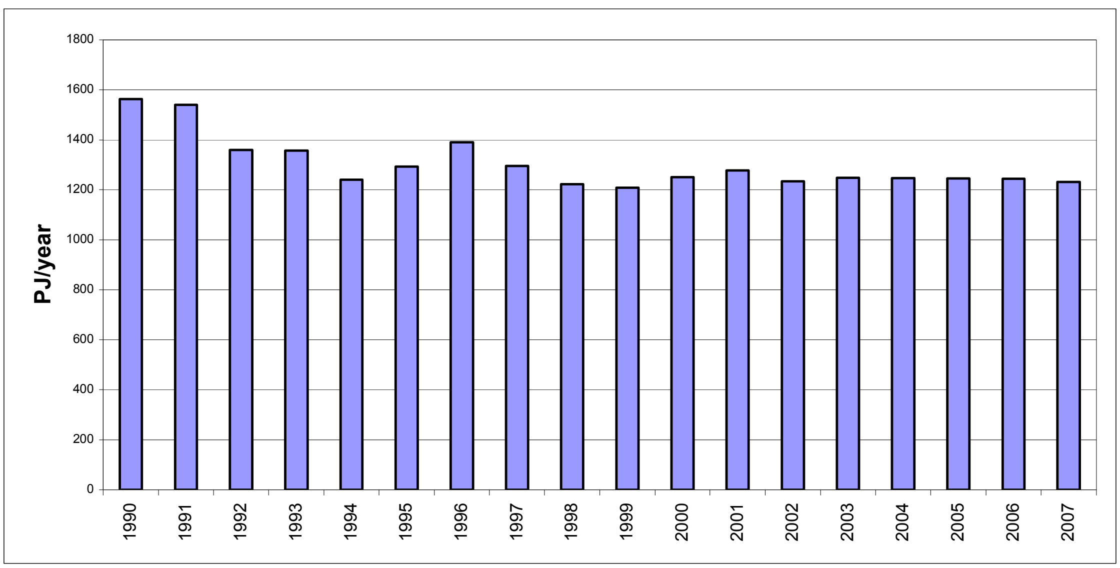

Fig. 3.3 Trends in fuel consumption in sectors 1A1, 1A2 and 1A4

3.1.2.2.2 CO_2 emissions

The manner of collecting and processing activity data from which the CO_2 emissions (and other direct greenhouse gases) are calculated was described in the previous chapter.

Emission factors expressing the carbon content in the individual kinds of fuels (in t C/TJ) and the oxidation factors are taken from the IPCC method, where the previous submissions have so far used only tabulated "default" values. At the request of the expert review team ERT (in-country review in 2007) these "default" emission factors were for coal and lignite replaced by the country specific factors taken from the study (*Fott, 1999*). Emission factors for other fuels than coal and lignite and all the oxidation factors remain unchanged. The emission factors employed are given in Tab. 3.3 of Chapter 3.1.2.2.

The calculations were performed in EXCEL tables and were archived.

Emissions are given in Table. 3.5.

Tab. 3.5 CO_2 emissions calculation from stationary sources in 1990 – 2007

	1A1 Energy industries [Gg CO_2]	1A2 Manufacturing Industries and Construction [Gg CO_2]	1A4 Other sectors [Gg CO_2]	Total 1A1 + 1A2 + 1A4 [Gg CO_2]
1990	57 707	46 616	32 347	**136 670**
1991	57 401	49 140	25 288	**131 828**
1992	51 270	41 106	23 060	**115 436**
1993	53 502	41 997	18 995	**114 494**
1994	53 658	32 609	18 145	**104 412**
1995	56 621	32 766	17 799	**107 186**
1996	59 257	36 626	17 750	**113 633**
1997	59 033	29 069	17 425	**105 526**
1998	55 694	28 588	13 856	**98 138**
1999	52 504	29 956	13 713	**96 174**
2000	59 616	28 185	13 244	**101 046**
2001	58 810	29 432	14 501	**102 742**
2002	57 122	27 912	13 555	**98 589**
2003	57 856	26 365	13 065	**97 287**
2004	57 277	26 003	12 890	**96 170**
2005	57 275	26 632	11 601	**95 508**
2006	59 077	24 399	12 751	**96 227**
2007	61 316	24 940	10 503	**96 758**

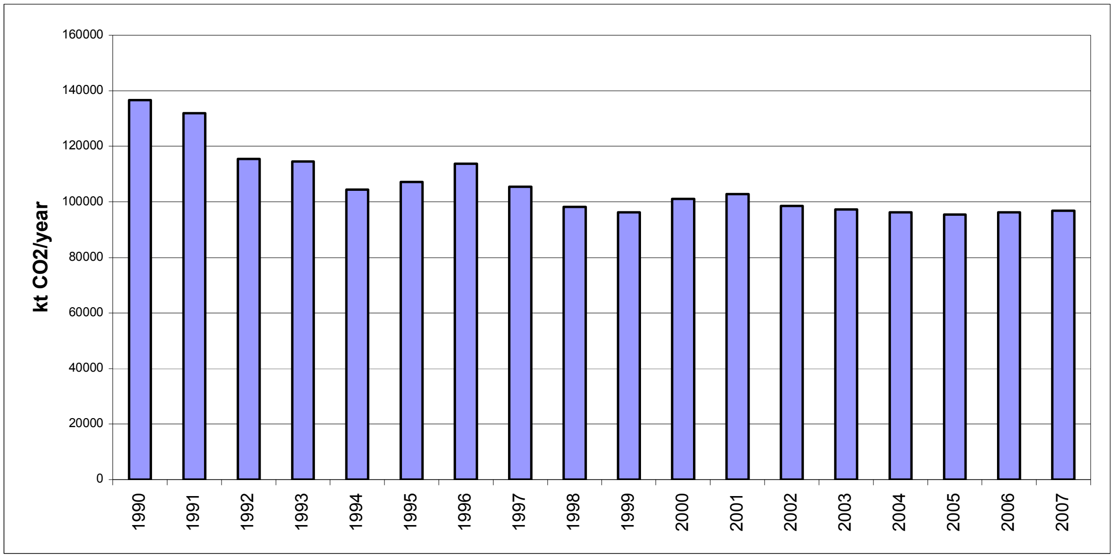

Fig. 3.4 CO_2 emissions trends from the sector 1A1, 1A2 and 1A4 from Fuels

Comparison with 1990 indicates a marked decrease in the level of emissions of carbon dioxide, corresponding to the decrease in the domestic consumption of primary fossil fuels. This is a consequence of the lower consumption of coal and its partial replacement by natural gas. The emissions from the manufacturing industry and other sectors decreased as a consequence of the marked decrease in consumption, especially of coal.

3.1.2.2.3 Methane emissions

Methane emissions from fuel combustion from stationary sources do not constitute *key sources*. Relatively the largest contribution comes from fuel combustion in local heating units.

The means of determining methane emissions is similar in many respects to the method of the individual consumption categories for carbon dioxide emissions. The simplest level (Tier 1) (*Revised 1996 IPCC Guidelines, 1997*) includes only summary fuel categories:

- coal-type solid fuels
- gaseous fuels
- liquid fuels
- wood fuel (biomass)
- charcoal
- other biomass.

Only the first four categories were filled with activity data in the inventory. These data were aggregated directly from the connected working sheets for the calculation of carbon dioxide by the consumption sector method.

In 2007, in accordance with the requirements of the ERT (in-country review in 2007), CH_4 emissions from combustion of all kinds of fuel were recalculated using the default emission factors over the entire time series.

This submission employed the emission factors for CH_4 in the individual sectors as tabulated below:

1A1 Energy Industries	
Liquid fuels	3 kg CH_4/TJ
Solid fuels	1 kg CH_4/TJ
Gaseous fuels	1 kg CH_4/TJ
Biomass	30 kg CH_4/TJ
1A2 Manufacturing Industries and Construction	
Liquid fuels	2 kg CH_4/TJ
Solid fuels	10 kg CH_4/TJ
Gaseous fuels	5 kg CH_4/TJ
Biomass	30 kg CH_4/TJ
1A4A Commercial/Institutional	
Liquid fuels	10 kg CH_4/TJ
Solid fuels	10 kg CH_4/TJ
Gaseous fuels	5 kg CH_4/TJ
Biomass	300 kg CH_4/TJ
1A4B Residential	
Liquid fuels	10 kg CH_4/TJ
Solid fuels	300 kg CH_4/TJ
Gaseous fuels	5 kg CH_4/TJ
Biomass	300 kg CH_4/TJ
1A4C Agriculture/Forestry/Fisheries	
Liquid fuels	10 kg CH_4/TJ
Solid fuels	300 kg CH_4/TJ
Gaseous fuels	5 kg CH_4/TJ
Biomass	300 kg CH_4/TJ

Emissions are given in Tab. 3.6.

Tab. 3.6 CH_4 emissions calculation from stationary sources in 1990 – 2007

	1A1 Energy industries [Gg CH_4]	1A2 Manufacturing Industries and Construction [Gg CH_4]	1A4 Other sectors [Gg CH_4]	Total 1A1 + 1A2 + 1A4 [Gg CH_4]
1990	0.67	4.31	62.96	67.93
1991	0.68	4.88	45.02	50.58
1992	0.60	3.91	43.43	47.94
1993	0.64	4.22	33.95	38.81
1994	0.63	3.41	29.72	33.76
1995	0.70	3.30	26.95	30.96
1996	0.72	3.69	24.39	28.80
1997	0.80	3.26	21.45	25.51
1998	0.78	2.98	17.40	21.16
1999	0.73	3.01	16.28	20.02
2000	0.73	3.03	15.11	18.87
2001	0.74	3.21	16.50	20.44
2002	0.68	3.25	14.72	18.65
2003	0.87	3.17	17.10	21.14
2004	0.96	3.02	19.02	23.01
2005	0.76	3.41	17.39	21.55
2006	0.82	2.75	24.85	28.42
2007	0.86	2.87	21.60	25.32

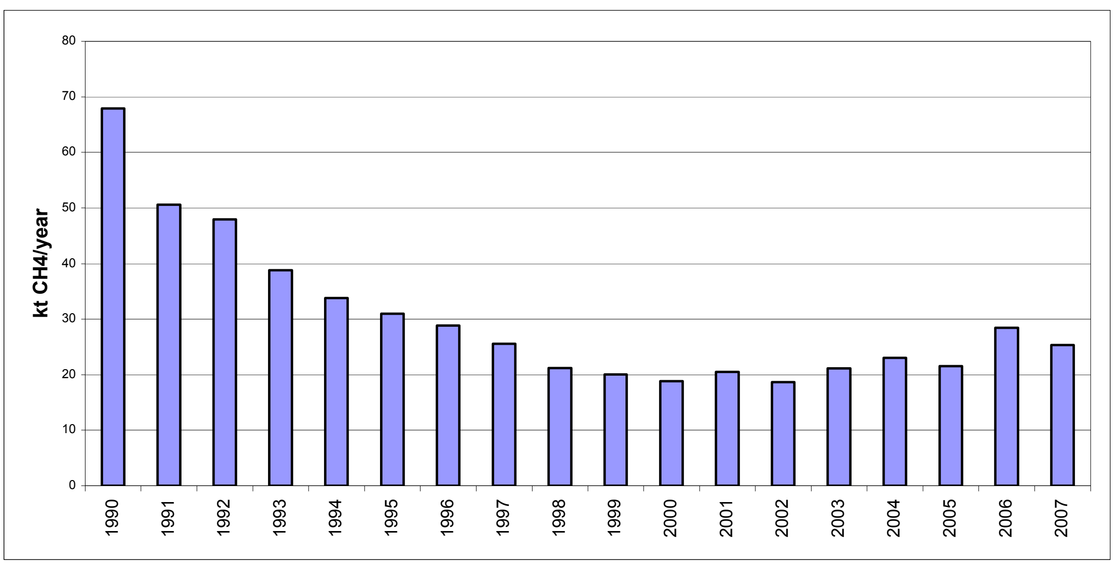

Fig. 3.5 CH_4 emissions trends from the sector 1A1, 1A2 and 1A4 from Fuels

Compared to 1990, there has been a substantial decrease in the level of methane emissions, caused primarily by a change in the structure of the consumption of the individual kinds of fuels. This consisted primarily in gradual replacement of solid fuels by natural gas. Since 1998, methane emissions have been more or less constant or have increased slightly. This could be caused by the return of a certain percentage of households to combustion of solid fuels for household heating.

Reduction of energy intensity in industry acts against this trend, but this effect is small. Because of the high emission factor in sector 1A4, trends in CH_4 emissions are affected by the increased fraction of biomass in households and agriculture in recent years.

3.1.2.2.4 N_2O emissions

N_2O emissions from stationary sources do not belong amongst *key sources* in the CR.

In 2007, in accordance with the requirements of the ERT (in-country review in 2007), N_2O emissions from combustion of all kinds of fuel were recalculated using the default emission factors over the entire time series.

This submission employed the emission factors for N_2O in all the sectors as tabulated below (uniformly for the entire sector of stationary combustion sources):

Liquid fuels 0.6 kg N_2O/TJ
Solid fuels 1.4 kg N_2O/TJ
Gaseous fuels 0.1 kg N_2O/TJ
Biomass 4.0 kg N_2O/TJ

Emissions are given in Tab. 3.7.

Tab. 3.7 N_2O emissions calculation from stationary sources in 1990 – 2007

	1A1 Energy industries [Gg N_2O]	1A2 Manufacturing Industries and Construction [Gg N_2O]	1A4 Other sectors [Gg N_2O]	Total 1A1 + 1A2 + 1A4 [Gg N_2O]
1990	0.805	0.576	0.433	1.814
1991	0.803	0.645	0.324	1.773
1992	0.723	0.521	0.294	1.538
1993	0.751	0.544	0.225	1.519
1994	0.745	0.445	0.215	1.404
1995	0.793	0.417	0.193	1.403
1996	0.822	0.461	0.188	1.471
1997	0.830	0.389	0.163	1.382
1998	0.787	0.357	0.130	1.275
1999	0.738	0.374	0.125	1.237
2000	0.833	0.374	0.120	1.327
2001	0.826	0.387	0.130	1.344
2002	0.796	0.394	0.122	1.312
2003	0.833	0.379	0.189	1.401
2004	0.838	0.361	0.213	1.413
2005	0.813	0.410	0.205	1.427
2006	0.852	0.322	0.251	1.425
2007	0.889	0.344	0.241	1.474

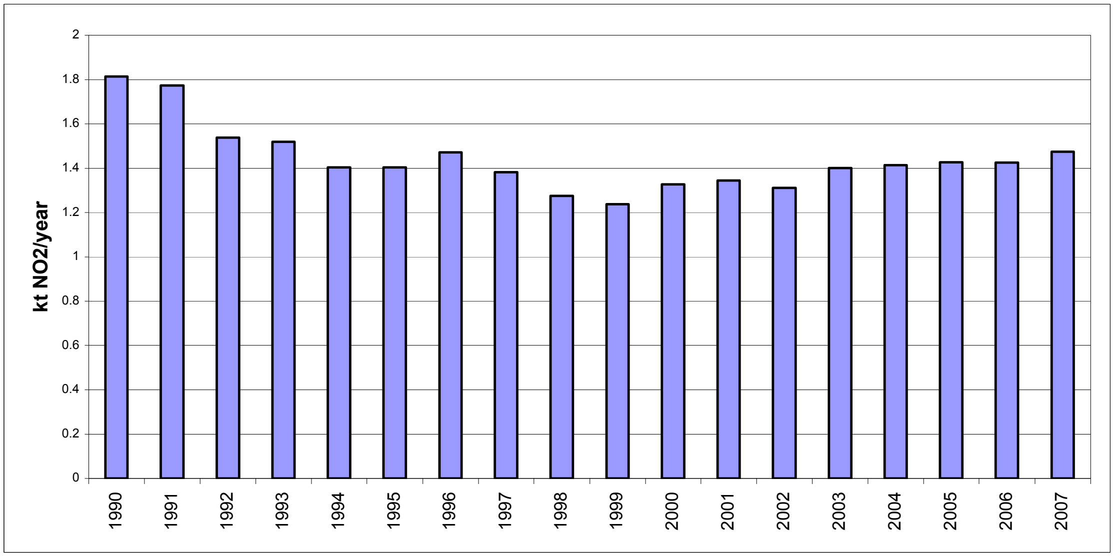

Fig. 3.6 N_2O emissions trends from the sector 1A1, 1A2 and 1A4 from Fuels

In the entire monitored period, a slight decrease in N_2O emissions is apparent only in the first half of the period (to 1999). The subsequent slight increase and stagnation towards the end of the period are apparent caused by increasing production of electricity, which is mostly produced from brown coal in the CR. The Energy Industry sector is also the decisive segment for N_2O emissions. This phenomenon could also be caused by an increasing fraction of combusted biomass, which has a relatively high emission factor compared to other fuels.

3.1.2.3 Uncertainties and time series consistency

Uncertainty estimation must reflect the fact that the activity data employed, i.e. the consumption of the individual kinds of fuels, are taken from the official data of the Czech Statistical Office (CSO). These statistics is based on the energy balance, which is divided into source (supply) and consumption parts.

The **source part** (TPES - Total Primary Energy Supply) consists of national data on the actual mining, export, import and changes in stocks in the individual years and for the individual kinds of fuels. The fuel structure corresponds to the structure used in the CRF system. The source part also corresponds to the manner of calculation of the amounts of fuel used in the country. This part of the energy balance can be considered to be suitable accurate, as this is an important commodity that is monitored primarily for economic reasons. The source part of the balance is utilised in the Reference Approach.

The **consumption part** is based on the source part. It is further divided into a part listing yields. This part describes transformation processes (e.g. coking bituminous coal to coke, crude oil to individual liquid fuels, production of generator gas from brown coal - lignite, etc.). Another part is concerned with inputs into processes (for production of electricity and heat in public and industrial installations). Simultaneously, the internal consumption in large industrial facilities is also monitored (e.g. for mining coal, transformation processes, etc.). Fuel not consumed in this part of the balance is transferred to the “final consumption” part, where consumption of fuel in agriculture (Agriculture/Forestry/Fisheries) and in services (Commercial/Institutional) is reported separately. Final consumption includes households, whose fuel consumption is calculated from data acquired in 10-year cycles during the census of inhabitants, houses and apartments (the last was held in 2001). This information is supplemented by CSO through special studies based on individual census studies (the last was held in 2003 – 4 on approx. 40 thousand respondents). Supporting information is also employed. The consumption of natural gas in households is an important item and can be obtained with quite high accuracy from regional distribution companies. The remainder is calculated and denoted as consumption in industry and construction.

The consumption part of the balance is not as robust as the source part. Data on consumption of fuels from the national emission register (REZZO) partly provides a potential for possible corrections. This data is obtained annually at thermal sources with an output of over 200 kW and at industrial sources where it is required by the national legislation. This corresponds to approx. 38 thousand places of operation (installations).

However, it is decisive that both parts of the energy balance are interconnected and do not contain duplicities.

The following survey gives a preliminary rough estimates of uncertainties in the use of activity data and emission factors (see Chapter 1) based mainly on expert judgment.

Tab. 3.8 Uncertainty analysis in data uncertainty for 2007 (Tier 1)

IPCC Source Category	Gas	Activity data uncertainty	Emission factor uncertainty
		[%]	[%]
1.A Stationary Combustion - Solid Fuels	CO_2	4	4
1.A Stationary Combustion - Gaseous Fuels	CO_2	4	3
1.A Stationary Combustion - Liquid Fuels	CO_2	4	3
1.A.5.b Mobile sources in Agriculture and Forestry	CO_2	4	3
1.A Stationary Combustion - Solid Fuels	CH_4	4	50
1.A Stationary Combustion - Gaseous Fuels	CH_4	4	50
1.A Stationary Combustion - Liquid Fuels	CH_4	4	50
1.A Stationary Combustion - Biomass	CH_4	4	50
1.A.5.b Mobile sources in Agriculture and Forestry	CH_4	20	50
1.A Stationary Combustion - Solid Fuels	N_2O	4	80
1.A Stationary Combustion - Gaseous Fuels	N_2O	4	80
1.A Stationary Combustion - Liquid Fuels	N_2O	4	80
1.A Stationary Combustion - Biomass	N_2O	4	80
1.A.5.b Mobile sources in Agriculture and Forestry	N_2O	20	70

The consistency of the time series is another instrument for subsequent control of inventories. Consequently, both activity data and calculated emissions are monitored over the whole time series. In the past two years, the working team concentrated primarily on the consistency of time series in consumption of liquid fuels in off-road machinery in agriculture and in other sources not listed elsewhere.

Uncertainty in the data will be gradually eliminated. The greatest uncertainty can be identified in the separation of fuels in the internal structure of subsector 1A2. The use of the CSO data for IEA constitutes substantial progress in reducing uncertainties.

3.1.2.4 Source-specific QA/QC and verification

Activity data for calculation of emissions in the IPCC methodology was taken from international reports of the energy balance from CSO, submitted to IEA in October of 2008. The data in this balance were verified on the basis of individual data from the following organizations:

- fuel extraction: Czech Mining Authority, Employers Federation of the Mining and Petroleum Industry, Miners' Association,
- liquid fuel consumption: Czech Association of the Petroleum Industry and Trade (CAPPO),
- production and consumption of natural gas: Annual Report of Distribution Companies of the Gas Industry, Transgas Balance.

Internal control procedures for the accuracy of the input data and the performed calculations (QA/QC and verification) are performed prior to export of the data for coordination at the CHMI coordination workplace.

To increase transparency, tables were prepared in EXCEL, containing activity and emission data processed and stored for the entire time series. The data are transferred from these tables to the CRF Reporter application. In data control (prior to data export), the reported data from the CRF Reporter are returned to EXCEL format and are mutually compared. This procedure reliably eliminates shortcomings that could arise through an elementary error in entering data or incorrect or non-uniform use of emission and oxidation factors. Final data export is performed only when the calculated data and the entered data do not exhibit any deviations.

Simultaneously, a method was elaborated permitting graphical depiction of the fuel balance and simple control that the sector approach includes all fuels used in the country and that none is counted twice. The diagrams for the individual kinds of fuels are stored with the workers.

Data verification is also based on cooperation with the NRF working team (CLRTAP/EMEP Emission Inventory).

Cooperation with CSO was extended. In 2008, this cooperation consisted of several subsequent steps:

- Acceptance of the official data reports for IEA - Eurostat – UNECE.
- Regular consultations with the employees of the Department of the processing of statistics for energy production, technical development and innovations in processing activity data in the IPCC methodology, in general for all kinds of fuels and especially in relation to the aspect of consumption of automotive fuels.
- External control of the source and consumption parts of the activity data for liquid fuels. The control was performed on the basis of a contract relationship and was related to the amount of liquid fuels in natural units, the calorific values employed and the resultant overall balance in energy units. A confirmation was issued by the Czech Statistical Office on the control, stating that the values employed correspond to information available at the present time (November 2008).

Formal control of the correctness and completeness of the data entered in CRF Tables was carried out by CHMI. This control was carried out at random. The new CRF Reporter employed for the first time this year substantially assists in application of control procedures, where attempts were made to utilize graphic depiction of time series for identification of gaps in the individual subcategories of sources.

3.1.2.5 Source-specific recalculations

No extensive recalculations of whole time series were performed in 2008 for years 1990 - 2005. As refined activity data were obtained for 2006 from the final energy balance, recalculation was performed for practically all stationary sources in 2006. However, the recalculation was not related to the emission factors employed, but only new activity data were used.

3.1.2.6 Source-specific planned improvement

The following measures are planned:

- To use nationally specific uncertainty values to a greater degree.
- Control of combustion of the fraction of petroleum-based fuel in the Energy and Waste sectors.
- To verify the possibility of obtaining more exact data on the consumption and quality characteristics of fuels from the database for trading in greenhouse gas emissions (EU ETS) and from the national database REZZO.

The importance of cooperation with CSO was emphasized in the previous text. Intensification of cooperation with the section for energy production in this institution must be considered a permanent task.

3.1.3 Mobile combustion

3.1.3.1 Source category description

The categories of means of transport for the purposes of calculations of greenhouse gas emissions did not change compared to 2006. The criteria for inclusion of a certain means of transport in a particular category consist in the kind of transport, the fuel employed and the type of emission standard that the particular vehicle must meet (in road transport). The categories of vehicles are not as detailed for non-road transport.

The categories of mobile sources are following:

1A3a Civil Aviation

- airplanes fuelled by aviation gasoline
- airplanes fuelled by jet kerosene

1A3b Road transportation

- motorcycles,
- passenger and light duty gasoline vehicles conventional,
- passenger and light duty gasoline vehicles with EURO 1 limits,
- passenger and light duty gasoline vehicles with EURO 2 limits,
- passenger and light duty gasoline vehicles with EURO 3 limits,
- passenger and light duty gasoline vehicles with EURO 4 limits,
- passenger and light duty diesel vehicles conventional,
- passenger and light duty diesel vehicles with EURO 1 limits,
- passenger and light duty diesel vehicles with EURO 2 limits,
- passenger and light duty diesel vehicles with EURO 3 limits,
- passenger and light duty diesel vehicles with EURO 4 limits,
- passenger cars using LPG, CNG and biofuels (separately),
- heavy duty diesel vehicles and buses, conventional,
- heavy duty diesel vehicles and buses, with EURO 1 limits,
- heavy duty diesel vehicles and buses, with EURO 2 limits,
- heavy duty diesel vehicles and buses, with EURO 3 limits,
- heavy duty diesel vehicles and buses with EURO 4 limits,
- heavy duty diesel vehicles and buses using LPG, CNG and biofuels (separately).

1A3c Railways

- diesel locomotives

1A3d Navigation

- ships with diesel engines

3.1.3.2 Methodological issues

3.1.3.2.1 CO_2 emissions

Carbon dioxide emissions were calculated on the basis of the total consumption of the individual automotive fuels used in transport (i.e. gasoline, diesel oil, LPG, CNG, biofuels and aviation fuels) and the emission factors for the weight of CO_2 corresponding to 1 kg of fuel burned. Consumption of the individual kinds of fuel by road, railway and water transport was determined on the basis of cooperation with the CSO. Consumption in road transport was further divided up into the following categories of means of transport on the basis of statistics on transport output:

- gasoline-fuelled passenger vehicles;
- diesel vehicles for passenger and light freight transport;
- diesel vehicles for heavy freight transport and buses;
- passenger and light vehicles fuelled by LPG, CNG and biofuels (separately);
- heavy trucks and buses fuelled by LPG, CNG and biofuels (separately).

The share of transport in total CO_2 emissions has exhibited an increasing trend in the Czech Republic during the 90's and this growth is continuing until 2007. Individual road and freight transport make the greatest contribution to energy consumption in transport. The amount of fuel sold is monitored annually and constitutes the main input data for calculation of energy consumption.

The consumption of diesel oil is continuing to increase inter-annually in the Czech Republic. The consumption of diesel oil increased by a total of 187 thousand tons in 2007, from 3 370 thous. t. in 2006 to 3 557 thous. t in 2007. The NIR for 2006 reported a favourable trend in consumption of gasoline, which decreased after increasing for many years (from 1 184 thous. t. in 1990 to 2 080 thous. t. in 2004): first to 2 042 thous. t. in 2005 and then to 1 999 thous. t. in 2006.

Unfortunately, this trend did not continue in this report for 2007, as the consumption of gasoline increased again in 2007, by 86 thous. t. compared to 2006 (a total of 2085 thous. t. of gasoline were consumed). This increase in the consumption of gasoline and diesel fuel is a result of the increase in number of vehicles and in the annual average number of kilometres travelled, especially by newer vehicles. The trend in the increase in the number of kilometres travelled cannot be affected even by the introduction of vehicles with lower consumption and lower CO_2 emissions, and also not by eco-labelling, i.e. informing the public about fuel consumption and CO_2 emissions in automobile salesrooms. Rather to the contrary; consumers with vehicles with lower consumption are motivated to travel a greater number of kilometres, increasing absolute consumption.

Mobile sources used for purposes other than transport – gasoline-powered lawn mowers, chain saws, construction machinery, etc. – make a smaller contribution to the increasing consumption of gasoline and diesel oil.

In relation to CO_2 emissions from air transport, it can be stated that domestic transport makes a very small contribution to these emissions – about 1%, as it is limited mainly to flights between the three largest cities in the Czech Republic, Prague, Brno and Ostrava. Similar to road transport and consumption of aircraft fuel, this is not monitored centrally by the Czech Statistical Office. Aircraft are fuelled mainly by jet kerosene, while the consumption of and CO_2 emissions from aviation gasoline are limited to small aircraft used in agriculture and in sports and recreational activities.

The total consumption of the army and the consumption of the domestic transport (estimated on the basis of the number of flights, distances between destinations and the specific consumption of fuels per the unit of distance in the LTO regime and the cruise itself) were subtracted from the total kerosene consumption. The remaining kerosene consumption is related to the international air transport.

Carbon dioxide emissions for the 2000 – 2006 time series were recalculated in 2008. The reasons for the recalculation and more detailed information are given in the relevant chapters (Chapters 3.1.3.5 and 9.2.4).

Tab. 3.9 CO_2 emissions calculation from mobile sources in 1990 – 2007 *[Gg CO_2]*

	Aviation (without Bunkers) 1.A3a	Road Transportation 1.A3b	Railways 1.A3c	Navigation 1.A3d	Agriculture (Mobile) 1.A5b	Total 1.A3 + 1.A5
1990	149	5 995	647	56	1 601	8 449
1991	136	5 406	576	56	1 409	7 582
1992	119	6 228	489	54	1 321	8 211
1993	97	6 329	411	54	1 276	8 167
1994	91	6 825	331	53	1 285	8 585
1995	80	8 656	330	55	1 013	10 134
1996	72	9 678	326	45	1 092	11 213
1997	66	10 376	280	38	1 140	11 900
1998	10	10 912	350	37	1 258	12 566
1999	10	11 195	325	22	1 237	12 788
2000	8.7	11 500	326	15.5	1 233	13 084
2001	11.6	12 354	304	24.9	1 211	13 906
2002	15.1	12 952	295	12.4	1 144	14 418
2003	15.4	14 771	289	12.4	1 065	16 153
2004	15.7	15 512	286	18.6	1 112	16 944
2005	12.9	16 854	273	15.5	1 097	18 252
2006	16.1	17 154	301	18.6	1 066	18 556
2007	32.1	18 028	298	15.7	1 078	19 452

3.1.3.2.2 CH_4 emissions

For road transportation, the method of methane emission calculation corresponds to the Tier 2 level, because different road vehicles produce different amounts of methane. It can be stated that methane emissions from road transportation exhibit the same differences as total hydrocarbons. Mobile emission sources were divided up into several categories according to the fuel used, the transport mode and the emission limit that a particular vehicle must meet. This division is more detailed because there are larger differences in methane production by individual vehicles. These categories are described in detail in Chapter 3.1.3.2 "Source category description".

The total consumption of gasoline, diesel oil, LPG, CNG and biofuels has been determined from the statistical surveys of the CSO. The next step consisted in separation of these fuel consumptions into the vehicle categories described above, according to their transport outputs acquired in the last National Traffic Census performed in the Czech Republic once every five years, last in 2005. The emission factors were the IPCC default values and, from 2004, the country-specific values as CDV became part of the emission inventory team.

The Czech Republic has been very successful in stabilizing and decreasing methane emissions derived from transport-related greenhouse gas emissions. The annual trends in these emissions are constantly decreasing and are very similar to other hydrocarbons emissions, which are limited in accordance with UN ECE regulations. New vehicles must fulfill substantially higher EURO standards for hydrocarbons than older vehicles (currently the EURO IV standard). The greatest problems are associated with the slow renewal of the freight transport fleet. There has been almost no decrease in the number of older trucks in this country and these older vehicles are frequently used in the construction and food industries (Adamec et al, 2005a).

Methane emissions from mobile sources are now calculated using methane emission factors taken from the internal database, containing both data from Czech emission measurements (mostly obtained from the Motor Vehicle Research Institute - TÜV UVMV) and internationally accepted values from the IPCC methodology, European Environmental Agency - Emission Inventory Guidebook, CORINAIR, etc. The resultant emission factors were calculated using the weighted averages of all data classified according to transport vehicle categories. The following categories were included: conventional gasoline-fuelled passenger cars, gasoline-fuelled passenger cars fulfilling EURO limits, diesel-fuelled passenger cars, light-duty vehicles, heavy-duty vehicles, diesel locomotives, diesel-fuelled watercraft, aircraft fuelled by aviation gasoline and kerosene-fuelled aircraft (Adamec et al, 2005b).

Emissions of CH_4 from mobile sources are given in Tab. 3.10.

Tab. 3.10 CH_4 emissions calculation from mobile sources in 1990 – 2007 *[Mg CH_4]*

	Aviation (without Bunkers) 1.A3a	Road Transportation 1.A3b	Railways 1.A3c	Navigation 1.A3d	Agriculture (Mobile) 1.A5b	Total 1.A3 + 1.A5
1990	15.1	1 200.0	44.0	4.0	335.7	1 598.8
1991	13.7	1 034.0	39.0	4.0	291.9	1 382.7
1992	12.0	1 210.0	33.0	4.0	270.1	1 529.0
1993	10.2	1 270.1	28.0	4.0	262.0	1 574.3
1994	8.8	1 395.4	22.6	3.6	264.0	1 694.4
1995	6.7	1 560.0	22.5	3.7	211.1	1 804.0
1996	4.8	1 589.6	22.2	3.1	212.8	1 832.5
1997	3.6	1 492.9	19.1	2.6	184.1	1 702.2
1998	1.5	1 331.4	23.8	2.5	145.4	1 504.7
1999	1.8	1 220.1	22.2	1.5	99.4	1 344.9
2000	1.5	1 710.0	20.5	1.0	85.6	1 818.6
2001	2.1	1 740.0	19.1	1.6	84.2	1 847.0
2002	2.8	1 650.0	18.5	0.8	81.1	1 753.1
2003	2.8	1 700.0	18.1	0.8	73.9	1 795.7
2004	2.9	1 610.0	17.9	1.2	78.2	1 710.2
2005	2.3	1 620.0	17.1	1.0	77.6	1 718.1
2006	2.9	1 530.0	16.3	1.2	68.6	1 618.9
2007	5.5	1 530.0	19.0	1.0	69.3	1 624.8

3.1.3.2.3 N_2O emissions

The increase in consumption of gasoline described in Chapter 3.1.3.2.1 is negatively reflected not only for carbon dioxide, but particularly in nitrogen monoxide. In contrast to carbon dioxide, where the emission factors for individual vehicles related to one kilogram of fuel are approximately constant, the emission factors for N_2O are higher for newer vehicles than for older vehicles. Newer vehicles have greater numbers of kilometers travelled, causing a slight increase in N_2O emissions by 100 tons, from 2230 to 2330 tons in this category of vehicles.

Road transport was identified as a key source of N_2O emissions over the past 3 years, as the share of vehicles with high N_2O emissions has been increasing over this time. Consequently, N_2O emissions from mobile sources represent a somewhat more important contribution than CH_4 emissions. In calculation of N_2O emissions from mobile sources, the most important source according to the IPCC methodology seems to be passenger automobile transport, especially gasoline-fuelled passenger cars with catalysts. The vehicle categories for the nitrous oxide calculation are the same as for methane (see above).

Because of big differences between national N_2O measurement results and values recommended in IPCC methodology, the special verification including the statistical evaluation has been performed.

The resulted values of N_2O emission factors from mobile sources are approaching to recommended IPCC values. The emissions factors for N_2O for vehicles with diesel motors and for vehicles with gasoline motors without catalysts are not very high and were taken in the standard manner from the methodical instructions (IPCC default values). The situation is more complex for vehicles with gasoline motors equipped with three-way catalysts. The IPCC methodology (*Revised 1996 IPCC Guidelines*, 1997) gives three pairs of emission factors for passenger cars with catalysts (for new and deactivated catalysts). The value for a deactivated catalyst is approximately three times that for a new catalyst. The pair of values recommended on the basis of Canadian research was selected because of the lack of domestic data; in addition, American and French coefficients are presented in the Reference Manual, Box 3 (*Revised 1996 IPCC Guidelines*, 1997). The arithmetic mean of the values for new and older used catalysts was taken as the final emission factor for passenger cars with catalysts.

The calculation was based on the consumption of gasoline and diesel oil by the main types of vehicles. Here, the consumption of gasoline must be divided into the part burned in vehicles equipped with three-way catalysts and other vehicles. The calculation was based on an estimate following from the study of the CDV prepared annually for ME, estimating the fraction of gasoline-propelled vehicles equipped with three-way catalysts (Adamec *et al*, 2002). According this study, the fraction of petrol-propelled vehicles equipped with three-way catalysts was recently equal 32 %. Similar to previous years, we assume that newer vehicles emit larger amounts and again express this by a coefficient of 1.5. The result of this calculation is that not quite 48 % of gasoline is combusted in vehicles with catalysts.

A partial increase in N_2O emissions can be expected in this category in connection with the growing fraction of vehicles equipped with three-way catalysts. This approach described above was recently revised and modified by CDV, which is a member of the Czech national GHG inventory team from 2005. CDV has been providing the transport data for the official Czech inventory since 2004. The CDV approach is based on combination of measurements performed for some cars typically used in the Czech Republic with widely used EFs values taken from literature (see Dufek, 2005).

The situation in relation to reporting N_2O emissions is rather complicated, as some of the measurements performed in the past in the Czech Republic were substantially different from the internationally recognized emission factors. Consequently, control measurements were performed on N_2O emissions from the commonest cars in the Czech passenger vehicle fleet (Skoda Felicia, Fabia and Octavia) during 2004 - 2006 years. These corrections brought the results closer to those obtained using IPPC emission factors than the older data, leading to better harmonization of the results of the nitrous oxide emission inventory per energy unit with those obtained in other countries. The locally measured data for measurements of N_2O emissions in exhaust gases were verified by assigning weighting criteria for each measurement; the most important of these criteria were the number of measurements, the analysis method, the type of vehicle and the fraction of these vehicles in the Czech vehicle fleet. (*Dufek, 2005 and Jedlicka et al, 2005*).

Nitrous oxide emission factors were obtained using a similar method to that employed for methane, by statistical evaluation of the weighted averages of the emission factors for each category of vehicle (see Chapter 3.1.3), employing the interactive database. This database now encompasses the results of the Czech measurements performed in 2004 and 2005 (Adamec et al, 2005b). Emissions of N_2O are given in Tab. 3.11.

Tab. 3.11 N_2O emissions calculation from mobile sources in 1990 – 2007 *[Mg N_2O]*

	Aviation (without Bunkers) 1.A3a	Road Transportation 1.A3b	Railways 1.A3c	Navigation 1.A3d	Agriculture (Mobile) 1.A5b	Total 1.A3 + 1.A5
1990	12.6	228.0	26.5	2.3	63.2	332.6
1991	11.6	269.1	23.5	2.3	55.0	361.5
1992	10.0	369.8	20.0	2.2	51.1	453.2
1993	8.5	487.0	16.8	2.2	50.0	564.5
1994	7.5	544.1	13.6	2.2	49.7	617.0
1995	5.9	807.5	13.5	2.2	39.7	868.9
1996	4.5	939.3	13.6	1.9	42.6	1 001.9
1997	3.6	1 066.0	15.3	1.8	51.1	1 137.8
1998	1.1	1 395.9	19.6	2.1	76.0	1 494.7
1999	1.3	1 615.9	18.7	1.2	81.3	1 718.4
2000	1.2	1 260.0	18.7	0.9	82.9	1 363.7
2001	1.6	1 400.0	17.5	1.4	81.5	1 502.0
2002	2.1	1 590.0	16.9	0.7	77.8	1 687.6
2003	2.1	1 890.0	16.6	0.7	71.6	1 981.0
2004	2.2	2 060.0	16.4	1.1	75.3	2 155.0
2005	1.8	2 200.0	15.7	0.9	74.6	2 292.9
2006	2.2	2 230.0	14.9	1.1	68.6	2 316.8
2007	4.4	2 330.0	17.0	0.9	69.3	2 421.7

3.1.3.3 Uncertainties and time series consistency

In spite of the fact that verification has been performed, the N_2O emission factors remain the greatest source of uncertainty for this pollutant, because the emission factors from various data sources differ. In checking the consistency of data series, attention was focused in 2006 primarily on emissions from internal air transport; particularly older data on internal flights is very difficult to obtain.

3.1.3.4 Source-specific QA/QC and verification

Consumption of all automotive fuels in the time series was determined in cooperation with CSO. The actual calculations of greenhouse gas emissions were performed by two independent institutions: The CDV and KONEKO, with regular mutual control of the results. Inaccuracies were gradually eliminated.

3.1.3.5 Source-specific recalculations

In the framework of the submission, in addition to calculation of emissions of greenhouse gases from mobile sources for 2007, complete recalculation of the time series of emissions from mobile sources was performed retroactively for 2000 – 2006. The recalculations were performed because of the availability of new, more exact input data on fuel consumption and fuel net calorific value. These data are determined in the framework of statistical surveys by the Czech Statistical Office. Another reason lay in the necessary recalculation of the emission factors of the individual defined categories of vehicles from g/MJ to g/kg of fuel, as the database of emission factors of the Transport Research Centre contains mainly data related to units of fuel consumed.

The new net calorific values for the fuels did not differ much from the original values (e.g. motor gasoline now has a net calorific value of 43.8), but contributed to better data consistency with the time series, manifested in homogenization of the "implied emission factor" parameter.

The calculated greenhouse gas emissions per unit of consumed energy have better values when based on this recalculation, as the inter-annual differences in these values decreased for the individual greenhouse gases. Both the energy consumptions and the emissions of carbon dioxide, methane and nitrogen monoxide were recalculated.

On the basis of refinement of data on fuel consumption in internal air transport, complete recalculation was performed for emissions of carbon dioxide, methane and nitrogen monoxide in this category. In previous years, fuel consumption in internal air transport was substantially over-estimated and consequently it was necessary to perform the relevant corrections, on the basis of newly determined data on internal flights.

3.1.3.6 Source-specific planned improvement

Control and refinement of the results will continue. In particular, studies will continue to be performed on the potential for refinement of the calculation of N_2O emissions on the basis of emission measurement results. More detailed monitoring of the statistics of air transport from the standpoint of internal flights is also expected.

3.2 Fugitive Emissions from Fuels (1B)

3.2.1 Overview

Mining, treatment and all handling of fossil fuels are sources of fugitive emissions. They consist mainly of emissions of methane and volatile organic compounds NMVOCs (petroleum extraction and processing). In the Czech Republic, CH_4 emissions from deep mining of hard coal are significant, while emissions from surface mining of brown coal, oil and gas production, distribution, storage and distribution are less important.

The current inventory includes CH_4 emissions for the following categories:

- *1B1a. Coal Mining and Handling (i. Underground Mines and ii. Surface Mines),*
- *1B2a Oil and 1B2b Natural Gas.*

In *1B Fugitive Emissions from Fuels* category, especially *1B1a Coal Mining and Handling* was evaluated as a *key category* (Tab. 3.12). Category 1B2 also was identified as a *key category* by the latest assessment, but only in one from the four tests (LA). Moreover, identifiers placed this category just over the borderline between *key* and non-*key categories.*

Fig. 3.7 depicts methane emissions trends from selected categories from the sector *1B Fugitive Emissions from Fuels*.

Tab. 3.12 Overview of significant categories of sources in this sector (2007)

Category	Character of category	Gas	% of total GHG*
1B1a Fugitive Emissions from Coal Mining and Handling	KC (LA, TA, LA*, TA*)	CH_4	3.0
1B2 Fugitive Emissions from Oil & Gas operations	non-KC	CH_4	0.5

* assessed without considering LULUCF (without * means considering LULUCF)

KC: key category,LA: identified by level assessment,TA: identified by trend assessment

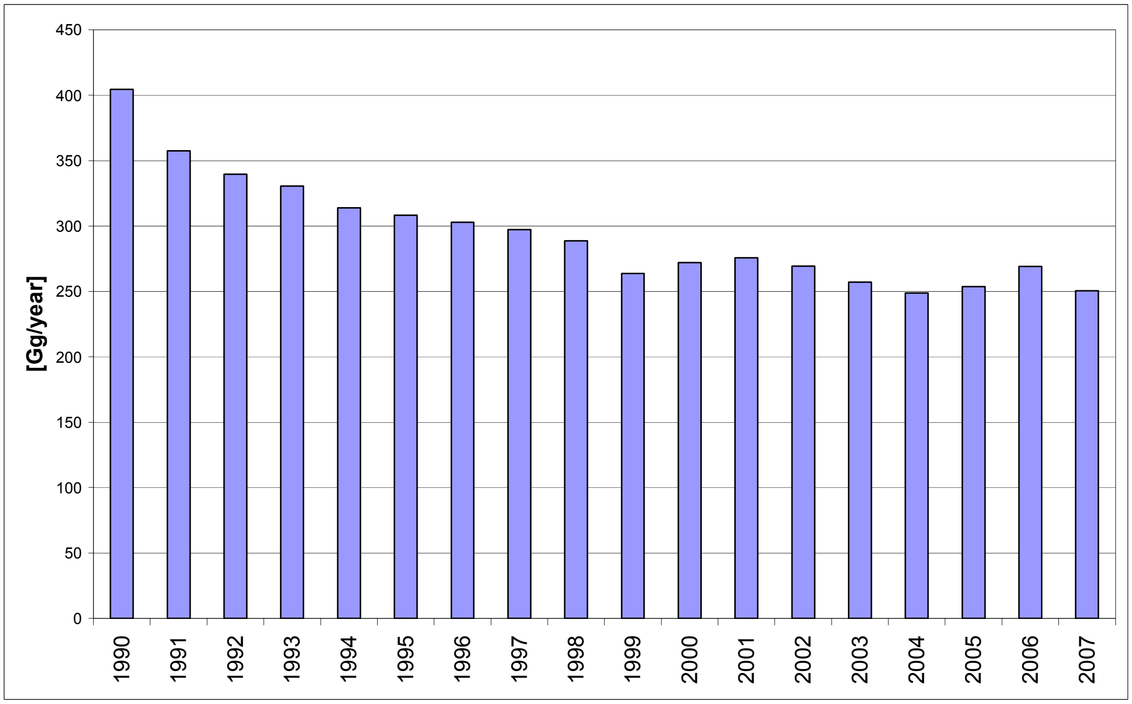

Fig. 3.7 Methane emissions trends from the sector Fugitive Emissions from Fuels *[Gg CH_4]*

3.2.2 Solid Fuels (1B1)

The main process that emits more than 80 % of methane emissions from the *1B1 Solid Fuels* category is deep mining of hard coal in the Ostrava-Karviná area. A lesser source consists in brown coal mining by surface methods and post-mining treatment of hard and brown coal.

3.2.2.1 Source category description

Coal mining (in particular hard coal mining) is accompanied by an occurrence of methane. Methane, as a product of the coal-formation process is physically bonded to the coal mass or is present as the free gas in pores and cracks in the coal and in the surrounding rocks. In deep hard coal mining, CH_4 is released from the coal mass and from the surrounding rocks into the mine air and must be removed to the surface to prevent formation of dangerous concentrations in the mine.

3.2.2.2 Methodological aspects

For *Solid Fuels*, the calculation uses national emission factors and activity data on the extraction of coal, which are available in yearbooks (*Mining Yearbook*, 1995 - 2007, *Statistical Yearbook*, 2007). National emission factors (Takla and Nováček, 1997) were used in calculating methane emissions in deep hard coal mining (Ostrava-Karviná coal-mining area); emission factors according to the IPCC methodology (*Revised 1996 IPCC Guidelines*, 1997) were used for the emission factors for emissions from the surface mining of brown coal and post-extraction treatment.

The mine ventilation must be calculated according to the amounts of gas released. At the end of 1950's mine gas removal systems were introduced in opening new mines and levels in the Ostrava-Karviná coal-mining area, which permitted separate exhaustion of partial methane released in the mining activity in the mixture containing the mine air. The total amount of methane emitted can be balanced quite accurately from the methane concentrations in the mine air and their total annual volume. The ratio between mining and the volume of methane emissions is given in Tab. 3.13, see (Takla and Nováček, 1997).

Tab. 3.13 Coal mining and CH_4 emissions in the Ostrava - Karvina coal-mining area

	Coal mining *[mil. t / year]*	CH_4 emissions		Emission factors	
		[mil. m^3 / year]	*[Gg / year]*	*[m^3 / t]*	*[kg / t]*
1960	20.90	348.9	250.3	16.7	12.0
1970	23.80	589.5	422.9	24.7	17.7
1975	24.11	523.8	375.8	21.7	15.6
1980	24.69	505.3	362.5	20.5	14.7
1985	22.95	479.9	344.3	20.9	15.0
1990	20.06	381.1	273.4	19.0	13.6
1995	15.60	270.7	194.2	17.4	12.4
1996	15.10	276.0	198.0	18.3	13.1
Total	**167.31**	**3 375.3**	**2 421.3**	**20.2**	**14.5**
1990 till 1996	50.76	927.8	665.6	18.3	13.1

During surface mining, escaping methane is not related to specific flow of air and thus it is far more difficult to monitor the amount of methane escaping into the air. Consequently, default IPCC emission factors are employed to calculate methane emissions from surface mining and from post-mining treatment (*Revised 1996 IPCC Guidelines*, 1997). Tab. 3.14 illustrates the calculation of fugitive emissions of methane from coal mining activities.

Tab. 3.14 Calculation of CH_4 emissions from coal mining in 2007

	A	B	C	D	E
	Ammount of Coal Produced	Emission Factor	Methane Emissions	Conversion Factors	Methane Emissions
	[mil. T]	*[m^3 CH_4 / t]*	*[mil. m^3]*	*[Gg CH_4/$10^6$$m^3$]*	*[Gg CH_4]*
			C=A*B		E=C*D
Mining (I - III) *OKR** (Tier 3)	12.895	18.3	236	0.67	158.1
Post-Mining (Tier 1) *OKR**	12.895	2.45	32	0.67	21.2
Mining (Tier 1)	45.664	1.15	53	0.67	35.2
Post-Mining (Tier 1)	45.664	0.1	5	0.67	3.1
				Total	**217.5**

** Ostrava-Karviná coal-mining area*

3.2.2.3 Uncertainty and time consistency

The inventory methods used in this inventory were consistently employed across the whole reporting period from the base year 1990 to 2007.

The uncertainty estimates have not yet been reported. Their full implementation is ongoing and is planned for inclusion in the coming years.

3.2.2.4 QA/QC and verification

For the purposes of internal quality control, the calculations were based on basic requirements that are defined as follows:

- routine control of consistency to ensure data integrity and their correctness and completeness;
- identification and correction of errors and omissions;
- documentation and archiving of all material used for the inventory preparation and QC activities.

Control of quality of the processed by national expert team is carried out both on the basis of the emission factors and activity data used. The consistency of activity data is controlled on the basis of the following sources:

- fuel extraction: Czech Mining Authority, Employers Federation of the Mining and Petroleum Industry, Miners' Association;

- extraction of domestic petroleum: Employers Federation of the Mining and Petroleum Industry, Miners' Association, Moravian Petroleum Mines;
- production and consumption of natural gas: Annual Report of Distribution Companies of the Gas Industry, Transgas Balance.

These sources have been also used in other parts of GHG emission inventory, e.g. in *Combustion Processes*, resulting in cross-control within the working team. The emissions calculated from the emission factors are then compared with previous years and a check is made to ensure that no sudden changes have occurred. All data (source and calculated) are stored by the national expert team.

Data are stored in files containing calculation for each year separately so that the calculation can be repeated. The files contain the activity data and the emission factors employed. The results of emission calculations are then transferred to trend tables and graphic outputs are created from them, permitting rapid control of important inter-annual deviations. In case of occurrence of important deviations, the calculation is controlled again and, if no error is found, the deviation is considered to correspond to fact. This procedure permits control of the individual activity data, from which the overall activity data used in the CRF Reporter for the individual subcategories is then composed.

The use of the new CRF Reporter then permits rapid control of the overall activity data and emission data and facilitates discovery of any errors. This method was fully utilized in the preparation of the latest emission inventory.

3.2.2.5 Recalculations

No recalculations are applicable for this sector. Recalculation was performed in 1998 and was reported in CRF and described in NIR 1998 - 2006.

3.2.2.6 Source-specific planned improvements

Deep mining of hard coal:

- refining of the emission factors for methane emissions;
- research on data that would permit determination of fugitive CO_2 emissions.

Specific attention will be paid to uncertainty establishment and assessment.

3.2.3 Oil and Natural Gas (1B2)

Approximately 10 % of emissions are formed in the Czech Republic from gas industry in extraction, storage, transport and distribution of natural gas and in its final use. Petroleum extraction and refining processes are less important. NMVOC emissions are formed primarily from petroleum refining and in storage and handling of petroleum products.

Methane emissions from the gas industry were determined using national emission factors based on the specific emission factors for the individual parts of the gas industry system (*Gas and Environment*, 1997, Alfeld, 1998). Determination of methane emissions from the processes of refining of petroleum is based on the recommended (default) emission factors according to the IPCC methodology.

3.2.3.1 Source category description

Methane emissions in this category are basically formed in several ways:

- through poor seals in the flanges and joints, fittings, probes in mining and storage fields and other parts of the pipeline system;
- through pipeline perforation;
- through technical discharge of gas into the air;
- through accidents.

In the 1990's, the gas industry was one of the most dynamically evolving (consumption increase) industrial categories in the Czech Republic. Natural gas is an important trade commodity and consequently its consumption, transport, distribution, storage and supplementary extraction in the territory of the Czech Republic is monitored carefully. As a result, activity data for the methane emission balance are available with high precision in this category.

The emissions of CO_2, CH_4 and N_2O from flaring were determined anew for 2007; these were originally reported in subcategory 1.B.2.C.2.2 Gas. The emissions were determined using the emission factors from *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Table 4.2.4.

Tab. 3.15 Calculation of emissions from flaring in Gas Production in 2007

	CO_2	CH_4	N_2O	Units
Emission Factors	0.0012	0.00000076	0.00000002	Gg/mil. m^3
	0.0352	0.0000223	0.00000062	Gg/PJ
Gas Production	6.413			PJ/year
Emissions	**0.226**	**0.000143**	**0.00000396**	**Gg/year**

The emissions were determined only for flaring, as venting is not employed in the Czech Republic.

3.2.3.2 Methodological aspects

Gas Extraction, Storage, Transit, Transport and Distribution

Leakages in the distribution network and household distribution pipes can be considered to constitute the most serious source of emissions. In the 1990's, the distribution network was newly constructed almost entirely from welded plastics and the old pipeline was reconstructed to a major degree in the same manner. Household distribution pipes are subject to strict standards and any poor seals can be identified by the characteristic smell. In addition to safety aspects, all leakages also have an economic impact both for the distribution company and for the end user, so this aspect is carefully monitored and, as soon as possible, immediately remedied. As a whole, the gas distribution in the CR is at a high technical level and it can be stated that all leakages are carefully sought out and eliminated.

As a method was developed in the last few years for determining methane emissions in the gas industry using specific emission factors, this sophisticated method of calculation continues to be used, although, from the standpoint of ref. (*Good Practice Guidance*, 2000), calculation using default values would probably suffice. Qualified estimation of methane emissions is thus carried out using specific emission factors for the individual parts of the gas industry system (Alfeld, 1998, *Gas and Environment*, 2000). The total emission value given corresponds to about 0.3 % of the total consumption of natural gas in the Czech Republic. The detailed calculation given corresponds to Tier 2.

Relatively low value of the implied emission factor for *Transmission/Processing* is caused by the fact that an international transit of natural gas represents a considerable part of the activity value.

Activity data on the gas distribution system are monitored and collected by RWE TRANSGAS a.s. and other distributing companies and by the Czech Gas Association. Detailed data are published in annual reports. All the activity data employed can be considered to have a relatively high level of precision (± 5 %).

In 2008, in the framework of the Czech Gas Union, a study was prepared to refine the emission factors for calculation of emissions in the Gas sector (Neužil, 2008). The Czech Gas Union is an organization that associates all the important distributors and suppliers of natural gas in the Czech Republic. Preparation of the study was inspired by the preparation of a similar study in the Netherlands. The study was based on new foreign data, the directly reported methane emissions in the Czech Republic and expert studies. It contains a proposal for new emission factors, leading to a reduction in fugitive emissions in this sector. The results of the study have not yet been incorporated into the emission calculations in this submission. A longer period of time will be required for implementation of the results of the study into the methodological procedure. The greatest difficulty will lie in establishing the time period from which the new emission factors will be used, as the study describes current conditions and its results do not permit retrospective recalculation of the entire or part of the time series.

Petroleum Extraction, Refining and Storage

Calculation of methane emissions in domestic petroleum production was carried out using the emission factor based on data from ref. (*UNIPETROL and Environment*, 1999), and currently has a value of 5.287 kg CH_4 / PJ of extracted petroleum. This emission factor is somewhat higher than the maximum value recommended by IPCC: 4.670 kg CH_4 / PJ (*Revised 1996 IPCC Guidelines*, 1997); however, it is the same order of magnitude. The calculation corresponds to Tier 2.

In the recent past, Czech refineries have undergone a quite extensive process of innovation and reconstruction, to decrease technical losses of raw materials and final products. Comprehensive verification has been carried out of the seals of the individual fittings, pumps and all the technical equipment. This entire process, which was carried out mainly for economic reasons, also led to a decrease in overall emissions, especially of NMVOCs. Consequently, the emission factors taken from (*Revised 1996 IPCC Guidelines*, 1997) can be considered to correspond to the current technical condition of refineries in this country. In this connection, it should be pointed out that fugitive emissions from refinery technology couldn't be determined by direct measurements, as they are not connected with specific air outlets or chimneys. Thus, they can be determined only on the basis of professional estimates from balance losses or using emission factors. The resultant emissions of the individual substances were compared with the data in the national emission database and are of the same order of magnitude.

As, according to the literature, methane constitutes about 10 % of total VOC emissions, it can be stated that the emission factor for methane would correspond to a level of about 0.07 kg / t of processed petroleum, which is the upper limit given in (*Revised 1996 IPCC Guidelines*, 1997). Technical progress in the past has permitted reduction of emissions by about 30 %. Consequently, an emission factor value of 1.150 kg / PJ is used to calculate methane emissions from petroleum refining/storage.

Tab. 3.15 lists CH_4 emissions reported summarily for refining and storage according with the CRF Reporter program, where CH_4 emissions are reported jointly in category *1B2a4 – Refining / Storage*.

No CH_4 emissions are formed in the distribution of liquid fuels (category *1B2a5 – Distribution of Oil Products*). The data for 1994 to 2006 were treated in this manner. Total emissions in the individual years did not change.

Because of the uncertainty, it is necessary to evaluate methane emissions in this subcategory at the level of Tier 1. However, the uncertainty entailed cannot significantly affect the overall balance.

Activity data on the extraction of the individual energy carriers (petroleum, gas) and on batches of petroleum in the petrochemical industry are available in yearbooks (*Mining Yearbook*, 1995 - 2007, *Statisical Yearbook*, 2007).

Data in Tab. 3.15 illustrate the calculation of fugitive emissions of from oil and natural gas and Tab. 3.16 summarizes the emissions factors used for the Gas Industry.

The emissions of CO_2, CH_4 and N_2O from venting and flaring were determined anew for 2007; these were originally reported in subcategory 1.B.2.C.1.1 Oil and 1.B.2.C.2.1 Oil . The emissions were determined using the emission factors from *2006 IPCC Guidelines for National Greenhouse Gas Inventories*, Table 4.2.4.

Tab. 3.16 Calculation of emissions from flaring in Oil Production in 2007

	CO_2	CH_4	N_2O	Units
Emission Factors	0.00114	0.00000070	0.000000018	Gg/PJ
Oil Production		10.40		PJ/year
Emissions	**0.0119**	**0.0000072**	**0.00000019**	**Gg/year**

Tab. 3.17 Calculation of emissions from venting in Oil Production in 2007

	CO_2	CH_4	Units
Emission Factors	0.0000026	0.000020	Gg/PJ
Oil Production	10.40		PJ/year
Emissions	**0.000027**	**0.00021**	**Gg/year**

3.2.3.3 Uncertainty and time consistency

The inventory methods used in this inventory were consistently employed across the whole reporting period from the base year 1990 to 2007.

The total uncertainty estimates have not yet been reported because of lack of data. Activity data uncertainties are quoted in the Methodological aspect chapter. Their full implementation is ongoing and is planned for inclusion in the coming years.

3.2.3.4 QA/QC and verification

The some procedures as mentioned in Chapter 1.1.2.4 QA/QC and verification are used.

3.2.3.5 Recalculations

No recalculations are applicable for this sector.

3.2.3.6 Source-specific planned improvements

Utilization of the Improved Methodology for determination of methane emissions in the gas industry in the Czech Republic to refine fugitive methane emissions in sector 1B2b – Natural Gas.

Specific attention will be paid to uncertainty establishment and assessment.

Tab. 3.18 Calculation of CH_4 emissions from oil and natural gas in 2007

Category	Tier	Activity	Emission Factors	CH_4 Emissions	Emissions CH_4
		A	B	C	D
				(kg CH_4)	(Gg CH_4)
				C = (A x B)	D = (C/10^6)
Production - OIL		*PJ oil produced*	*kg CH_4/PJ*		
(domestic production)	3	10.40	5 287	54 967	0.055
Refining		*PJ oil refined*	*kg CH_4/PJ*		
	1 - 2	316.1	1 150	363 467	0.363
				CH_4 from OIL	**0.418**
Production - GAS		*PJ gas produced*	*kg CH_4/PJ*		
(domestic production NG)	3	6.41	39 354	252 377	0.252
Transmission and Distribution		*PJ gas transported*	*kg CH_4/PJ*		
(transit transport and high pressure pipeline)	2	1 464.2	7 786	11 399 836	11.40
Distribution		*PJ gas distributed*	*kg CH_4/PJ*		
(low pressure pipeline)		144.7	130 369	18 866 330	18.87
Other Leakage		*PJ gas stored*	*kg CH_4/PJ*		
(underground storage)	3	137.76	14 762	2 033 618	2.03
				CH_4 from GAS	**32.46**

4 Industrial Processes (CRF Sector 2)

In principle, this category includes mainly emissions from actual processes and not from fuel combustion used to supply energy for carrying out these processes. For example, in the production of cement, consideration is given only to emissions derived from the thermal decomposition of mineral raw materials (specifically CO_2 emissions from the decomposition of limestone) and not from fuel used to heat the rotary kiln (considered in category 1A2). However, the situation in iron and steel production is more complicated. Evaluation of the CO_2 emissions is based on consumption of metallurgical coke in blast furnaces, where coke is used dominantly as a reducing agent (iron is reduced from iron ores), even though the resulting blast furnace gas is also used for energy production, mainly in metallurgical plants. It should also be borne in mind that emissions occurring during petroleum refining belong in categories 1A1b or 1B2 (fugitive emissions).

Direct greenhouse gases in this sector consist mainly of CO_2 emissions in the production of iron and steel and mineral products (cement, lime, glass and ceramic production, limestone and dolomite use). Iron and steel and cement production can be considered to be *key categories* (KC) according to IPCC *good practice* (*Good Practice Guidance*, 2000, *Good Practice Guidance for LULUCF*, 2003). The production of nitric acid, which leads to emissions of N_2O, and the use of F-gases can be considered to be categories just over the borderline between *key* and *non-key categories*. Tab. 4.1 gives a summary of the main sources of direct greenhouse gases in this sector (not only KC).

Tab. 4.1 Overview of significant sources in sector Industrial prosesses (2007)

Category	Character of category	Gas	% of total GHG*
2C1 Iron and steel	KC (LA, TA, LA*, TA*)	CO_2	5.3
2A1 Cement production	KC (LA, LA*)	CO_2	1.4
2F1-6 F-gases Use - ODS substitutes	KC (LA, TA, LA*, TA*)	HFCs, PFCs	1.1
2A3 Limestone and Dolomite Use	KC (LA, TA, LA*, TA*)	CO_2	0.7
2A2 Lime production	KC (LA, LA*)	CO_2	0.5
2B2 Nitric acid production	KC (LA, LA*)	N_2O	0.5
2B1 NH_3 production	non-KC	CO_2	0.4

* assessed without considering LULUCF

KC: key category, LA, LA*: identified by level assessment with and without considering LULUCF, respectively

TA, TA*: identified by trend assessment with and without considering LULUCF, respectively

4.1 Mineral Products (2A)

This category include CO_2 emissions from Cement and Lime production, Limestone and Dolomite Use, Glass and Ceramics production.

4.1.1 Source category description

Cement Production (2A1) is one of the traditional anthropogenic sources of carbon dioxide included in inventories; however, its importance is incomparably smaller than the total combustion of fossil fuels. Process-related CO_2 is emitted during the production of clinker (calcination process) when calcium carbonate ($CaCO_3$) is heated in a cement kiln up to temperatures of about 1 300 °C. During this process, calcium carbonate is converted into lime (CaO - calcium oxide) and CO_2. CO_2 emissions from combustion processes taking place in the cement industry (especially heating of rotary kilns) have been reported in IPCC Category 1A2.

CO_2 is emitted from *Lime Production (2A2)* during the calcination step. Calcium carbonate ($CaCO_3$) in limestone and calcium / magnesium carbonates in dolomite rock ($CaCO_3$•$MgCO_3$) are decomposed to form CO_2 and quicklime (CaO) or dolomite quicklime (CaO•MgO), respectively. On the other hand, the use of hydrated lime (e.g. building industry - hardening of mortar, water softening, sugar production) mostly results in the reaction of CO_2 with lime to form calcium carbonate.

The category *2A3 Limestone and Dolomite Use* includes emissions from sulphur removal with limestone and emissions from limestone and dolomite use in sintering plants. From the chemical standpoint, sulphur removal from combustion products in coal combustion, using limestone, is a related source of CO_2 emissions, although it is not of great importance. Here, it holds that one mole of SO_2 removed releases one mole of CO_2 without regard to the sulphur-removal technology employed and the stoichiometric excess. These amounts have increased since 1996, when the first sulphur-removal unit came into operation.

The *2A7 Other* category summarizes emissions from *Glass Production (2A7.1)* and from *Brick and Ceramics Production (2A7.2)*. In the first case emissions are derived particularly from the decomposition of alkaline carbonates added to glass-making sand, in the second one, Brick and Ceramics Production, are derived particularly from the decomposition of alkaline carbonates and fossil organic compounds included in the raw materials.

4.1.2 Methodological Issues

CO_2 emissions from *2A1 Cement production* can be calculated according to the IPCC methodology from the production of cement (Tier 1) or clinker (Tier 2). Since 2006 submission Tier 2 has been employed Data on cement clinker production is available in the Czech Republic from two independent sources, the CSO and the Czech Cement Association (CCA), which associates all Czech cement producers. Data from CSO differ from those provided by CCA, probably due to exclusion of clinker imports and exports by CSO. The CCA data was considered to be more accurate for preparation of national GHG emission inventories; in addition, data about clinker production from CSO have not been publicly available since 2004.

All operating cement plants in the Czech Republic are equipped with dust control technology and the dust is then recycled to the kiln. Only in one cement plant is a small part of the CKD discarded, for technical reasons. The amount of disposed CDK is not known. An expert from CCA estimates that the disposed amount varies around 500 t per year (Ing. Gemrich, 2009, personal communication). This amount (and the related emissions) is completely insignificant and is not take into account in emissions estimations.

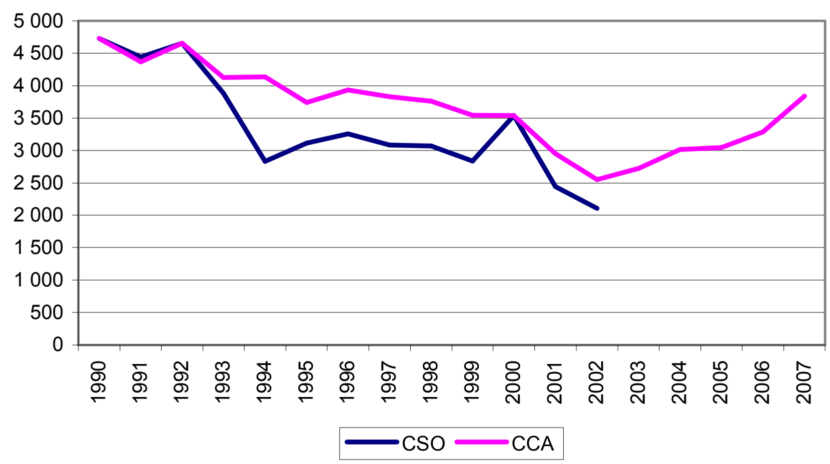

Fig. 4.1 Czech Cement Asspciation (CCA) and Czech Statistical Office (CSO) data comparison *[thous.t]*

The emission factor was derived from the parameters for the limestone and dolomite used or clinker produced by the individual cement producers in 1990, 1996, 1998 - 2002 and 2005 - 2007 (the EF value was extrapolated for the other years). These data have been collected for preparation and implementation of the EU Emission Trading Scheme and for fulfilling reporting obligations since 2005, when the system started. EU ETS includes all the cement kilns in Czech Republic. Information from individual kilns (CO_2 emissions, CaO content) is reported to the competent authority. For reasons of confidentiality, it is not possible to make public the direct inputs from cement producers, except for emission data. EF, which is calculated based on CO_2 emissions and clinker production, varies from 0.5267 to 0.5534 t CO_2 / t clinker and includes emissions from calcinations.

In 2006, CO_2 emissions decreased by 30 % compared to 1990 and were equal to 1 748 Gg CO_2. CO_2 emissions from this sector decreased consistently between 1990 and 2002 and then increased slightly. Process-related emissions from cement production for the whole 1990 - 2007 period are presented in Tab. 4.2. Cement production and related emissions are driven by demand of the building industry.

Emissions from *2A2 Lime production* were calculated as the sum of CO_2 emissions from lime production in accordance with 2000 GPG. National EF reflects the production of lime and quick lime (0.7884 t CO_2 / t lime) as well as the average purity (93%) (Vácha, 2004).

Activity data are based on statistics from the Czech Lime Association, which publishes data on pure lime production, so that these data were considered to be more accurate in comparison with data from the Czech Statistical Office, which do not differentiate between lime and hydrated lime.

Only CO_2 emissions generated in the process of the calcination step of lime treatment are considered under category 2A2 CO_2 emissions from combustion processes (heating of kilns and furnaces) are reported under category *1A2 Manufacturing Industries and Construction*. Tab. 4.2 lists data for pure lime production (taken from the Czech Lime Association).

As can be seen in Tab. 4.2 the overall trend for lime production decreased slightly in the 1990 - 2006 period; in 2006 lime production was 43 % lower than in 1990. Tab. 4.2 also shows comparison of CO_2 emissions calculated according to IPCC methodology and process-related emissions reported for EU ETS. ETS data closely corresponds to the IPCC methodology and national circumstances.

Tab. 4.2 Activity data and CO_2 emissions from cement and lime production in 1990 - 2007

	Cement clinker produced *[t / year]*	Process-specific CO_2 emissions *[Gg]*	Lime produced *[t / year]*	Process-specific CO_2 emissions *[Gg]*	
				IPCC methodology	EU ETS
1990	4 726	2 489	1 823	1 337	
1991	4 368	2 309	1 152	845	
1992	4 653	2 468	1 134	831	
1993	4 122	2 195	1 062	779	
1994	4 134	2 208	1 100	807	
1995	3 740	2 005	1 115	818	
1996	3 934	2 116	1 133	831	
1997	3 829	2 083	1 163	853	
1998	3 758	2 068	1 087	797	
1999	3 547	1 963	1 074	787	
2000	3 537	1 937	1 130	829	
2001	2 954	1 629	1 128	827	
2002	2 549	1 403	1 112	815	
2003	2 725	1 485	1 102	808	
2004	3 017	1 627	1 103	809	
2005	3 045	1 625	1 040	763	738
2006	3 288	1 748	1 034	758	748
2007	3 837	2 043	1 083	794	772

Category *2A3 Limestone and Dolomite Use* include emissions from sulphur removal with limestone and emissions from limestone and dolomite use in sintering plants. Emission from sulphur removal have varied, in recent years, from 0.4 to 0.6 Mt CO_2 according to electricity production from thermal (brown coal) power plant. CO_2 emissions from sulphur removal were calculated from coal consumption for electricity production, sulphur content and the effectiveness of sulphur removal units between 1996, when the first sulphur removal units came into operation, and 2005. In 2005, these data were verified with data from individual power plants, which were collected for EU ETS preparation and which cover the years 1999 – 2005. Data form EU ETS has been used since 2006. Tab. 4.3 lists data for this category.

Emissions from limestone and dolomite use in sintering plants were new source, in 2006 submission, which was identified in the process of preparation of the EU Emission Trading Scheme. Only 2 sintering plants have existed in the CR in recent times. CO_2 emissions from this category are calculated on the basis of data from statistics (The Steel Federation, Inc - production of agglomerate / sinter) and the EF value, which was derived from EU ETS CO_2 emission data based on the limestone and dolomite compositions and consumptions (0.08 t CO_2 / t sinter). Tab. 4.3 lists data for this category.

CO_2 emissions from *2A7.1 Glass production* equaled 236 Gg in 2007. The emission factor value of 0.14 t CO_2 / t glass was taken from the new version of the guidebook (EMEP / CORINAIR Atmospheric Emission Inventory Guidebook, 1999). Tab. 4.3 lists data for Glass Production and from Brick and Ceramics Production.

Emissions from *2A7.2 Brick and Ceramics Production* are derived particularly from the decomposition of alkaline carbonates and fossil organic compounds included in the raw materials. The EF value was derived from individual installation data collected for EU ETS (emissions) and from CSO (production). The calculation is based on the total production of ceramic products and the EF value.

Tab. 4.3 CO_2 emissions from Limestone and Dolomite Use in desulphurization unit, sinter plant, Glass Production and Brick and Ceramics Production in 1990 – 2007 [Gg]

	CO_2 emissions from desulfurization	CO_2 emissions from sinter plant	CO_2 emissions from Glass Production	CO_2 emissions from Brick and Ceramics Production
1990	NO	678	173	153
1991	NO	605	148	128
1992	NO	283	146	123
1993	NO	251	142	147
1994	NO	291	154	151
1995	NO	519	116	144
1996	76	587	123	176
1997	241	510	136	213
1998	417	492	142	271
1999	537	438	146	211
2000	540	468	168	226
2001	551	482	168	202
2002	551	492	189	152
2003	560	473	198	162
2004	551	494	233	161
2005	589	467	232	181
2006	587	483	245	155
2007	614	492	236	188

4.1.3 Uncertainty and time consistency

All uncertainty estimates of activity data and emission factors have so far been based on expert judgment (see Tab. 1.3 in Chapter 1).

Time series consistency is ensured as the inventory approaches concerned are employed identically across the whole reporting period from the base year 1990 to 2007.

4.1.4 QA/QC and verification

Activity data for cement and lime production are compared with CSO or EU ETS data, if available. Emissions from limestone use for sulfur removal were validated with data from the EU Emission Trading Scheme, which includes all installations with sulphur-removal units in the Czech Republic. The differences between these two data sources and methodologies were relatively very small, since that data from ETS are used and reported. In the EU ETS emissions reports from individual installations are verified by independent verifiers.

In the year 2007, for the methodology used in this sector, *2A Mineral Products*, were presented and discussed on the Second Workshop on Data Consistency between National GHG inventories and reporting under EU ETS, which was organized by the EEA in Copenhagen on 12-15 Sept., 2007. During the workshop, detailed methods of data processing and compilation and the emission factors used, including their values and origin, were presented. Participants of this workshop did not find any problematic areas.

4.1.5 Recalculations

Recalculations was performed in sector Lime production. For emissions estimates was used GPG IPCC methodology supplement with national data. Emission was compared with available data from EU ETS, which very good coresponds.

4.1.6 Source-specific planned improvements

It is planed to implement uncertainty assessment for all sub/sectors.

4.2 Chemical Industry (2B)

4.2.1 Source category description

This category include mainly CO_2 emissions from *2B1 Ammonia Production* and N_2O emissions from *2B2 Nitric Acid Production*. Besides, limited N_2O is also emitted from caprolactam production and a small amount of CH_4 is emitted from 2B5 (other). Only N_2O emissions are identified in this category as a key source (level assessment).

4.2.2 Methodological Issues

CO_2 emissions from *2B1 Ammonia Production* (including hydrogen production by steam gasification followed by the shift reaction) are reported in the Industrial processes category, even though they were originally reported under *1A2 Manufacturing Industries and Construction*.

Emissions are calculated from the corresponding amount of ammonia produced, using the technologically-specific emission factor 2.40 Gg CO_2 / Gg NH_3 (Markvart and Bernauer, 2005, 2006). This emission factor was derived from the relevant technical literature (*Ullman's Encyclopedia*, 2005). A potential uncertainty in the emission factor for ammonia would not influence the total sum of CO_2 emissions because a corresponding amount of residual oil (masout) is not considered in the energy sector. To ensure time consistency, the entire time series of CO_2 from ammonia production from 1990 is rearranged in this way. The relevant activity data and corresponding emissions are given in Tab. 4.4.

Tab. 4.4 Activity data and CO_2 emissions from ammonia production in 1990 – 2007

Year	1990	1991	1992	1993	1994	1995	1996	1997
Residual fuel oil used for NH_3 product., *[TJ]*	11 113	10 770	11 104	10 383	11 593	10 235	11 015	10 095
Ammonia produced, *[kt]*	335.9	325.5	335.6	313.8	350.4	309.3	332.9	305.1
CO_2 from 2B1, *[Gg]*	806.8	781.9	806.1	753.8	841.6	743.0	799.7	732.9

Year	1998	1999	2000	2001	2002	2003	2004	2005
Residual fuel oil used for NH_3 product., *[TJ]*	10 407	8 864	10 144	8 538	7 449	9 696	9721	8478
Ammonia produced, *[kt]*	314.5	267.9	306.6	258.0	225.1	293.0	290.8	253.6
CO_2 from 2B1, *[Gg]*	755.5	643.6	736.5	619.9	540.8	703.9	698.7	609.3

Year	2006	2007
Residual fuel oil used for NH_3 product., [TJ]	8086	7575
Ammonia produced, [kt]	241.9	226.6
CO_2 from 2B1, [Gg]	581.1	544.4

Nitrous oxide emissions from *2B2 Nitric Acid Production* are generated as a by-product in the catalytic process of oxidation of ammonia. It follows from domestic studies (Markvart and Bernauer, 1999, 2000, 2003), describing conditions prior to 2004, that the resulting emission factor depends on the technology employed: higher emission factor values are usually given for processes carried out at normal pressure, while lower values are usually given for medium-pressure processes. Two types of processes were carried out in this country before 2004, at pressures of 0.1 MPa and 0.4 MPa.. The amount of nitrous oxide in the exit gases is also affected by the type of process employed to remove nitrogen oxides, NO_X (i.e. NO and NO_2). In this country, the process of Selective Catalytic Reduction (SCR) is mostly used, which slightly increases the amount of N_2O, and also to a certain degree Non-Selective Catalytic Reduction (NSCR), which also removes N_2O to a considerable degree.

Studies (Markvart and Bernauer, 2000, 2003) recommend the following emission factors for various types of production technology and removal processes that are given in Tab. 4.5. The emission factors for the basic process (without DENOX technology) are in accord with the principles given in the above-cited IPCC methodology. The effect of the NO_X removal technology on the emission factor for N_2O was evaluated on the basis of the balance calculations presented in studies (Markvart and Bernauer, 1999, 2000, 2003).

Tab. 4.5 Emission factors for N_2O recommended by (Markvart and Bernauer, 2000) for 1990 - 2003

Pressure in HNO_3 production	0.1 MPa			0.4 MPa		
Technology DENOX	--	SCR	NSCR	--	SCR	NSCR
Emission factors N_2O *[kg N_2O / t HNO_3]*	9.05	9.20	1.80	5.43	5.58	1.09

Collection of activity data for HNO_3 production is more difficult than for cement production because of the present legislation, which complicates the releasing of statistical data on manufactured products where the number of producers is smaller than (or equal to) three. Therefore, it was necessary to obtain them by questioning all three producers in the Czech Republic, see (Markvart and Bernauer, 1999, 2000, 2003, 2004)

Studies (Markvart and Bernauer, 1999, 2000, 2003, 2004) also give the value of N_2O emissions from the production of caprolactam: 0.27 Gg N_2O per annum. However, this amount is small compared with other sources. A recent study (Markvart and Bernauer, 2007) reports a small increase in this value to 3.1 Gg N_2O per annum since 2006. Adipic acid, which is considered to be a significant source of N_2O

on a global scale, has not been manufactured in the Czech Republic for some time. Further potential sources of N_2O from other nitration processes in chemical technology should be negligible.

During 2003, conditions changed substantially as a result of the installation of new technologies operating under a pressure of 0.7 MPa. At the same time, some older units operating under atmospheric pressure of 0.1 MPa were phased out. These changes in technology were monitored in the recent study of Markvart and Bernauer (Markvart and Bernauer, 2005). This study presents a slightly modified table of N_2O emission factors, while those for new technologies were obtained from a set of continuous emission measurements lasting several months. Other values are based on several discrete measurements. A table of these technology-specific emissions factors is given below.

In the last quarter of 2005, a new N_2O mitigation unit based on catalytic decomposition of N_2O was experimentally installed for 0.7 MPa technology. As a consequence of this technology, the relevant EF decreased from 7.8 to 4.68 kg N_2O/t HNO_3 (100 %). Therefore, the mean value in 2005 for the 0.7 MPa technology was equal to 7.02 kg N_2O/t HNO_3 (100 %), (Markvart and Bernauer, 2006)

Tab. 4.6 Emission factors for N_2O recommended by Markvart and Bernauer, for 2004 and thereafter

Pressure	0.1 MPa	0.4 MPa	0.4 MPa	0.7 MPa
DENOX process	SCR	SCR	NSCR	SCR
EF, kg N_2O / t HNO_3 (100 %)	9.05	4.9	2.72	7.8 [a)]

[a)] EF without mitigation. Cases of mitigation in 2005, 2006 and 2007 are described in the text

The N_2O mitigation unit mentioned above also was occasionally tested in 2006, decreasing the EF for 0.7 MPa technology from 7.8 to 5.94. Thus, the implied emission factor reached 5.43 kg N_2O/t HNO_3 (100 %) in 2006 (Markvart and Bernauer, 2007).

In 2007, the mitigation unit described above was more effective and therefore relevant. EF for 0.7 MPa technology, which includes mitigation, equaled 4.37. Thus, the implied emission factor attained its lowest value of 4.5 kg N_2O/t HNO_3 (100 %) in 2007 (Markvart and Bernauer, 2008). The decrease in the emission factor for 0.7 MPa technology due to installation of the N_2O mitigation unit and gradual improvement of the effectiveness is given in Tab. 4.7.

Tab. 4.7 Decrease in the emission factor for 0.7 MPa technology due to installation of the N_2O mitigation unit

Year	2004 [a)]	2005	2006	2007
EF, kg N_2O / t HNO_3 (100 %)	7.8	7.02	5.94	4.37
Effectiveness of mitigation, %	-	10	23.9	43.9

[a)] EF without N_2O mitigation.

Tab. 4.8 gives the emissions of N_2O from production of nitric acid including production values. Calculations of N_2O emissions from nitric acid based on study (Markvart and Bernauer, 1999) were firstly used to obtain emission estimates in 1998. This approach, resulting in emission factor values lying in the range 6.3 - 6.9 kg/t (weighed average), was also employed for revised data for 1990-1995.

Tab. 4.8 Emission trends for HNO_3 production and N_2O emissions

	Production of HNO_3, *[Gg HNO_3 (100 %)]*	Emissions of N_2O *[Gg N_2O]* from HNO_3 production
1990	530.0	3.63
1991	349.6	2.37
1992	439.4	2.98
1993	335.9	2.27
1994	439.8	2.94
1995	498.3	3.37
1996	484.8	3.06
1997	483.1	3.33
1998	532.5	3.59
1999	455.0	2.95
2000	505.0	3.36
2001	505.1	3.32
2002	437.1	2.87
2003	500.6	2.86
2004	533.7	3.46
2005	532.2	3.26
2006	543.1	2.95
2007	554.2	2.49

Estimation of CH_4 from the chemical industry (category 2B5) is based on the CORINAIR methodology. The *2B Chemical Industry* emits only 0.3 – 0.6 Gg of methane. This contribution (0.41 Gg in 2007) is not very important. Emission estimates of precursors for the relevant subcategories (starting with the 2001 inventory) have been transferred from NFR to CRF, as described in the previous chapters.

4.2.3 Uncertainty and time consistency

All uncertainty estimates of activity data and emission factors have so far been based on expert judgment (see Tab. 1.3 in Chapter 1). Their improvement is ongoing and is planned for inclusion in the next NIR.

Time series consistency is ensured as the inventory approaches concerned are employed identically across the whole reporting period from the base year of 1990 to 2007.

4.2.4 QA/QC and verification

The sector-specific QA/QC plan follows from the overall plan described in Chapter 1. The greatest attention was focused on identifying gaps and imperfections using the new reporting software (CRF Reporter), specifically by observing trends in figures and by checking IEFs. Attention was also focused on checking sources from inter-sector boundaries (Energy, Industry) that they are neither omitted nor counted twice. CO_2 emissions from residual oil used for ammonia production are not considered in Energy sector.

Activity data available in the official CSO materials in relation to QA/QC were independently determined by experts from CHMI and by the external consultants (M. Markvart and B. Bernauer) data and were mutually compared. Experts at CHMI additionally checked most of the calculations carried out by external consultants and vice versa.

Technology-specific methods for N_2O emission estimates have been improved by incorporating direct emission measurements, especially for new technology (0.7 MPa), which is now predominant in the Czech Republic.

4.2.5 Recalculations

No recalculations are applicable for this year. The CO_2 series from ammonia synthesis have been rearranged (from 1A2 to 2B1) in the 2006 submission, information is provided in NIR, CHMI 2006.

4.2.6 Source-specific planned improvements

It is planed to improve the uncertainty assessment.

4.3 Metal Production (2C)

4.3.1 Source category description

This category include mainly CO_2 emissions from *2C1 Iron and Steel Production*. Besides, small amount of CH_4 is emitted too. CO_2 emissions from iron and steel are identified as a key source category. CO_2 emissions from the process of iron and steel production were originally reported in the energy category *1A2 Manufacturing Industries and Construction* together with energy related emissions from iron and steel. In the 2001 inventory, these emissions were re-classified according to Good Practice (*Good Practice Guidance*, 2000) as emissions from Industrial processes, 2C1. In this way, the relevant rearrangements have been applied to the whole data series. More detailed information is given below.

4.3.2 Methodological Issues

CO_2 emissions from *2C1 Iron and Steel Production* were recategorized in accordance with the IPCC *Good Practice* (*Good Practice Guidance*, 2000) starting with the GHG emission inventory for 2001. As mentioned above, these emissions, which are connected with the actual metallurgical process, were previously included in category 1A2. Obviously, they now constitute a significant key source in category 2. To achieve time consistency, the above-mentioned rearrangement has recently been applied to the whole time series since 1990 and was presented first in the 2006 submission.

CO_2 emissions were determined for category 2C1 using a procedure corresponding to Tier 1 of the *Good Practice Guidance* for 2C1. This calculation was based on the amount of coke consumed in blast furnaces. The calculation was carried out using NCV = 27.81 MJ/kg and using the carbon emission factor for coke, 29.5 t C / TJ, which is the IPCC *default* value (*Revised 1996 IPCC Guidelines*, 1997). As the final products in metallurgical processes are mostly steel and iron with very low carbon contents, the relevant correction for the amount of carbon remaining in the steel or iron was taken into account by using factor 0.98, i.e. the same factor that is standardly used for combustion of solid fuels (the oxidation factor). The major part of CO_2 emissions calculated in this manner is, in reality, emitted in the form of the products of combustion of blast-furnace gas occurring mainly in metallurgical plants, while a smaller part is emitted from heat treatment of pig iron during its transformation to steel.

The relevant activity data and corresponding emissions are given in Tab. 4.9.

Tab. 4.9 Activity data and CO_2 emissions from iron and steel in 1990 - 2007

Year	1990	1991	1992	1993	1994	1995	1996	1997
Coke consumed in blast furnaces, *[kt]*	4 222	2 959	3 447	2 582	2 724	2 866	2 643	2 811
CO_2 from 2C1, *[Gg]*	12 533	8 781	10 230	7 690	8 231	8 659	8 012	8 553

Year	1998	1999	2000	2001	2002	2003	2004	2005
Coke consumed in blast furnaces, *[kt]*	2 483	1 964	2 321	2 174	2 270	2 499	2 851	2 466
CO_2 from 2C1, *[Gg]*	7 555	5 996	7 086	6 612	6 882	7 576	8 491	7 318

Year	2006	2007
Coke consumed in blast furnaces, *[kt]*	2 829	2 724
CO_2 from 2C1, *[Gg]*	8 425	8 030

Estimation of CH_4 from metal production is based on the CORINAIR methodology. Metal production emits only 2.5 – 6.0 Gg of methane.

Emissions of methane in 2007 equaled 3.3 Gg, of which 1.6 Gg corresponds to the contribution of methane emissions from coke production. In this case, the relevant activity data correspond to the amount of coke produced and the Energy Balances of the CR are given. In contrast, the activity data used for calculation of CO_2 emissions, which are given in Tab. 4.9, correspond to the amount of coke consumed in blast furnaces. These data were determined from the CSO material "Energy intensity of manufacture of selected products". It should be pointed out that these two series are not completely identical (e.g. part of the coke produced is used for other purposes and imported coke can also be used in blast furnaces).

Emission estimates of precursors for the relevant subcategories (starting with inventory 2001) have been transferred from NFR to CRF, as described in previous chapters.

4.3.3 Uncertainty and time consistency

The uncertainty estimates were based on expert judgment (see Tab. 1.3 in Chapter 1). Their improvement is ongoing and is planned for inclusion in the next NIR.

Consistency of the time series is ensured as the inventory approaches concerned are employed identically across the whole reporting period from the base year of 1990 to 2007.

4.3.4 QA/QC and verification

The sector-specific QA/QC plan follows from the overall plan described in Chapter 1. The greatest attention was focused on identifying gaps and imperfections using the new reporting software (CRF Reporter), specifically by observing trends in figures and by checking IEFs. Attention was also focused on checking sources from inter-sector boundaries (Energy, Industry) that they are neither omitted nor counted twice. CO_2 emissions from coke used in blast furnaces are not considered in Energy sector.

Activity data available in the official CSO materials in relation to QA/QC were independently determined by experts from CHMI and KONEKO and were mutually compared. Experts at CHMI additionally checked most of the calculations carried out by experts at KONEKO and vice versa.

4.3.5 Recalculations

The CO_2 series from iron and steel have been recategorized (from 1A2 to 2C1) in the 2006 submission, information are provided in (NIR, CHMI 2006). No recalculations were employed in this submission.

4.3.6 Source-specific planned improvements

It is planned to implement uncertainty assessment. Moreover, application of more advanced Tier 2 methodology for Iron and steel production is planned in the future. At the present time, options are being explored for obtaining the relevant data for this purpose.

4.4 Other Production (2D)

In this sector are reported only indirect GHGs and SO_2 from sectors Pulp and Paper; Food and Drink.

4.5 Production of Halocarbons and SF_6 (2E)

Halocarbons and SF_6 are not produced in Czech Republic.

4.6 Consumption of Halocarbons and SF_6 (2F)

4.6.1 Source Category Description

Emissions of F-gases (HFCs, PFCs, SF_6) in the Czech Republic are at a relatively low level due to the absence of large industrial sources of F-gases emissions. As mentioned above, F-gases are not produced in the Czech Republic and therefore there are no fugitive emissions from manufacturing. Additionally, there is no production of other fluorinated gases (CFCs, HCFCs, etc.) that could lead to by-product F-gases emissions and there is no aluminium and magnesium industry in the Czech Republic.

F-gases emissions from national sources are coming only from their consumption in applications as follows:

1. SF6 used in electrical equipment,
2. SF6 used in sound proof windows production,
3. SF6 used in special applications (laboratory),
4. HFCs, PFCs and SF6 used in semiconductor manufacturing,
5. HFCs and PFCs used as refrigerants in refrigeration and air conditioning equipment,
6. HFCs used as propellants in aerosols,
7. HFCs used as blowing agents,
8. HFCs used as extinguishing agents in fixed fire fighting systems.

No official statistics that would allow easy disaggregated reporting and / or use of the highest tiers are currently available in the Czech Republic. All the data are collected based on voluntary cooperation between sectoral experts and private companies.

For source consumption of F-gases, potential emissions increased from 169.4 Gg $CO_{2\ eq.}$ in 1995 to 4 046.2 Gg $CO_{2\ eq.}$ in 2007. This significant increase could be explained mainly due to a substantial increase in the use of HFCs. For the source consumption of F-gases, actual emissions increased from 76.1 Gg $CO_{2\ eq.}$ in 1995 to 1 701.6 Gg $CO_{2\ eq.}$ in 2007. This significant increase could be explained mainly due to a substantial increase in the use of HFCs in refrigeration. The marked sharp increase between 2006 and 2007 is due to a production increase in a new air-conditioning production plant and car factory and also the increased amount used for services. Detailed information about actual and potential emissions is given in the CRF Tables.

Tab. 4.10 HFCs, PFCs and SF_6 potential emissions in 1995 - 2007 *[Gg $CO_{2\ eq.}$]*

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
HFCs	2.2	134.5	479.4	577.9	411.9	674.3	1 045.1	1 092.4	1 343.9	1 215.0	1 280.6	2 574.0	3 884.8
PFCs	0.4	4.2	1.2	1.2	2.7	9.5	14.5	17.9	28.6	21.0	13.8	30.3	27.6
SF_6	166.8	183.1	180.5	126.0	110.9	206.0	223.2	211.8	339.3	208.0	156.9	161.9	133.8
Total	169.4	321.8	661.1	705.1	525.5	889.8	1 282.8	1 322.2	1 711.8	1 444.0	1 451.2	2 766.2	4 046.2

Tab. 4.11 HFCs, PFCs and SF_6 actual emissions in 1995 - 2007 *[Gg $CO_{2\ eq.}$]*

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
HFCs	0.7	101.3	244.8	316.6	267.6	262.5	393.4	391.3	590.1	600.3	594.2	872.4	1 605.6
PFCs	0.1	4.1	0.9	0.9	2.6	8.8	12.3	13.7	24.5	17.3	10.1	22.6	20.2
SF_6	75.2	77.5	95.5	64.2	77.0	141.9	168.7	67.7	101.3	51.9	85.9	83.1	75.9
Total	76.1	182.9	341.2	381.6	347.1	413.2	574.4	472.7	715.9	669.5	690.2	978.0	1 701.6

4.6.2 General Methodological Issues

Currently, the national F-gases inventory is based on the method of actual emissions. The method of potential emissions is used only as supporting information.

According to the *Revised 1996 IPCC Guidelines*, 1997, potential emissions have been calculated from the consumption of F-gases (sum of domestic production and import minus export and environmentally sound disposal). Due to the relatively short time of F-gases usage, it has been assumed that the disposed amount is insignificant. The potential methodology is the same for all categories of use of F-gases. The actual emissions methodology is specified for each category. The method employed assumes that actual emissions should not exceed potential emissions.

As these substances are not nationally produced, import and export information coming from official customs authorities are of the key importance. Individual F-gases do not have a separate custom codes in the customs tariff list as individual chemical substances. SF_6 is listed as a part of cluster of non-metal halogenides and oxides, HFCs and PFCs are listed as total in the cluster of halogen derivatives of acyclic hydrocarbons. In order to determine the exact amounts of these substances, it is essential to obtain information from the customs statistics and from individual importers and exporters, about (a) the imported and exported amounts and (b) kinds of substances (or their mixtures), (c) the amounts and types of disposed F-gases and also (d) the areas of usage; consequently, all importers and exporters are additionally requested to complete a specific questionnaire on export and import of F-gases and to support the questionnaire by additional information on the quantity, composition and use. The most important importers and exporters also report the imported and/or exported type of F-gases and amounts directly to MoE. This is the third source of data, which is used only for control of potential emissions and partly for sectoral split. More detailed description of the methodology is available under the separate document (Řeháček and Michálek, 2005) which also contents all relevant information for potential and actual emissions calculations. Emissions of F-gases are based on data on import and export of individual chemicals or their mixtures (as bulk), but not on products.

4.6.3 Sector-Specific Methodological Issues

This chapter specifies the actual emissions methodology used for a given sector. In the following chapters, individuals sectors with similar methodology are connected, e.g. a similar approach is used in the foam blowing and sound-proof windows sectors for estimation of actual emissions, and thus the approach is described in one joint chapter. More detailed information on the data and methodology used are included in a special study prepared by the external partners Řeháček and Michálek in 2008 (Řeháček and Michálek, 2008).

The most important category in view of actual emissions is Refrigeration and Air Conditioning Equipment, which is responsible for 83 % of actual F-gases emissions.

4.6.3.1 Refrigeration and Air Conditioning Equipment

In the CRF Tables, emissions from this category are divided into only two sub-categories: *2IIAF11 Domestic Refrigeration* and *2IIAF16 Mobile Air-Conditioning*; emissions from other subcategories are also included in these two categories, because of lack of detailed information.

Emissions from *Mobile Air-Conditioning* include mainly emissions from the "First-Fill" in two Czechs car factories and from the relatively small amount used for servicing old equipment. The calculation was performed using Equation 3.44 from 2000 GPG; recently, has been assumed that emissions from disposal and destruction are negligible because of the relatively short time of use of F-gases in this sector. This fact is also endorsed by the information on disposed refrigerants (Řeháček and Michálek, 2007). The contribution of this sector to the total actual F-gases emissions was 6.5 % in 2006. It can be anticipated that emissions from this category will increase in the future.

Emissions from *Domestic Refrigeration* include emissions from servicing old equipment and emissions from production new air-conditioning equipment since 2007. The calculation is performed using the Tier 2 top-down approach methodology (Equation 3.40 from 2000 GPG); recently it has been assumed that emissions from removal from use and destruction are negligible because of the relatively short time of use of F-gases in this sector (Řeháček and Michálek, 2008). This sector have the highest share on the total actual emissions of F-gases, which equaled 89.6 % in 2007.

4.6.3.2 Foam Blowing and Production of Sound-Proof Windows

F-gases are used in the Czech Republic only for producing hard foam. Only HFC-143a is used regularly for foam blowing. HFC-227ea and HFC-245ca were used once for testing purposes. SF_6 is used for production of sound-proof windows. Emissions from these different categories are calculated in a similar way. The default methodology and EF described in 2000 GPG are used for sound-proof windows, specifically Equations 3.24 and 3.35. Similar equations are used for foam blowing. The share of these sectors in the total emissions of F-gases equalled 0.2 and 0.5 %, respectively, in 2007.

4.6.3.3 Fire Extinguishers

Emission from this category is calculated on the basis of GPG 2000. Calculations are based on data about production of new equipment and data about service of old equipment. The share of this sector in the total actual F-gases emissions was 1.6 % in 2007.

4.6.3.4 Aerosols / Metered Dose Inhalers and Solvents

Emissions from these categories (*2F4 Aerosols / Metered Dose Inhalers* and *2F5 Solvents*) are based on 2000 GPG and Equation 3.35; EF equals 50 %. The contribution of these sectors to the total actual F-gases emissions equalled 3.0 and 0.3 %, respectively, in 2007.

4.6.3.5 Semiconductor Manufacture

Actual emissions from this category are calculated on the basis of Tier 1 methodology. Emissions from this category correspond to 1.0 % of the total actual 2007 emissions of F-gases. The percentage shares in previous years were higher, but decreased mainly because of a decrease in use of F-gases in this category. No data are available for more precise emission calculations and this category is not very important.

4.6.3.6 Electrical Equipment

Emissions from this category are calculated according to 2000 GPG, specifically Equation 3.13., which is called the Tier 3a method. Basic data about new equipment and services can be obtained from above mentioned questionnaires. This equipment is produced by only one company and is serviced by several companies. Emissions from this category correspond to 3.8 % of the total actual emissions of F-gases in 2007. The share of this category in the total actual emissions has decreased rapidly since 1995 due to a decrease in the use of SF_6 in this sector and increase in the use of HFCs in refrigeration.

4.6.3.7 Others

This category includes the *2F9 Other / Laboratories* category. This category was included in the 2006 submission for the first time and encompasses emissions of SF_6 from laboratory use. The amount of F-gases in 2007 was not identified in this category. Potential and actual emissions are calculated in the same way in this sector.

4.6.4 Uncertainty and time consistency

The uncertainty estimates were based on expert judgment (see Tab. 1.3 in Chapter 1). Their improvement is ongoing and is planned for inclusion in the next NIR.

Time series consistency is ensured as the inventory approaches concerned are employed identically across the whole reporting period from the base year 1990 to 2006.

4.6.5 QA/QC and verification

Verification has been performed by comparison of data received from the customs authorities, from submitted questionnaires and from reports of important importers and/or exporters to MoE. Methodology and calculations are performed independently two times and compared. This comparison find some slight EF fault for SF_6 emissions.

4.6.6 Recalculations

Recalculations and Tier 2 application were performed in the 2006 submission and information is provided (CHMI 2006). In 2006, the potential approach was supplemented by actual calculations.

4.6.7 Source-specific planned improvements

In the future, it is planned that data will be obtained about the lifetime of refrigeration and air-conditioning equipment. It is also planned to perform an uncertainty assessment.

In the current situation, only emissions from bulk import and export are calculated and reported; an inventory of F-gases in products is under preparation. First result were already published (Karbanová, 2008 and Vacková and Vácha, 2008), but it is necessary to continue, verify data sources, methodology, results and prepare whole time-series estimates.

4.7 Acknowledgement

The authors would like to thank representatives form the Czech Ministry of the Environment, Department of Climate Change, Unit of Emission Trading for providing EU ETS data.

5 Solvent and Other Product Use (CRF Sector 3)

NMVOC emission shows a long-term decreasing trend. This is caused by many factors, the chief of which are primarily gradual replacement of synthetic coatings and other agents with a high content of volatile substances by water-based coatings and other preparations with low solvent contents in industry and amongst the population. In addition, BAT have been introduced in large industrial sources, especially those covered by the regime of Act No. 76/2002 Coll., on integrated prevention (IPPC). This favourable trend has been slowed down recently by increasing domestic production, especially in the automobile industry.

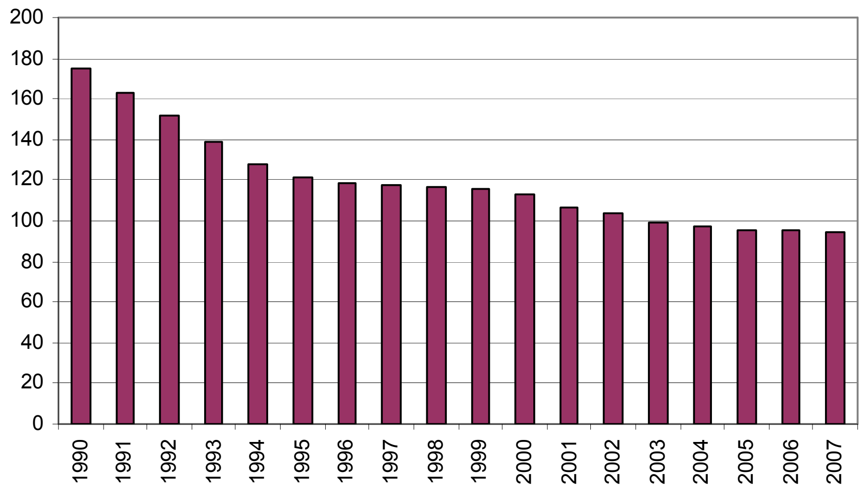

Fig. 5.1 Trend of NMVOC emissions from Solvent and Other Product Use *[Gg NMVOC]*

5.1 Source category description

This category includes particularly emissions of NMVOC (ozone precursor) from the use of solvents, which are simultaneously considered to be a source of CO_2 emissions (these solvents are mostly obtained from fossil fuels), as their gradual oxidation in the atmosphere is also a factor. However, the use of solvents is not an important source of CO_2 emissions - in 2007, CO_2 emissions were calculated at the level of 0.298 Mt CO_2.

This category (Solvent and Other Product Use) also includes N_2O emissions from its use in the food industry and in health care. These not very significant emissions corresponding to 0.69 Gg N_2O were derived from production in the Czech Republic.

In the Czech Republic, no relevant data are available to distinguish between N_2O used in anaesthesia and for aerosol cans. Therefore, the existing split (50% share for anaesthesia) was based only on a rough estimate.

Our new suggestion of this distinction, 23.5 % contribution from anaesthesia, is based on analogy with two neighbour countries: Austria (24.5% anaesthesia) and Slovakia (22.6% anaesthesia). After consultations with the relevant industrial experts, a decision will be made about possible recalculation in the next submission.

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5.2 Methodological aspects

The IPCC methodology (Revised 1996 IPCC Guidelines, 1997) uses the CORINAIR methodology (EMEP / CORINAIR Guidelines, 1999) for processing NMVOC emissions in this category. This manual also gives the following conversions for the relevant activities, which can be used in conversion of data from the CORINAIR (i.e. SNAP) structure to the IPCC classification.

Tab. 5.1 Conversion from SNAP into IPCC nomenclature

SNAP	SOLVENT AND OTHER PRODUCT USE	IPCC	
06 01	Paint application Items 06.01.01 to 06.01.09	3A	Paint application
06 02	Degreasing, dry cleaning and electronic Items 06.02.01 to 06.02.04	3B	Degreasing and dry cleaning
06 03	Chemical products manufacturing or processing. Items 06.03.01 to 06.03.14	3C	Chemical products
06 04	Other use of solvents + related activities Items 06.04.01 to 06.04.12	3D	Other
06 05	Use of N_2O Items 06.06.01 to 06.06.02	3D	Other

Inventory of NMVOC emissions for 2007 for this sector is based on a study prepared by SVÚOM Ltd. Prague (Geimplová and Thürner, 2008). This study is elaborated annually for the UNECE / CLRTAP inventory in NFR and is also adopted for the National GHG inventory.

Solvent Use chapter is based on the following sources of information:

- statistical information on producers and imports from the Czech Statistical Office,
- REZZO data,
- annual reports of the Association of Coatings Producers and Association of Industrial Distilleries,
- information from the Customs Administration.
- regular monitoring of economic activities and economic developments in the CR, knowledge and monitoring of important operations in the sphere of surface treatments, especially in the area of application of coatings, degreasing and cleaning;
- regular monitoring of investment activities is performed in the CR for technical branches affecting the consumption of solvents and for overall developmental technical trends of all branches of industry;
- monitoring of implementation of BAT in the individual technical branches;
- technical analysis of consumption of solvents in households; NMVOC emissions from households are entirely fugitive and, according to qualified estimates, contribute 16.5 % to total NMVOC emissions.

The activity data used in the individual categories and subcategories vary considerably. Basic processing of data is performed in a more detailed classification than that used in the CRF Reporter. A survey of the individual groups of products and the formats of the activity data for basic processing of emission data are apparent from the following survey.

It is apparent from the Tab. 5.2 that uniform expression of the activity data cannot be employed, as this corresponds in the individual cases to consumption of coatings, degreasing agents, solvents and, in some cases, the weight of the final production, e.g. Dry Cleaning. Consequently, total NMVOC emissions are employed as activity data in the CRF Reporter.

NMVOC emissions oxidize relatively rapidly in the atmosphere, so that CO_2 emissions generated as a consequence of this atmospheric oxidation are also reported in CRF. The CO_2 emissions are calculated using a conversion factor that contains the ratio C/NMVOC = 0.855 and a recalculation ratio of C to CO_2 equal to 44/12. The overall conversion factor has a value of 3.14.

Tab. 5.2 Structure for basic processing of emission data and the dimensions of activity data

A Paint Application	**EF - units**
PAINT APPLICATION - MANUFACTURE OF AUTOMOBILES	10^3 m^2
PAINT APPLICATION - CAR REPAIRING	t of paint
PAINT APPLICATION - CONSTRUCTION AND BUILDINGS	t of paint
PAINT APPLICATION - DOMESTIC USE	t of paint
PAINT APPLICATION - COIL COATING	10^3 m^2
PAINT APPLICATION - WOOD	t of paint
OTHER INDUSTRIAL PAINT APPLICATION	t of paint
OTHER NON INDUSTRIAL PAINT APPLICATION	t of paint
B Degreasing and Dry Cleaning	
METAL DEGREASING	t
DRY CLEANING	t
ELECTRONIC COMPONENTS MANUFACTURING	t
OTHER INDUSTRIAL CLEANING	t
C Chemical Products Manufacture / Processing	
POLYESTER PROCESSING	t
POLYVINYLCHLORIDE PROCESSING	t
POLYSTYRENE FOAM PROCESSING	t
RUBBER PROCESSING	t
PHARMACEUTICAL PRODUCTS MANUFACTURING	t
PAINTS MANUFACTURING	t
INKS MANUFACTURING	t
GLUES MANUFACTURING	t
ADHESIVE MANUFACTURING	t
ASPHALT BLOWING	t
TEXTILE FINISHING	10^3 m^2
LEATHER TANNING	10^3 m^2
D Other	-

5.3 Uncertainty and time consistency

The uncertainty estimates have not yet been reported. Their implementation is ongoing and is planned for inclusion in the following NIR.

Time series consistency is ensured as the inventory approaches concerned are employed identically across the whole reporting period from the base year 1990 to 2007.

5.4 QA/QC and verification

The emission data in this section were taken from the UNECE / CLRTAP inventories in NFR. Annual reports are available on the method of calculation for the individual years from 1998. Following transfer of the emission data to the new CRF Reporter, it was apparent that trends in the emissions for all of Sector 3 – Solvent and Other Product Use – did not exhibit any significant deviations.

A control was performed of the company processing the data (SVÚOM Ltd. Prague) and the coordinator of processing of UNECE / CLRTAP inventories in NFR. It was found that more exact data were available to 2000, permitting assignment of consumption of the individual types of solvents and other preparations containing NMVOC to individual subcategories, from which the emissions are calculated in 4 main subcategories of *Sector 3 Solvent and Other Product Use*. As the total consumption of substances containing NMVOC in all of CR is relatively well known, from 2000 the emissions that could not be identified in the individual subcategory *3B Decreasing and Dry Cleaning* were transferred to *Category 3D Other Solvent Use*, because they were missing in the overall balance.

5.5 Recalculations

No recalculations are applicable for this year.

5.6 Source-specific planned improvements

The results of the QA/QC procedures lead to the conclusion that it will be advantageous in the near future to perform slight correction of the data from 1990.

6 Agriculture (CRF Sector 4)

6.1 Overview of sector

Agricultural greenhouse gas emissions under Czech national conditions consist mainly of emissions from enteric fermentation (CH_4 emissions only), manure management (CH_4 and N_2O emissions) and agricultural soils (N_2O emissions only). The other IPCC subcategories – rice cultivation, prescribed burning of savannas, field burning of agricultural residues and "other" – do not occur in the Czech Republic.

Methane emissions are derived from animal breeding. These are derived primarily from enteric fermentation (digestive processes), which is manifested most for ungulate animals (in this country mostly cattle). Other emissions are derived from fertilizer management, where methane is formed under anaerobic conditions (with simultaneous formation of ammonia which, however, is not monitored in the framework of greenhouse gas inventories).

Nitrous oxide emissions are formed mainly by nitrification-denitrification processes in soils. The anthropogenic contribution that is determined in the national inventory of greenhouse gases is caused by nitrogenous substances derived from inorganic nitrogen-containing fertilizers, manure from animal breeding and nitrogen contained in parts of agricultural crops that are returned to the soil (for example, in the form of straw together with manure, or that are ploughed into the soil). In addition, emissions are also included from stables and fertilizer management and indirect emissions derived from atmospheric deposition and from nitrogenous substances flushed into water courses and reservoirs.

6.1.1 Key categories

For Agriculture, five of six relevant categories of sources were evaluated by a new analysis (accordingly the UNFCCC secretariat and the IPCC *Good Practice Guidance for LULUCF*, 2003) as the *key categories*. However, categories 4B and 4D2 were identified as *key categories* only by trend assessment - *for the first* time and yielded values just over the borderline between *key* and non-*key categories*. An overview of sources, including their contribution to aggregate emissions, is given in Tab. 6.1.

Tab. 6.1 Overview of significant categories in this sector (2007)

Category		Character of category	Gas	% of total GHG*
4D1	Agricultural soils, direct emissions	KC (LA, TA, LA*, TA*)	N_2O	1.7
4A	Enteric fermentation	KC (LA, TA, LA*, TA*)	CH_4	1.6
4D3	Agricultural soils, indirect emissions	KC (LA, TA, LA*, TA*)	N_2O	1.2
4B	Manure management	KC (TA, TA*)	CH_4	0.3
4D2	Pasture, range and paddock manure	KC (TA)	N_2O	0.2
4B	Manure management	non-KC	N_2O	0.2

* assessed without considering LULUCF

KC: key category, LA, LA*: identified by level assessment with and without considering LULUCF, respectively

TA, TA*: identified by trend assessment with and without considering LULUCF, respectively

6.1.2 Quantitative overview

Agriculture is the third largest sector in the Czech Republic with 5.3 % of total GHG emissions (including land-use change and forestry) in 2007 (7 838 Gg $CO_{2\ eq.}$); approximately 59 % (4 624 Gg $CO_{2\ eq.}$) of emissions is coming from Agricultural Soils. From 1990 to 2007 emissions from

Agriculture decreased by 50 %. The quantitative overview and emission trends during the period 1990-2007 are provided in Tab. 6.2 and Fig. 6.1.

The trend series are consistent both for methane and for nitrous oxide. For methane, the decrease in emissions for enteric fermentation since 1990 is connected with the decrease in the numbers of animals (especially cattle) while the decrease in emissions derived from manure (especially swine manure) is not as great, as there has been a smaller decrease in the number of head of swine. It would seem that conditions have partly stabilized somewhat in agriculture since 1994.

Tab. 6.2 The emissions from the Agriculture sector by subcategories in the 1990-2007 period *[Gg $CO_{2\ eq.}$]*

Year	Total Emissions	Enteric Fermentation *(4A)*	Manure Management *(4B)*	Agricultural Soils *(4D)*
1990	15467.44	4869.50	1699.75	8898.20
1991	13714.07	4587.79	1633.82	7492.46
1992	11952.29	4111.38	1502.85	6338.06
1993	10445.45	3556.47	1380.58	5508.40
1994	9641.51	3114.53	1212.50	5314.48
1995	9579.73	3032.24	1149.32	5398.16
1996	9173.83	3003.74	1156.47	5013.63
1997	9003.53	2801.94	1124.26	5077.34
1998	8593.94	2627.34	1072.65	4893.94
1999	8601.55	2683.38	1065.34	4852.82
2000	8387.14	2577.06	1007.05	4803.03
2001	8587.08	2595.87	1000.11	4991.10
2002	8352.94	2534.90	960.03	4858.01
2003	7771.76	2468.19	931.90	4371.66
2004	8037.49	2389.81	886.83	4760.86
2005	7764.64	2393.46	852.96	4518.22
2006	7669.69	2348.67	842.45	4478.57
2007	7837.74	2371.72	841.70	4624.32

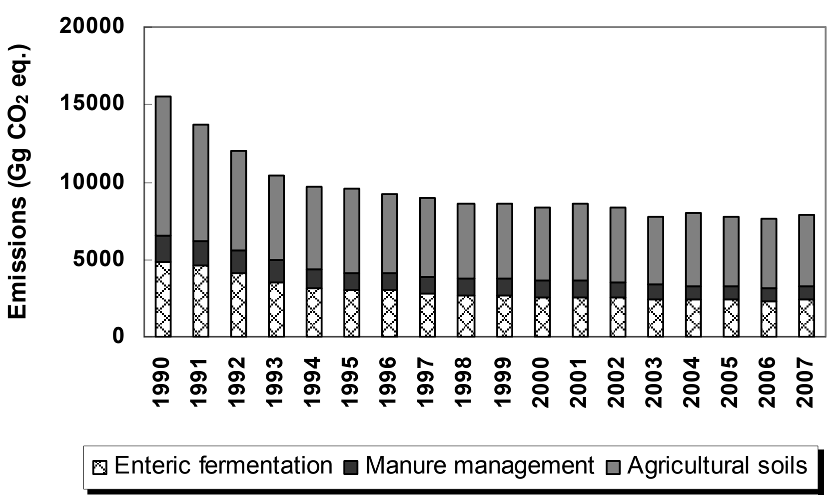

Fig. 6.1 The emission trend in agricultural sector during reporting period 1990 – 2007 (in Gg $CO_{2\ eq.}$)

6.2 Enteric fermentation (4A)

6.2.1 Source category description

This chapter describes estimation of the CH_4 emissions from *Enteric Fermentation*. In 2007, 82.9 % of agricultural CH_4 emissions arose from this source category (the relevant values are given in Tab. 6.2).

This category includes emissions from cattle (dairy and non-dairy cattle), swine, sheep, horses and goats. Buffalo, camels and llamas, and mules and asses do not occur in the Czech Republic. Enteric fermentation emission from poultry has not been estimated, the IPCC Guidelines do not provide a default emission factor for this animal category.

6.2.2 Methodological issues

Emissions from enteric fermentation of domestic livestock have been calculated by using IPCC Tier 1 and Tier 2 methodologies presented in the Revised IPCC Guidelines (IPCC 1997) and IPCC Good Practice Guidance (IPCC 2000). Methane emissions for cattle, which are a dominant source in this category, have been calculated using the Tier 2 method, while for other livestock the Tier 1 method was used. The contribution of emissions from livestock other than cattle to the total emissions from enteric fermentation is not significant.

6.2.2.1 Enteric fermentation of cattle

As the most important output of the national study (Kolar. Havlikova and Fott. 2004), a system of calculation spreadsheets have been developed and used for all the relevant calculations of CH_4 emissions.

The emission factor for methane from fermentation (EF) in kg/head p.a. according to the (*Revised 1996 IPCC Guidelines,* 1997) and (*Good Practice Guidance,* 2000) is proportional to the daily food intake and the conversion factor. It thus holds that

$$EF_i = 365 / 55.65 * \text{daily food intake}_i * Y .$$

where the "daily food intake" (MJ/day) is taken as the mean feed ration for the given type of cattle (there are several subcategories of cattle) and Y is the conversion facto, which is considered to be Y = 0.06 for cattle. Coefficient 55.65 has dimensions of MJ/kg CH_4.

In principle, this equation should be solved for each cattle subcategory, denoted by index i. The Czech Statistical Office, see (*Statistical Yearbooks*. 1990 – 2007), provides following categorization of cattle:

- Calves younger than 6 months of age
- Young cattle 6 – 12 months of age (young bulls, young heifers)
- Bulls over 1 year of age. including bullocks (1 – 2 years, over 2 years)
- Heifers 1 – 2 years of age
- Heifers over 2 years of age
- Cows

More disaggregated sub-categories given above in parenthesis are given in the study by external agricultural consultants of CHMI (Hons and Mudrik, 2003). In the calculation, it is also very important to distinguish between dairy and sucker cows (nursing cows), where the fraction of sucker cows (sucker cows/all cows) gradually increased in the 1990–2006 time period see (Hons and Mudrik, 2003).

According to the IPCC methodology, Tier 2 (*Revised 1996 IPCC Guidelines,* 1997 and *Good Practice Guidance,* 2000), the "daily food intake" for each subcategory of cattle is not measured directly, but is calculated from national zoo-technical inputs, mainly weight (including the final weight of mature animals), weight gain (for growing animals), daily milk production including the percentage of fat (for cows) and the feeding situation (stall, pasture). The national zoo-technical inputs (noted above) were updated by expert from the Czech University of Agriculture in Prague in 2006. Examples of input data used (Hons and Mudrik, 2003, Mudrik and Havranek, 2006) are given below, Tab. 6.3 - Tab. 6.5.

Tab. 6.3 Weights of individual categories of cattle, 1990 – 2007, in kg

Categories of cattle	1990 - 1994	1995 - 1998	1999 - 2004	2005 - 2007
Mature cows (dairy and sucker)	520	540	580	585
Heifers > 2 years	485	490	505	510
Bulls and bullocks > 2 years.	750	780	820	840
Heifers 1-2 years	380	385	395	395
Bulls 1-2 years	490	510	530	540
Heifers 6-12 months	275	280	285	285
Bulls 6-12 months	325	330	335	340
Calves to 6 months	128	132	133	135

Tab. 6.4 Weight gains of individual categories of cattle, 1990 – 2007, in kg / day

Categories of cattle	1990 - 1994	1995 - 1998	1999 - 2004	2005 - 2007
Heifers 1-2 years	0.69	0.74	0.73	0.83
Bulls 1-2 years	0.74	0.76	0.84	0.84
Heifers 6-12 months	0.55	0.63	0.70	0.70
Bulls 6-12 months	0.82	0.94	1.12	1.12
Calves to 6 months	0.58	0.62	0.68	0.68

Tab. 6.5 Feeding situation, 1990 – 2007, in % of pasture, otherwise stall is considered

Categories of cattle	1990 - 1994	1995 - 1998	1999 - 2004	2005 - 2007
Mature cows (dairy and sucker)	10	20	20	22
Heifers > 2 years	30	30	30	35
Bulls and bullocks > 2 years	30	40	40	40
Heifers 1-2 years	30	40	40	40
Bulls 1-2 years	30	40	40	40
Heifers 6-12 months	30	40	40	40
Bulls 6-12 months	30	40	40	40

Percentages of pasture are related only to the summer part of the year (180 days), while only the stall type is used in the rest of year. Milk production statistics are displayed in Tab. 6.6, in which only milk from dairy cows is considered. The daily milk production increased to 18.08 liters/day/head in 2007, with an average fat content of 3.90 %. Milk from sucker cows is not included in this table; a relevant daily milk production of 3.5 l /day head was used for the calculation.

As the official statistics (specifically from the Czech Statistical Office) provide population values for cows and other cattle, the resulting EFs in the CRF Tables are defined for the categories of "all cows" and "cattle other than cows", even though the relevant cells in the CRF are denoted as "dairy cows" and "other cattle".

Details of the calculation are given in the above-mentioned study (Kolar, Havlikova and Fott, 2004) and the results are illustrated in Tab. 6.7. It is obvious that EFs have increased slightly since 1990 because of the increasing weight and milk production for cows and because of the increasing weight and weight gain for other cattle. It is remarkable that default values for Western Europe were attained in the mid nineties (100 and 48 kg CH_4/head p.a.). On the other hand, CH_4 emission form enteric fermentation of cattle dropped during the 1990 – 2007 period to about one half of the former values due to the rapid decreases in the numbers of animals kept.

Tab. 6.6 Milk production of dairy cows, 1990 – 2007

	Dairy cows *[thousands]*	Milk production *[thousands liters per year]*	Daily production *[liters / day head]*	Fat content *[%]*
1990	1206.0	4 695 770	10.67	4.03
1991	1165.0	4 096 310	9.63	4.09
1992	1006.1	3 720 648	10.13	4.07
1993	902.0	3 349 971	10.18	4.10
1994	796.1	3 133 907	10.79	4.04
1995	732.1	3 031 091	11.34	4.02
1996	712.6	3 039 290	11.69	4.08
1997	656.3	2 703 493	11.29	4.02
1998	598.4	2 716 317	12.44	4.05
1999	583.3	2 736 226	12.85	4.03
2000	547.7	2 708 119	13.55	4.00
2001	528.7	2 701 761	14.00	4.03
2002	495.7	2 727 578	15.08	3.98
2003	489.7	2 646 000	14.80	3.98
2004	475.6	2 569 759	14.80	3.98
2005	437.9	2 739 000	17.13	3.90
2006	426.0	2 713 300	17.45	3.90
2007	412.0	2 718 870	18.08	3.90

Tab. 6.7 Methane emissions from enteric fermentation, cattle (Tier 2), 1990 – 2007

	Cows *[thousands]*	Other *[thousands]*	EF. cows *[kg CH_4 / hd]*	EF. other *[kg CH_4 / hd]*	Em. cows *[Gg CH_4]*	Em. other *[Gg CH_4]*	Emissions *[Gg CH_4]*
1990	1236	2296	96.01	44.38	118.7	101.9	220.6
1991	1195	2165	92.16	44.98	110.1	97.4	207.5
1992	1036	1914	93.95	46.08	97.3	88.2	185.5
1993	932	1580	94.20	45.61	87.8	72.1	159.9
1994	830	1331	96.04	45.36	79.7	60.4	140.1
1995	768	1262	99.84	47.58	76.7	60.1	136.7
1996	751	1238	101.38	47.86	76.1	59.2	135.4
1997	702	1164	99.04	48.35	69.5	56.3	125.8
1998	647	1054	103.27	48.36	66.8	51.0	117.8
1999	642	1015	107.09	50.99	68.8	51.8	120.5
2000	615	960	108.76	51.13	66.9	49.1	116.0
2001	611	971	109.52	51.47	66.9	50.0	116.9
2002	596	924	111.42	51.87	66.4	47.9	114.3
2003	590	884	110.42	52.14	65.2	46.1	111.2
2004	573	855	110.43	52.03	63.3	44.5	107.8
2005	574	823	114.41	51.55	65.7	42.4	106.8
2006	564	810	114.95	50.72	64.8	41.1	104.7
2007	565	827	115.33	50.39	65.2	41.7	106.7

6.2.2.2 Enteric fermentation of other livestock

Compared to cattle, the contribution of other farm animals to the whole CH_4 emissions from enteric fermentation is much smaller, only about 5 %. Therefore, CH_4 emissions from enteric fermentation of other farm animals (other than cattle) are estimated by the Tier 1 approach. Because of some features of keeping livestock in the Czech Republic that are similar to the neighbouring countries of Germany and Austria, default EFs for Tier 1 approaches recommended for Western Europe were employed. The obsolete national approach used in the past, which was found not to be comparable with other European countries (Dolejš, 1994 and Jelínek *et al*. 1996), was definitively abandoned. The recalculated values are presented for the whole period since 1990.

6.2.3 Time-series consistency

As mentioned above, methane emissions from the breeding of farm animals are caused both by enteric fermentation and also by the decomposition of animal excrements (manure). Determination of these emissions was prepared at the level of both Tier 1 and Tier 2. As enteric fermentation is considered according to Tab. 6.1 to constitute a *key source*, preference should be given to determination in Tier 2.

For quite a long time, calculations were based on historical studies (Dolejš, 1994) and (Jelínek *et al*, 1996). In principle, emissions from animal excrements could be calculated according to Tier 1 (this is not a *key source*); however, because of tradition and for consistency of the time series, the final values were also calculated according to Tier 2 using the emission factors from above-mentioned studies (Dolejš, 1994; Jelínek et al, 1996). An approach based on historical studies was indicated to be obsolete in many reviews organized by UNFCCC. Moreover, IEFs (implied emission factors) were mostly found as outliers: especially EFs for enteric fermentation in cattle seemed to be substantially underestimated. Details of the historical approach are given in former NIRs (submitted before 2006).

The Czech team accepted critical remarks put forth by the International Review Teams (ERT) and prepared a new concept for calculation of CH_4 emissions. This concept, in accordance with the plan for implementing Good Practice, is based on the following options:

1) Emissions of methane from enteric fermentation of livestock (a *key source*) come predominantly from cattle. Therefore Tier 2, as described in Good Practice (*Good Practice Guidance*, 2000) is applied only to cattle.
2) CH_4 emissions from enteric fermentations of other farm animals are estimated by the Tier 1 approach. Because of some features of keeping livestock in the Czech Republic that are similar to the neighbouring countries of Germany and Austria, default EFs for Tier 1 approaches recommended for Western Europe were employed.

Increased attention was first paid to enteric fermentation. It was stated that cooperation with specialized agricultural experts is crucial to obtain new consistent and comparable data of suitable quality. The relevant nationally specific data, milk production, weight, weight gain for growing animals, type of stabling, etc. were collected by our external experts (Hons and Mudrik, 2003). Moreover, statistical data for sufficiently detailed classification of cattle, which are available in the Czech Republic, were also collected at the same time. Calculation of enteric fermentation of cattle using the Tier 2 approach was described in a study (Kolar, Havlikova and Fott, 2004) for the whole time series since 1990 using the above-mentioned country-specific data. The necessary QA/QC procedures were performed in cooperation with experts from IFER.

6.2.4 Source-specific QA/QC and verification

In the process of implementation of the Good Practice (*Good Practice Guidance*, 2000) increased attention was first paid to enteric fermentation, which has led to a decision to revise the existing method of determination methane emissions. It was stated that cooperation with specialized agricultural experts is crucial to achieve new consistent and comparable data of the proper quality. As explained in the beginning of this chapter, the traditional but obsolete approach was found to be unacceptable. Furthermore, recalculations of CH_4 emissions from Agriculture were also recommended by several recent Review Reports under the UNFCCC review process for National GHG inventories.

Consequently, it was decided to revise the entire procedure for calculation of methane emissions from livestock in accordance with the *Good Practice Guidance*. Recently, such an approach (Tier 2) has been employed for recalculating enteric fermentation of cattle in a study by the authors (Kolar, Havlikova and Fott, 2004), who have compiled new emission estimates for the whole 1990-2003 period using nationally specific data collected by our external experts (Hons and Mudrik, 2003). Other methane emissions from Agriculture were also recalculated by Tier 1 methods and reported this year as a part of the 2006 submission using the new CRF Reporter.

The nationally specific data like weight of individual categories of cattle, weight gains of these categories and recent feeding situation were revised in 2006. The new values were estimated in a similar way by our external experts (Mudrik and Havranek, 2006) for the next period.

A more detailed QA/QC program of agricultural inventory is currently under development.

QC applied for *Enteric Fermentation* Tier 2 for activity data and emission factors.

QA/QC plans for the agricultural sector include the following Tier 2 QC measures for activity data and emission factors. These measures are implemented every year during the agricultural inventory. Potential errors are documented and corrections are made if necessary.

QA/QC plans for activity data include checking all important animal categories, checking that data sources of all animal numbers are properly documented and checking the consistency in animal numbers between agricultural statistics and the calculation model.

QA/QC plans for emission factors include checking that correct emission factors are used for each animal category, checking that the source and magnitude of all emission factors are properly documented and checking that emission factors are calculated correctly.

Apart from official review process, emission inventory methods and results are internally reviewed among the technical experts involved in the emission inventory of the sectors Agriculture and LULUCF. The input information and calculations are archived by the expert team and the coordinator of NIR. Hence, all the background data and calculations are verifiable.

6.2.5 Recalculations

The units (liters/day/dairy cattle population) of milk production were converted to the required units (liters/day/head) for the entire reported period of 1990-2007 in 4.A. CRF Tables.

Two corrections were made in the values of 4.A/Non-dairy cattle/Average gross energy intake CRF Tables in 2005 and 2006.

No other recalculations have been performed.

6.2.6 Planned improvements

The relevant QA/QC procedures for agriculture will be implemented in accordance with the general QA/QC plan given in Chapter 1. To achieve improvements in the future, the NIS team plans to implement the Revised 2006 IPCC Guidelines as soon as they are approved and launched. The NIS team believes that the new methodology helps to better identify and address existing gaps.

The analysis of uncertainties is currently in progress; the results would be available in the next submission.

6.3 Manure management (4B)

This chapter describes the estimation of CH_4 and N_2O emissions from animal manure. In 2007, 17.1 % of agricultural CH_4 emissions and 7 % of agricultural N_2O emissions were caused by this source category.

6.3.1 Source category description

From 1990 to 2007, emissions from *Manure Management* decreased by 10.7 % to 842 Gg CO_2 eq. Emissions from cattle and swine dominate the trend. The reduction in the cow population is partly counterbalanced by an increase in cow efficiency (increasing gross energy intake and milk production).

This emission source covers manure management of domestic livestock. Both nitrous oxide (N_2O) and methane (CH_4) emissions from manure management of livestock (cattle, swine, sheep, horses, goats and poultry) are reported. The animal waste management systems (AWMS) are distinguished for N_2O emission estimations: liquid system, daily spread, solid storage&dry lot and other manure management systems. Nitrous oxide is produced by the combined nitrification-denitrification processes occurring in the manure nitrogen. Methane is produced in manure during decomposition of organic material by anaerobic and facultative bacteria under anaerobic conditions. The amount of emissions is dependent e.g. on the amount of organic material in the manure and climatic conditions.

Tab. 6.8 The emissions from *Manure Management* in the 1990-2007 period.

Year	Emissions from *Manure Management*			
	CH_4 emissions		N_2O emissions	
	[Gg CH_4]	[Gg CO_2 eq.]	[Gg N_2O]	[Gg CO_2 eq.]
1990	48.07	1009.44	2.23	690.30
1991	46.14	969.03	2.14	664.79
1992	42.31	888.58	1.98	614.27
1993	38.61	810.73	1.84	569.85
1994	33.83	710.53	1.62	501.97
1995	32.07	673.44	1.54	475.88
1996	32.22	676.64	1.55	479.83
1997	31.26	656.39	1.51	467.87
1998	29.74	624.48	1.45	448.18
1999	29.49	619.30	1.44	446.04
2000	27.88	585.53	1.36	421.52
2001	27.72	582.08	1.35	418.03
2002	26.60	558.52	1.30	401.52
2003	25.80	541.76	1.26	390.14
2004	24.57	516.03	1.20	370.80
2005	23.64	496.48	1.15	356.49
2006	23.35	490.25	1.14	352.20
2007	23.35	490.30	1.13	351.40

6.3.2 Methodological issues

6.3.2.1 Methane emissions

CH_4 emissions from manure management were identified as a *key source* only by trend assessment (TA); hence these emissions for all farm animals are estimated by the Tier 1 approach. Default EFs for Western Europe were employed for similar reasons as in the previous paragraph (Tab. 6.8). Similarly as for enteric fermentation, the obsolete national approach used in the past was abandoned because of lack of comparability with other countries.

Tab. 6.9 IPCC default emission factors for assessment of CH_4 emissions from *Manure Management*

Livestock type	EF (kg/head/yr)
Dairy Cattle	14
Non-Dairy Cattle	6
Sheep	0.19
Goats	0.12
Horses	1.39
Swine	3
Poultry	0.078

6.3.2.2 N_2O emissions

N_2O emissions from manure management were identified as a *non-key source* and the Tier 1 methodology is used for emission estimation. N_2O emissions are calculated on the basis of N excretion per animal and waste management system. Following the guidelines, all emissions of N_2O taking place before the manure is applied to soils are reported under *Manure Management*. The IPCC Guidelines method for estimating N_2O emissions from manure management entails multiplying the total amount of N excretion (from all animal species/categories) in each type of manure management system by an emission factor for that type of manure management system (Tab. 6.10). The emissions are then summed over all the manure management systems.

Tab. 6.10 IPCC default N excretion values for livestock categories

Livestock type	Nitrogen Excretion Nex (kg/head/yr)	Type of AWMS				
		Liquid	Daily spread	Solid	Pasture	Other
		Fraction of Manure Nitrogen per AWMS (in %)				
Dairy Cattle	100	46	24	21	8	1
Non-Dairy Cattle	70	55	0	2	33	9
Sheep	20	0	0	2	87	11
Swine	20	77	0	23	0	0
Poultry	0.6	13	0	1	2	84
Horses	25	0	0	0	96	4
Goats	25	0	0	0	96	4

6.3.2.3 Emission factors

The emission factors for animal waste management systems (AWMS) - *Liquid, Solid Storage, Pasture/ Range/Paddock* and *Other Systems* - were taken from the IPCC guidelines (IPCC 1997, see Tab. 6.11).

Tab. 6.11 IPCC default values for N_2O emission factors from animal waste per animal waste management system

AWMS	Emission Factor (EF_3) (kg N_2O-N per kg N excreted)
Liquid	0.001
Solid Storage	0.02
Pasture/Range/Paddock	0.02
Other Systems	0.005

6.3.3 Time-series consistency

As mentioned above, methane emissions from the breeding of farm animals are caused both by enteric fermentation and also by the decomposition of animal excrements (manure). Determination of the second of them was prepared at the level Tier 1.

The Czech team accepted critical remarks put forth by the International Review Teams (ERT). A concept, in accordance with the plan for implementing Good Practice, is based on option, that CH_4 emissions from manure management for all farm animals are estimated by the Tier 1 approach. For similar reasons as in the previous paragraphs, the default emission factors for Western Europe were employed.

On the basis of the recommendations of the ERT, the estimation of manure management N_2O emissions from horses and goats is reported as two individual groups of animals (category *Other livestock* was regrouped to two categories), applying the IPCC Tier 1 method and the 1996 IPCC default values. The total emissions from the category "N_2O emissions from Manure Management" were not affected.

6.3.4 Source-specific recalculations and QA/QC

Apart from official review process, emission inventory methods and results are internally reviewed among the technical experts involved in the emission inventory of the sectors Agriculture and LULUCF. In relation to the consistency of the emission series for N_2O (manure management), it should be mentioned that emission estimates have been calculated in a consistent manner since 1996 according to the default methodology (*Revised 1996 IPCC Guidelines*, 1997). Emission estimates for 1990, 1992, 1994 and 1995 were obtained and reported in several recent years; the data for 1991 and 1993 were reported in 2004.

As for CH_4 from manure management, similar recalculations using the Tier 1 method has been undertaken for years 1990 – 2004 and for the first time presented in the 2006 submission.

QC applied for Manure management category Tier 1 for activity data and emission factors:

QA/QC plans for the agricultural sector include the following Tier 1 QC measures for activity data and emission factors. These measures are implemented every year during the agricultural inventory. Potential errors are documented and corrections are made if necessary.

QA/QC plans for activity data include

- checking all important animal categories are included
- checking data sources of all animal numbers and nitrogen excrection per animal are properly documented
- checking the consistency of time-series
- checking if there is new national data available for nitrogen excreted annually per animal and for estimating the distribution of different manure management systems

QA/QC plans for emission factors include checking if there is new national data available for emission factors and that source objectives for agricultural objectives have been set and documented.

6.3.5 Recalculations

The *Other livestock* sub-category was regrouped to two categories as required by ERT. Now the N_2O emissions from horses and goats are reported as emissions from two individual groups of animals, applying the IPCC Tier 1 method and the 1996 IPCC default values. The total emissions from the category of “N_2O emissions from Manure Management” were not affected.

No other recalculations were required for this category.

6.3.6 Planned improvements

Relevant QA/QC procedures for agriculture will be implemented in accordance with the general QA/QC plan given in Chapter 1. To achieve improvements in the future, the NIS team plans to implement the Revised 2006 IPCC Guidelines as soon as they are approved and launched. The NIS team believes that the new methodology helps to better identify and address existing gaps.

Currently, the analysis of uncertainties is in progress; the results would be available in the next submission.

6.4 Agricultural Soils (4D)

6.4.1 Source category description

This source category includes direct and indirect nitrous oxide emissions from agricultural soils. Both these categories (direct and indirect) of N_2O soil emissions are the *key sources* (Tab. 6.1). Nitrous oxide is produced in agricultural soil as a result of microbial nitrification-denitrification processes. The processes are influenced by chemical and physical characteristics (availability of mineral N substrates and carbon, soil moisture, temperature and pH). Thus, addition of mineral nitrogen in the form of synthetic fertilizers, animal manure applied to soils, crop residue, N-fixing crops enhance the formation of nitrous oxide emissions.

Nitrous oxide emissions from agriculture include these subcategories:

- direct emissions from agricultural soils (emissions from synthetic fertilizers, animal manure applied to soils, crop residue and N-fixing crops);
- emissions from pasture manure;
- indirect emissions coming from atmospheric deposition;
- indirect emissions from nitrogenous substances flushed into water courses and reservoirs.

In 2007, 59 % of total N_2O emissions from Agriculture originated from *Agricultural Soils*, while the rest originated from *Manure Management*. The trend in N_2O emissions from this category is decreasing: in 2007 emissions were 52 % below the base year level.

Tab. 6.12 presents the N_2O emissions of Agricultural soils by sub-category.

Tab. 6.12 N_2O emissions by category from *Agricultural Soils* (4D) in the 1990-2007 period (in Gg N_2O). Sub-categories a, b, c, d in the Table represent individual sources of direct emissions - (a) Synthetic fertilizers, (b) Animal manure applied to soils, (c) N-fixing crops and (d) Crop residue.

N_2O emissions from soils *[Gg N_2O]*								
Year	Total emissions	Direct emissions				Pasture Manure	Indirect emissions	
		a	b	c	d		Atmosph. deposition	Leaching
1990	28.70	7.39	4.99	0.15	2.22	2.28	1.94	9.74
1991	24.17	5.26	4.79	0.19	1.94	2.17	1.7	8.11
1992	20.45	4.00	4.40	0.20	1.63	1.90	1.47	6.85
1993	17.77	3.19	4.01	0.23	1.60	1.58	1.28	5.87
1994	17.14	3.59	3.52	0.16	1.68	1.34	1.19	5.66
1995	17.41	4.05	3.34	0.14	1.64	1.26	1.19	5.8
1996	16.17	3.36	3.36	0.14	1.65	1.22	1.12	5.33
1997	16.38	3.64	3.26	0.10	1.73	1.14	1.11	5.39
1998	15.79	3.59	3.11	0.13	1.65	1.03	1.07	5.2
1999	15.65	3.54	3.08	0.12	1.72	1.00	1.06	5.14
2000	15.49	3.77	2.91	0.09	1.60	0.95	1.04	5.14
2001	16.10	3.99	2.90	0.09	1.82	0.96	1.05	5.28
2002	15.67	4.02	2.78	0.07	1.68	0.91	1.03	5.19
2003	14.10	3.39	2.69	0.06	1.43	0.88	0.95	4.69
2004	15.36	3.83	2.56	0.09	2.18	0.86	0.96	4.88
2005	14.57	3.65	2.47	0.10	1.90	0.85	0.92	4.68
2006	14.45	3.80	2.43	0.09	1.58	0.85	0.93	4.76
2007	14.92	3.95	2.43	0.07	1.77	0.87	0.95	4.87

6.4.2 Methodological issues

Although nitrous oxide emissions from agriculture are key sources, emissions are estimated and analyzed by the Tier 1 approach of the IPCC methodology (*Revised 1996 IPCC Guideline*s, 1997). A set of interconnected spreadsheets in MS Excel has been used for the relevant calculations for several years. The emissions from nitrogen excreted to pasture range and paddocks by animals are reported under animal production in CRF table 4D2. The nitrogen from manure that is spread daily is consistently included in the manure nitrogen applied to soils.

6.4.2.1 Activity data

The standard calculation of Tier 1 required the following input information:

- the number of head of farm animals (dairy cows, other cattle, pigs, sheep, poultry, horses and goats),
- the annual amount of nitrogen applied in the form of industrial fertilizers
- the annual harvests of cereals and legumes.

All these data were taken from the Statistical Yearbooks of the Czech Republic (*Statistical Yearbooks*, 1990 – 2007). Other input data consists in the mass fraction $X_{i,j}$ of animal excrement in animal category i (i = dairy cows, other cattle, pigs, ...) for various types of excrement management (AWMS - Animal Waste Management System) j (j = anaerobic lagoons, liquid manure, solid manure, pasturage, daily spreading in fields, other). Here, it holds that $X_{i,1} + X_{i,2} + ... + X_{i,6} = 1$. For Tier 1, (*Revised 1996 IPCC Guidelines*, 1997) gives only the values of matrix X for typical means of management of animal excrement in Eastern and Western Europe. As we are aware that agricultural farming in the Czech Republic has not yet been classified according to this system, we performed the calculation for AWMS parameters presented in the IPCC methodology (*Revised 1996 IPCC Guidelines*, 1997) for the case of Western Europe. Nevertheless, collection of the relevant country specific AWMS parameters is under way and perhaps it will be possible to employ such an approach sometime in the future.

6.4.2.2 Emission factors and other parameters

IPCC default emission factors have been used for calculating N_2O emissions from agricultural soils. The emission factors for calculation of direct N_2O emissions from the agriculture soil category, direct emissions from atmospheric deposition and leaching were used according to Tab. 6.13.

Tab. 6.13 Emission factors (EFs) for the calculation of Agriculture/Agricultural Soils

	Emissions (sources)	Emission Factors
Direct emissions	Synthetic fertilizer	EF_1=0.0125 kg N_2O-N/kg N
	Animal Waste	
	N-fixing crops	
	Crop residue	
Pasture, range & paddock manure	Grazing animals	EF_3=0.02 kg N2O-N/kg N
Indirect emissions	Atmospheric Deposition	EF_4=0.01 kg N_2O-per kg emitted NH_3 and NO_x
	Nitrogen Leaching	EF_5=0.025 kg N_2O - per kg of leaching N

6.4.3 Time-series consistency

In relation to the consistency of the emission series for N_2O (agricultural soils), it should be mentioned that emission estimates have been calculated in a consistent manner since 1996 according to the default methodology (*Revised 1996 IPCC Guidelines*, 1997). Emission estimates for 1990, 1992, 1994 and 1995 were obtained and reported in several recent years; the data for 1991 and 1993 are reported (together with year 2004) this year as part of the 2006 submission.

The quantitative overview and emission trends during period 1990-2007 are shown in Table 6.2. The trend in N_2O emissions from agricultural soils is summarized in Table 6.11. From 1990 till 2007 the total emissions from agricultural soils decreased by 50 % (rapidly during period 1990-1995, about 40 %), direct emissions decreased by 45 % and indirect emissions by 50 %. More than 60 % reduction was reached in the animal production.

6.4.4 Source-specific QA/QC and verification

QA/QC plans for the agricultural sector include the QC measures based on guidelines of IPCC (IPCC 2000). These measures are implemented every year during the agricultural inventory. Potential errors and inconsistencies are documented and corrections are made if necessary. Apart from official review process, emission inventory methods and results are internally reviewed among the technical experts involved in the emission inventory of the sectors Agriculture and LULUCF.

QA/QC plans for the agricultural sector include the following Tier 1 QC measures for activity data. Potential errors and inconsistencies are documented and corrections are made if necessary. These measures are implemented every year during the agricultural inventory:

- checking of consistency in the amount of synthetic fertilizers (agricultural statistics)
- checking of all important animal categories are included
- checking of consistency of animal numbers (agricultural statistics)
- checking of data sources of nitrogen excreted annually per animal are well documented
- checking if there is new national data available on nitrogen excreted annually per animal
- checking if there is new national data available on distribution of different manure management systems
- checking of all important crop species are included for calculating N2O emissions from crop residues, from N-fixing crops respectively.

QC plans for emission factors include checking if there is new national data available for emission factors. Source specific quality objectives for the agricultural inventory have been set and documented. A more detailed QA/QC program of agricultural inventory is currently under development.

Following the ERT, the Czech emission inventory team verified the activity data required for this category and found that the previously reported data based on expert judgment of areas could not be confirmed and verified from the official statistics. According to the new expert common consensus (RNDr. I. Skorepova, Ing. P. Fott, CSc., Doc. Ing. E. Cienciala, PhD, Ing. Z. Exnerova), there are no cultivated histosols on agricultural land in this country and hence also no data for this category. Organic soils mostly occur on forest land and they are reported in the LULUCF sector.

6.4.5 Recalculations

No recalculations were performed in this submission.

The recalculations of 4.D.1.5 Cultivation of Histosols were performed in the previous 2008 submission. According to the new expert common consensus, there are no cultivated histosols on agricultural land in this country and hence also no data for this category.

6.4.6 Planned improvements

Relevant QA/QC procedures for agriculture will be implemented in accordance with the general QA/QC plan given in Chapter 1. To achieve improvements in the future, the NIS team plans to implement the Revised 2006 IPCC Guidelines as soon as they are approved and launched. The NIS team believes that the new methodology helps to better identify and address existing gaps, specifically in the area of emissions and removals of GHG from different kinds of soils.

Currently, the analysis of uncertainties is in progress; the results should be available in the next submission.

7 Land Use, Land-Use Change and Forestry (CRF Sector 5)

7.1 Overview

The emission inventory of the *5 Land Use, Land Use Change and Forestry* (LULUCF) sector includes emissions and removals of greenhouse gases (GHG) resulting from land use, land-use change and forestry. The inventory is based on application of the IPCC Good Practice Guidance for Land Use, Land-Use Change and Forestry (IPCC 2003, further also abbreviated as GPG for LULUCF) and the new reporting format adopted by the 9th Conference of Parties to UNFCCC. The application of GPG for LULUCF in the national emission inventory entails manifold new requirements on the inventory of the sector, which have been implemented gradually. The current inventory of the LULUCF sector represents an advanced phase of this revision. It employs further refinement of the system for land use identification at the level of the individual cadastral units, which was also utilized for determination of land-use changes. Apart from the refined land use and land-use change identification system, this inventory introduces additional methodological improvements and reflects the suggestions following from the latest reviews of the LULUCF emission inventory. Where feasible, the methodological elements from IPCC 2006 Guidelines for National Greenhouse Gas Inventories (IPCC 2006) for the Agriculture, Forestry and Other Land Use (AFOLU) were also used. Although the current submission will still undergo further development and consolidation, it already establishes a basis for providing the additional information on LULUCF activities required under the Kyoto protocol.

The current inventory includes CO_2 emissions and removals, and emissions of non-CO_2 gases (CH_4, N_2O, NO_X and CO) from biomass burned in forestry and disturbances associated with land-use conversion. The inventory covers all six major LULUCF land-use categories, namely *5A Forest Land, 5B Cropland, 5C Grassland, 5D Wetlands, 5E Settlements and 5F Other Land*, which were linked to the Czech cadastral classification of lands. The emissions and/or removals of greenhouse-gases are reported for all mandatory categories. The current submission covers the whole reporting period from the base year of 1990 to 2007 (Fig. 7.1).

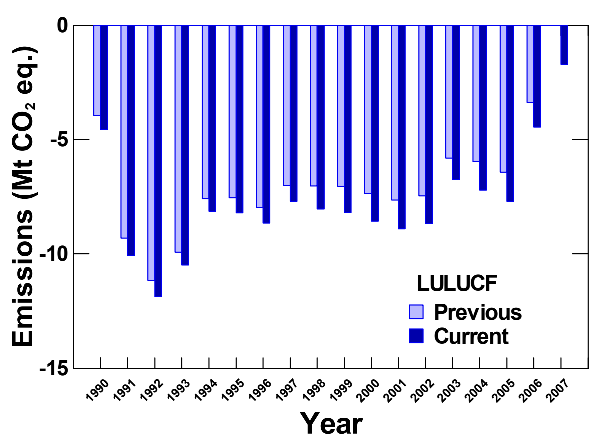

Fig. 7.1 Current and previously reported assessment of emissions for the LULUCF sector. The values are negative, hence representing net removals of green-house gases.

7.1.1 Estimated emissions

Tab. 7.1 provides a summary of the LULUCF GHG estimates for the base year 1990 and the most recently reported year 2007. In 2007, the net GHG flux for the LULUCF sector, estimated as the sum of emissions and removals, equaled -1.720 Mt CO_2 eq., thus representing a net removal of GHG gases. In relation to the estimated emissions in other sectors in the country for the inventory year 2007, the removals realized within the LULUCF sector decrease the GHG emissions generated in other sectors by 1.1 %. Correspondingly, for the base year of 1990, the total emissions and removals in the LULUCF sector equaled -4.565 Mt CO_2.eq. In relation to the emissions generated in all other sectors, the inclusion of the LULUCF estimate reduces the total emissions by 2.3 % for the base year of 1990. It is important to note that the emissions within the LULUCF sector exhibit high inter-annual variability (Fig. 7.3) and the values shown in Tab. 7.1 should not be interpreted as trends. The entire data series can be found in the corresponding CRF Tables.

Tab. 7.1 GHG estimates in Sector 5 (LULUCF) and its categories in 1990 (base year) and 2007.

Sector/category	Emissions 1990 Gg CO_2 eq.	Emissions 2007 Gg CO_2 eq.
5 Total LULUCF	**-4 565**	**-1 720**
5A Forest Land	**-5 880**	**-1 583**
5A1 Forest Land remaining Forest Land	5 473	-1 155
5A2 Land converted to Forest Land	-407	-428
5B Cropland	**1 336**	**134**
5B1 Cropland remaining Cropland	1089	55
5B2 Land converted to Cropland	247	79
5C Grassland	**128**	**383**
5C1 Grassland remaining Grassland	59	4
5C2 Land converted to Grassland	-187	-387
5D Wetlands	**22**	**19**
5D1 Wetlands remaining Wetlands	(0)	(0)
5D2 Land converted to Wetlands	22	19
5E Settlements	**85**	**93**
5E1 Settlements remaining Settlements	(0)	(0)
5E2 Land converted to Settlements	85	93
5F Other Land	**(0)**	**(0)**

Note: Emissions of non-CO_2 gases (CH_4 and N_2O) are also included.

7.1.2 Key categories

Of the main categories listed in Tab. 7.1, two of them were identified as key categories according to the IPCC Good Practice (Good Practice Guidance, IPCC 2000, Good Practice Guidance for LULUCF, IPCC 2003). Of these LULUCF categories, the largest effect on the overall emission inventory in the country is attributed to *5A1 Forest Land remaining Forest Land*. With a contribution of -0.9 %, it is the only LULUCF category identified by the level assessment for the year 2007 (Tab. 7.2). It was also identified as a key category by the trend assessment. The emissions of this category are determined by the changes in biomass carbon stock. Additionally, one LULUCF categories were identified by the trend assessment (Tab. 7.2), namely *5B1 Cropland remaining Cropland*. In *5B1*, the trend analysis reflected the effect of liming on emissions from agricultural soils, which has decreased rapidly since the early 1990s (Fig. 7.3).

Tab. 7.2 Key categories of the LULUCF sector (2007)

Category	Character of category	Gas	% of total GHG
5A1 Forest Land remaining Forest Land	KC (LA, TA)	CO_2	-0.90
5B1 Cropland remaining Cropland	KC (TA)	CO_2	0.04

KC: key category, LA - identified by level assessment, TA - identified by trend assessment

% of total GHG: relative contribution of category to net GHG (including LULUCF)

7.2 General methodological issues

7.2.1 Methodology for representing land-use areas

The reporting format requires the estimation of GHG emissions into the atmosphere by sources and sinks for six land-use categories, namely Forest Land, Cropland, Grassland, Wetlands, Settlements and Other Land. Each of these categories is divided into lands remaining in the given category during the inventory year, and lands that are newly converted into the category from a different one. Accordingly, GPG for LULUCF outlines the appropriate methodologies for estimation of emissions.

Consistent representation of land areas and identification of land-use changes constitute the key steps in the inventory of the sector in accordance with GPG for LULUCF. The land-use representation and land-use change identification system was build gradually since the 2007 NIR submission. It was radically improved in the 2008 NIR submission and further refined in this inventory submission.

Initially, the identification of land-use categories was based on two key data sources. Information on areas of the individual land-use categories was obtained from the Czech Office for Surveying, Mapping and Cadastre (COSMC; www.cuzk.cz). It provided annually updated cadastral information, published as aggregated data in the statistical yearbooks. The second data source utilized previously was the Land Cover Database of the Pan-European CORINE project (reference years 1990 and 2000), administered by the Czech Ministry of the Environment. The combination of COSMC cadastral data and CORINE land-use change trends permitted estimation of land-use changes. Although this method was endorsed by the 2007 in-country review, the aggregated land-use information did not provide sufficient spatial details and the CORINE-derived trends remained uncertain for several reasons.

Since the 2008 NIR submission, land-use representation and the land-use change identification system have been based exclusively on the annually updated COSMC data, elaborated at the level of about 13 thousands individual cadastral units. This system was built in several steps, including 1) source data assembly 2) linking land-use definitions 3) identification of land-use change 4) complementing time series. These steps are described below. The result is a system of consistent representation of land areas having the attributes of both Approach 2 and Approach 3 (GPG for LULUCF), permitting accounting for all land-use transitions in the annual time step.

7.2.1.1 Source data compilation

The methodology requirements and principles associated with the approaches recommended by the GPG for LULUCF (IPCC 2003) imply that, for the reported period of 1990 to 2007, the required land use should be available for the period starting from 1969. Information on land use was obtained from the Czech Office for Surveying, Mapping and Cadastre (COSMC), which administers the database of “Aggregate areas of cadastral land categories” (AACLC). The AACLC data were compiled at the level of the individual cadastral units (1992-2007) and individual districts (1969-2007). There are over 13 000 cadastral units, the number of which varied due to separation or division for various administrative reasons. In the period of 1992 to 2007, the total number of cadastral units varied between 13 027 and 13 079.

To identify the administrative separation and division of cadastral units, these were crosschecked by comparing the areas in subsequent years using a threshold of one hectare difference. Neighboring cadastral units mutually changing their areas in subsequent years were integrated. Until the reported year of 2006, this concerned a total of 706 former and/or current units that were integrated into 235 newly labeled units. This resulted in a total of 12 624 cadastral units, for which the annual land-use change was specifically estimated (see below). The land use system was further refined for 2007. The eventual integration of cadastral units is performed on an annual basis and hence concerns only those cadastral units where some land was exchanged between two subsequent years. For 2007, this decreased the number of integrated cadastral units from 235 to only 31, which affected a total of 54 cadastral units. This further increased the spatial resolution of the system, as the land use change identification could be analyzed for 12 996 individual units in 2007 as compared to 12 624 units for the previous years (Fig. 7.2).

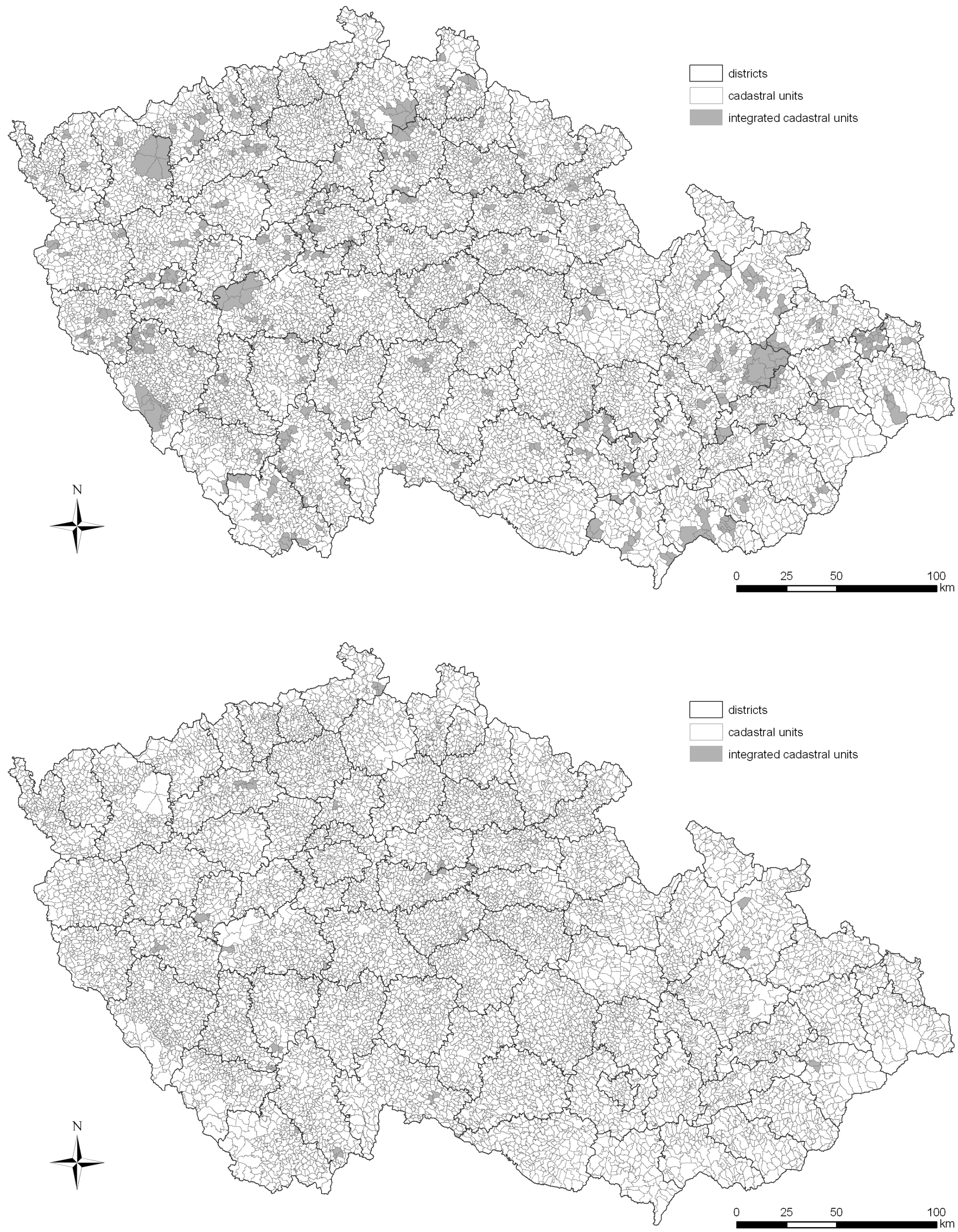

Fig. 7.1: Cadastral units (grey lines), integrated cadastral units (shading) and district borders (black lines) as used until year 2006 (top) and the further refined situation for year 2007 (bottom).

To obtain information on land-use and land-use change prior 1993, a complementary data set from COSMC at the level of 76 district units was prepared. It actually covered the period since 1969. It was required for application of the IPCC default transition time period of 20 years for carbon stock change in soils. The overlapping time period of 1993 to 2006 was utilized to correct the land-use change assessment based on the coarser, i.e., district data (see below for details). The spatial coverage of cadastral and district units is also shown in Fig. 7.2.

7.2.1.2 Linking land-use definitions

The analysis of land use and land-use change is based on the data from the "Aggregate areas of cadastral land categories" (AACLC), centrally collected and administered by COSMC and regulated by Act No. 265/1992 Coll., on Registration of proprietary and other material rights to real estate, and Act No. 344/1992 Coll., on the real estate cadastre of the Czech Republic (the Cadastral Act), both as amended by later regulations. AACLC distinguishes ten land categories, six of them belonging to land utilized by agriculture (arable land, hop-fields, vineyards, gardens, orchards, grassland) and four under other use (forest land, water surfaces, built-up areas and courtyards, and other land). Additionally, the land register included information on land use for every land parcel. Different AACLC land categories may have identical use. Both land categories and land use in the COSMC database were linked so as to most closely match the default definitions of the six major land-use categories (Forest Land, Cropland, Grassland, Wetlands, Settlements and Other Land) as given by GPG for LULUCF (IPCC 2003). The specific definition content can be found in the respective Chapters 7.3 to 7.8 devoted to each of the major land-use categories.

7.2.1.3 Land-use change identification

The critical issue of any LULUCF emission inventory is the determination of land-use change. This inventory identifies and quantifies land-use change by balancing the six major land-use areas for each of the individual or integrated cadastral units (12 996 units in year 2007) on an annual basis using the subsequent years of the available period. The approach is exemplified in Fig. 7.2. In the example of the cadastral unit of Jablunkov, it can be observed that, during 2006, three land-use categories lost their land, while one exhibited an increase. This identifies three types of land-use conversion with specific areas corresponding to the proportion of the loss of all the contributing categories. Similarly, if the converted land were to be attributed to two or more land-use categories, it would be accordingly distributed in proportion to the increase in their specific areas. Since this task is computation-intensive, involving tens of thousands of matrix manipulations, it is handled by a specific software application developed for this purpose using the MS-Access file format. All identified land-use transfers are summarized by each type of land-use change on an annual basis to be further used for calculation of the associated emissions.

YEAR	ID_CU (Name)	Cropland	Forestland	Grassland	Otherland	Settlements	Wetlands	ALL
2005	656305 (Jablunkov)	2880337	1737355	3480215	302322	1649308	336775	10386312
2006	656305 (Jablunkov)	2806120	1737355	3473992	302322	1729860	336666	10386315
Difference		-74217	0	-6223	0	**80552**	-109	3
	Increment					100%		**80552**
	Loss	92.1%		7.7%			0%	-80549
	Estimation	**74220**		**6223**			**109**	
	Conversion type	**Area (m2)**						
	Cropland_Settlements	74220						
	Grassland_Settlements	6223						
	Wetlands_Settlements	*109*						

Fig. 7.2: Example of land-used change identification for year 2006 and cadastral unit 656306 (Jablunkov); all spatial units are in m^2.

7.2.1.4 Complementing time series

The above described calculation of land-use change could only be performed for the years 1993 to 2007, because the data on land-use for the individual cadastral units has only been available since 1992. For the years preceding 1993, i.e., for land-use change attributed to the years 1970 to 1992, an identical approach as described above was used, but with aggregated cadastral input data at the level on the individual districts. The effect of an increased scale and data aggregation always results in a lower area of identified land-use change. This is probably due to within-domain compensation of area losses and increments. To compensate this effect for the 1970 to 1992 data series, a correction was applied to the estimates, based on district data input. The correction was based on a linear regression function between *R* (the ratio of identified land conversions at the level of the districts and individual cadastral units) and the logarithmically transformed areas from the data at the district level. The corrections were derived at the level of the major land-use categories, using the annual data from the period of 1993 to 2006, for which the land-use conversions could be estimated independently at both spatial levels, i.e., districts and individual cadastral units. More details, including the statistics and estimated parameters of the regression equation, are given in Cienciala and Apltauer (2007). The correction procedure was the final step in land-use database operations required to provide a consistent data-series on annual land-use conversions for the 1970 to 2007 period.

7.2.2 Land-use change – overall trends and annual matrices

The overall trends in the areas of the major land-use categories in the Czech Republic for the 1970 to 2007 period are shown in Fig. 7.3. The largest quantitative change is associated with the Cropland and Grassland land-use categories.

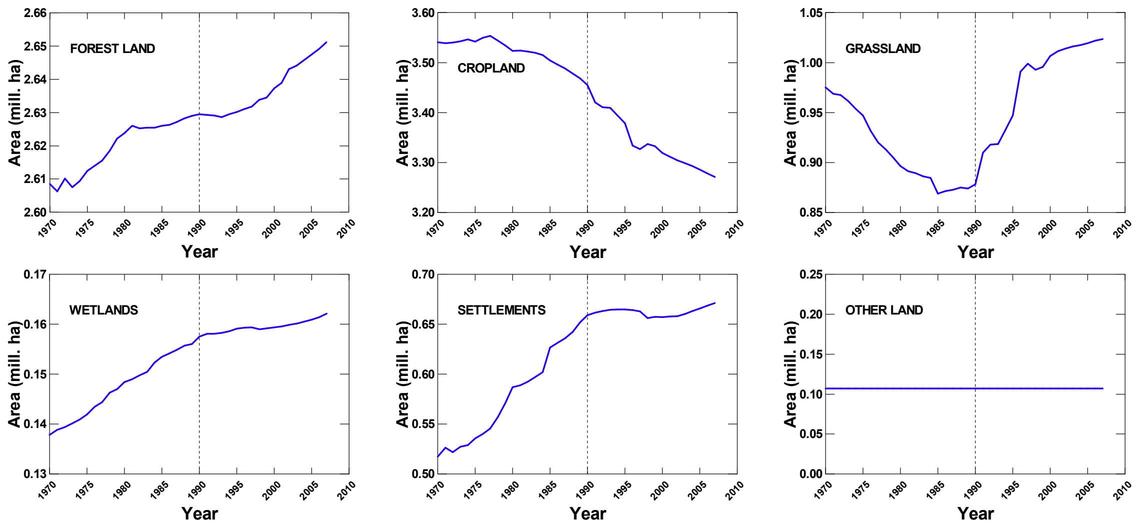

Fig. 7.3 Trends in areas of the six major land-use categories in the Czech Republic between 1970 and 2007 (based on information from the Czech Office for Surveying, Mapping and Cadastre).

An insight into the net trends shown in Fig. 7.3 is provided by analysis of land-use changes as described in Section 7.1.2. Tab. 7.3 shows a product of that analysis, namely the areas of land-use change among the major land-use categories over the 1990 to 2007 period in the form of land-use change matrices for the individual years. It is important to note that the annual totals for the individual years in the matrices do not necessarily correspond to the areas that appear in the CRF Tables, which accounts for the progressing 20-year transition period that began in 1970. This is a Tier 1 assumption of GPG for LULUCF for estimation of changes in soil carbon stock. This also implies that the areas relevant to the biomass pool are not the same as those for the soil pools; this is important for interpretation of the emission factors estimated from the land-use change areas accumulated over 20-year periods. Secondly, for Forest Land, the available input information at a detailed (cadastral, district) level did not permit separation of the fraction of permanently unstocked Forest Land devoted to use other than growing forests. This small fraction of Forest Land was separated ex-post after estimating land-use changes and summing over the whole country, when it was assigned to Grassland.

Tab. 7.3 Land-use matrices describing initial and final areas of particular land-use categories and the identified annual land-use conversions among these categories for years 1990 to 2007.

Year 1990		Initial (1989)						*Area (kha)*
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (1990)	Forest Land	**2 628.2**	0.5	0.7	0.0	0.0	0.0	2 629.5
	Grassland	0.1	**867.3**	10.8	0.0	0.0	0.0	878.2
	Cropland	0.1	1.2	**3 453.4**	0.1	0.2	0.0	3 455.0
	Wetland	0.0	0.4	0.4	**155.9**	0.8	0.0	157.5
	Settlements	0.3	3.7	3.7	0.1	**651.2**	0.0	658.9
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 628.7	873.1	3 469.0	156.1	652.2	107.2	**7 886.4**

Year 1991		Initial (1990)						*Area (kha)*
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (1991)	Forest Land	**2 628.8**	0.1	0.4	0.0	0.0	0.0	2 629.3
	Grassland	0.4	**876.4**	32.6	0.0	0.3	0.0	909.8
	Cropland	0.3	0.5	**3 419.4**	0.0	0.2	0.0	3 420.4
	Wetland	0.1	0.1	0.6	**157.4**	0.0	0.0	158.1
	Settlements	0.2	0.3	3.4	0.0	**657.7**	0.0	661.6
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 629.6	877.4	3 456.4	157.4	658.2	107.2	**7 886.4**

Year 1992		Initial (1991)						*Area (kha)*
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (1992)	Forest Land	**2 628.7**	0.1	0.2	0.0	0.0	0.0	2 629.1
	Grassland	0.2	**907.3**	10.2	0.1	0.0	0.0	917.9
	Cropland	0.1	0.7	**3 409.9**	0.0	0.2	0.0	3 410.9
	Wetland	0.0	0.1	0.2	**157.8**	0.0	0.0	158.1
	Settlements	0.3	0.4	2.0	0.1	**660.5**	0.0	663.3
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 629.5	908.6	3 422.4	158.0	660.7	107.2	**7 886.4**

Year 1993		Initial (1992)						*Area (kha)*
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (1993)	Forest Land	**2 628.2**	0.1	0.1	0.0	0.2	0.0	2 628.6
	Grassland	0.1	**916.6**	1.6	0.0	0.3	0.0	918.6
	Cropland	0.2	0.6	**3 407.9**	0.0	0.4	0.0	3 409.1
	Wetland	0.0	0.1	0.0	**157.9**	0.3	0.0	158.3
	Settlements	0.5	0.4	1.2	0.1	**662.3**	0.0	664.6
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 629.1	917.8	3 410.9	158.1	663.4	107.2	**7 886.4**

Year 1994		Initial (1993)						*Area (kha)*
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (1994)	Forest Land	**2 628.1**	0.2	0.2	0.1	0.9	0.0	2 629.5
	Grassland	0.1	**917.2**	14.8	0.0	0.4	0.0	932.5
	Cropland	0.1	0.7	**3 392.7**	0.0	0.4	0.0	3 394.0
	Wetland	0.0	0.1	0.0	**158.1**	0.4	0.0	158.6
	Settlements	0.4	0.4	1.3	0.1	**662.6**	0.0	664.8
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 628.7	918.6	3 409.1	158.4	664.7	107.2	**7 886.7**

Year 1995		**Initial (1994)**						*Area (kha)*
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (1995)	Forest Land	**2 629.0**	0.4	0.3	0.0	0.5	0.0	2 630.1
	Grassland	0.1	**930.9**	15.4	0.0	0.5	0.0	946.9
	Cropland	0.2	0.8	**3 376.9**	0.1	0.6	0.0	3 378.5
	Wetland	0.0	0.1	0.1	**158.4**	0.4	0.0	159.1
	Settlements	0.3	0.4	1.2	0.1	**662.8**	0.0	664.8
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 629.5	932.5	3 393.9	158.6	664.8	107.2	**7 886.6**

Year 1996		**Initial (1995)**						*Area (kha)*
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (1996)	Forest Land	**2 629.2**	0.4	0.9	0.0	0.5	0.0	2 631.0
	Grassland	0.3	**943.7**	45.4	0.1	1.3	0.0	990.9
	Cropland	0.2	2.2	**3 330.8**	0.1	0.8	0.0	3 334.0
	Wetland	0.0	0.1	0.1	**158.8**	0.3	0.0	159.3
	Settlements	0.4	0.5	1.4	0.1	**661.8**	0.0	664.2
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 630.1	946.9	3 378.6	159.1	664.7	107.2	**7 886.7**

Year 1997		**Initial (1996)**						*Area (kha)*
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (1997)	Forest Land	**2 630.1**	0.4	0.3	0.0	0.9	0.0	2 631.8
	Grassland	0.2	**987.2**	10.2	0.1	1.1	0.0	998.8
	Cropland	0.2	2.6	**3 322.2**	0.1	1.3	0.0	3 326.4
	Wetland	0.0	0.1	0.1	**159.0**	0.2	0.0	159.4
	Settlements	0.4	0.6	1.1	0.1	**660.8**	0.0	662.9
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 630.9	990.9	3 334.0	159.3	664.3	107.2	**7 886.6**

Year 1998		**Initial (1997)**						*Area (kha)*
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (1998)	Forest Land	**2 630.3**	0.7	0.5	0.1	2.3	0.0	2 633.8
	Grassland	0.4	**983.6**	5.8	0.3	2.8	0.0	992.9
	Cropland	0.4	13.4	**3 318.3**	0.4	4.5	0.0	3 337.0
	Wetland	0.1	0.2	0.1	**158.2**	0.4	0.0	159.0
	Settlements	0.5	0.9	1.5	0.3	**652.9**	0.0	656.1
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 631.7	998.8	3 326.2	159.3	662.8	107.2	**7 886.0**

Year 1999		**Initial (1998)**						*Area (kha)*
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (1999)	Forest Land	**2 632.9**	0.5	0.3	0.0	0.7	0.0	2 634.5
	Grassland	0.1	**991.1**	4.1	0.0	0.4	0.0	995.7
	Cropland	0.1	0.9	**3 330.6**	0.0	0.6	0.0	3 332.2
	Wetland	0.1	0.1	0.2	**158.7**	0.1	0.0	159.2
	Settlements	0.6	0.6	1.9	0.1	**654.4**	0.0	657.5
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 633.8	993.1	3 337.1	159.0	656.2	107.2	**7 886.4**

Year 2000		Initial (1999)						Area (kha)
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (2000)	Forest Land	**2 633.8**	0.5	0.5	0.1	2.4	0.0	2 637.3
	Grassland	0.1	**992.9**	13.1	0.1	0.4	0.0	1 006.6
	Cropland	0.1	1.7	**3 316.6**	0.1	0.3	0.0	3 318.8
	Wetland	0.1	0.1	0.2	**158.9**	0.1	0.0	159.3
	Settlements	0.4	0.5	1.9	0.1	**654.3**	0.0	657.2
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 634.5	995.8	3 332.2	159.3	657.5	107.2	**7 886.5**

Year 2001		Initial (2000)						Area (kha)
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (2001)	Forest Land	**2 636.8**	0.5	0.4	0.0	1.1	0.0	2 638.9
	Grassland	0.1	**1 004.8**	6.0	0.0	0.5	0.0	1 011.4
	Cropland	0.1	0.8	**3 310.3**	0.0	0.3	0.0	3 311.6
	Wetland	0.0	0.1	0.1	**159.2**	0.1	0.0	159.6
	Settlements	0.3	0.4	1.9	0.1	**655.1**	0.0	657.8
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 637.3	1 006.6	3 318.7	159.4	657.2	107.2	**7 886.5**

Year 2002		Initial (2001)						Area (kha)
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (2002)	Forest Land	**2 638.4**	0.9	1.1	0.0	2.5	0.0	2 643.1
	Grassland	0.1	**1 009.3**	3.7	0.0	0.9	0.0	1 014.0
	Cropland	0.0	0.3	**3 303.9**	0.1	0.1	0.0	3 304.5
	Wetland	0.1	0.1	0.2	**159.4**	0.2	0.0	159.9
	Settlements	0.3	0.8	2.6	0.1	**654.3**	0.0	658.1
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 638.9	1 011.4	3 311.6	159.6	658.0	107.2	**7 886.8**

Year 2003		Initial (2002)						Area (kha)
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (2003)	Forest Land	**2 642.1**	0.6	0.7	0.0	0.7	0.0	2 644.2
	Grassland	0.1	**1 011.2**	4.6	0.0	0.3	0.0	1 016.3
	Cropland	0.1	1.5	**3 296.9**	0.0	0.1	0.0	3 298.6
	Wetland	0.0	0.1	0.2	**159.7**	0.1	0.0	160.1
	Settlements	0.5	0.6	2.1	0.1	**656.9**	0.0	660.2
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 642.9	1 014.0	3 304.5	159.9	658.1	107.2	**7 886.7**

Year 2004		Initial (2003)						Area (kha)
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (2004)	Forest Land	**2 643.5**	0.8	0.8	0.0	0.6	0.0	2 645.7
	Grassland	0.1	**1 013.8**	3.1	0.0	0.4	0.0	1 017.4
	Cropland	0.1	0.7	**3 291.9**	0.0	0.2	0.0	3 292.8
	Wetland	0.0	0.2	0.2	**159.9**	0.1	0.0	160.5
	Settlements	0.5	0.9	2.7	0.1	**658.9**	0.0	663.1
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 644.2	1 016.4	3 298.7	160.1	660.2	107.2	**7 886.8**

Year 2005		Initial (2004)						Area (kha)
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (2005)	Forest Land	**2 645.1**	0.9	0.9	0.0	0.6	0.0	2 647.4
	Grassland	0.1	**1 015.1**	4.0	0.0	0.3	0.0	1 019.5
	Cropland	0.1	0.4	**3 284.9**	0.0	0.2	0.0	3 285.7
	Wetland	0.0	0.2	0.2	**160.4**	0.1	0.0	160.9
	Settlements	0.4	0.8	2.7	0.1	**661.9**	0.0	666.0
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 645.7	1 017.4	3 292.8	160.5	663.1	107.2	**7 886.7**

Year 2006		Initial (2005)						Area (kha)
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (2006)	Forest Land	**2 647.0**	0.7	1.0	0.0	0.4	0.0	2 649.1
	Grassland	0.1	**1 017.6**	4.0	0.0	0.2	0.0	1 021.9
	Cropland	0.1	0.4	**3 277.5**	0.0	0.2	0.0	3 278.2
	Wetland	0.0	0.2	0.3	**160.7**	0.2	0.0	161.4
	Settlements	0.3	0.7	2.8	0.1	**664.9**	0.0	668.8
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 647.4	1 019.5	3 285.6	160.9	665.9	107.2	**7 886.7**

Year 2007		Initial (2006)						Area (kha)
	Category	Forest Land	Grassland	Cropland	Wetlands	Settlements	Other Land	
Final (2007)	Forest Land	**2 648.8**	0.6	0.9	0.0	0.9	0.0	2 651.2
	Grassland	0.1	**1 019.9**	3.5	0.0	0.2	0.0	1 023.7
	Cropland	0.0	0.5	**3 270.4**	0.0	0.2	0.0	3 271.2
	Wetland	0.0	0.2	0.3	**161.2**	0.4	0.0	162.1
	Settlements	0.3	0.7	3.0	0.1	**667.1**	0.0	671.2
	Other Land	0.0	0.0	0.0	0.0	0.0	**107.2**	107.2
	Area (kha)	2 649.1	1 021.9	3 278.1	161.4	668.8	107.2	**7 886.7**

7.2.3 Methodologies to estimate emissions

The estimation of emissions and removals of CO_2 and non-CO_2 gases for the sector was performed according to Chapter 3 of GPG for LULUCF (IPCC 2003). Additionally, the 2006 Guidelines for National Greenhouse Gas Inventories – Agriculture, Forestry and Other Land Use (IPCC 2006) were consulted whenever appropriate. The following text describes the inventory for the individual land-use categories, noting vital information on the category within the conditions of the Czech Republic, the methodology employed, uncertainty and time consistency, QA/QC and verification, recalculations and source-specific planned improvements.

7.3 Forest Land (5A)

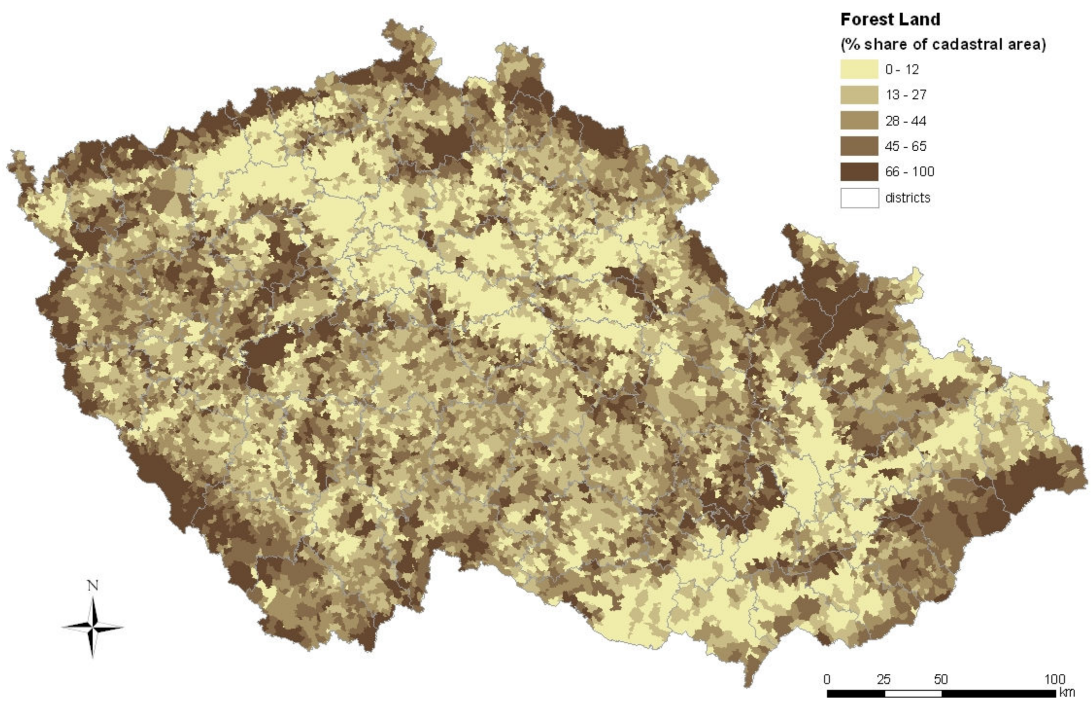

Fig. 7.4 Forest land in the Czech Republic – distribution calculated as a spatial share of the category within cadastral units.

7.3.1 Source category description

The Czech Republic is a country with a long forestry tradition. Practically all the forests can be considered to be temperate-zone managed forests under the IPCC definition of forest management (GPG Chapter 3, IPCC 2003). With respect to the definition thresholds of the Marrakesh Accords, Forest Land is defined as land with woody vegetation and with tree crown cover of at least 30 %, over an area exceeding 0.05 ha containing trees able to reach a minimum height of 2 m at maturity[9]. This definition of forests excludes the areas of permanently unstocked cadastral forest land, such as forest roads, forest nurseries and land under power transmission lines. The permanently unstocked area of cadastral forest land has predominantly the attributes of Grassland, and therefore it was ascribed to that category. Hence, Forest Land in this emission inventory corresponds to the national definition of timberland (Czech Forestry Act 84/1996). In 2007, the stocked forest area (timberland) qualifying under the category of Forest Land in this emission inventory equaled 2 598 thousand ha, representing 98 % of the cadastral forest land in the Czech Republic. The permanently unstocked area represents 2 % of the forest land according to cadastral data and it was linked by this proportion to the area of Forest Land for the whole time series since 1969.

Forests currently occupy 33.6 % of the area of the country (MA 2008). The tree species composition is dominated by conifers, which represent 75 % of the timberland area. The four most important tree species in this country are spruce, pine, beech and oak, which account for 52.8, 17.0, 6.7 and 6.9 % of the total cadastral forest area, respectively (MA 2008). Broadleaved tree species have been favored in

[9] These parameters, together with the minimum width of 20 m for linear forest formations, were given in the Czech Initial Report under the Kyoto Protocol.

new afforestation since 1990. The proportion of broadleaved tree species increased from 21 % in 1990 to about 24 % in 2007. The total growing stock (merchantable wood volume) in forests in the country has increased during the reported period from 564 mil. m^3 in 1990 to 673 mil. m^3 in 2007.

Two major sources of information on forests are available in the Czech Republic. The primary source of activity data on forests used for this emission inventory is the forest taxation data in Forest Management Plans (further denoted as FMP), which are administered centrally by the Forest Management Institute (FMI), Brandýs n. L. With a forest management plan cycle of 10 years, the annual update of the FMP database is related to 1/10 of the total forest area scattered throughout the country. The information in FMP represents an ongoing national stand-wise type of forest inventory. The second source of information consists in the data from the first cycle of the statistical (sample based, tree level) forest inventory performed during 2001-2004 by FMI. The results of this forest inventory were published in 2007 (FMI, 2007)[10]. This emission inventory is exclusively based on FMP data, which have also been exclusively used for all the international reporting on forests of the Czech Republic to date.

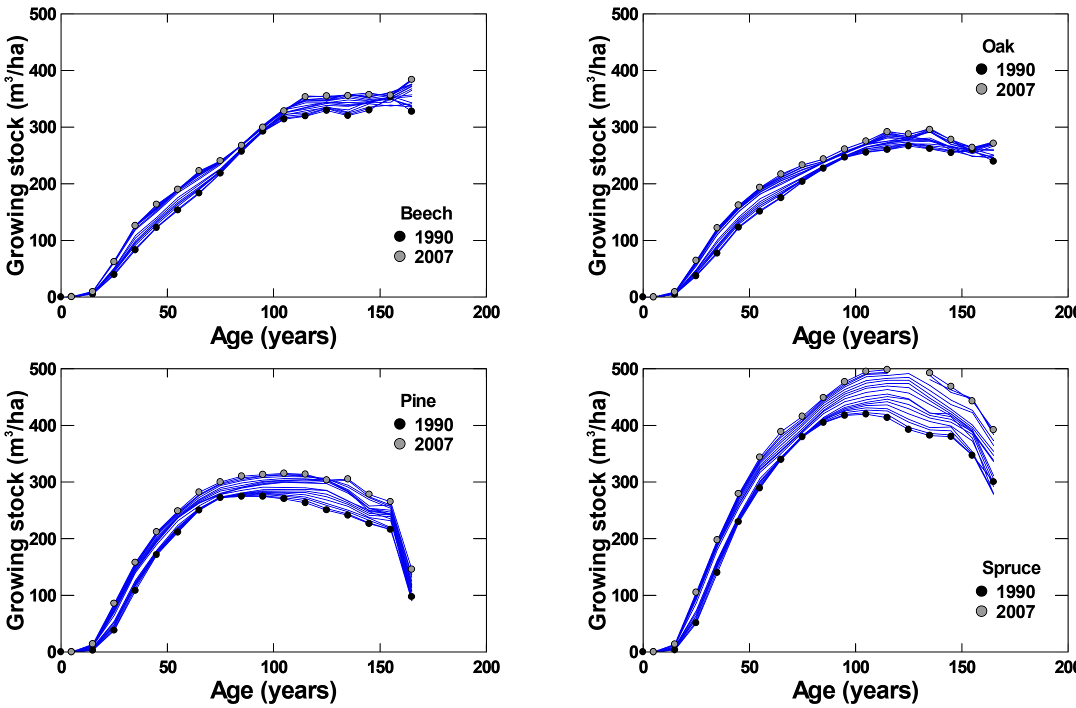

Fig. 7.5 Activity data - average growing stock volume against stand age for the four major groups of species during 1990 to 2007; each line corresponds to an individual inventory year. The symbols identify only the situation in 1990 and 2007.

[10] The first cycle of the statistical (sample based, tree level) forest inventory was performed during 2001-2004 by the Forest Management Institute (FMI), Brandýs n. Labem. These data indicate significantly higher growing stock volumes than those reported so far for this country. This was mainly prescribed to methodological differences between the stand-wise inventory used for Forest management planning and the tree-level, sample based statistical forest inventory (e.g., Černý *et al*. 2006; FMI 2007). However, only one inventory cycle of sample based inventory it is not readily usable for detecting carbon stock change in forests. So far, no decision has yet been made on the 2nd national (statistical) forest inventory cycle (as of 2008). Nonetheless, the data of the first cycle would be suitable for several other purposes, such as for constructing better country-specific biomass expansion factors. Unfortunately, FMI blocks releasing tree-level data for the analyses needed. Effective utilization of statistical forest inventory would also require several methodology adjustments, taking into account the specific needs of the carbon (emission) inventory. These plans are under consideration. Similarly, it remains to be decided when the data from the statistical forest inventory of FMI will be used for international reporting.

FMP data were aggregated in line with the country-specific approaches at the level of the four major tree species (i-beech: all broadleaved species except oaks, ii-oak: all oak species, iii-pine: pines and larch, iv-spruce: all conifers except pines and larch) and age-classes (10-year intervals). For these categories, growing stock (merchantable volume, defined as tree stem and branch volume under bark with a minimum diameter threshold of 7 cm), the corresponding areas and other auxiliary information were available for each inventory year. It can be observed in Fig. 7.5 that the average growing stock has increased steadily for all tree species groups since 1990 in this country. In addition to the four major categories by predominant tree species, clear-cut areas are also distinguished, forming another, specific sub-category of Forest Land as reported in this submission. A clear-cut area is defined as a temporarily unstocked area following final or salvage harvest of forest stands. It ceases to exist once it is reforested, which must occur within two years according to the Czech Forestry Act. There is no detectable carbon stock change for this category and it is introduced solely for the purpose of transparent and consistent reporting of forest land. In 2007, clear-cut areas represented 1.0 % of Forest Land.

The annual harvest volume constitutes the other key information related to forestry. This value is available from the Czech Statistical Office (CSO). CSO collects this information on the basis of about 600 country respondents (relevant forest companies and forest owners) and encompasses commercial harvest and fuel wood, and included compensation for the forest areas not covered by the respondents. The total drain of merchantable wood from forests increased from 13.3 mil. m^3 in 1990 to 18.5 mil. m^3 in 2007 (all data refer to underbark volumes). Additionally, harvest loss of 5 and 15 % is applied to final and salvage logging volumes, respectively. The salvage logging operations concern primarily stands of coniferous species, which are commonly hit by windstorms, snow and bark-beetle calamities in this country.

7.3.2 Methodological aspects

Category *5A Forest Land* includes emissions and sinks of CO_2 associated with forests and non-CO_2 gases generated by burning in forests. This category is composed of *5A1 Forest Land remaining Forest Land*, and *5A2 Land converted to Forest Land*. The following text describes the major methodological aspects related to emission inventories of both forest sub-categories.

The methods of area identification described in Section 7.1.2 distinguish the areas of forest with no land-use change over the 20 years prior the reporting year. These lands are included in subcategory *5A1 Forest Land remaining Forest Land*. The other part represents subcategory *5A2 Land converted to Forest Land*, i.e., the forest areas "in transition" that were converted from other land-use categories over the 20 years prior to the reporting year. The areas of forest subcategories, i.e., *5A1* and *5A2* accumulated over a 20-year rolling period can be found in the corresponding CRF Tables. The annual matrices of identified land-use and land-use changes are given in Tab. 7.3 above.

7.3.2.1 Forest Land remaining Forest Land

Carbon stock change in category *5A1 Forest Land remaining Forest Land* is given by the sum of changes in living biomass, dead organic matter and soils. The carbon stock change in living biomass was estimated using the default method[11] according to Eq. 3.3.2 of GPG for LULUCF. This method is based on separate estimation of increments and removals, and their difference.

The reported growing stock of merchantable volume from the database of FMP formed the basis for assessment of the carbon increment (Eqs. 3.2.4 and 3.2.5 of GPG for LULUCF). The key input to calculate the carbon increment is the volume increment (I_v) data. In the Czech Republic, these values have been traditionally calculated by FMI (FMP database administrator) and reported to the national and international statistics. The calculation is performed at the level of the individual stands and species using the available growth and yield data and models. The increment data were partly revised in the previous NIR (2008) to unify two different base information sources (Schwappach 1923; Černý

[11] Alternative approaches of the stock-change method (Eq. 3.2.3; IPCC 2003) were also analyzed (Cienciala *et al*. 2006a) for this category. However, for several reasons the default method was finally adopted, which is discussed in the cited study.

et al. 1996) for increment estimates and to apply only the latest source across the entire reporting period. This was to comply with the GPG for LULUCF requirements of consistent time series. No change, apart from entering the increment of latest reported year, was made to the increment in this inventory submission (Fig. 7.6).

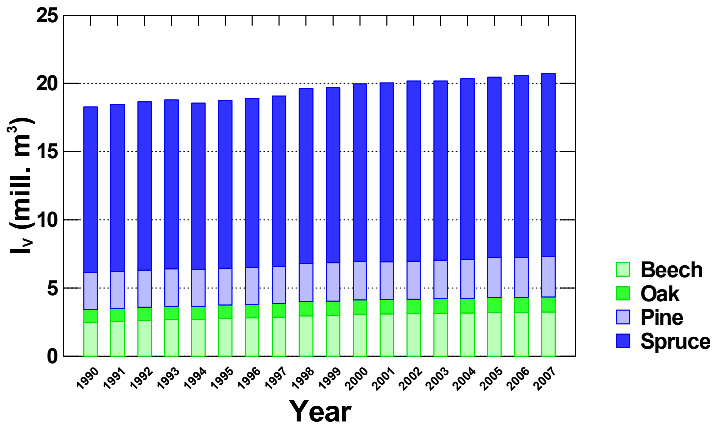

Fig. 7.6 Current annual increment (I_V; m^3 underbark) by the individual tree species groups as used in the reporting period 1990 to 1999.

The merchantable volume increment (I_v) is converted to the biomass increment (G_{Total}), biomass conversion and expansion factors applicable for increment ($BCEF_i$) using Eqs. 2.9 and 2.10 (AFOLU 2006) as follows:

$$\Delta C_G = \sum_j (A_j * G_{Total_j} * CF_j) \quad (1)$$

where A_j and CF_j represent the actual stand area (ha) and carbon fraction of dry matter (t C per t dry matter), respectively, for each major tree species type j (beech, oak, pine, spruce), while G_{Total} is calculated for each j as follows:

$$G_{Total} = \sum \{ I_V * BCEF_i * (1 + R) \} \quad (2)$$

where R is a root/shoot ratio to include the below-ground component. The total biomass increment is multiplied by the carbon fraction and the applicable forest land area. Tab. 7.4 lists the factors used in the calculation of the biomass carbon stock increment.

Tab. 7.4 Input data and factors used in carbon stock increment calculation (1990 and 2007 shown) for beech, oak, pine and spruce species groups, respectively.

Variable or conversion factor	Unit	Year 1990	Year 2007
Area of forest land remaining forest land (A)	Kha	372; 152; 455; 1503	448; 171; 436; 1479
Biomass conv. & exp. factor, incr. ($BCEF_i$)	Mg m^{-3}	0.74; 0.83; 0.54; 0.61	0.73; 0.82; 0.54; 0.61
Carbon fraction in biomass (CF)	t C/t biomass	0.50	0.50
Root/shoot ratio (R)	-	0.23	0.23
Volume increment (I_v)	m^3	6.55; 5.96; 5.84; 7.89	7.12; 6.33; 6.70; 8.95

In Tab. 7.4, A represents only the areas of *5A1 Forest Land remaining Forest Land*, updated annually. The applied biomass conversion and expansion factors applicable for the increment ($BCEF_i$) and growing stock volumes ($BCEF_h$) are based on national allometric studies (Cienciala *et al*. 2006a, 2006b, 2008) or biomass compilations that include data from the Czech Republic (Wirth *et al*. 2004, Wutzler *et al*. 2008). Since the biomass conversion and expansion factors are age-dependent (Lehtonen *et al*. 2004, 2007), they respect the actual age-class distribution of the dominant tree species. Hence, the $BCEF_i$ values shown in Table 7.4 are weighted means considering the actual areas of the individual age classes for each of the major tree species. *CF* of 0.50 is a generally accepted default constant, which is also recommended by IPCC (2003). *R* was selected as a conservative value from the range recommended for temperate-zone forests by IPCC (2003). It corresponds well to the available relevant experimental evidence (Černý 1990, Green *et al*. 2006). I_v is the annually updated volume increment estimated per species group as described above.

The estimation of carbon drain (*L*; Eq. 2) in the category *5A1 Forest Land remaining Forest Land* basically follows Eqs. 3.2.6, 3.2.7 and 3.2.8 (IPCC 2003). It uses the annual amount of total harvest removals (*H*) reported by the CSO for individual tree species in the country. *H* covers thinning and final cut, as well as the amount of fuel wood, which is reported as an assortment under the conditions of Czech Forestry. To include a potentially unaccounted-for loss associated with *H,* the factor F_{HL} was applied to *H*; it was calculated from annual harvest data and the share of salvage logging, assuming 5 % loss under planned forest harvest operations and 15 % for accidental/salvage harvest applicable for coniferous species. Hence, the harvest volumes entering the actual emission calculation (*H* in eq. 3 below) include the correction by the above described factor, F_{HL}. The calculation of the carbon drain (*L*; loss of carbon) otherwise also follows Eq. 2.12 (AFOLU 2006) as

$$L_{wood-removals} = H * BCEF_h * (1 + R) * CF \tag{3}$$

where $BCEF_h$ represents a biomass expansion and conversion factor applicable to harvested volumes, derived from national studies or regional compilations that include the data from the Czech Republic as noted and mentioned above. The application of $BCEF_h$ considers the share of the planned harvested volume and the actual salvage logging that was not planned. In the case of planned harvest volumes, the age-dependent $BCEF_h$ values also consider the mean felling age, which is taken from the national reports of the Ministry of Agriculture. For salvage logging, $BCEF_h$ represents the volume-weighted mean of all age classes for the individual dominant tree species, as the actual stand age of those harvested volumes is unknown. The other factors (*CF, R*) are identical to those described under Tab. 7.4. The specific values of input variables and conversion factors used to calculate *L* are listed in Table 7.5.

Tab. 7.5 Specific input data and factors used in calculation of carbon drain (1990 and 2007 shown) for beech, oak, pine and spruce species groups, respectively.

Variable or conversion factor	Unit	Year 1990	Year 2007
Harvest volume (*H*)	mill. m^3	0.84; 0.31; 1.33; 10.84	0.92; 0.31; 1.16; 16.11
Biomass expansion factor ($BCEF_h$)	Mg m^{-3}	0.67; 0.79; 0.53; 0.58	0.67; 0.79; 0.53; 0.58

The impact of disturbances (Eq. 2.14, AFOLU 2006) has not been explicitly estimated. To the present time, the disturbance in Czech forests since 1990 has not reached proportions above the buffering capacity of Czech forestry management practices. Consequently, any salvage felling is flexibly allocated to the desired amount of planned wood removals, and is thereby accounted for in the reported harvest volumes.

The assessment of the net carbon stock change in organic matter (deadwood and litter) followed the Tier 1 (default) GPG for LULUCF assumption of zero change in these carbon pools. This is a safe assumption, as the country did not experience significant changes in forest types, disturbance or management regimes within the reporting period.

The above assumption also applies to the soil carbon pool, in which the net carbon stock change was considered to equal zero (Tier 1, IPCC 2003). This concerns both mineral and organic soils. The organic soils occur only in the areas of the Spruce sub-category on *5A1 Forest Land remaining Forest Land*. They represent protected peat areas in mountainous regions dominated by spruce stands, with no or specific management practices. No such areas occur under other the sub-categories by the predominant species of Beech, Oak and Pine.

Emissions in category *5A1 Forest Land remaining Forest Land* include, in addition to CO_2, also other greenhouse gases (CH_4, CO, N_2O and NO_X) resulting from burning. This encompasses both prescribed fires associated with burning of biomass residues and also emissions due to wildfires. The emissions from burning of biomass residues were estimated according to Eq. 3.2.19 and the emission ratios in Table 3A.1.15 (Tier 1, IPCC 2003). Under the conditions in this country, part of the biomass residues is burned in connection with final cut. The expert judgment employed in this inventory revision considers that 30 % of the biomass residues including bark is burned. This biomass fraction was quantified on the basis of the annually reported amount of final felling volume of broadleaved and coniferous species, $BCEF_h$ and CF as applied to harvest removals (above). The amount of biomass burned (dry matter) was estimated as 569 Gg in 1990 and 1016 Gg in 2007.

The emissions of greenhouse gases due to wildfires were estimated on the basis of known areas burnt annually by forest fires and the average biomass stock in forests according to Eq. 3.2.9 (IPCC 2003). This equation used a default factor of biomass left to decay after burning (0.45; Table 3A.1.12). The associated amounts of non-CO_2 gases (CH_4, CO, N_2O and NO_X) were estimated according to Eq. 3.2.19. The full time series and the associated emissions of non-CO_2 gases can be found in the corresponding CRF tables.

There are no direct N_2O emissions from N fertilization on Forest Land, as there is no practice of nitrogen fertilization of forest stands in the Czech Republic. Similarly, non-CO_2 emissions related to drainage of wet forest soils are not reported, as this activity no longer occurs in practice.

7.3.2.2 Land converted to Forest Land

The methods employed to estimate emissions in the *5A2 Land converted to Forest Land* category are similar to those for the category of Forest Land remaining Forest Land, but they differ in some assumptions, which follow the recommendations of GPG for LULUCF.

For estimation of the net carbon stock change in living biomass on Land converted to Forest Land by the Tier 1 method (IPCC 2003), the carbon increment is proportional to the extent of afforested areas and the growth of biomass. The revised methodology of land-use change identification (Section 7.1.2) provides areas of all conversion types updated annually. Land areas are considered to be under conversion for a period of 20 years, according the Tier 1 assumption of GPG for LULUCF. Under the conditions in this country, all newly afforested lands are considered as intensively managed lands under the prescribed forest management rules as specified by the Czech Forestry Act.

Until 2006, the increment applicable to age classes I and II (stand age up to 20 years) was estimated from the actual wood volumes and areas that were available per major species groups. Using the available activity stand level data categorized by species and age classes and the national growth and yield model SILVISIM (Černý 2005), the wood increment was derived for all the age classes above 20 years. For age class one (1-10 years), the increment was simply calculated from the reported areas and volumes, assuming a mean age of five years. The increment of age class two (11 to 20 years) was estimated from linear interpolation between the increment of age classes I and III. For the year 2007 (and subsequently), the increment is derived for individual tree species using the ratio of the increment for the individual species to the total stand increment estimated from the period 2000 to 2006.

Since the specific species composition of the newly converted land is unknown, the increment estimated for the major tree species was averaged using the weight of actual areas for the individual tree species known from the unchanged (remaining) forest land. Expressed in terms of dry mass, the estimated mean increment for 2007 was 2.94 t/ha, a slightly lower value than those given for temperate coniferous (3 t/ha) and broadleaved (4 t/ha) forests as defaults in GPG for LULUCF. The carbon loss associated with biomass in the category of Land converted to Forest Land was assumed to be insignificant (zero). This is because the first significant thinning occurs only in older age classes, which is implicitly accounted for within the category Forest Land remaining Forest Land.

The net changes of carbon stock in dead organic matter were assumed to be insignificant (zero), in accordance with the assumptions of the Tier 1 method (IPCC 2003).

The net change of carbon stock in mineral soils was estimated using the country-specific Tier 2/Tier 3 method. It was based on the vector map of topsoil organic carbon content (Macků *et al*. 2007, Šefrna and Janderková 2007; Fig. 7.7).

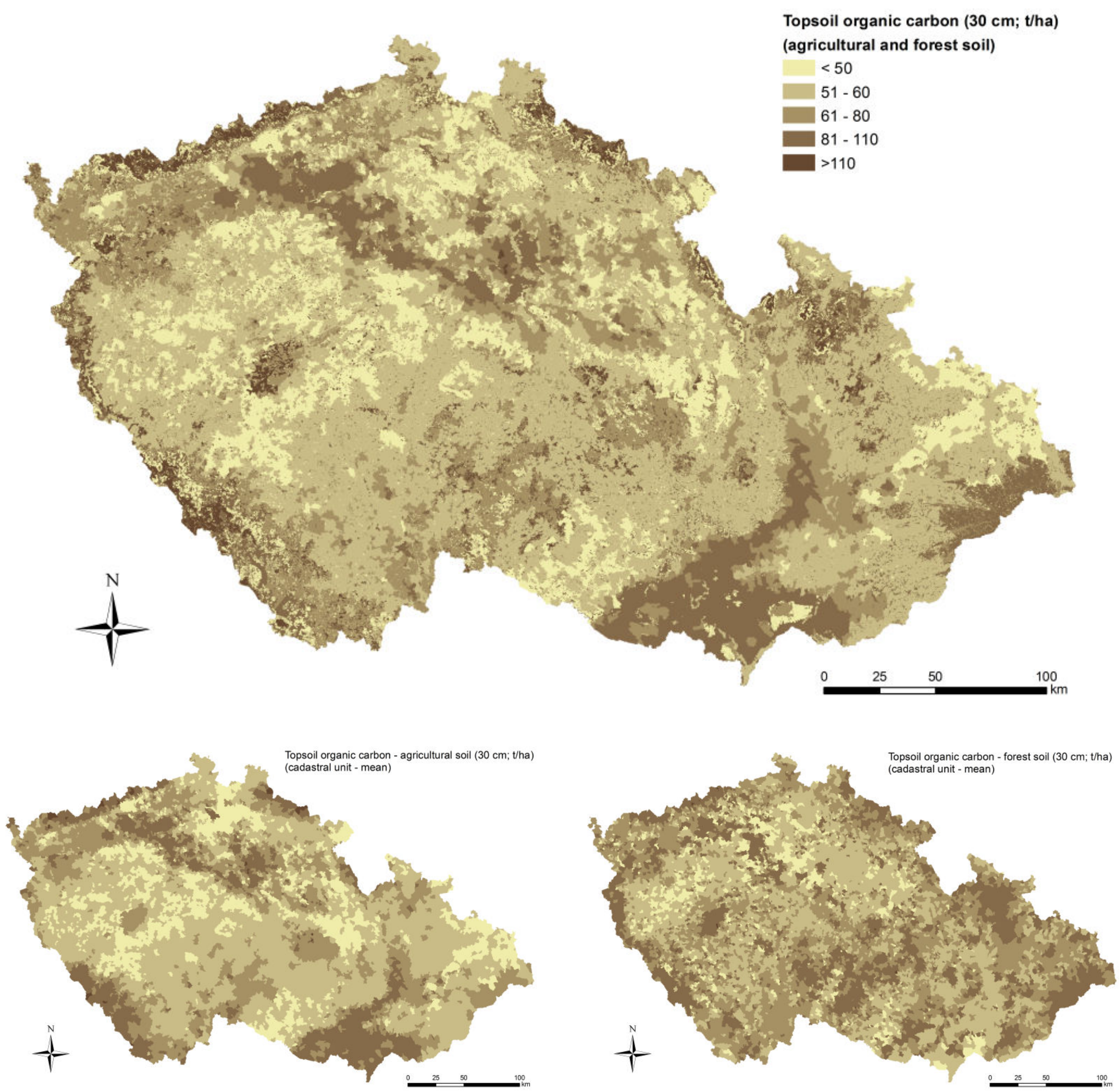

Fig. 7.7 Top - topsoil (30 cm) organic carbon content map adapted from Macků *et al*. (2007), Šefrna and Janderková (2007); bottom –topsoil carbon content for agricultural (left) and forest (right) soils estimated as cadastral unit means from the source maps. The unit (t/ha) and unit categories are identical for all maps.

The map constructed for forest soils utilized over six thousand soil samples, linking the forest ecosystem units - stand site types and ecological series available in maps 1:5 000 and 1:10 000, as used in the Czech system of forest typology (Macků *et al*. 2007). This represents the soil organic carbon content to a reference depth of 30 cm, including the upper organic horizon. The carbon content on agricultural soils was prepared so as to match the forest soil map in terms of reference depth and categories of carbon content, although based on interpretation of coarser 1:50 000 and 1:500 000 soil maps (Šefrna and Janderková 2007). The polygonal source maps were used to obtain the mean carbon content per individual cadastral unit (n=12 996 in 2007), serving as reference levels of soil carbon stock applicable to forest and agricultural soils. Since agricultural soils include both Cropland and Grassland land-use categories, the bulk soil carbon content obtained from the map was adjusted for the two categories. This was performed by applying a ratio of 0.85 relating the soil carbon content between Cropland and Grassland (J. Šefrna, personal communication 2007) and considering the actual areas of Cropland and Grassland in the individual cadastral units. This system permitted estimation of the soil carbon stock change among categories *5A Forest Land, 5B Cropland* and *5C Grassland*. The estimated quantities of carbon stock change at the level of the individual spatial units entered 20-year accumulation matrices distributing carbon into fractions over 20 years (Tier 1, IPCC 2003). These quantities, together with the accumulated areas under the specific conversion categories, were used for estimation of emissions and removals of CO_2.

The net changes of carbon stock in organic soils, occurring only in the sub-category of stands dominated by spruce, were assumed to be insignificant (zero). This is in accordance with the assumptions of the Tier 1 method (IPCC 2003).

Non-CO_2 emissions from burning are not estimated for category *5A2 Land converted to Forest Land*, as there is no such practice in this country. The same applies to the N_2O emissions from nitrogen fertilization, which is not employed in this country.

7.3.3 Uncertainty and time consistency

The methods used in this inventory were consistently employed across the whole reporting period from the base year of 1990 to 2007. The uncertainty estimation was guided by the Tier 1 methods outlined in GPG for LULUCF (IPCC 2003), employing the following equations:

$$U_{Total} = \sqrt{U_1^{\ 2} + U_1^{\ 2} + \ldots + U_n^{\ 2}} \qquad (4)$$

where U_{total} is the percentage uncertainty in the product of the quantities and U_i denotes the percentage uncertainties with each of the quantities (Eq. 5.2.1, IPCC 2003).

For the quantities that are combined by addition or subtraction, we used the following equation to estimate the uncertainty:

$$U_E = \frac{\sqrt{(U_1 * E_1)^2 + (U_2 * E_2)^2 + \ldots . + (U_n * E_n)^2}}{| E_1 + E_2 + \ldots . + E_n |} \qquad (5)$$

where U_E is the percentage uncertainty of the sum, U_i is the percentage uncertainty associated with source/sink *i*, and E_i is the emission/removal estimate for source/sink *i* (Eq. 5.2.2, IPCC 2003).

The uncertainty estimation utilized primarily the default uncertainty values as recommended by UNFCCC (2005) and IPCC (2003, 2006) that concern areas of land use (3 %), biomass increment (6 %), amount of harvest (20 %), carbon fraction in dry wood mass (2 %), root/shoot factor (30 %), and factor (1-f_{BL}; 75 %), used in calculation of emissions from forest fires. The uncertainty applicable to *BCEF* was 22 %, which was derived from the work of Lehtonen *et al*. (2007). The uncertainty associated with fractions of unregistered loss of biomass under felling operations was set by expert judgment at 30 %.

For 2007, the overall uncertainty for category *5A1 Forest Land remaining Forest Land* was estimated as 21 %. The corresponding uncertainty for the category *5A2 Land converted to Forest Land* reached 56 %. The overall uncertainty for the category *5A Forest Land* reached 21 %.

7.3.4 QA/QC and verification

Basically all the calculations are based on the activity data taken from the official national sources, such as the Forest Management Institute (Ministry of Agriculture), the Czech Statistical Office, the Czech Office for Surveying, Mapping and Cadastre (COSMC) and the Ministry of the Environment. Data sources are verifiable and updated annually. The gradual development of survey methods and implementation of information technology, checking procedures and increasing demand on quality result in increasing accuracy of the emission estimates. The QA/QC procedures generally cover the elements listed in Table 5.5.1 of GPG for LULUCF (IPCC 2003).

The input information and calculations are archived by the expert team and the coordinator of NIR. Hence, all the background data and calculations are verifiable.

Apart from official review process, emission inventory methods and results are internally reviewed among the technical experts involved in the emission inventory of the Agriculture and LULUCF sectors. Whenever feasible, the methods are subject to peer-review in case of the cited scientific publications, and expert team reviews within the relevant national research projects (CzechCARBO, CzechTERRA) funded by the Ministry of the Environment.

7.3.5 Recalculations

The category of Forest Land was recalculated for the whole time period, which concerned categories 5A1 and 5A2. This was required due to the further refined land-use change identification system including the treatment of unstocked cadastral forest land. Additionally, application of the revised age-dependent biomass expansion and conversion factors also affected the estimation of emissions and removals of greenhouse gases within the category of Forest Land remaining Forest Land. Overall for the *5A Forest Land* category, the estimated removals increased by 14.3 % compared to the previous estimates (Fig. 7.11).

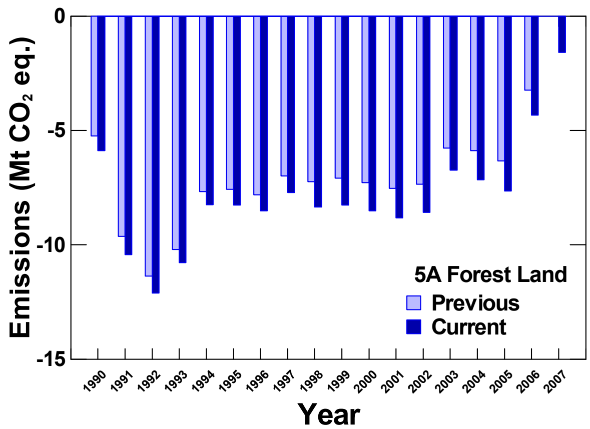

Fig. 7.8 Current and previously reported assessment of emissions for category 5A Forest Land. The values are negative, hence representing net removals of green-house gases.

7.3.6 Source-specific planned improvements

The current revision applicable for Forest Land and associated land-use change introduced improvements following the suggestions of the last in-country review, such as reporting emissions/removals by sub-categories of major tree species groups, revised categorization of land-use and an improved land-use determination system. Nonetheless, the category will require additional efforts to further consolidate the current estimates. This includes a further improvement of the uncertainty assessment, formalization and enhancement of QA/QC procedures. Over a longer term, utilization of the stock change method as explored in Cienciala *et al*. (2006) will be considered in connection with the data from the statistical forest inventory (see [10] above). This includes an assessment of how the data from the recently initiated statistical landscape inventory (CzechTerra, SP/2d1/93/07, funded by the Ministry of the Environment) could be utilized.

7.4 Cropland (5B)

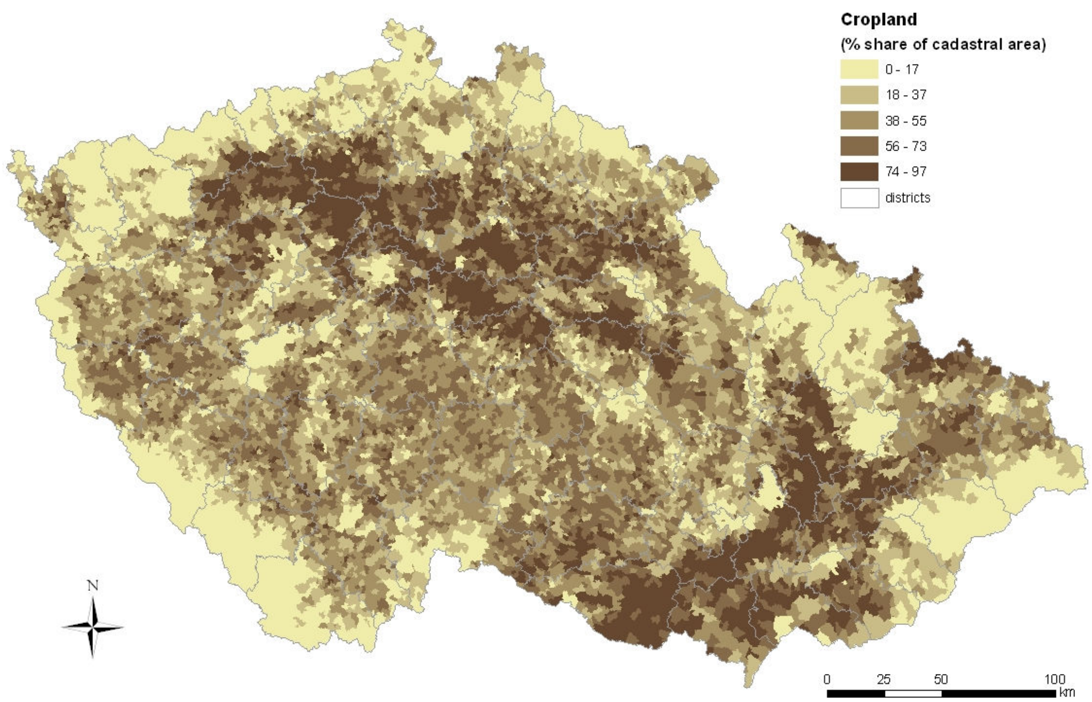

Fig. 7.9 Cropland in the Czech Republic – distribution calculated as a spatial share of the category within cadastral units.

7.4.1 Source category description

In the Czech Republic, Cropland is predominantly represented by arable land (93 % of the category), while the remaining area includes hop-fields, vineyards, gardens and orchards. These categories correspond to five of the six real estate categories on agricultural land from the database of “Aggregate areas of cadastral land categories” (AACLC), collected and administered by COSMC.

Cropland is spatially the largest land-use category in the country. Simultaneously, the area of Cropland has constantly decreased since the 1970s, with a particularly strong decreasing trend since 1990 (Fig. 7.3). While, in 1990, Cropland represented approx. 44 % of the total area of the country, this share decreased to nearly 41 % in 2007. It can be expected that this trend will continue. Agricultural methods are gradually becoming more effective and the current area of arable land is excessive. The conversion of arable land to grassland is also actively promoted by state subsidies. In addition, there is a growing demand for land for infrastructure and settlements. The current estimate of probable excess lands qualifying for conversion to other land-use in the near future is about 600 000 ha. Conversion to grassland concerns mainly the lands of less productive regions of alpine and sub- alpine regions.

7.4.2 Methodological aspects

The emission inventory of Cropland concerns sub-categories *5B1 Cropland remaining Cropland* and *5B2 Land converted to Cropland*. The emission inventory of Cropland considers changes in living biomass and soil. In addition, CO_2 emissions resulting from application of agricultural limestone and N_2O emissions associated with soil disturbance during land-use conversion to cropland are quantified for this category.

7.4.2.1 Cropland remaining Cropland

For category *5B1 Cropland remaining Cropland*, the changes in biomass can be estimated only for perennial woody crops. Under the conditions in this country, this might be applicable to the categories of vineyards, gardens and orchards. Hence, to estimate emissions associated with biomass on Cropland, we applied a default factor for the biomass accumulation rate (2.1 t C/ha/year, Table 3.3.2, IPCC 2003) and estimated changes in the areas concerned.

The carbon stock changes in soil in the category Cropland remaining Cropland are given by changes in mineral and organic soils. Organic soils basically do not occur on Cropland; they occur as peatland in mountainous regions on Forest Land. While organic soils practically do not occur on Cropland, emissions were estimated for mineral soils. Based on the average carbon content on Cropland estimated from the detailed soil carbon maps (Fig. 7.8), we applied the default relative stock change factors for land use (F_{LU},; 1.0), management (F_{MG} ; 1.08) and input of organic matter (F_I ; 1.0), respectively (Table 5.5; IPCC 2006). These differentiate management activities on individual Cropland subcategories, in our case arable land, hop fields and the sub-categories containing perennial woody crops. The average soil carbon on typical arable cropland, estimated as the area-weighted average from individual cadastral units, was 59 t/ha, while it was estimated as 63.7 t/ha for soils with woody vegetation, such as in orchards. The changes in soil carbon stock, associated with the annually changing proportion of land areas of cropland sub-categories, result in emissions/removals. These are calculated after redistribution of the estimated carbon stock change over a 20-year rolling period.

The Cropland category also includes emissions due to liming, which were estimated from the reported limestone use and application area. The application of agricultural limestone was previously intensive in this country, but decreased radically during the 1990s. Hence, the amount of limestone applied in 1990 equaled over 2.5 mil. tonnes, but decreased to less than 200 000 tonnes annually during the most recent years (see the corresponding CRF Tables). Liming by either limestone ($CaCO_3$) or dolomite ($CaMg(CO_3)_2$) is used to improve soil for crop growth by increasing the availability of nutrients and decreasing acidity. However, the reactions associated with limestone application also lead to evolution of CO_2, which must be quantified. Of the reported total limestone use in agriculture, 95 % was ascribed to Cropland (the reminder to Grassland), based on expert judgment (V. Klement, Central Institute for Supervising and Testing in Agriculture – personal communication, 2005). The quantification followed the Tier 1 method of GPG for LULUCF (Eq. 3.3.6 IPCC 2003), with an emission factor of 0.12 t C/t $CaCO_3$. Separate data are not available for limestone and dolomite, hence the aggregate estimates for total lime applications are reported.

Non-CO_2 greenhouse gas emissions from burning do not occur in category *5A2 Land converted to Forest Land*, as there is no such practice in this country.

7.4.2.2 Land converted to Cropland

Category *5B2 Land converted to Cropland* includes land conversions from other land-use categories. Cropland has generally decreased in area since 1990, by far most commonly converted to Grassland. However, the newly introduced land-use identification system was also able to detect some land conversion in the opposite direction, i.e., to Cropland.

The estimation of carbon stock changes in biomass in the category *5B2 Land converted to Cropland* was based on quantifying the difference between the carbon stock before and after the conversion, including the estimate of one year of cropland growth (5 t C/ha; Table. 3.3.8, IPCC 2003). This follows Tier 1 assumptions of GPG for LULUCF and the recommended default values for the temperate zone. For biomass carbon stock on Grassland prior the conversion, the default factors of 6.8 t/ha for above-ground and below-ground biomass were used (Table 6.4, IPCC 2006). For biomass carbon stock on *5A Forest Land* prior conversion, the annually updated average growing stock volumes, species-specific volume-weighted BCEF, and other factors such as the below-ground biomass ratio were used as described the *5A Forest Land* category in Section 7.2.2.1 above.

A biomass content of 0 t/ha was assumed after land conversion to *5B Cropland*.

The estimation of the carbon stock change in soils for the category *5B2 Land converted to Cropland* in the Czech Republic concerns mineral soils. The soil carbon stock changes following the conversion from Forest Land and Grassland were quantified by the country-specific Tier 2/Tier 3 approach is described in detail in Section 7.2.2.2 above.

The Land converted to Cropland category represents a source of non-CO_2 gases, namely emissions of N_2O due to mineralization. The estimation followed the Tier 1 approach of Eqs. 3.3.14 and 3.3.15 (IPCC 2003). Accordingly, N_2O was quantified on the basis of the detected changes in mineral soils employing a default emission factor of 0.0125 kg N_2O-N/kg N, and C:N ratio of 15.

Other non-CO_2 emissions may be related to those from burning. However, this is not common practice in this country and no other non-CO_2 emissions besides the above described are reported in the LULUCF sector.

7.4.3 Uncertainties and time series consistency

The methods used in this inventory were consistently employed across the whole reporting period from the base year of 1990 to 2007, which applies also for the land use category of Cropland. The uncertainty estimation was guided by the Tier 1 methods outlined in GPG for LULUCF (IPCC 2003) and described in Section 7.3.3. The uncertainty estimation utilized primarily the default uncertainty values as recommended by UNFCCC (2005) and IPCC (2003, 2006). The following uncertainty default values were used: land use areas 3 %, biomass accumulation rate 75 %, average above-ground to below-ground biomass ratio *R* (root-shoot-ratio) 100 %, average biomass stock 8 %, stock change factor for land use 50 %, stock change factor for management regime 5 %, amount of lime 10 %, emission factor for liming 5 % and reference biomass carbon stock prior and after land-use conversion 75 %. The uncertainty applicable to *BCEF* was 22 %, which was derived from the work of Lehtonen *et al*. (2007).

For 2007, the total estimated uncertainty for category *5B1 Cropland remaining Cropland* was 13 %. The corresponding uncertainty for category *5B2 Land converted to Cropland* was 19 %. The overall uncertainty for category *5B Cropland* was 12 %.

7.4.4 QA/QC and verification

The emission estimates are based on the activity data taken from the official national sources and follow the recommendations of GPG for LULUCF. The data sources are verifiable and updated annually. All the input information and calculations are archived by the expert team and the coordinator of NIR. Hence, all the background data and calculations are verifiable. Other QA/QC elements were adopted in the same manner as described in Section 7.3.4 above.

7.4.5 Recalculations

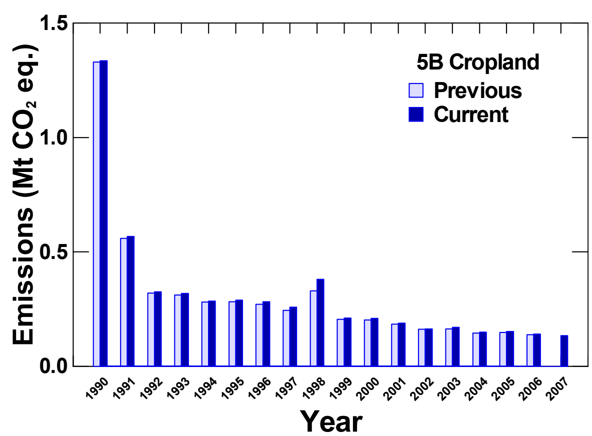

Fig. 7.10 Current and previously reported assessment of emissions for category 5B Cropland.

The category of Cropland was recalculated for the whole time series. This was mainly required due to application of an improved set of biomass conversion and expansion factors, which affected the emission estimates for land-use conversions involving forest land. The difference in emission estimates between the previous and current NIRs for category 5B Cropland for the entire reporting period are shown in Fig. 7.13. The difference in estimated emissions was an average of 3.36 %.

7.4.6 Source-specific planned improvements

Similarly as for other categories, additional efforts will be exerted to further consolidate the current estimates for Cropland. Specific attention will be paid to a further improvement of the uncertainty assessment, verification of the activity data and factors related to land management and overall formalization and enhancement of the QA/QC procedures.

7.5 Grassland (5C)

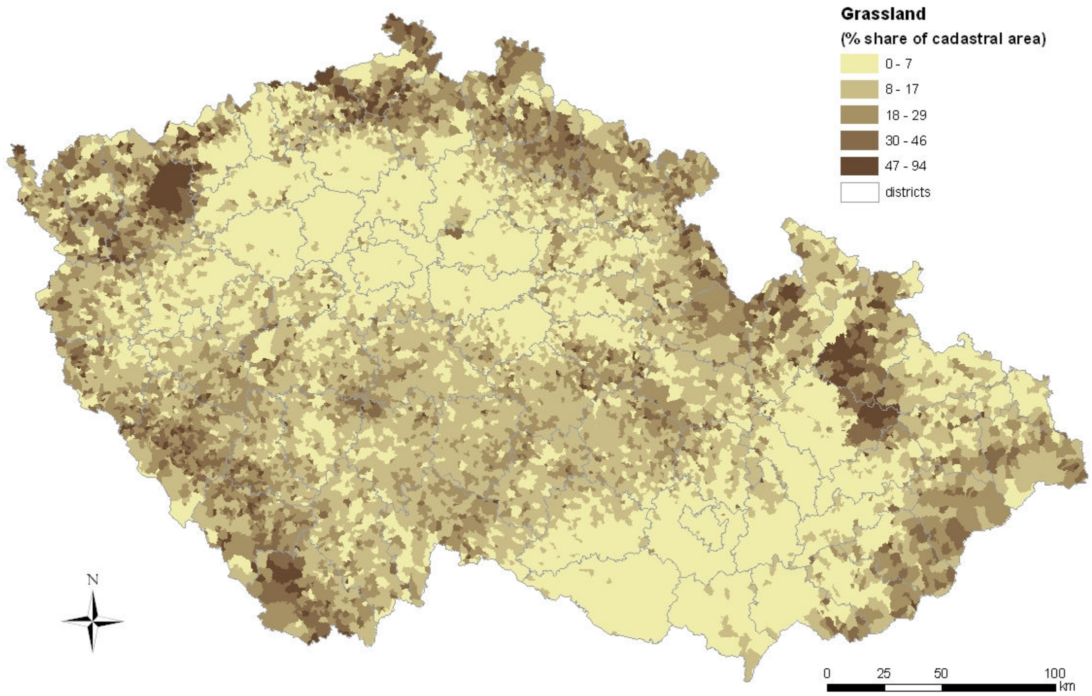

Fig. 7.11 Grassland in the Czech Republic – distribution calculated as a spatial share of the category within cadastral units.

7.5.1 Source category description

Through its spatial share of almost 14 % in 2007, the category of Grassland ranks third among land-use categories in the Czech Republic. Its area has been growing rapidly since 1990 (Fig. 7.3). Grassland as defined in this inventory corresponds to the grassland real estate category, one of the six such categories of agricultural land in the database of "Aggregate areas of cadastral land categories" (AACLC), collected and administered by COSMC. This land is mostly used as pastures for cattle and meadows for growing feed. Additionally, the fraction of permanently unstocked cadastral Forest Land is also included under Grassland. This is because it predominantly has the attributes of Grassland (such as land under power transmission lines).

The importance of Grassland will probably increase in this country, both for its production role and for preserving biodiversity in the landscape. According to the national agricultural programs, the representation of Grassland should further increase to about 18 % of the area of the country. The dominant share will be converted from Cropland, the share of which is still considered excessive. After implementation of subsidies in the 1990s, the area of Grassland has increased by almost 17 % (in 2007) since 1990.

7.5.2 Methodological aspects

The emission inventory of *5C Grassland* concerns sub-categories *5C1 Grassland remaining Grassland* and *5C2 Land converted to Grassland*. Similarly to *5B Cropland*, the emission inventory of *5C Grassland* considers changes in living biomass and soil. In addition, the effect of application of agricultural limestone is quantified for this category.

7.5.2.1 Grassland remaining Grassland

For category *5C1 Grassland remaining Grassland*, the assumption of no change in carbon stock held in living biomass was employed, in accordance with the Tier 1 approach of IPCC (2003). This is a safe assumption for the conditions in this country and any application of higher tier approaches would not be justified with respect to data requirements and the expected insignificant stock changes.

In this inventory, the emissions estimates from changes in soil carbon stock were estimated for category *5C1*. These changes are due to an effect of different management regimes and the changing proportion of the concerned subcategories of *5C1*. Specifically, the changes are estimated for permanently unstocked cadastral Forest Land, which has the attributes of unmanaged grassland and is treated accordingly in the emission estimates (see Section 7.3.1). Other land belonging to the category of Grassland is considered as typically managed grassland. The reference soil carbon stock for this category is estimated as area-weighted mean for all the individual cadastral units. The analogous mean carbon content for the category of unmanaged grassland is determined using the corresponding factors (Table 5.5; IPCC 2006). These included the stock change factor for land use (F_{LU}; 1.0), stock change factor for the management regime (F_{MG}; 0.95) and stock change factor for input of organic matter (F_I; 1.0). The estimated area-weighted average soil carbon stock for classically managed grassland was equal to 69 t C/ha, while that for unmanaged grassland was 65.5 t/ha. This is estimated for the whole reporting period and the soil carbon stock change was derived from the difference between the consecutive years. The changes in soil carbon stock associated with the annually changing proportion of land areas of cropland sub-categories result in emissions/removals. These are calculated after redistribution of the estimated carbon stock change over a 20-year rolling period.

Other explicitly quantified effect on soil carbon that results in CO_2 emissions is that of limestone application. This was quantified as described in Section 7.3.2.1 for *5B Cropland*. The applicable amount of limestone was set at 5 % of the reported limestone use on agricultural lands, based on expert judgment (V. Klement, Central Institute for Supervising and Testing in Agriculture – personal communication, 2005).

Non-CO_2 gases on category *5C1 Grassland remaining Grassland* do not concern the LULUCF sector in the Czech Republic.

7.5.2.2 Land converted to Grassland

For category *5C2 Land converted to Grassland*, the estimation concerns carbon stock changes in living biomass and soils. For living biomass, the calculation used Eq. 3.4.13 (IPCC 2003) with the assumed carbon content before the conversion of *5B Cropland* set at 5 t C/ha (Table 3.4.8; IPCC 2003) and that of Forest Land calculated from the mean growing stock volumes as described in Section 7.3.2.2 above. The biomass carbon content immediately after the conversion was assumed to equal zero and carbon stock from one-year growth of grassland vegetation following the conversion was assumed to be 6.8 t C/ha (Table 3.4.9; IPCC 2003).

The estimation of carbon stock change in soils for category *5C2 Land converted to Grassland* in the Czech Republic concerns the changes in mineral soils. The soil carbon stock changes following the conversion from *5A Forest Land* and *5B Cropland* were quantified by the country-specific Tier 2/Tier 3 approach described in detail in Section 7.2.2.2 above.

7.5.3 Uncertainties and time series consistency

Similarly as for other land-use categories, the methods used in this inventory for Grassland were consistently employed across the whole reporting period from the base year of 1990 to 2007. The uncertainty estimation was guided by the Tier 1 methods outlined in GPG for LULUCF (IPCC 2003) and described in Section 7.3.3. The uncertainty estimation utilized primarily the default uncertainty values as recommended by IPCC (2003, 2006). The following uncertainty default values were used: land use areas 3 %, average above-ground to below-ground biomass ratio *R* (root-shoot-ratio) 100 %, average biomass stock 8 %, stock change factor for land use 50 %, stock change factor for management regime 5 %, amount of lime 10 %, emission factor for liming 5 % and reference biomass carbon stock prior to and after land-use conversion 75 %. The uncertainty applicable to *BCEF* was 22 %, which was derived from the work of Lehtonen *et al*. (2007).

For 2007, the total estimated uncertainty for category *5C1 Grassland remaining Grassland* reached 11 %. The corresponding uncertainty for category *5C2 Land converted to Grassland* reached 14 %. The overall uncertainty for category *5C Grassland* also reached 14 %.

7.5.4 QA/QC and verification

The emission estimates are based on the activity data taken from the official national sources and follow the recommendations of GPG for LULUCF. Data sources are verifiable and updated annually. All the input information and calculations are archived by the expert team and the coordinator of NIR. Hence, all the background data and calculations are verifiable.

7.5.5 Recalculations

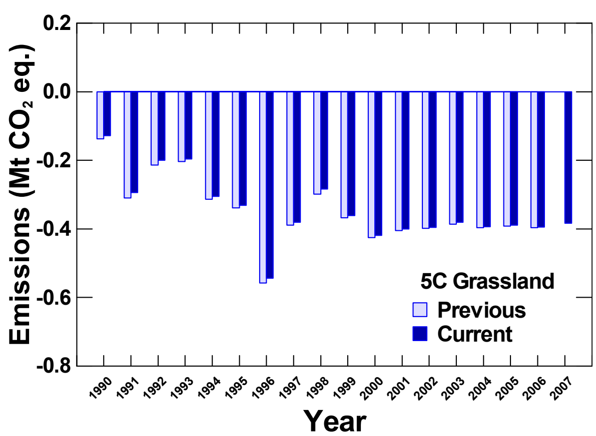

Fig. 7.12 Current and previously reported assessment of emissions for category 5C Grassland. The values are negative, hence representing net removals of green-house gases.

Similarly as for other categories, category *5C Grassland* was recalculated for the whole time period, which concerned both categories *5C1* and *5C2*. The currently recalculated emission estimates remain negative, i.e., represent a sink of GHGs for the entire reporting period. The new estimates are, on an average, smaller by about 2.6 %. These changes are due to the newly reported emissions from mineral soils in category *5C1* and the improved biomass expansion and conversion factors used in the land-use conversions including forest land.

7.5.6 Source-specific planned improvements

Further efforts to consolidate the emission estimates are expected for the category of Grassland. Specific attention will be paid to a refinement of the uncertainty assessment, verification of the activity data and factors related to land management and overall formalization and enhancement of the QA/QC procedures.

7.6 Wetlands (5D)

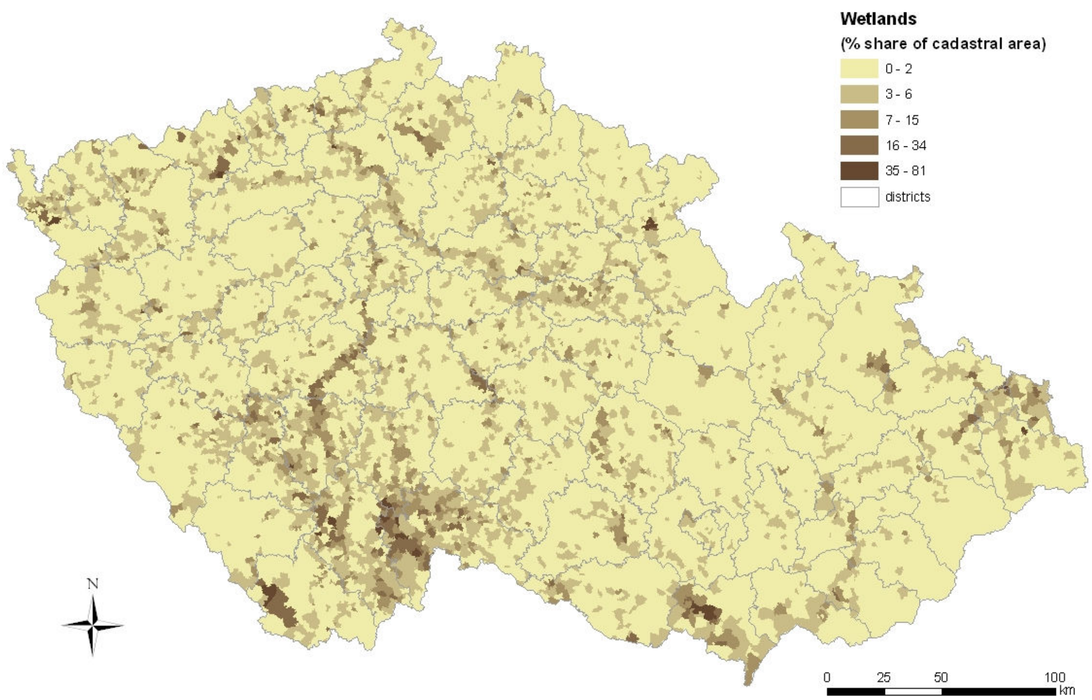

Fig. 7.13 Wetlands – distribution calculated as a spatial share of the category within cadastral units.

7.6.1 Source category description

Category *5D Wetlands* as classified in this emission inventory includes riverbeds, and water reservoirs such as lakes and ponds, wetlands and swamps. These areas correspond to the real estate category of water area of the "Aggregate areas of cadastral land categories" (AACLC), collected and administered by COSMC. It should be noted that there are about 11 wetlands identified as Ramsar[12] sites in this country. However, these areas are commonly located in several IPCC land-use categories and are not directly comparable with the actual content of the 5D emission category.

The area of *5D Wetlands* currently covers 2.0 % of the total territory. It has been growing steadily since 1990 (Fig. 7.3) with an even stronger trend since 1970. It can be expected that this trend will continue and that the area of Wetlands will increase further. This is mainly due to programs aimed at increasing the water retention capacity of the landscape[13].

[12] Convention on Wetlands, Ramsar, Iran, 1971

[13] Based on the land-use history, the growth potential could be considered to be rather large. For example, as of 1990, the category included 50.7 th. ha of ponds, which represented only 28 % of their extent during the peak period in the 16th Century (Marek 2002)

7.6.2 Methodological aspects

The emission inventory of sub-category *5D1 Wetlands remaining Wetlands* can address the areas in which the water table is artificially changed, which correspond to peat-land draining or lands affected by water bodies regulated through human activities (flooded land). Both categories are insignificant under the conditions in this country. Hence, the emissions for *5D1 Wetlands remaining Wetlands* were not explicitly estimated and they can safely be considered negligible.

Sub-category *5D2 Land converted to Wetlands* encompass conversion from *5A Forest Land*, 5B *Cropland* and *5C Grassland*. This is a very minor land-use change identified in this country, which corresponds to the category of land converted to flooded land. The emissions associated with this type of land-use change are derived from the carbon stock changes in living biomass. They were estimated using the Tier 1 approach and Eq. 3.5.6 of GPG for LULUCF, which simply relates the biomass stock before and after the conversion. The corresponding default values were employed: the biomass stock after conversion equaled zero, while the mean biomass stock prior to the conversion in the *5A Forest Land*, 5B *Cropland* and *5C Grassland* categories was estimated and/or assumed identically as described above in Sections 7.3.2.2 and 7.4.2.2.

7.6.3 Uncertainties and time series consistency

The methods used in this inventory for Wetlands were consistently employed across the whole reporting period from the base year of 1990 to 2007. Similarly as for the other land-use categories, the uncertainty estimation was guided by the Tier 1 methods outlined in GPG for LULUCF (IPCC 2003) and described in Section 7.3.3. It utilized primarily the default uncertainty values as recommended by IPCC (2003, 2006). The following uncertainty default values were used: land use areas 3 %, biomass, average biomass stock 8 %, stock change and reference biomass carbon stock prior and after land-use conversion 75 %, average above-ground to below-ground biomass ratio *R* (root-shoot-ratio) 100 %. The uncertainty applicable to *BCEF* was 22 %, which was derived from the work of Lehtonen *et al.* (2007).

Since the emission estimate concerns only category *5D2 Land converted to Wetlands*, the uncertainty is estimated for this category. For 2007, the estimated uncertainty for category *5D2* was 66 %.

7.6.4 QA/QC and verification

The emission estimates are based on the activity data taken from the official national sources and follow the recommendations of GPG for LULUCF. Data sources are verifiable and updated annually. All the input information and calculations are archived by the expert team and the coordinator of NIR. Hence, all the background data and calculations are verifiable.

7.6.5 Recalculations

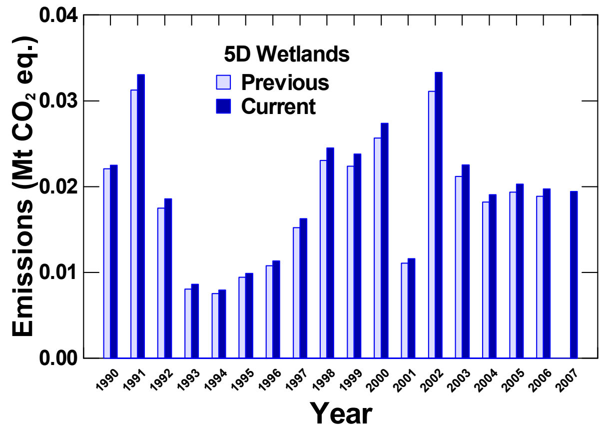

Fig. 7.14 Current and previously reported assessment of emissions for the category 5D Wetlands.

The category of *5D Wetlands* is a tiny source of emissions, reflecting the steadily increasing area of this category. The current recalculation resulted in slightly increased emission, namely by an average of 5.5 % during the reported period. The major reason for these changes lies in the refined biomass conversion and expansion factors employed in the category concerning Forest Land converted to Wetlands.

7.6.6 Source-specific planned improvements

For the category of *5D Wetlands*, we plan to provide an interpretation of the links between wetlands identified under Ramsar (see[12]) and the areas under the definition employed here. Attention will also be paid to a further improvement in the uncertainty assessment and overall formalization and enhancement of the QA/QC procedures.

7.7 Settlements (5E)

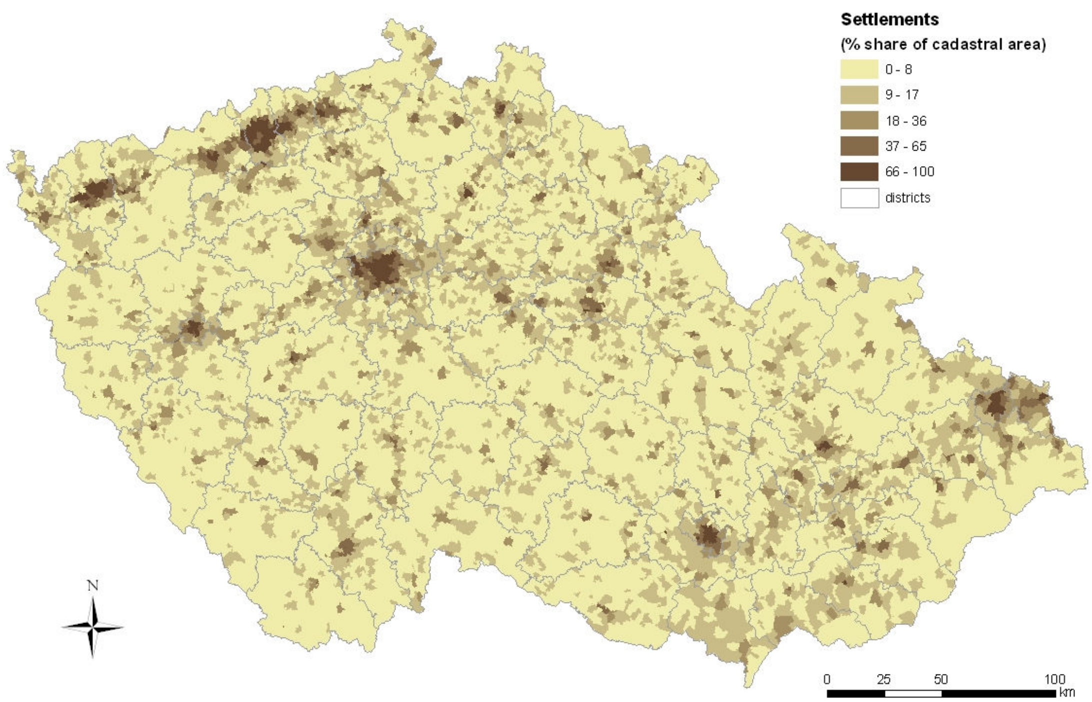

Fig. 7.15 Settlements – distribution calculated as a spatial share of the category within cadastral units.

7.7.1 Source category description

Category *5E Settlements* is defined by IPCC (2003) as all developed land, including transportation infrastructure and human settlements. For this emission inventory, the area definition under category *5E Settlements* was revised to better match the IPCC (2003) default definition. The category currently includes two categories of the database "Aggregate areas of cadastral land categories" (AACLC), collected and administered by COSMC, namely "Built-up areas and courtyards" and "Other lands". Of the latter AACLC category, all types of land-use were included with the exception of "unproductive land", which corresponds to category *5F Other Land*. Hence, the Settlements category also includes all land used for infrastructure, as well as that of industrial zones and city parks, previously included in category *5F Other Land*.

The currently defined category of Settlements represents about 8.5 % of the area of the country. The area of this category has increased since 1990 and especially during the most recent years (Fig. 7.3).

7.7.2 Methodological aspects

The emission inventory for this category concerns primarily *5E2 Land converted to Settlements*. As for category *5E1 Settlements remaining Settlements*, emissions of CO_2 were considered insignificant as no change in biomass, dead organic matter and soil carbon pools is assumed (Tier 1, IPCC 2006). Emissions quantified in this inventory concern Forest Land converted to Settlements. The emissions result from the biomass carbon stock change, which was quantified using Eq. 3.6.1 (IPCC 2003). The carbon stock prior conversion was estimated as described in Section 7.3.2.2. All biomass is assumed to be lost during the conversion, according to the Tier 1 assumption of GPG for LULUCF.

7.7.3 Uncertainties and time series consistency

The methods used in this inventory for *5E Settlements* were consistently employed across the whole reporting period from the base year of 1990 to 2007. The uncertainty estimation was guided by the Tier 1 methods outlined in GPG for LULUCF (IPCC 2003) and described in Section 7.3.3. It utilized primarily the default uncertainty values as recommended by IPCC (2003, 2006). The following uncertainty default values were used: land use areas 3 %, reference biomass carbon stock prior and after land-use conversion 75 %, average biomass stock 8 %, and average above-ground to below-ground biomass ratio *R* (root-shoot-ratio) 100 %. The uncertainty applicable to *BCEF* was 22 %, which was derived from the work of Lehtonen *et al*. (2007).

The emission estimate concerns only category *5E2 Land converted to Settlements*; therefore, the uncertainty is estimated only for this category. For 2007, the estimated uncertainty for the category *5D2* was 127 %.

7.7.4 QA/QC and verification

The emission estimates are based on the activity data taken from the official national sources and follow the recommendations of GPG for LULUCF. The data sources are verifiable and updated annually. All the input information and calculations are archived by the expert team and the coordinator of NIR. Hence, all the background data and calculations are verifiable. Other QA/QC elements were adopted in the same manner as described in Section 7.3.4 above.

7.7.5 Recalculations

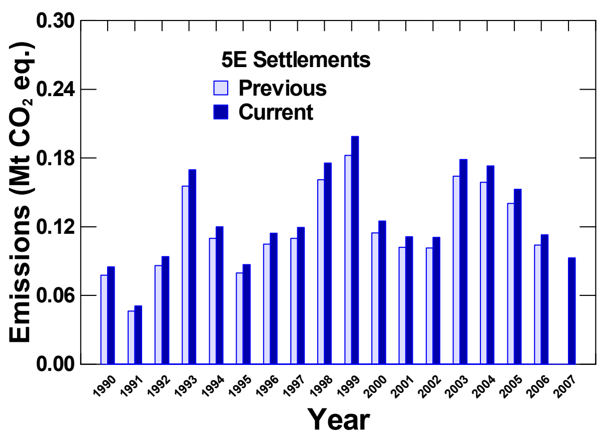

Fig. 7.16 Current and previously reported assessment of emissions for the category 5E Settlements.

The category of Settlements is a source of emissions. This is a result of the increasing area of this category at the expense of other land-use categories. The current recalculation was performed due to the adoption of the refined biomass expansion and conversion factors affecting emission estimates involving land-use conversions from Forest Land. Consequently, the currently estimated emissions are, on an average, 9.5 % higher as compared to the previous estimate for the entire reporting period.

7.7.6 Source-specific planned improvements

Further efforts to consolidate the emission estimates are expected for the category of Settlements. This will include an assessment of how the data from the recently initiated statistical landscape inventory (CzechTerra, SP/2d1/93/07, funded by the Ministry of the Environment) could be utilized. Attention will also be paid to further improvement of the uncertainty assessment, verification of the activity data and overall formalization and enhancement of the QA/QC procedures.

7.8 Other Land (5F)

7.8.1 Source category description

Based on the latest in-country review, the definition of *5F Other Land* was changed in the previous (2008) NIR submission. Since then, *5F Other Land* represents unmanaged (unmanageable) land areas, matching the IPCC (2003) default definition. These areas were assessed from the database of “Aggregate areas of cadastral land categories” (AACLC), collected and administered by COSMC. It is a part the AACLC category “other lands” with the specific land use category “unproductive land”, assessed from the 2006 land census of COSMC. This category represents 1.0 % of the territory of the country and it is considered to be constant, not involving any land-use conversions.

7.8.2 Methodological aspects

Change in carbon stocks and non-CO_2 emissions are not considered for *5F1 Other Land remaining Other Land* (IPCC 2003). Since no land-use conversion involving “other land” is assumed by this inventory, no emissions were considered in the entire category *5F Other Land*.

7.8.3 Uncertainties and time series consistency

The uncertainty estimates are not reported here. Time series consistency is ensured as the inventory approaches and/or assumptions are applied identically across the whole reporting period from the base year 1990 to 2007.

7.8.4 QA/QC and verification

The activity data are based on land-use information from the national sources and the estimation approaches follow the recommendations of GPG for LULUCF.

The QA/QC elements were adopted in the same manner as described in Section 7.3.4 above, limited to those relevant for this specific land-use category.

7.8.5 Recalculations

No recalculations concern category *5F Other Land*.

7.8.6 Source-specific planned improvements

There are no short-term plans concerning this category.

7.9 Acknowledgement

The authors would like to thank Vladimír Henžlík, formerly at the Forest Management Institute in Brandýs n. Labem, for some of the activity data used in this chapter and his expert advice. Thanks are also due to Jana Kučerová of the Institute of Forest Ecosystem Research in Jílové u Prahy, for her assistance. Some of the analyses required for this inventory were performed within the project CzechCARBO (VaV/640/18/03), funded by the Czech Ministry of the Environment.

8 Waste (CRF sector 6)

8.1 Overview

Waste sector consists from several categories. Main source category of this sector is 6A methane emission from solid waste disposal sites. In 2007 this category emitted 115 Gg of methane (2416 Gg of CO_2 ekv). Second source category is 6B emissions form wastewater, which is calculated as a sum of four subcategories – emissions of methane from industrial wastewater treatment, domestic wastewater treatment, on site treatment and emissions of nitrous oxide from wastewater. These subcategories summed up in 2006 emitted 24.5 Gg of methane and 0.65 Gg of N_2O (715 Gg of CO_2 ekv.). Last source category in this sector is incineration of municipal, clinical and hazardous waste which produced in total 418 Gg of fossil CO2 this inventory year. In total sector 6 produced 3475 Gg of CO_2.

Tab. 8.1 Overview of significant categories in this sector (2007)

Category	Character of category	Gas	% of total GHG*
6A Solid Waste Disposal on Land	KC (LA, TA, LA*, TA*)	CH_4	1.60
6B Waste Water Handling	non-KC	CH_4	0.35
6C Waste Incineration	KC (TA, TA*)	CO_2	0.27
6B Waste Water Handling	non-KC	N_2O	0.13

* assessed without considering LULUCF

KC: key category,LA, LA*: identified by level assessment with and without considering LULUCF, respectively

TA, TA*: identified by trend assessment with and without considering LULUCF, respectively

CHMI cooperated in compilation of emission inventory from this sector with professional workplaces, in particular with the Institute for Environmental Science of the Faculty of Sciences at Charles University in Prague (PřFUK) (Havránek, 2001), the University of Chemical Technology (VŠCHT) (Zábranská, 2002; Zábranská, 2004) and Institute for Research and Use of Fuels in Prague Běchovice (ÚVVP) (Straka, 2001). In the framework of this cooperation, all the emission inventories in this category were recalculated for the entire time series from the reference year of 1990 to the present. At the present time, this sector is managed by the Charles University Environmental Center (CUEC).

8.2 Solid Waste Disposal on Land (6A)

8.2.1 Source category description

Treatment and disposal of municipal, industrial and other solid waste produces significant amounts of methane (CH_4). Decomposition of organic material derived from biomass sources (e.g., crops, wood) is the primary source of CO_2 released from waste. These CO_2 emissions are not included in national totals, because the carbon is of biogenic origin and net emissions are accounted for under land use change and forestry.

This category produces emissions of other micropollutants such as non-methane volatile organic compounds (NMVOCs) as well as smaller amounts of nitrous oxide (N_2O), nitrogen oxides (NO_x) and carbon monoxide (CO). In this report only CH_4 is addressed.

8.2.2 Methodological issues

Key activity data for methane quantification from 6.A is amount of waste disposed in to landfills. Share on total is shown in Tab. 8.1. Annual disposal is shown in Fig. 8.1. Data for annual disposal are from mixed sources because for correct application of FOD model one needs data from 1950 to present days. These data are not available in the country therefore assumptions about past must be used. These assumptions are described in the working paper published on this issue (Havránek, 2007).

Tab. 8.2 Municipal waste utilization and disposal practices in the Czech Republic *[Gg]*, 2007[14]

Total disposal and utilisation	Utilisation of waste as a fuel (R1)	Recovery of organic substances (R3)	Recycling of inorganic matter (R4-R5)	Use of waste for reclaiming landscape (N1)	Depositio n under ground (Landfilling) (D1)	Biological treatment (D8)	Treatment by soil processes (D2)	Combusti on on land (D10)	Physical-chemical treatment (D9)	Other cate-gories
4130	375	105	81	112	3315	20	0	2	6	0
100%	9%	2%	2%	3%	80%	0%	0%	0%	0%	0%

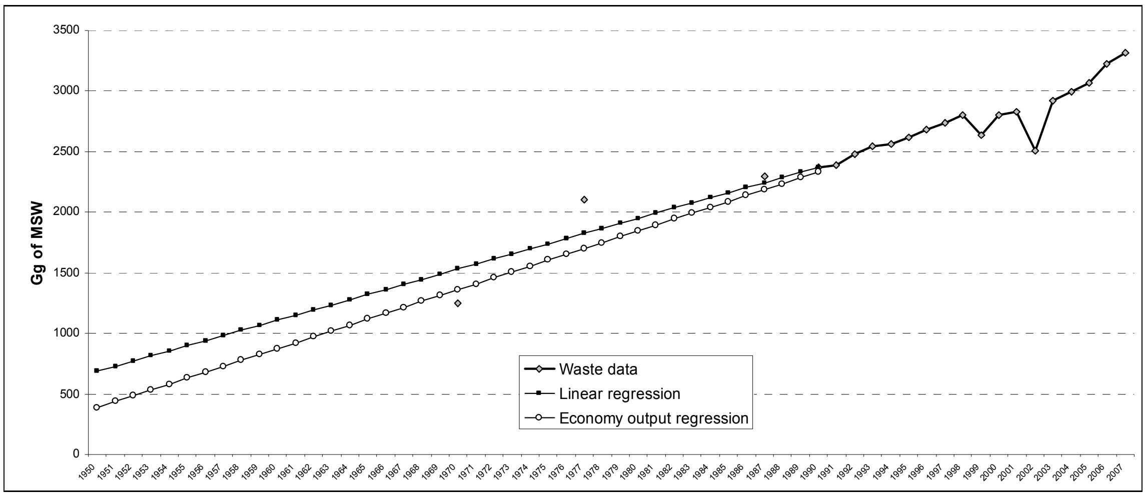

Fig. 8.1 Waste disposal in to landfills 1950-2007, Czech Republic.

The method we are using for estimation of methane emissions from this source category is tier 2 FOD approach (First order decay model). In new methodology it is actually basic tier for this category. First order decay (FOD) model assumes gradual decomposition of waste disposed to landfill. For calculation of GHG emissions from we used IPCC Spreadsheet for Estimating Methane emissions from Solid Waste Disposal Sites which is part of new methodology guidelines IPCC, 2007 (referred further on as IPCC model, 2006).

Waste composition

Waste composition is also problematic for the same reason as the amount of waste. No data are available on the waste composition in 1950 and there are also no data that can be quoted and taken as representative for the country in the following years. Some measurements have been performed but seem to be rather local and the general Municipal Solid waste (MSW) composition can differ substantially. Therefore, we assumed that the waste composition (waste stream percentages) is same as the reference IPCC values for Eastern Europe. We also assume (due to the lack of national data) that this composition was similar throughout the entire time series. The composition distribution is given in Tab. 8.3.

[14] Preliminary data

Tab. 8.3 Default waste composition for the Eastern Europe (IPCC model, 2006)

Food	30 %	Textile	4.5 %
Garden	0 %	Nappies	0 %
Paper	22 %	Plastics, other inert	36 %
Wood	7.5 %		

Organic carbon

Information on the waste composition is useful only if we know how much organic carbon a particular waste stream contains. For this estimation, the author used the default values suggested by IPCC. The default value was also used for the fraction of Degradable Organic Carbon (DOC) that actually decomposed ($DOC_f = 0.5$).

Methane generation rate

The methane generation rate (k) is closely related to the particular substance and the available moisture. For the FOD equation, the author used the rates for particular waste streams (wood, paper etc.) based on the default IPCC values for defined climatic conditions (see Tab. 8.4).

Tab. 8.4 Degradable organic carbon fraction – wet waste (IPCC model, 2006)

	Range	Default	Used values
Food waste	0.08-0.20	0.15	0.15
Garden	0.18-0.22	0.2	0.2
Paper	0.36-0.45	0.4	0.4
Wood and straw	0.39-0.46	0.43	0.43
Textiles	0.20-0.40	0.24	0.24
Disposable nappies	0.18-0.32	0.24	0.24

The average annual temperature in the Czech Republic is about 7 °C. The annual precipitation is higher than potential evapotranspiration. Therefore, the author used the values for a wet temperate climate, which are given in Tab. 8.5.

Tab. 8.5 IPCC Climate Zone Definitions (IPCC model, 2006)

	Mean annual temperature	Mean annual precipitation	Mean annual precipitation / Potential evapotranspiration
Dry temperate	0 - 20°C		<1
Wet temperate	0 - 20°C		>1
Dry tropical	> 20°C	<1000 mm	
Moist and wet tropical	> 20°C	>1000 mm	

Methane correction factor

Methane correction factor (MCF) is a value that expresses overall management of the landfills in the country. Better-managed and deeper landfills have larger MCF values. Shallow SWDS ensure that there is far more oxygen penetrating into the landfill body to aerobically decomposes DOC. The suggested IPCC values are given in a Tab. 8.6. Because landfill management has changed during the period of interest, Tab. 8.7 includes various assumptions associated with this factor. Data on MCF before 1993 are based on expert judgment. No data about unmanaged SWDS were available for 1993, so no data were included for this year.

Tab. 8.6 Methane correction values (IPCC, 1996)

	MCF
Unmanaged, shallow	0.4
Unmanaged, deep	0.8
Managed	1.0
Managed, semi-aerobic	0.5
Uncategorised	0.6

Tab. 8.7 Used MCF values in time, 1950-2007

	MCF
1950 – 1959	0.6
1960 – 1969	0.6
1970 – 1979	0.8
1980 – 1989	0.9
1990 – 2007	1.0

Oxidation factor

As methane moves from the anaerobic zone to the aerobic and semi-aerobic zones close to the landfill surface, part of it becomes oxidized to CO_2. There is no conclusive agreement in the scientific community on how intensive the oxidation of methane is. Oxidation is indeed site-specific due to the effects of local conditions (including fissures and cracks, compacting, landfill cover etc.). No representative measurement or estimations of oxidation factor are available for the Czech Republic. Some studies are quoted in Straka, 2000 that mention a non-zero oxidation factor, but these figures seem to be site-specific and therefore cannot be used as representative for the whole country. However, the methodology (IPCC, 2000) suggests that an oxidation factor higher than 0.1 should not be used if no site measurements are available (a larger value adds uncertainty). The author used the recommended oxidation factor of 0.1 in our assessment.

Delay time

When waste is disposed in SWDS, decomposition (and methanogenesion) does not start immediately. The assumption employed in the IPCC model is that the reaction starts on the first of January in the year after deposition, which is equivalent to an average delay time of six months before decay to methane commences. It is good practice to assume an average delay of from two to six months. If a value greater than six months is chosen, evidence to support this must be provided. The Czech Republic has no representative country-specific value for delay time, so the author used a default value of 6 months.

Fraction of methane

This parameter indicates the share (mass) of methane in the total amount of *Landfill Gas* (LFG). In previous calculations of methane emissions from SWDS (NIR, 2004), a value 0.61 was used. This figure was based on measurement of a limited number of sites (Straka, 2000). This value is higher than the range of 0.5-0.6 suggested by IPCC. In this work, we revised these values based on new evidence (MTI, 2005). MTI receives annual reports from landfills capturing their LFG; SWDS report the gross calorific value of their captured LFG. We used this value for comparison with the gross calorific value of pure methane, yielding a value 0.55, which was used in the quantification.

Recovered methane

Methane that is collected by an artificial system and incinerated (e.g. for energy purposes) is not considered as an emission of GHG (due to the biogenic origin of the carbon). Recovered methane (R) is used in the equation in Appendix 1. There is no default value for R, so the author used country estimates based on Straka, 2000 and MPO, 2005[15]. Values for particular years are shown in Table 7 of calculation spreadsheet, CH_4 recovery column.

Total emissions of methane are based on the equation from the IPCC CH_4 model. Detailed time series from 1950 with breakdown into individual waste components is given in the paper by Havranek 2007, together with the other model outputs. Tab. 8.8 gives the trends in emissions of methane from SWDS following recalculation.

Tab. 8.8 Emissions of methane from SWDS *[Gg]*, Czech Republic, 1990-2007

	CH_4 generation	CH_4 recovery	CH_4 oxidized	CH_4 emission
1990	91	-3	-9	79
1991	95	-3	-9	83
1992	99	-4	-10	86
1993	103	-4	-10	89
1994	107	-4	-10	93
1995	110	-4	-11	96
1996	114	-6	-11	97
1997	118	-12	-11	95
1998	121	-13	-11	97
1999	125	-14	-11	100
2000	127	-13	-11	102
2001	130	-14	-12	105
2002	133	-16	-12	106
2003	135	-16	-12	107
2004	138	-16	-12	109
2005	141	-17	-12	112
2006	145	-19	-13	113
2007	149	-21	-13	115

8.2.3 Uncertainties and time-series consistency

Due to lack of country specific data there is uncertainty of the default values. In Havranek, 2007 there is sensitivity analysis for several key factors and assumption, but overall quantification of uncertainties is lacking. This is considered a high priority and will be conducted in following years as soon as budget constrains allows that. Due to application of new tier and whole subcategory recalculation we may state that this category is methodologically consistent. Inconsistencies in data sources are inherent to long time of activity data series and can’t be solved other way than uncertainty assessment in total emission

8.2.4 QA/QC and verification

Activity data coming from national agencies and ministries are subjects of internal QA/QC mechanisms. Recalculation that is fully described in Havranek, 2007 was approved by in country review team in 2007.

8.2.5 Recalculations

No recalculation took place in this category this year.

[15] Data up to 2002 are based on Straka, 2000, year 2002 is expert estimate based on trend and 2003 on is based on MPO 2005.

8.3 Waste-water Handling (6B)

8.3.1 Source category description

This category has CRF code 6B and consists of four separately calculated sub-categories – emissions of methane from *6B1 Industrial Wastewater*, *6B2 Domestic and Commercial Waste Water* and *6B3 Other (Treatment on site)* and emissions of nitrous oxide from *6B2 Domestic and Commercial Waste Water*.

8.3.2 Methodological issues

The basic factor for determining methane emissions from wastewater handling is the content of organic pollution in the water. The content of organic pollution in municipal wastewater and sludge is given as BOD_5 (the biochemical oxygen demand). BOD is a group method of determination of organic substances and expresses the amount of oxygen consumed in the biochemical oxidation, and is thus a measure of biologically degradable substances. In contrast, COD (chemical oxygen demand) is the amount of oxygen required for chemical oxidation and includes both biologically degradable and biologically non-degradable substances. COD is used according to the *Revised 1996 IPCC Guidelines*, 1997 for calculation of methane emissions from industrial wastewater and is always larger than BOD.

The current IPCC methodology employs BOD for evaluation of municipal wastewaters and sludge and COD for industrial wastewaters. The new method is also extended to include determination of emissions from sludge that are primarily the products of various methods of treatment of wastewaters and, under anaerobic conditions, may contribute to methane production and methane emissions. The amount of nitrous oxide emitted from wastewaters is a function of protein consumption in the population rather than BOD or COD.

8.3.2.1 Industrial wastewater (6B1)

The main activity data for estimation of methane emission from this subcategory is determination of the amount of degradable pollution in industrial wastewater. In this inventory we use specific production of pollution - the amount of pollution per production unit - kg COD / kg product and then we multiply it by the production, or from the overall amounts of industrial wastewater and from a qualified estimate of their concentrations (in kg COD/m^3). We use the procedure from the IPCC methodology (*Revised 1996 IPCC Guidelines*, 1997; *Good Practice Guidance*, 2000). The necessary activity data were taken from the material of CZSO (*Czech Statistical Office*) (*Statistical Yearbook* 2005, 2005) and the other parameters required for the calculation were taken from the IPCC *Good Practice* (*Good Practice Guidance*, 2000). On the basis of information on the total amount of industrial wastewater of 178 mil.m^3 (actually only 176 mil.m^3 were treated) (*Environmental Statistical Yearbook* 2007, 2008), it was also possible to determine "unidentified" amount of wastewater (300 thous.m^3), which were assigned an average concentration of 3 kg COD/m^3. In addition, it was estimated, in accordance with (*Revised 1996 IPCC Guidelines*, 1997), that the amount of sludge equals 10% of the total pollution in industrial water (25% was assumed in Meat & Poultry, Paper and Pulp and in Vegetables, Fruits & Juices category) these estimates are based on Dohanyos and Zábranská, 2000; Zábranská, 2002; Zábranská, 2004, see Tab. 8.9.

Tab. 8.9 Estimation of COD generated by individual sub-categories 2007

	Production [kt/year]	COD/m^3 [kg /m^3]	Wastewater/t [m^3/t]	Share of sludge [%]	COD of sludge [t]	COD of wastewater [t]
Alcohol Refining	59	11.0	24.00	0.10	1 552	13 969
Dairy Products	1117	2.7	7.00	0.10	2 111	18 995
Malt & Beer	2355	2.9	6.30	0.10	4 303	38 724
Meat & Poultry	415	4.1	13.00	0.25	5 533	16 600
Organic Chemicals	168	3.0	67.00	0.10	3 383	30 445
Pet. ref./Petrochemicals[16]	0	1.0	0.60	0.10	0	0
Plastics and Resins	1096	3.7	0.60	0.10	243	2 190
Pulp & Paper	752	9.0	162.00	0.25	274 039	822 118
Soap and Detergents	29	0.9	3.00	0.10	7	67
Starch production	83	10.0	9.00	0.10	748	6 733
Sugar Refining	383	3.2	9.00	0.10	1 103	9 927
Textiles(natural)	40	0.9	172.00	0.10	616	5 547
Vegetable Oils	111	0.9	3.10	0.10	29	263
Vegetables, Fruits & Juices	109	5.0	20.00	0.25	2 713	8 140
Wine & Vinegar	60	1.5	23.00	0.10	206	1 857
Unidentified wastewater	387	3.0	1.00	0.10	116	1 046
Total					**296 704**	**976 622**

Tab. 8.10 Parameters for CH_4 emissions calculation from industrial wastewater 1990-2007

	MCF	1990	1993	1996	1999	2002	2005	2007
Non-treated	0.05	29 %	18 %	13 %	5 %	7 %	3 %	1 %
Aerobic treatment of water	0.06	67 %	73 %	70 %	70 %	65 %	68 %	69 %
Anaerobic treatment of water	0.70	4 %	8 %	17 %	25 %	28 %	29 %	30 %
Aerobic treatment of sludge	0.10	40 %	40 %	40 %	40 %	30 %	27 %	27 %
Anaerobic treatment of sludge	0.30	60 %	60 %	60 %	60 %	70 %	73 %	73 %

In accord with (*Good Practice Guidance*, 2000), the maximum theoretical methane production B_0 was considered to equal 0.25 kg CH_4/kg COD. This value is in accordance with national factors presented in Dohanyos and Zábranská, 2000.

The calculation of the emission factor for wastewater is based on a qualified estimate of the ratio of the use of individual technologies during the entire recalculated time series. In the future, this ratio will shift towards anaerobic treatment of wastewater and sludge because of the energy advantages of this means of treating wastewater. Tab. 8.9 describes this trend. The conversion factor for anaerobic treatment is 0.06 and, for aerobic treatment 0.7.

In contrast to a quite stable for technologies for treating wastewater (6.B.2), ratio used for sludge keeps shifting in favor to anaerobic treatment. This is mostly due its economic efficiency. The calculation of the emission factor for sludge was based on the assumption that 27% is treated anaerobically with a conversion factor of 0.3 and the remaining 73 % by other, especially aerobic methods with a conversion factor of 0.1. Similarly as in the 6.B.2, it is assumed that all the methane from the anaerobic processes is burned (mostly usefully in cogeneration units, as flaring is used less and less and cogeneration technology seems to be economically effective); however, in contrast to

[16] Due to changes in statistical data we are unable to identify Pet. ref./Petrochemicals and Plastics and Resins anymore and they are summed up in unidentified waste water category.

municipal water, methane from anaerobic sludge and wastewater is included. This assumption is based on national standards and regulations presented in subchapter below (Zábranská, 2004). For the calculation of the methane emissions is sufficient to consider only aerobic processes (where the methane is not oxidized to biological CO_2). Experts at the *University of Chemical Technology* recommended the conversion factors and other parameters given in this part, see (Dohanyos and Zábranská, 2000; Zábranská, 2004).

Tab. 8.11 Emissions of CH_4 (Gg) from 6B1, 1990-2007, Czech Republic

	1990	2000	2001	2002	2003	2004	2005	2006	2007
CH_4 production	49.8	63.5	66.4	77.4	75.4	77.4	76.9	80.6	80.9
Oxidized CH_4	25.3	50.3	55.5	64.5	63.0	65.0	64.7	67.9	68.1
Total CH_4 emissions	24.5	13.3	10.9	12.9	12.3	12.2	12.1	12.7	12.3

8.3.2.2 Municipal and commercial wastewater treatment (6B2) and treatment on site (6B3)

The basic activity data (and their sources) for determining emissions from these subcategories are as follows:

- the number of inhabitants (source Czech Statistical Office);
- the organic pollution produced per inhabitant (source IPCC default value);
- the conditions under which the wastewater is treated. (source Czech Statistical Office, with some specific national factors);
- the amount of proteins in the diet of the population (source FAO).

Calculations for conditions in this country are based on pollution production per inhabitant of 18.25 kg BOD p.a. (Revised 1996 IPCC Guidelines, 1997), of which approx. 33% is present in the form of insoluble substances, i.e. is separated as sludge. This factor was slightly changed in 2003 year mainly due to increasing water savings in water use (aprox. 10-20%). Total amount of organic pollution is constant, but density is higher than for period before 2003. From year 2003 onwards we assume that 40% of BOD is separated as sludge. (Zábranská, 2004).

Another data entering the calculation are also the number of inhabitants connected to the sewers and the percent of treated wastewater collected in the sewers. Tab. 8.6 gives shows amount for the time series.

According to the IPCC Good Practice (Good Practice Guidance, 2000), the maximum theoretical methane production B0 equals 0.25 kg CH_4/kg COD, corresponding to 0.6 kg CH_4/kg BOD. This data is used to determine the emission factors for municipal wastewater and sludge. In determining the emission factor for sludge, it is necessary to evaluate the technology used to treat the particular sludge and to assign a conversion factor to it - MCF - Methane Conversion Factor - giving the part of the organic material that will be transformed as methane (the remainder to CO_2). Refs. (Dohanyos and Zábranská, 2000; Zábranská, 2004) give a survey of the nationally specific factors for the ratio of aerobic and anaerobic technologies for the 1990-2004, given in Table 8.7. There is also a certain fraction of wastewater that does not enter the sewer system and is treated on site. For this situation, the IPCC methodology (Revised 1996 IPCC Guidelines, 1997; Good Practice Guidance, 2000) recommends that separation into wastewater and sludge not be carried out (this corresponds to latrines, septic tanks, cesspools, etc.). The residual wastewater in the Czech Republic which does not enter the sewer system is considered to be treated on site. All methane generated in anaerobic processes for sludge is considered to be removed (recovered for energy purposes or flared). Remaining methane is considered to be emitted. This assumption is based on Czech national standards (to certain degree similar to ISO standards) CSN 385502, CSN 105190 and CSN 756415. On the basis of these standards, every wastewater treatment facility is obliged to maintain safety and abate gas emission. Leakage might occur only during accidents, but the amount of methane emitted is assumed to be insignificant (the estimate by expert judgment is less than 1% of the total amount) (Zábranská, 2004).

In the estimation of methane emissions from wastewater and sludge, it is necessary to determine the total amount of organic substances contained in them and to determine (estimate) the emission factors for the individual means of wastewater treatment. For this purpose, professional cooperation was undertaken with the *University of Chemical Technology* and a study was carried out (Havránek, 2001), supplementing an earlier study (Zábranská, 2002) and related to a new study (Zábranská, 2004).

Tab. 8.12 Population connection to sewers and share of treated water, 1990-2006, Czech Republic

	Total population (thous. pers.)	Sewer connection (%)	Water treated (%)		Total population (thous. pers.)	Sewer connection (%)	Water treated (%)
1990	10 362	72.6	73.0	**1999**	10 282	74.6	95.0
1991	10 308	72.3	69.6	**2000**	10 272	74.8	94.8
1992	10 317	72.7	78.7	**2001**	10 224	74.9	95.5
1993	10 330	72.8	78.9	**2002**	10 201	77.4	92.6
1994	10 336	73.0	82.2	**2003**	10 202	77.7	94.5
1995	10 330	73.2	89.5	**2004**	10 207	77.9	94.9
1996	10 315	73.3	90.3	**2005**	10 234	79.1	94.6
1997	10 303	73.5	90.9	**2006**	10 267	80.0	94.2
1998	10 294	74.4	91.3	**2007**	10 323	80.8	95.8

(Source: CSO)

Tab. 8.13 Methane conversion factors (MCF) and share of individual technology types [%], 1990-2005

	MCF	1990	1993	1996	1999	2002	2005	2007
On-site treatment[17]	0.15	100	100	100	100	100	100	100
Discharged into rivers	0.05	27	21	10	5	7	5	4
Aerobic water	0.05	48	54	65	70	68	72	73
Anaerobic water	0.50	25	25	25	25	25	23	23
Aerobic sludge	0.10	45	40	35	30	20	15	15
Anaerobic sludge	0.50	55	60	65	70	80	85	85

The method of quantification is described in the IPCC guidelines as a tier 1 approach and in this subcategory we follow it without any modification. The amount of methane emitted from 6B2 is given by the equation:

$$\textbf{Total Gg CH}_4\textbf{ p.a.} = \textbf{Gg CH}_{4\,(tos)} + \textbf{Gg CH}_{4\,(wwt)} + \textbf{Gg CH}_{4\,(sld)} - \textbf{R}$$

Where *tos* is the part of the wastewater treated on site, *wwt* is the part treated as wastewater and *sld* is the part treated as sludge. R is the recovered methane (flared or used as gas fuel). Each part (*tos, wwt, sld*) is calculated as the share of this part in the organic pollution (according to Tab. 8.13), multiplied by an emission factor.

Particular MCFs are calculated as a weighted average – thus, the *wwt* emission factor is, in fact, the maximum methane capacity multiplied by the weighted average of MCF for aerobic, anaerobic and river discharge treatment options. The results for 2006 are presented in Tab. 8.14.

[17] Amount of organic pollution associated to this technology is average pollution per capita multiplied by amount of people not connected to sewers (Tab. 8.12)

Tab. 8.14 Emissions of CH_4 and N_2O *[Gg]* from 6B2 and 6B3, 1990-2006, Czech Republic

	1990	2000	2001	2002	2003	2004	2005	2006	2007
CH_4 production	22.3	23.9	24.9	25.1	27.0	27.0	27.3	27.5	27.7
Oxidized CH_4	7.4	9.7	11.1	11.4	14.8	14.8	15.1	15.3	15.5
Total CH_4 emissions	14.9	14.3	13.9	13.8	12.3	12.3	12.2	12.2	12.2
Total N_2O emissions	0.52	0.65	0.64	0.64	0.64	0.64	0.64	0.65	0.65

Determination of N_2O emissions from municipal wastewater is part of a broader complex of calculations, concerned particularly with the area of agriculture. Tier 1 calculation is based on the number of inhabitants and estimation of the average annual protein consumption. The N_2O emissions according to the *Revised 1996 IPCC Guidelines*, 1997 would then equal:

$$\mathbf{N_2O\ emissions = 10\ 323\ 000 \times 25 \times 0.16 \times 0.01 \times 44 / 28 / 1\ 000\ 000 = 0.65\ Gg}$$

The values of 0.16 kg N/kg protein and 0.01 kg N_2O-N/kg N correspond to the mass fraction and standard recommended emission factor. The amount of proteins consumed in the Czech Republic is derived from the nutrition statistics of FAO (Faostat, 2005).

8.3.3 Uncertainties and time-series consistency

This particular category is methodologically consistent and each year is quantified using same method. Data sources for methane activity data are the same and therefore we may assume activity data consistency in time as well. There is very few national specific factors used (mainly share of each treatment technology in the country) and most of activity data are based on statistics of central statistical office.

Consistency of time series can be disturbed by non-continuous change in technology share which is based on particular studies in time and as happened in case of industrial water by change of activity data from survey, where statistical office may deny access to data that are part of business secret.

Consistency of N_2O quantification is disturbed by switch of activity data source in 2000 (global nutrition values were substituted by country specific protein consumption) which led to slight increase in this subcategory. There is plan to smooth the trend and recalculate this according to new data, but due to overall insignificance of this sub-category is on low priority at the moment.

Uncertainty of the most factors (default IPCC values) is determined in IPCC guidelines. Whole uncertainty of the source category is not quantified yet and there is outlook to implement software tool to do this in following years.

8.3.4 QA/QC and verification

Activity data are taken from official channels (Czech Statistical Office). Quality assurance of the activity data is guaranteed by the data provider - the Czech Statistical Office; the use of standardized comprehensive methodology harmonized with the EU is guaranteed. However, this office does not calculate or publish inaccuracy or uncertainty values for their data.

8.3.5 Recalculations

There were no recalculations from the last NIR.

8.4 Waste incineration (6C)

8.4.1 Overview

This category contains emissions from waste incineration in the Czech Republic. Types of waste incinerated include municipal solid waste (MSW), industrial waste, hazardous waste, clinical waste and sewage sludge. Waste incineration is defined as the combustion of waste in controlled incineration facilities. Modern waste incinerators have tall stacks and specially designed combustion chambers, which ensure high combustion temperatures, long residence times, and efficient waste agitation while introducing air for more complete combustion. This category includes emissions of CO_2 and N_2O from such practices.

8.4.2 Source category description

Incineration of municipal solid waste does not have a long tradition in the Czech Republic. The first incinerator plant was built in 1989 in Brno (SAKO a.s.). Since then, two other incinerators have been built - one in Liberec (TERMIZO) and the newest one in 1998 in Prague (Pražské služby a.s.). The total capacity of municipal waste incinerators in the Czech Republic is given in Tab. 8.15.

Tab. 8.15 Capacity of municipal waste incineration plants in the Czech Republic, 2007

Incinerator	Capacity (Gg)
TERMIZO	96
Pražské služby a.s.	310
SAKO a.s.	240

There are also 76 other facilities incinerating or co-incinerating industrial waste with a total capacity 600 Gg of waste. Most of this capacity is not used.

8.4.3 Methodological issues

Consistent with the 1996 Guidelines (IPCC, 1997), only CO_2 emissions resulting from oxidation, during incineration and open burning of carbon in waste of fossil origin (e.g., plastics, certain textiles, rubber, liquid solvents, and waste oil) are considered in net emissions and should be included in the national CO_2 emissions estimate.

Estimation of CO_2 emissions from waste incineration is based on the tier 1 approach (*Good Practice Guidance*, 2000). It assumes that total fossil carbon dioxide emissions are dependent on the amount of carbon in waste, on the fraction of fossil carbon and on the combustion efficiency of waste incineration. As no country-specific data were available for the necessary parameters the calculation default data was taken from the IPCC Good Practice Guidance (*Good Practice Guidance*, 2000), see Tab. 8.16. Data for 2003 are given in Tab. 8.17 and the model equation for the category of municipal waste is given in a box below the table.

Tab. 8.16 Default data used for emission of CO_2 from waste incineration (*Good Practice Guidance,* 2000)

	Amount of carbon fraction	Fossil carbon fraction	Combust efficiency
Municipal Solid Waste	0.4	0.4	0.95
Clinical Waste	0.6	0.4	0.95
Hazardous Waste	0.5	0.9	0.995
Sludge Waste	0.3	0	0.95

Tab. 8.17 Various waste type incinerated (*ČSÚ, MoE, hazardous waste disposal in 2007*)

	Gg of waste
Municipal Solid Waste	382
Clinical Waste	2
Hazardous Waste	105

Based on the suggested range of emission factors (*Good Practice Guidance*, 2000, waste chapter) we estimated the N_2O emission from waste incineration in the Czech Republic. The suggested emission factor range for grate furnace incineration of waste is between 5.5- 66 kg of N_2O per Gg of incinerated MSW. We used the suggested average value of 35 kg of N_2O per Gg of waste. Data on incinerated waste were taken from Tab. 8.17.

$$\mathbf{N_2O \text{ emissions} = MSW \times EF / 1000\,000 = 382 \times 35 / 1000000 = 0.013 \text{ Gg of } N_2O}$$

Using GWP of 310 for N_2O, **0.014 Gg** equals **4.14 Gg** of CO_2 equivalents.

Tab. 8.18 Emissions of GHG *[Gg]* from 6C, 2003-2007

	2003	2004	2005	2006	2007
CO_2 emissions	245.78	225.53	232.99	212.82	210.8
N_2O emissions	0.015	0.014	0.015	0.013	0.013

8.4.4 Uncertainties and time-series consistency

The new methodological approach (tier 1) was adopted in the previous year and so far only the time series for 2003 has been recalculated. We plan to recalculate the whole time series from 1990 to improve the methodological consistency of this source category. This task has moderate priority. New IPCC methodologies (IPCC, 2007) also include a method for estimation of CH_4 from waste incineration and in time we plan to enlarge this category for the additional gas. However, the estimated small amount of the gas in the total gives this low priority.

8.4.5 QA/QC and verification

Activity data are taken from the official channels (Czech Statistical Office). Quality assurance of the activity data is guaranteed by the data provider - the Czech Statistical Office; the use of standardized comprehensive methodology harmonized with the EU is guaranteed. However, this office does not calculate or publish the inaccuracy or uncertainty of their data. We cross-check data on incineration of MSW with companies.

8.4.6 Recalculations

There were no recalculations from last year.

9 Recalculations

9.1 History of Czech Inventories

The first attempt of compilation of a complete Czech GHG Inventory was done in 1994 as a part of the "Country study project" supported by the U. S. Government. This Inventory was based on an older version of the IPCC Methodology and was prepared by non-governmental organization SEVEn in co-operation with CHMI (Tichý *et al*, 1995).

The first version of the Czech GHG Inventory compiled by CHMI under the supervision of the Ministry of Environment was prepared in 1995 and 1996 for 1990 - 93 and 1994 - 1995 periods, respectively (Fott et al, 1995, 1996). Both inventories were based on the former version of the IPCC Methodology and were considerably inspired by the "Country study", in both the positive and the negative sense. Relevant emissions / removals estimates for the 1990 - 1995 period were also summarized in the *Second National Communication* in 1997.

Older results presented before 1997 were distorted by some imperfections and gaps due to application of the older version of the IPCC guidelines and application of obsolete national studies concerning agriculture and waste sectors. The chief imperfections can be characterized in this way:

A) All N_2O emission were completely distorted: while N_2O emission from fuel combustion were significantly overestimated by using EFs based on the obsolete CORINAIR90 guidebook, emissions from agriculture were, on the contrary significantly underestimated using the older version of the IPCC Guidelines (as is explained in Chapter 6).

B) Methane emissions from agriculture based on the older national study issued even before the first version of the IPCC methodology (only the draft version was available) appear out-of-date at the present time. Emission estimates based on this study are rather underestimated in comparison with other European countries. This case is analyzed in detail in Chapter 6. In contrast to N_2O, where the relevant methodology was changed for data after 1996, updating of the CH_4 data series for enteric fermentation and manure management has been completed only recently.

Other imperfections were of less importance but not negligible, so that they had to be addressed. Some examples are listed bellow:

1. The former estimates of CH_4 from the waste sector, using activity data based mainly on expert judgment rather than on more rigorous statistics, was later found not to be in accordance with the (*Good Practice Guidance*, 2000)
2. More relevant country specific data were obtained for CH_4 emissions from deep coal mining in 1997, resulting in somewhat lower estimates
3. It was found after editing the (*Revised 1996 IPCC Guidelines*, 1997) that the Sectoral approach for CO_2 used for the 1990 - 1995 period is not quite perfect and in accordance with the Revised Guidelines. On the other hand, the Reference approach was used properly.

The editing the *Revised 1966 IPCC Guidelines* in 1997 formed a good basis for analyzing imperfections in inventories. Subsequently, specifically topics A), 2) 3) and 4), occurring in the first GHG inventories for 1990 - 1995 data, were immediately revised and employed in inventories for data after 1996. Revision of data for CH_4 from Waste (topic 1) was carried out later, based on Good Practice (*Good Practice Guidance*, 2000).

The described recalculations are summarized below (see Tab. 9.1).

9.2 Overview of Recalculations

9.2.1 *Previous recalculations*

A survey of the most important recalculations carried out so far is given in the following table.

Tab. 9.1 Survey of previous recalculations

Year of recal-culation	Recalculated years	Recalculated category	Reason of recalculation	Reporting of recalculated results
1997	1990 - 95	CH_4 from coal mining, 1B1	National EFs were evaluated (see topic 2 from the previous page)	3rd National Communication, 1999 Submission 2002 for UNFCCC Explained in NIR
2001	1995 - 1998	HFCs, PFCs, SF_6	Identified gaps in import data	3rd National Communication, 2001 Submission 2002 for UNFCCC
2002	1990 - 2000	CH_4 from Waste	Application of Good Practice (see topic 1 from the previous page)	Submission 2002- 2006 for UNFCCC Explained in NIR
2002-2005	1990 - 1995	N_2O from all sources	Application of Revised IPCC Guidelines (see topic A from the previous page)	Submissions 2002 - 2006 for UNFCCC Explained in NIR
2002-2005	1990 - 1995	CO_2 from Energy	Sectoral Approach from Revised Guidelines applied (see topic 3 from previous page)	Submissions 2002 - 2006 for UNFCCC Explained in NIR

Cases of recalculations summarized above and other previous revisions are explained in more detail in Chapters 3 - 8.

9.2.2 *Recent recalculations*

Many gaps and imperfections were identified in the past few years and the relevant recalculations were carried out but were not yet reported in former submissions. Implementation of the new official software - CRF Reporter appeared to be a good opportunity to report these recalculations, because reporting of recalculated data is much easier in this system. Introduction of EU ETS according to Directive 87/2003/EC was another important impetus to supplement existing inventories, especially in the area of mineral processes. On the other hand, recalculations and revisions in LULUCF were motivated by the necessity to properly implement the supplemented IPCC methodology (*Good Practice in* LULUCF, 2003).

<u>Summary of recent recalculations and revisions for the 1990-2004 period reported in submission 2006 (before Initial Report)</u>

On the basis of the results of the QA/QC procedures to date and in connection with the conclusions of the international review organized by UNFCCC, the Czech team has performed the relevant recalculations or rearrangements in the following subcategories:

- Rearrangement of emissions from non-energy use of fuels (production of iron and steel, production of ammonia) from category 1A Fuel Combustion Activities to category 2 Industrial processes, specifically 2C1 and 2B1)

- Recalculation of emissions of methane from 4 Agriculture (enteric fermentation and manure management) using the procedures described in the IPCC Good Practice (Good Practice Guidance, 2000)
- Rearrangement of CO2 emissions from sulphur removal from coal combustion from category 1B1c to category 2A3 Limestone and Dolomite Use.
- Adding a new source (gap filling) to category 2A3 Limestone and Dolomite Use – emissions from limestone and dolomite use in sinter plants.
- Recalculation of CO2 emissions from category 2A1 Cement Production using Tier 2 methodology based on the cement clinker production data.
- Recalculation of CO2 emissions from category 2A2 Lime Production using data on lime and hydrated lime production and lime use.
- Adding a new source (gap filling) to category 2A7.2 Brick and Ceramics – emissions from decarbonization and fossil-organic material oxidation.
- Revision and recalculation of CO2 series for 2A7.1 Glass Production.
- Use of new Tier 2 methodology – "Actual emissions" for all relevant categories of F-gases.
- LULUCF: all previously reported categories under LUCF were recalculated. They concern i) recalculations of CO2 emissions related to carbon stock change in the previous LUCF category 5A Changes in Forest and Other Woody Biomass Stocks, currently within LULUCF category 5A Forest Land, Carbon Stock Change; ii) recalculations of CH4 and N2O emissions from controlled burning, which was previously included in LUCF category 5F Other Land), currently under the LULUCF category 5A Forest Land, Biomass Burning
- Revision and recalculation of CH4 series for 1B2b (Fugitive emissions – Natural gas)

Recalculations and revisions for the 1990-2005 period reported in submission 2007 (not responding "in-country" review of *Initial report*)

Only a few recalculations were carried out in the previous - 2007 submission, which had in most cases only little effect on resulting emissions:

Energy

In energy sector (1A) so far not reported activity data for 1996 and 1997 were submitted this year (submission 2007). In the same time, complete recalculations of emissions in years 1996 and 1997 for sector 1A using definitive energy balance was accomplished. It leads to differences 3.7 % for 1996 and -3.5% for 1997 in the total (aggregated) GHG emission (excluding LULUCF).

Industrial processes

In this submission only a small correction in SF_6 emissions from the subcategory "Sound-Proof Windows" was accomplished due to improvement of relevant EF. The differences from former values were in all cases less than 1 kt CO_2 eq per year.

LULUCF

A new item included in this inventory was the estimation of emissions associated with burning from wildfires. These emissions concern the quantities of CO_2 and non-CO_2 gases (CH_4, N_2O) generated in the category *5A1 Forest Land remaining Forest Land*, and are correspondingly pronounced in higher categories. A minor adjustment was made in estimation of soil carbon stock change for all land use conversions involving cropland due to adjusted factor used in calculations; see Chapter 7.3.5 of previous NIR for details.

9.2.3 Recalculations taking into consideration the “in-country review” in 2007

To summarise what is important concerning recent and new recalculations - there were two important “waves” of recalculations: (i) in the 2006 submission before the Initial Report under the Kyoto Protocol (the *Czech Republic’s Initial Report under the Kyoto Protocol*, 2006) and (ii) now, in the 2008 submission, as a consequence of the “in-country” UNFCCC review that took place in March 2007. The second item (ii) is discussed in the following paragraphs.

As a result of the above-mentioned review, the Czech Republic was asked by the Expert Review Team (ERT) to perform extra instant revisions (during 6 weeks) to prevent possible adjustment:

- To use the country-specific emission factor for CO2 for coals instead of the default values to be in line with the IPCC Good Practice Guidance
- To use the IPCC default emission factors for CH4 and N2O for stationary fuel combustion instead of the former national values because of lack of transparency
- To apply the Tier 2 approach (FOD) instead of Tier 1 for CH4 emissions from landfills to prevent possible overestimation of the base year (the amount of municipal waste land-filled has gradually increased since the 1960s).

These invitational revisions and other recommendations of ERT were taken into account in this (2008) submission and the relevant values were inserted in the CRF for respective time interval (for the invitational revisions mentioned above, all the data have been inserted for the period since 1990).

To be more specific, important new recalculations were performed in following sectors:

Energy

In accordance with the ERT requirement, the recommended recalculations based on the official data from the final CSO balance have been performed since 1998. Simultaneously, older data previous to 1998 were also controlled and minor corrections were introduced in some cases.

In addition, thorough recalculation has been performed in the transport sector (1A3) since 2000, to be fully consistent with the CDV methodology. Simultaneously, it was necessary to ensure interconnection with the former methodology used in 1990 – 1995. For air transport, activity data from CSO was harmonized with the data from the statistics for air transport, newly establishing the borderline between national and international air transport.

Industrial processes

In subsector 2C (production of iron and steel), two kinds of data related to coke were differentiated in accordance with ERT: to begin with, data corresponding to coke consumption in blast furnaces, employed for determination of CO_2,and also data for production of coke in coking chambers, related to methane emissions.

Agriculture

The recalculations of 4.D.1.5 “Cultivation of Histosols” were performed in the 2008 submission. Following the 2006 in-country review, the Czech emission inventory team verified the activity data required for this category and found that the previously reported data based on expert judgment of areas could not be confirmed and verified from the official statistics. According to the new expert common consensus, there are no cultivated histosols on agricultural land in the country and hence also no data for this category.

LULUCF

Practically all the items concerning the LULUCF sector were recalculated for this submission. This was required due to the implementation of the refined land use identification system, providing improved area estimates for all the land-use categories and for the entire reporting period. Additionally, several land-use definitions and factors used in emission estimation procedures were revised. This inventory also consequently employs the 20-year default rolling period for converted lands. The effects of these revisions on emission estimates are shown in relation to the previous estimates in the graphs and are discussed in the text under the corresponding LULUCF chapters.

Waste

On the basis of the recommendations of the international ERT inspection team, the methodology was changed from Tier 1 to Tier 2 for calculation of methane emissions from category *6A Solid Waste Disposal on Land*. The new method calculates the dynamics of the decomposition processes in landfills and thus provides not only better estimates of current conditions, but also reliable models for future developments. The entire time series was recalculated according to the new methodology.

9.2.4 New recalculations performed in this submission

Energy – stationary sources

As refined activity data were obtained for 2006 from the final energy balance, recalculation was performed for practically all stationary sources in 2006. However, the recalculation was not related to the emission factors employed, but only new activity data were used.

Energy – mobile sources

In the framework of the submission, in addition to calculation of emissions of greenhouse gases from mobile sources for 2007, complete recalculation of the time series of emissions from mobile sources was performed retroactively for 2000 – 2006. The recalculations were performed because of the availability of new, more exact input data on fuel consumption and fuel calorific value. These data are determined in the framework of statistical surveys by the Czech Statistical Office. Another reason lay in the necessary recalculation of the emission factors of the individual defined categories of vehicles from g/MJ to g/kg of fuel, as the database of emission factors of the Centrum dopravního výzkumu, v.v.i. (Transport Research Centre) contains mainly data related to units of fuel consumed.

The new calorific values for the fuels did not differ much from the original values (for example, automotive gasoline now has a calorific value of 43.8 MJ/kg, while this was formerly 43.32 MJ/kg), but contributed to better data consistency with the time series, manifested in homogenization of the "implied emission factor" parameter.

The calculated greenhouse gas emissions per unit of consumed energy have better values when based on this recalculation, as the inter-annual differences in these values decreased for the individual greenhouse gases. Both the energy consumptions and the emissions of carbon dioxide, methane and nitrogen monoxide were recalculated.

Industrial processes

The recalculations of 2.A.2 Lime production were performed in the 2008 submission. Following the 2006 in-country review and 2008 centralized review, the Czech emission inventory team has carefully checked all the parameters of the emission estimates and decided that removals will not be take into account. The methodology is based on the IPCC GPG supplement with national EF, which reflects production of lime and quick lime (0.7884 t CO2 / t lime) and the average purity (93%). Emission estimates were checked against EU ETS data.

Agriculture

On the basis of the recommendations of the ERT, the units of milk production were changed to the required units (litters/day/head) for the entire reported period of 1990-2007 in 4.A./Cattle CRF Tables.

The sub-category *Other livestock (Manure Management* category*)* was regrouped to two categories as required by the ERT. Now the N_2O emissions from horses and goats are reported as emissions from two individual groups of animals, applying the IPCC Tier 1 method and the 1996 IPCC default values. The total emissions from this category were not affected.

In accordance with verification, older data previous to 2006 were verified and minor corrections were introduced in some cases:

1. In sub-category 4.D.1.3.N-fixing Crops, year 2002, the value of N_2O emissions was corrected to 0.06521625
2. In sub-category 4.A. Cattle/Non-dairy cattle the values of Average gross energy intake for 2005 and 2006 were corrected.

LULUCF

Category *5A* Forest Land was recalculated for the whole time period, which affected both sub-categories *5A1* and *5A2*. This was required due to the further refined land-use change identification system and application of revised age-dependent biomass expansion and conversion factors.

Category *5B* Cropland was recalculated for the whole time series. This was required due to application of an improved set of biomass conversion and expansion factors, which affected the emission estimates for land-use conversions involving forest land.

Category *5C* Grassland was also recalculated for the whole time series. This was required due to the newly reported emissions from mineral soils in category *5C1* and the improved biomass expansion and conversion used in the land-use conversions including Forest Land.

Categories *5D* Wetlands and *5E* Settlements were recalculated for the whole time period. This was required due to the improved biomass expansion and conversion used in the land-use conversions involving Forest Land.

Detailed explanations of these recalculations are given in the relevant sectoral chapters.

10 References

2006 IPCC Guidelines for National Greenhouse Gas Inventories, Vol. 1-5, IPCC 2006

Adamec V., Dufek J., Jedlička J.: *Study of trends in transport in 2001 from the standpoint of the environment,* Transport Research Centre (CDV), Brno, May 2002 (in Czech)

Adamec V., Jedlička J., Dufek J. et al: *Study of trends in transport in 2004 from the standpoint of the environment,* Transport Research Centre (CDV), Brno, May 2005a (in Czech)

Adamec V., Dufek J., Jedlička J.: *Inventories of emissions of GHG form transport ,* Report of CDV for CHMI, Transport Research Centre, Brno, November 2005b (in Czech)

Alfeld, K.: *Methane Emissions Produced by the Gas Industry Worldwide*, IGU Study Group 8.1: Methane emissions, Essen, January 1998

Cienciala E., Henžlík V., Zatloukal V.: *Assessment of carbon stock change in forests – adopting IPCC LULUCF Good Practice Guidance in the Czech Republic*. Forestry Journal (Zvolen), 52(1-2): 17-28, 2006a.

Cienciala E., Cerny M., Tatarinov F., Apltauer A. and Exnerova Z. Biomass functions applicable to Scots pine. Trees 20: 483-495, 2006b.

Cienciala E., Apltauer J.: *Additional Information to LULUCF activities arising from the Kyoto protocol*. Report to the Czech Ministry of Environment, 2007 (In Czech).

Cienciala E., Apltauer J., Exnerova Z. and Tatarinov F. Biomass functions applicable to oak trees grown in Central-European forestry. Journal of Forest Science 54, 109-120, 2008.

Commentary on the emission inventory of NMVOC for 2004 in the sector "Solvent use and applications - 060000", SVÚOM Ltd. Prague, October 2005 (in Czech)

Czech Republic's Initial report under the Kyoto Protocol. Ministry of Environment of the Czech Republic, Prague, October 2006

Czech Hydrometeorological Institute*: Czech Informative Inventory Report (IIR) 2007, Submission under the UNECE / CLRTAP Convention,* Prague*,* March 2009

Czech Statistical Office*: Energy Balance of the Czech Republic in 2003, 2004, 2005, part 8 - Energy,* Prague, 14 March 2007

Czech Statistical Office*: Energy Balance of the Czech Republic in 2004, 2005, 2006 part 8 - Energy,* Prague, 31 March 2008 (http://www.czso.cz/csu/2008edicniplan.nsf/engpubl/8106-08-2004,_2005,_2006)

Černý, M.: *Use of the growth models of main tree species of the Czech Republic in combination with the data of the Czech National Forest Inventory*. In: Neuhöferová P (ed) The growth functions in forestry. Korf´s growth function and its use in forestry and world reputation. Kostelec nad Černými lesy, Prague 2005 (in Czech).

Černý, M., Pařez, J., Malík, Z.: *Growth and yield tables for the main tree species of the Czech Republic*. App. 3, Ministry of Agriculture, Czech Forestry Act 84/1996, Praha 1996 (In Czech),

Černý, M.: *Biomass of Picea abies (L.) Karst. in Midwestern Bohemia*. Scand.J.For.Res. 5, 83-95, 1990.

Černý, M., Pařez, J., Zatloukal, V.: Growing stock estimated by FNI CR 2001-2004. Lesnická práce, 9 (85): 10-12, 2006.

Dohányos M., Zábranská J.: *Proposals for refining the calculation of methane emissions from municipal and industrial wastewater*; Report for CHMI, Prague 2000 (in Czech)

Dolejš: *Emissions of greenhouse gases in agriculture in the Czech Republic,* Report for PROINCOM Pardubice, Research Institute of Animal Production, Uhříněves, Prague 1994 (in Czech)

Dufek, J.: Verification and evaluation of weight criteria of available data sources N2O from transportation, Report CDV Brno for CHMI, Brno, November 2005

EMEP / CORINAIR *Atmospheric Emission Inventory Guidebook*, UN ECE - EMEP 1999

Energy balances of the Czech Republic in 1990 – 2005, Czech Statistical Office, Prague 1992 - 2006

Energy Economy - Czech Republic 2002 - 2006 in numbers; KONEKO marketing Ltd. Prague (Czech and English version), past edition 2007

FAOSTAT, Food Balance Sheets, Food and agriculture organization, URL: http://faostat.fao.org/faostat/, 2005

FMI (2007) *National Forest Inventory in the Czech Republic 2001-2004. Introduction, Methods*, Results. 224 pp.

Fott P., Bláha J., Pecka K.: *Inventories of greenhouse gases in 1990 - 1993*, CHMI, "Global Climate Change" Project , Environmental Project No. 49/14/1/95, Prague 1995 (in Czech)

Fott P., Pretel J., Bláha J., Pecka K.: *Inventories of greenhouse gases in 1994 - 1995*, CHMI, "Global Climate Change II" Project , Environmental Project No. 310/1/96, Prague 1996 (in Czech)

Fott P., Pretel J., Bláha J., Neužil V.: *National GHG Inventory Report of the Czech Republic* (NIR), last year 2000, CHMI, Prague 2002

Fott P., Pretel J., Vácha D., Bláha J., Neužil V.: *National GHG Inventory Report of the Czech Republic* (NIR), last year 2001, CHMI, Prague 2003

Fott P., Pretel J., Vácha D., Bláha J., Neužil V., Havránek M.: *National GHG Inventory Report of the Czech Republic* (NIR), last year 2002, CHMI, Prague 2004

Fott P., Pretel J., Vácha D., Bláha J., Neužil V., Havránek M.: *National GHG Inventory Report of the Czech Republic* (NIR), last year 2003, CHMI, Prague 2005

Fott, P.: *Carbon emission factors of coal and lignite: Analysis of Czech coal data and comparison with European values*. Environmental Science and Policy (Elsevier), **2**, 1999, p. 347 - 354

Fott, P., Vácha D., Neužil V., Bláha J.: *Reference approach for estimation of CO2 emissions from fossil fuels and its significance for GHG inventories in the Czech Republic*. Ochrana ovzduší 21 (No.1), 2009, p. 26 - 30 (in Czech)

Geimplová, H., Thürner, M.: *NMVOC emission inventory in year 2006*. Report for CHMI, Prague 2007 (in Czech)

Geimplová, H., Thürner, M.: *NMVOC emission inventory in year 2007*. Report for CHMI, Prague 2008 (in Czech)

Good Practice Guidance and Uncertainty Management in National GHG Inventories, IPCC 2000

Good Practice Guidance for Land Use, Land Use Change and Forestry, IPCC 2003

Green C., Tobin B., O'Shea M., Farrell E., Byrne K.: *Above- and belowground biomass measurements in an unthinned stand of Sitka spruce (Picea sitchensis (Bong) Carr.)*. European Journal of Forest Research DOI 10.107/s10342-005-0093-3, 2006.

Havránek M.: *Emissions of greenhouse gases from the waste sector in CR*, Thesis. Institute of the Environment, Faculty of Sciences, Charles University and CHMI, Prague 2001 (in Czech)

Havránek M.: *Emissions of methane from solid waste disposal sites in the Czech Republic during 1990-2005: Application of first order decay model,* Charles University Environment Center Working Paper WP2007/02, Prague 2007

Hons P., Mudřík Z.: *Czech country-specific data for estimation of methane emissions from enteric fermentation of cattle*. AGROBIO report for CHMI, Prague 2003 (in Czech)

Integrovaný registr znečišťování životního prostředí, 2008, http://www.irz.cz/

IPCC Guidelines for National Greenhouse Gas Inventories, Vol. 1-3, IPCC / OECD / IEA, 1995

Jedlička J., Dufek J., Adamec V.: *Greenhouse gas emission balance*, (In: 20th International Air Protection Conference p. 96-99, ISBN 80-969365-2-2, High Tatras - Štrbské Pleso (Slovakia), November 23 – 25, 2005

Jelínek A, Plíva P., Vostoupal B.: *Determining VOC emissions from agricultural activities in the Czech Republic,* Report for CHMI, Research Institute of Agricultural Technology, Prague, 1996 (in Czech)

Karbanová L.: *Emission Inventory of HFCs, PFCs and SF_6 in exported and imported products*, Thesis. Faculty of the Environment, Jan Evangelista Purkyně University in Ústí nad Labem, Ústí nad Labem 2008 (in Czech)

Kolář F, Havlíková M., Fott P.: *Recalculation of emission series of methane from enteric fermentation of cattle*. Report of CHMI, Prague 2004 (in Czech)

Lehtonen A., Makipaa R., Heikkinen J., Sievanen R. and Liski J. Biomass expansion factors (BEFs) for Scots pine, Norway spruce and birch according to stand age for boreal forests. Forest Ecology and Management 188: 211-224, 2004.

Lehtonen A., Cienciala E., Tatarinov F. and Mäkipää, R. Uncertainty estimation of biomass expansion factors for Norway spruce in the Czech Republic. Annals of Forest Science 64(2): 133-140, 2007.

Macků, J., Sirota, I., Homolová, K. *Carbon balance in forest topsoil of the Czech Republic*. VaV 640/18/03 Czech Carbo – Study of carbon in terrestrial ecosystems of the Czech Republic - interim project report. Czech Carbo VaV/640/18/03. Prague 2007 (in Czech).

Marek V.: *Development of Land Resources in the Czech Republic.* Proceedings of the Czech National Soil Conference, Prague 2002 (In Czech).

Markvart M., Bernauer B.: *Emission factors for nitrous oxide from combustion processes, chemical technology and mobile sources,* Kateko Report for CHMI, Prague 1999 (in Czech)

Markvart M., Bernauer B.: *Emission trends in nitrous oxide from industrial processes in the nineteen nineties,* Report for CHMI, Prague 2000. (in Czech)

Markvart M., Bernauer B.: *Nitrogen industry as a source of nitrous oxide emissions in the Czech rep*ublic, Report for CHMI, Prague 2003 (in Czech)

Markvart M., Bernauer B.: *Emissions of nitrous in the Czech Republic in years 2000 - 2003*, Report for CHMI, Prague 2004 (in Czech)

Markvart M., Bernauer B.: *Emissions of nitrous in from chemical industry*, Report for CHMI, Prague 2005 (in Czech)

Markvart M., Bernauer B.: *Dominant sources of GHG in chemical industry in the Czech Republic in years 2003 - 2005*, Report for CHMI, Prague 2006 (in Czech)

Markvart M., Bernauer B.: *Emmisios of N_2O and CO_2 in chemical industry in the Czech Republic in years 2004 - 2006*, Report for CHMI, Prague 2007 (in Czech)

Markvart M., Bernauer B.: *Emmisios of GHG in chemical industry in the Czech Republic in years 2005 - 2007*, Report for CHMI, Prague 2008 (in Czech)

Mining Yearbooks, 1994 - 2005 (in Czech)

MONTANEX, a.s., Český báňský úřad a Zaměstnavatelský svaz důlního a naftového průmyslu, Mining Yearbooks, 2005 – 2007. March 2008

MA (2008). *Report about forest and forestry conditions in the Czech Republic 2007 (Green Report)*, Ministry of Agriculture, Prague 2008.

Mudřík Z., Havránek F. *Czech country-specific data for estimation of methane emissions from enteric fermentation of cattle- updated data* (pers.communication, October, 2006)

National Greenhouse Gas Inventory Report, NIR (reported inventory 2004), CHMI Praha, 2006 (http://unfccc.int/national_reports)

National Greenhouse Gas Inventory Report, NIR (reported inventory 2005), CHMI Praha, 2007 (http://unfccc.int/national_reports)

National Greenhouse Gas Inventory Report, NIR (reported inventory 2006), CHMI Praha, 2008 (http://unfccc.int/national_reports)

Neužil, V: *Improved Methodology for determination of methane emissions in the gas industry in the Czech Republic,* Czech Gas Union, Prague, December 2008 (in Czech)

Production, use and disposal of waste in year 2003, Czech Statistical Office, Prague 2004 (in Czech)

Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Vol. 1-3, IPCC 1997

Řeháček V., Michálek L.: *Information on emissions of greenhouse gases containing fluorine in CR in 2004*, Report for CHMI, Prague 2005 (in Czech)

Řeháček V., Michálek L.: *Information on anthropogenic emissions of greenhouse gases of sulphur hexafluoride, hydrofluorocarbons and perfluorocarbons in CR in 2007*, Report for CHMI, Prague 2008 (in Czech)

Second National Communication of the Czech Republic on the UN Framework Convention on Climate Change, ME CR, Prague 1997

Schwappach A.:*Ertrags tafeln der Wichtigeren Holzarten*, Neumann J., Neudamm 1923.

Statistical Environmental Yearbooks of the Czech Republic. Ministery of Environment of the Czech Republic, Prague 1995-2006

Statistical Yearbooks of the Czech Republic, Czech Statistical Office, Prague 1995 – 2007

Statistical Yearbook of the Czech Republic 2007, Czech Statistical Office, Prague 2008

Straka F., Musilová M., Crha J., Pavlas M.: *Emissions of greenhouse gases from wastes in the territory of CR in 1996*, Institute for Research and Use of Fuels, Prague-Běchovice for CHMI, Prague 1997 (in Czech)

Straka, F.: *Calculation of emissions from landfills in CR*, Institute for Research and Use of Fuels, Prague February 2001 (in Czech)

Supply of Basic Final Refinery Products in the CR, Czech Statistical Office, Prague 1995 - 2005

Šefrna, L., Janderková, J. *Organic carbon content in soil associations of the map 1:500000, Agricultural soils*. VaV 640/18/03 Czech Carbo – Study of carbon in terrestrial ecosystems of the Czech Republic - interim project report. Czech Carbo VaV/640/18/03. Prague 2007 (in Czech).

Takla G., Nováček P.: *Emissions of mine gases in the Ostrava-Karviná coal-mining area and potential for minimization,* Proceedings from the conference Emissions of natural gas - economic and environmental impacts, Czech Gas Association, May 1997 (in Czech)

Takla, G.: *Methane emissions from deep coal mining*, national conference “Natural Gas Emissions - New Clean Air Act and international reliability of the methane emission inventory in the Czech Republic”, Czech Gas Association, 2002 (in Czech)

Third National Communication of the Czech Republic on the UN Framework Convention on Climate Change, ME CR, Prague 2001

Tichý M., Voráčková Z., Dvořák P.: *Inventory of emissions of greenhouse gases in the Czech Republic in 1990*, SEVEn, Prague 1995 (in Czech)

Transformation Processes in the CR Energy Industry in 2005, Czech Statistical Office, Prague 2006

Ullmans's encyclopedia of Industrial Chemistry, Release 2005, 7th Edition, John Willey 2005

Vácha, D.: *Methodology for CO_2 emissions estimates for cement production and CO2 emissions and removals form lime production and use*, ČHMI Report, 2004 (in Czech)

Vacková. L.; Vácha, D.: *F-gases emissions form import and export of products*; Air Protection 2008; Tatry – Štrbské pleso (in Czech)

Wikkerink J.B.W.: *Improvement in the determination of methane emissions from gas distribution in the Netherlands*, 23rd World Gas Conference, Amsterdam 2006

Wirth C., Schumacher J. and Schulze E.-D. Generic biomass functions for Norway spruce in Central Europe - a-meta-analysis approach toward prediction and uncertainty estimation. Tree Physiology 24, 121-139, 2004.

Wutzler T., Wirth C. and Schumacher J. Generic biomass functions for Common beech (Fagus sylvatica L.) in Central Europe - predictions and components of uncertainty, Canadian Journal of Forest Research 38(6): 1661–1675, 2008.

Zábranská J.: *Proposals for update of the calculation of methane emissions from municipal and industrial wastewater in 2002 - 2003*; University of Chemical Technology*,* Report for CUEC, Prague 2004 (in Czech)

Abbreviations

AACLC	Aggregate areas of cadastral land categories
APL	Association of Industrial Distilleries (Asociace průmyslových lihovarů)
AVNH	Association of Coatings Producers (Asociace výrobců nátěrových hmot)
CAPPO	Czech Association of the Petroleum Industry (Česká asociace petrolejářského průmyslu a obchodu)
CCA	Czech Cement Association
CDV	Transport Research Centre (Centrum dopravního výzkumu)
CGA ČPS	Czech Gas Association Český plynárenský svaz
CHMI ČHMÚ	Czech Hydrometeorological Institute Český hydrometeorologický ústav
CNG	compressed natural gas
COD	chemical oxygen demand
COSMC	Czech Office for Surveying, Mapping and Cadastre
CSO ČSÚ	Czech Statistical Office Český statistický úřad
CUEC COŽP UK	Charles University Environment Center Centrum pro otázky životního prostředí Univerzity Karlovy
BOD	biochemical oxygen demand
DOC	degradable organic carbon
EEA	European Environmental Agency
FAO	Food and Agriculture Organization
FMI ÚHÚL	Forest Management Institute, Brandýs nad Labem Ústav pro hospodářskou úpravu lesů
FMP	Forest Management Plans
FOD (model)	first order decay (model)

IEA	International Energy Agency
IFER	Institute of Forest Ecosystem Research (Ústav pro výzkum lesních ekosystémů)
IGU	International Gas Union
LPG	liquid petroleum gas
MA MZe	Ministry of Agriculture (CR) Ministerstvo zemědělství (ČR)
MCF	methane correction factor
ME (CR) MŽP (ČR)	Ministry of Environment (CR) Ministerstvo životního prostředí (ČR)
MIT	Ministry of Industry and Trade (CR)
MSW	municipal solid waste
NACE	nomenclature classification of economic activities
REZZO	Register of Emissions and Sources of Air Pollution (Registr emisí a zdrojů znečišťování ovzduší)
SEVEn	The Energy Efficiency Center (Středisko pro efektivní využívání energie)
SWDS	Solid Waste Disposal Sites
VŠCHT	Institute of Chemical Technology (Vysoká škola chemicko technologická)
ÚVVP	Institute for Research and Use of Fuels (Ústav pro výzkum a využití paliv)

Annex 1

Reference Approach and Comparison with Sectoral Approach

The IPCC Reference Approach (*Revised 1996 IPCC Guidelines*, 1997) is based on determining carbon dioxide emissions from domestic consumption of individual fuels (called also as apparent consumption). Domestic fuel consumption is calculated in the usual manner as:

extraction + imports – exports – *international bunkers* - change in stocks

“International Bunkers” enters the calculation for the Czech Republic only for “jet kerosene” fuel.

Extraction includes domestic extraction of crude oil, natural gas (of crude oil or coal origin) and hard and brown coal. The obtaining of other solid fuels, mostly wood for burning, is given in the calculation under the special item solid biomass. In this method, emissions from this fuel are not included in emissions from combustion processes, as they are calculated in the inventory in the LULUCF category. Imports of fuel include imports of natural gas, crude oil, petroleum products, hard and brown coal, coke and briquettes. Exports and changes in stocks include similar items.

The Reference Approach also takes into account non-energy consumption of fuels. A substantial portion of fuels for non-energy use consist stored carbon in petroleum products (lubricating and special oils, asphalt and particularly naphtha used in the production of plastics, etc.). Stored carbon is encompassed also in non-energy products (tars) produced from hard coal in coke plants and from gasification process of brown coal in the production of energy gas (fuel for combined steam-gas systems) are also important. On the other hand, some of the intermediate products from the pyrolysis of petrochemical materials are used directly as heating gases and oils and some of the final products (plastics) are also burned after use. In addition, most lubricating and special oils are finally used as heating oils or are burned during use (the lubricating oils of internal combustion motors). Data on non-energy consumption are taken from the Czech Statistical Office (international CSO reports for IEA/Eurostat; the last reported year was 2007).

The amount of carbon corresponding to the individual fuels is calculated from the domestic consumption of the individual fuels using the carbon emission factors. This amount is multiplied by a stoichiometric coefficient of 44/12 and the relevant oxidation factors. The sum of the results for all the fuels corresponds to the total amount of CO_2 derived from fossil fuels.

At the request of the Expert Review Team (CRF), the originally used default emission factors for coals from 2006 were replaced by the country specific factors taken from the study of (Fott,1999). Emission factors for other fuels than carbon and all the oxidation factors remain unchanged.

Tab. A1.1 recapitulation of the original and newly used nationally specific emission factors

Fuels	Original default values [t C/TJ]	New country specific emission factors [t C/TJ]
Czech bituminous (hard) coal	25.8	25.43
Czech brown coal / lignite	27.6	27.27

These CO_2 country specific factors for hard and brown coals are now used both for the Sectoral and for the Reference approaches in all the years from 1990 to 2007.

Processing of the activity data for the Sectoral Approach is described in detail in Chapter 3, Energy. The comparison of data on fuel consumption from the Sectoral and Reference approaches, respectively, is presented in Tab. A1.1

Tab. A1.2 Comparison of the Sectoral and Reference approaches – fuel consumption

	Reference Approach	Sectoral Approach	Fixed Fuels **	Coke in Iron Industry	Res. Oil in NH_3 Product.	Total *	Approach Difference
	[TJ/year]	[TJ/year]	[TJ/year]	[TJ/year]	[TJ/year]	[TJ/year]	[%]
1990	1 899 006	1 691 398	20 201	118 229	11 227	1 841 055	3.1
1991	1 770 924	1 655 782	12 523	82 841	10 880	1 762 026	0.5
1992	1 631 753	1 485 220	14 871	96 506	11 217	1 607 814	1.5
1993	1 586 646	1 479 230	15 609	72 545	10 489	1 577 872	0.6
1994	1 512 563	1 359 556	19 290	77 645	11 711	1 468 202	2.9
1995	1 579 022	1 442 264	23 764	81 683	10 339	1 558 049	1.3
1996	1 649 612	1 554 379	14 246	75 586	11 128	1 655 339	-0.3
1997	1 576 222	1 467 835	12 984	80 683	10 198	1 571 700	0.3
1998	1 491 248	1 403 523	13 277	71 273	10 513	1 498 586	-0.5
1999	1 453 437	1 392 461	13 423	56 561	8 955	1 471 399	-1.2
2000	1 486 658	1 439 020	12 805	66 851	10 248	1 528 923	-2.8
2001	1 535 915	1 474 588	16 278	62 380	8 625	1 561 871	-1.7
2002	1 496 467	1 439 158	13 379	64 927	7 525	1 524 988	-1.9
2003	1 541 207	1 476 837	12 259	71 468	9 795	1 570 359	-1.9
2004	1 545 196	1 483 950	12 106	80 100	9 721	1 585 876	-2.6
2005	1 541 476	1 498 283	12 004	69 039	8 478	1 587 804	-3.0
2006	1 550 631	1 497 222	10 254	79 482	8 086	1 595 044	-2.9
2007	1 564 041	1 499 905	10 749	75 750	7 575	1 593 978	-1.9

* „Total“ is a sum of preceding columns excluding Reference Approach

** “Fixed Fuels” means non-combusted fuels containing stored carbon

It is apparent from the table that consumption of fuels taken into account in the Reference Approach and the “Total” consumption do not differ too much. The comparison of CO_2 emissions is presented in Tab. A1.3.

Tab. A1.3 Comparison of the Sector and Reference approaches – CO_2 emissions

	Reference Approach	Sectoral Approach	Coke in Iron Industry	Res. Oil in NH_3 Product.	Total *	Approach Difference
	CO_2 [Gg]	CO_2 [Gg]	CO_2 [Gg]	CO_2 [Gg]	CO_2 [Gg]	[%]
1990	161 238	145 613	12 533	807	158 953	1.4
1991	149 741	139 912	8 781	782	149 475	0.2
1992	137 075	124 194	10 230	806	135 230	1.3
1993	131 760	123 104	7 690	754	131 548	0.2
1994	125 025	113 312	8 231	842	122 385	2.1
1995	128 814	117 653	8 659	743	127 055	1.4
1996	135 020	125 200	8 012	800	134 012	0.7
1997	129 140	117 785	8 553	733	127 071	1.6
1998	120 749	111 052	7 555	756	119 363	1.1
1999	116 996	109 287	5 996	644	115 927	0.9
2000	121 307	114 438	7 086	736	122 260	-0.8
2001	123 767	116 935	6 612	620	124 167	-0.3
2002	120 867	113 266	6 882	541	120 689	0.1
2003	124 541	113 659	7 576	704	121 939	2.1
2004	124 701	113 304	8 491	699	122 494	1.8
2005	123 577	113 934	7 318	609	121 861	1.4
2006	124 035	114 948	8 425	581	123 954	0.1
2007	126 204	116 297	8 030	550	124 877	1.1

* „Total“ is a sum of preceding columns excluding Reference Approach

The table can be further extended to include CO_2 emissions formed by oxidation of solvents in the Solvent Use sector and also through incineration of wastes. It can be seen from the Table A1.4 that the differences between the Reference Approach and the sum of CO_2 from fossil fuels also does not exceed ±2 % in this case and the differences are even lower than in foregoing case.

Tab. A1.4 Comparison of the Reference Approach and the total of emitted CO_2

	Reference Approach	Sectoral Approach	Coke in Iron Ind.	Res. Oil in NH_3 Prod.	Solvent Use	Incinerat. of Waste	Total *	Approach Difference
	CO_2 [Gg]	CO_2 [Gg]	CO_2 [Gg]	CO_2 [Gg]	CO_2 [Gg]	CO_2 [Gg]	CO_2 [Gg]	[%]
1990	161 238	145 613	12 533	807	550		159 503	1.1
1991	149 741	139 912	8 781	782	514	357	150 346	-0.4
1992	137 075	124 194	10 230	806	476	357	136 063	0.7
1993	131 760	123 104	7 690	754	436	357	132 341	-0.4
1994	125 025	113 312	8 231	842	402	357	123 144	1.5
1995	128 814	117 653	8 659	743	382	357	127 794	0.8
1996	135 020	125 200	8 012	800	372	357	134 741	0.2
1997	129 140	117 785	8 553	733	370	357	127 798	1.0
1998	120 749	111 052	7 555	756	366	357	120 086	0.5
1999	116 996	109 287	5 996	644	364	357	116 648	0.3
2000	121 307	114 438	7 086	736	354	357	122 971	-1.4
2001	123 767	116 935	6 612	620	335	357	124 859	-0.9
2002	120 867	113 266	6 882	541	325	357	121 371	-0.4
2003	124 541	113 659	7 576	704	311	368	122 618	1.5
2004	124 701	113 304	8 491	699	305	327	123 126	1.3
2005	123 577	113 934	7 318	609	299	358	122 518	0.9
2006	124 035	114 948	8 425	581	298	386	124 638	-0.5
2007	126 204	116 297	8 030	550	300	390	125 567	0.5

* „Total“ is a sum of preceding columns excluding Reference Approach

For comparison of the Reference and Sectoral approaches, the tables published in last year’s submission were extended to include 2007 data and assessment was performed of the difference between the Reference Approach and the Sectoral Approach. For this purpose, the comparison also included carbon from fossil fuels that are a source of CO_2 emissions in the other sectors. This refers mainly to the carbon that is reported under metallurgical coke in Sector 2 Industrial Processes. It also encompasses residual oil, which is used for the production of ammonia, also in Sector 2 Industrial Processes.

A certain percentage of fossil carbon is converted in transformation processes to the form of solvents, which are used in coatings and other operations for surface treatment. This amount of carbon is reported in Sector 3 Solvent and Other Product Use. The carbon can have two fates. Most large painting plants are equipped with facilities for disposal of NMVOC emissions. This equipment converts NMVOC either directly or indirectly to CO_2 (thermal and catalytic oxidation, biofilters). When solvents are used in small painting plants or outside of plants, the carbon evaporates into the air in the form of NMVOC. After a certain period of time, this is again oxidized to CO_2.

Another part of fossil carbon is used as raw material for the manufacture of plastics. Plastics end up in waste incineration plants or in landfills. In incineration plants, the carbon in the plastics is converted to CO_2. This CO_2 is reported in Sector 6C Waste Incineration. In managed landfills, plastics very slowly decompose through biochemical processes.

However, part of plastics stores carbon from petrochemical raw materials for a long time. At the beginning of the monitored period, the fraction of carbon stored for naphtha was estimated at 50%. The remaining 50% of carbon was considered to oxidise to CO_2. Recently, plastics have been increasingly recycled. The recycled material obtained is used to manufacture products with long lifetimes. Consequently, since 2004, the fraction of stored carbon has been gradually increased from a value of 50% to a value of 80%. The following survey gives the gradual increase.

1990 - 2003	2004	2005	2006	2007
0.5	0.6	0.7	0.8	0.8

Starting in 2007, a constant value of 80% will be used in subsequent years, unless further refining arguments arise.

Annex 2

Key Category Analysis (Tier 1)

Table A2.1 Spreadsheet for Tier 1 KC Analysis, 2007 - Level Assessment including LULUCF

N	Cat	IPCC Source Categories	GHG	Em or Rem, Gg	Absol., Gg	LA, %	Cumul, %
1	1A	1.A Stationary Combustion - Solid Fuels	CO2	75 313	75 313	49.09	49.09
15	1A	1.A.3.b Transport - Road Transportation	CO2	18 039	18 039	11.76	60.84
4	1A	1.A Stationary Combustion - Gaseous Fuels	CO2	16 618	16 618	10.83	71.68
41	2	2.C.1 Iron and Steel Production	CO2	8 030	8 030	5.23	76.91
7	1A	1.A Stationary Combustion - Liquid Fuels	CO2	4 828	4 828	3.15	80.06
30	1B	1.B.1.a Coal Mining and Handling	CH4	4 567	4 567	2.98	83.03
52	4	4.D.1 Agricultural Soils, Direct Emissions	N2O	2 550	2 550	1.66	84.69
55	6	6.A Solid Waste Disposal on Land	CH4	2 417	2 417	1.58	86.27
49	4	4.A Enteric Fermentation	CH4	2 372	2 372	1.55	87.81
32	2	2.A.1 Cement Production	CO2	2 043	2 043	1.33	89.15
54	4	4.D.3 Agricultural Soils, Indirect Emissions	N2O	1 803	1 803	1.18	90.32
43	2	2.F.1-6 F-gases Use - ODS substitutes	HFC, PFC	1 612	1 612	1.05	91.37
60	5	5.A.1 Forest Land remaining Forest Land	CO2	-1 347	1 347	0.88	92.25
34	2	2.A.3 Limestone and Dolomite Use	CO2	1 106	1 106	0.72	92.97
27	1A	1.A.5.b Mobile sources in Agriculture and Forestry	CO2	1 078	1 078	0.70	93.67
33	2	2.A.2 Lime Production	CO2	794	794	0.52	94.19
38	2	2.B.2 Nitric Acid Production	N2O	773	773	0.50	94.69
17	1A	1.A.3.b Transport - Road Transportation	N2O	722	722	0.47	95.17
31	1B	1.B.1.b Fugitive Emission from Oil, Natural Gas and Other	CH4	692	692	0.45	95.62
37	2	2.B.1 Ammonia Production	CO2	544	544	0.35	95.97
56	6	6.B Wastewater Handling	CH4	514	514	0.34	96.31
50	4	4.B Manure Management	CH4	490	490	0.32	96.63
68	5	5.A.2 Land converted to Forest Land	CO2	-428	428	0.28	96.91
35	2	2.A.7 Glass, Bricks and Ceramics	CO2	424	424	0.28	97.18
58	6	6.C Waste Incineration	CO2	413	413	0.27	97.45
70	5	5.C.2 Land converted to Grassland	CO2	-387	387	0.25	97.70
51	4	4.B Manure Management	N2O	351	351	0.23	97.93
3	1A	1.A Stationary Combustion - Solid Fuels	N2O	343	343	0.22	98.16
10	1A	1.A Stationary Combustion - Biomass	CH4	320	320	0.21	98.36
18	1A	1.A.3.c Transport - Railways	CO2	298	298	0.19	98.56
47	3	3 Solvents and Other Product Use	CO2	298	298	0.19	98.75
53	4	4.D.2 Pasture, Range and Padock Manure	N2O	271	271	0.18	98.93
48	3	3 Solvents and Other Product Use	N2O	215	215	0.14	99.07
57	6	6.B Wastewater Handling	N2O	201	201	0.13	99.20
2	1A	1.A Stationary Combustion - Solid Fuels	CH4	180	180	0.12	99.32
61	5	5.A.1 Forest Land remaining Forest Land	CH4	175	175	0.11	99.43
40	2	2.B.5 Other	N2O	94	94	0.06	99.49
72	5	5.E.2 Land converted to Settlements	CO2	93	93	0.06	99.55
11	1A	1.A Stationary Combustion - Biomass	N2O	93	93	0.06	99.61
24	1A	1.A.3.e Transport - Other Transportation	CO2	76	76	0.05	99.66
69	5	5.B.2 Land converted to Cropland	CO2	72	72	0.05	99.71
42	2	2.C.1 Iron and Steel Production	CH4	70	70	0.05	99.76
45	2	2.F.8 F-gases Use - Electrical Equipment	SF6	65	65	0.04	99.80
63	5	5.B.1 Cropland remaining Cropland	CO2	55	55	0.04	99.83
16	1A	1.A.3.b Transport - Road Transportation	CH4	32	32	0.02	99.86
12	1A	1.A.3.a Transport - Civil Aviation	CO2	32	32	0.02	99.88
5	1A	1.A Stationary Combustion - Gaseous Fuels	CH4	28	28	0.02	99.89
29	1A	1.A.5.b Mobile sources in Agriculture and Forestry	N2O	21	21	0.01	99.91
71	5	5.D.2. Land converted to Wetlands	CO2	19	19	0.01	99.92
62	5	5.A.1 Forest Land remaining Forest Land	N2O	18	18	0.01	99.93
44	2	2.F.7 F-gases Use - Semiconductore Manufacture	PFC, SF6	16	16	0.01	99.94
21	1A	1.A.3.d Transport - Navigation	CO2	16	16	0.01	99.95
9	1A	1.A Stationary Combustion - Liquid Fuels	N2O	12	12	0.01	99.96
6	1A	1.A Stationary Combustion - Gaseous Fuels	N2O	9	9	0.01	99.97
46	2	2.F.9 F-gases Use - Other SF6	SF6	9	9	0.01	99.97
39	2	2.B.5 Other	CH4	9	9	0.01	99.98
73	5	5.F.2. Land converted to Other Land	CO2	7	7	0.00	99.98
20	1A	1.A.3.c Transport - Railways	N2O	5	5	0.00	99.99
36	2	2.A.7 Glass, Bricks and Ceramics	CH4	5	5	0.00	99.99
59	6	6.C Waste Incineration	N2O	4	4	0.00	99.99
64	5	5.C.1 Grassland remaining Grassland	CO2	4	4	0.00	100.00
8	1A	1.A Stationary Combustion - Liquid Fuels	CH4	3	3	0.00	100.00
28	1A	1.A.5.b Mobile sources in Agriculture and Forestry	CH4	1	1	0.00	100.00
14	1A	1.A.3.a Transport - Civil Aviation	N2O	1	1	0.00	100.00
19	1A	1.A.3.c Transport - Railways	CH4	0	0	0.00	100.00
23	1A	1.A.3.d Transport - Navigation	N2O	0	0	0.00	100.00
13	1A	1.A.3.a Transport - Civil Aviation	CH4	0	0	0.00	100.00
26	1A	1.A.3.e Transport - Other Transportation	N2O	0	0	0.00	100.00
22	1A	1.A.3.d Transport - Navigation	CH4	0	0	0.00	100.00
25	1A	1.A.3.e Transport - Other Transportation	CH4	0	0	0.00	100.00
65	5	5.D.1 Wetlands remaining Wetlands	CO2	0	0	0.00	100.00
66	5	5.E.1 Settlements remaining Settlements	CO2	0	0	0.00	100.00
67	5	5.F.1 Other Land remaining Other Land	CO2	0	0	0.00	100.00
		With LULUC		**149 103**	**153 428**		

Table A2.2 Spreadsheet for Tier 1 KC Analysis, 2007 - Level Assessment excluding LULUCF

N	Cat	IPCC Source Categories	GHG	Emissions, Gg	Absol., Gg	LA, %	Cumul, %
1	1A	1.A Stationary Combustion - Solid Fuels	CO2	75 313	75 313	49.93	49.93
15	1A	1.A.3.b Transport - Road Transportation	CO2	18 039	18 039	11.96	61.90
4	1A	1.A Stationary Combustion - Gaseous Fuels	CO2	16 618	16 618	11.02	72.91
41	2	2.C.1 Iron and Steel Production	CO2	8 030	8 030	5.32	78.24
7	1A	1.A Stationary Combustion - Liquid Fuels	CO2	4 828	4 828	3.20	81.44
30	1B	1.B.1.a Coal Mining and Handling	CH4	4 567	4 567	3.03	84.47
52	4	4.D.1 Agricultural Soils, Direct Emissions	N2O	2 550	2 550	1.69	86.16
55	6	6.A Solid Waste Disposal on Land	CH4	2 417	2 417	1.60	87.76
49	4	4.A Enteric Fermentation	CH4	2 372	2 372	1.57	89.33
32	2	2.A.1 Cement Production	CO2	2 043	2 043	1.35	90.69
54	4	4.D.3 Agricultural Soils, Indirect Emissions	N2O	1 803	1 803	1.20	91.88
43	2	2.F.1-6 F-gases Use - ODS substitutes	HFC, PFC	1 612	1 612	1.07	92.95
34	2	2.A.3 Limestone and Dolomite Use	CO2	1 106	1 106	0.73	93.68
27	1A	1.A.5.b Mobile sources in Agriculture and Forestry	CO2	1 078	1 078	0.71	94.40
33	2	2.A.2 Lime Production	CO2	794	794	0.53	94.92
38	2	2.B.2 Nitric Acid Production	N2O	773	773	0.51	95.44
17	1A	1.A.3.b Transport - Road Transportation	N2O	722	722	0.48	95.92
31	1B	1.B.1.b Fugitive Emission from Oil, Natural Gas and Other	CH4	692	692	0.46	96.38
37	2	2.B.1 Ammonia Production	CO2	544	544	0.36	96.74
56	6	6.B Wastewater Handling	CH4	514	514	0.34	97.08
50	4	4.B Manure Management	CH4	490	490	0.33	97.40
35	2	2.A.7 Glass, Bricks and Ceramics	CO2	424	424	0.28	97.68
58	6	6.C Waste Incineration	CO2	413	413	0.27	97.96
51	4	4.B Manure Management	N2O	351	351	0.23	98.19
3	1A	1.A Stationary Combustion - Solid Fuels	N2O	343	343	0.23	98.42
10	1A	1.A Stationary Combustion - Biomass	CH4	320	320	0.21	98.63
18	1A	1.A.3.c Transport - Railways	CO2	298	298	0.20	98.83
47	3	3 Solvents and Other Product Use	CO2	298	298	0.20	99.02
53	4	4.D.2 Pasture, Range and Padock Manure	N2O	271	271	0.18	99.20
48	3	3 Solvents and Other Product Use	N2O	215	215	0.14	99.35
57	6	6.B Wastewater Handling	N2O	201	201	0.13	99.48
2	1A	1.A Stationary Combustion - Solid Fuels	CH4	180	180	0.12	99.60
40	2	2.B.5 Other	N2O	94	94	0.06	99.66
11	1A	1.A Stationary Combustion - Biomass	N2O	93	93	0.06	99.72
24	1A	1.A.3.e Transport - Other Transportation	CO2	76	76	0.05	99.77
42	2	2.C.1 Iron and Steel Production	CH4	70	70	0.05	99.82
45	2	2.F.8 F-gases Use - Electrical Equipment	SF6	65	65	0.04	99.86
16	1A	1.A.3.b Transport - Road Transportation	CH4	32	32	0.02	99.88
12	1A	1.A.3.a Transport - Civil Aviation	CO2	32	32	0.02	99.91
5	1A	1.A Stationary Combustion - Gaseous Fuels	CH4	28	28	0.02	99.92
29	1A	1.A.5.b Mobile sources in Agriculture and Forestry	N2O	21	21	0.01	99.94
44	2	2.F.7 F-gases Use - Semiconductore Manufacture	PFC, SF6	16	16	0.01	99.95
21	1A	1.A.3.d Transport - Navigation	CO2	16	16	0.01	99.96
9	1A	1.A Stationary Combustion - Liquid Fuels	N2O	12	12	0.01	99.97
6	1A	1.A Stationary Combustion - Gaseous Fuels	N2O	9	9	0.01	99.97
46	2	2.F.9 F-gases Use - Other SF6	SF6	9	9	0.01	99.98
39	2	2.B.5 Other	CH4	9	9	0.01	99.99
20	1A	1.A.3.c Transport - Railways	N2O	5	5	0.00	99.99
36	2	2.A.7 Glass, Bricks and Ceramics	CH4	5	5	0.00	99.99
59	6	6.C Waste Incineration	N2O	4	4	0.00	100.00
8	1A	1.A Stationary Combustion - Liquid Fuels	CH4	3	3	0.00	100.00
28	1A	1.A.5.b Mobile sources in Agriculture and Forestry	CH4	1	1	0.00	100.00
14	1A	1.A.3.a Transport - Civil Aviation	N2O	1	1	0.00	100.00
19	1A	1.A.3.c Transport - Railways	CH4	0	0	0.00	100.00
23	1A	1.A.3.d Transport - Navigation	N2O	0	0	0.00	100.00
13	1A	1.A.3.a Transport - Civil Aviation	CH4	0	0	0.00	100.00
26	1A	1.A.3.e Transport - Other Transportation	N2O	0	0	0.00	100.00
22	1A	1.A.3.d Transport - Navigation	CH4	0	0	0.00	100.00
25	1A	1.A.3.e Transport - Other Transportation	CH4	0	0	0.00	100.00
		Without LULUCF		**150 823**	**150 823**		

Table A2.3 Spreadsheet for Tier 1 KC Analysis, 2007 - Trend Assessment including LULUCF

N	IPCC Source Categories	GHG	Abs / BY, Gg	Abs / CY, Gg	LA, %	Dif	TA
15	1.A.3.b Transport - Road Transportation	CO2	5 995	18 039	11.76	0.987	11.61
1	1.A Stationary Combustion - Solid Fuels	CO2	110 713	75 313	49.09	-0.150	7.37
4	1.A Stationary Combustion - Gaseous Fuels	CO2	12 438	16 618	10.83	0.571	6.19
7	1.A Stationary Combustion - Liquid Fuels	CO2	13 518	4 828	3.15	-1.480	4.66
60	5.A.1 Forest Land remaining Forest Land	CO2	5 580	1 347	0.88	-2.822	2.48
43	2.F.1-6 F-gases Use - ODS substitutes	HFC, PFC	0	1 612	1.05	1.320	1.39
41	2.C.1 Iron and Steel Production	CO2	12 533	8 030	5.23	-0.241	1.26
49	4.A Enteric Fermentation	CH4	4 869	2 372	1.55	-0.733	1.13
30	1.B.1.a Coal Mining and Handling	CH4	7 600	4 567	2.98	-0.344	1.03
55	6.A Solid Waste Disposal on Land	CH4	1 663	2 417	1.58	0.632	1.00
54	4.D.3 Agricultural Soils, Indirect Emissions	N2O	3 620	1 803	1.18	-0.687	0.81
52	4.D.1-2 Agricultural Soils, Direct Emissions	N2O	4 573	2 550	1.66	-0.474	0.79
2	1.A Stationary Combustion - Solid Fuels	CH4	1 335	180	0.12	-6.079	0.72
63	5.B.1 Cropland remaining Cropland	CO2	1 089	55	0.04	-18.563	0.66
17	1.A.3.b Transport - Road Transportation	N2O	71	722	0.47	1.222	0.58
34	2.A.3 Limestone and Dolomite Use	CO2	678	1 106	0.72	0.707	0.51
58	6.C Waste Incineration	CO2	0	413	0.27	1.320	0.36
24	1.A.3.e Transport - Other Transportation	CO2	494	76	0.05	-5.175	0.26
10	1.A Stationary Combustion - Biomass	CH4	56	320	0.21	1.144	0.24
50	4.B Manure Management	CH4	1 009	490	0.32	-0.739	0.24
53	4.D.2 Pasture, Range and Padock Manure	N2O	706	271	0.18	-1.284	0.23
70	5.C.2 Land converted to Grassland	CO2	187	387	0.25	0.837	0.21
33	2.A.2 Lime Production	CO2	1 337	794	0.52	-0.363	0.19
18	1.A.3.c Transport - Railways	CO2	647	298	0.19	-0.851	0.17
35	2.A.7 Glass, Bricks and Ceramics	CO2	326	424	0.28	0.550	0.15
51	4.B Manure Management	N2O	690	351	0.23	-0.645	0.15
32	2.A.1 Cement Production	CO2	2 489	2 043	1.33	0.101	0.14
27	1.A.5.b Mobile sources in Agriculture and Forestry	CO2	1 601	1 078	0.70	-0.165	0.12
47	3 Solvents and Other Product Use	CO2	550	298	0.19	-0.529	0.10
68	5.A.2 Land converted to Forest Land	CO2	407	428	0.28	0.368	0.10
56	6.B Wastewater Handling	CH4	825	514	0.34	-0.285	0.10
61	5.A.1 Forest Land remaining Forest Land	CH4	97	175	0.11	0.762	0.09
69	5.B.2 Land converted to Cropland	CO2	226	72	0.05	-1.803	0.09
12	1.A.3.a Transport - Civil Aviation	CO2	149	32	0.02	-3.333	0.07
38	2.B.2 Nitric Acid Production	N2O	1 127	773	0.50	-0.139	0.07
57	6.B Wastewater Handling	N2O	162	201	0.13	0.517	0.07
11	1.A Stationary Combustion - Biomass	N2O	27	93	0.06	1.032	0.06
37	2.B.1 Ammonia Production	CO2	807	544	0.35	-0.162	0.06
48	3 Solvents and Other Product Use	N2O	215	215	0.14	0.320	0.04
64	5.C.1 Grassland remaining Grassland	CO2	59	4	0.00	-14.065	0.03
3	1.A Stationary Combustion - Solid Fuels	N2O	495	343	0.22	-0.123	0.03
40	2.B.5 Other	N2O	84	94	0.06	0.433	0.03
72	5.E.2 Land converted to Settlements	CO2	85	93	0.06	0.404	0.02
21	1.A.3.d Transport - Navigation	CO2	56	16	0.01	-2.251	0.02
42	2.C.1 Iron and Steel Production	CH4	127	70	0.05	-0.500	0.02
44	2.F.7 F-gases Use - Semiconductore Manufacture	PFC, SF6	0	16	0.01	1.320	0.01
9	1.A Stationary Combustion - Liquid Fuels	N2O	34	12	0.01	-1.457	0.01
31	1.B.1.b Fugitive Emission from Oil, Natural Gas and Other	CH4	896	692	0.45	0.026	0.01
16	1.A.3.b Transport - Road Transportation	CH4	25	32	0.02	0.537	0.01
5	1.A Stationary Combustion - Gaseous Fuels	CH4	21	28	0.02	0.585	0.01
62	5.A.1 Forest Land remaining Forest Land	N2O	10	18	0.01	0.762	0.01
73	5.F.2. Land converted to Other Land	CO2	21	7	0.00	-1.787	0.01
46	2.F.9 F-gases Use - Other SF6	SF6	0	9	0.01	1.320	0.01
8	1.A Stationary Combustion - Liquid Fuels	CH4	14	3	0.00	-2.885	0.01
29	1.A.5.b Mobile sources in Agriculture and Forestry	N2O	20	21	0.01	0.408	0.01
45	2.F.8 F-gases Use - Electrical Equipment	SF6	78	65	0.04	0.117	0.00
59	6.C Waste Incineration	N2O	0	4	0.00	1.320	0.00
6	1.A Stationary Combustion - Gaseous Fuels	N2O	7	9	0.01	0.571	0.00
28	1.A.5.b Mobile sources in Agriculture and Forestry	CH4	7	1	0.00	-3.524	0.00
36	2.A.7 Glass, Bricks and Ceramics	CH4	3	5	0.00	0.705	0.00
39	2.B.5 Other	CH4	8	9	0.01	0.370	0.00
71	5.D.2. Land converted to Wetlands	CO2	22	19	0.01	0.163	0.00
14	1.A.3.a Transport - Civil Aviation	N2O	4	1	0.00	-1.526	0.00
20	1.A.3.c Transport - Railways	N2O	8	5	0.00	-0.239	0.00
19	1.A.3.c Transport - Railways	CH4	1	0	0.00	-0.996	0.00
23	1.A.3.d Transport - Navigation	N2O	1	0	0.00	-1.235	0.00
26	1.A.3.e Transport - Other Transportation	N2O	0	0	0.00	-5.175	0.00
13	1.A.3.a Transport - Civil Aviation	CH4	0	0	0.00	-1.422	0.00
22	1.A.3.d Transport - Navigation	CH4	0	0	0.00	-2.762	0.00
25	1.A.3.e Transport - Other Transportation	CH4	0	0	0.00	-7.847	0.00
65	5.D.1 Wetlands remaining Wetlands	CO2	0	0	0.00		0.00
66	5.E.1 Settlements remaining Settlements	CO2	0	0	0.00		0.00
67	5.F.1 Other Land remaining Other Land	CO2	0	0	0.00		0.00
	TOTAL		**202 496**	**153 428**	**100**		**45.72**

Table A2.4 Spreadsheet for Tier 1 KC Analysis, 2007 - Trend Assessment excluding LULUCF

N	IPCC Source Categories	GHG	Em / BY, Gg	Em / CY, Gg	Rel, %	Dif	TA
15	1.A.3.b Transport - Road Transportation	CO2	5 995	18 039	11.96	0.959	11.47
1	1.A Stationary Combustion - Solid Fuels	CO2	110 713	75 313	49.93	-0.179	8.94
4	1.A Stationary Combustion - Gaseous Fuels	CO2	12 438	16 618	11.02	0.542	5.98
7	1.A Stationary Combustion - Liquid Fuels	CO2	13 518	4 828	3.20	-1.509	4.83
41	2.C.1 Iron and Steel Production	CO2	12 533	8 030	5.32	-0.270	1.44
43	2.F.1-6 F-gases Use - ODS substitutes	HFC, PFC	0	1 612	1.07	1.291	1.38
49	4.A Enteric Fermentation	CH4	4 869	2 372	1.57	-0.762	1.20
30	1.B.1.a Coal Mining and Handling	CH4	7 600	4 567	3.03	-0.373	1.13
55	6.A Solid Waste Disposal on Land	CH4	1 663	2 417	1.60	0.603	0.97
54	4.D.3 Agricultural Soils, Indirect Emissions	N2O	3 620	1 803	1.20	-0.716	0.86
52	4.D.1-2 Agricultural Soils, Direct Emissions	N2O	4 573	2 550	1.69	-0.502	0.85
2	1.A Stationary Combustion - Solid Fuels	CH4	1 335	180	0.12	-6.108	0.73
17	1.A.3.b Transport - Road Transportation	N2O	71	722	0.48	1.193	0.57
34	2.A.3 Limestone and Dolomite Use	CO2	678	1 106	0.73	0.678	0.50
58	6.C Waste Incineration	CO2	0	413	0.27	1.291	0.35
24	1.A.3.e Transport - Other Transportation	CO2	494	76	0.05	-5.204	0.26
50	4.B Manure Management	CH4	1 009	490	0.33	-0.768	0.25
10	1.A Stationary Combustion - Biomass	CH4	56	320	0.21	1.115	0.24
53	4.D.2 Pasture, Range and Padock Manure	N2O	706	271	0.18	-1.312	0.24
33	2.A.2 Lime Production	CO2	1 337	794	0.53	-0.392	0.21
18	1.A.3.c Transport - Railways	CO2	647	298	0.20	-0.879	0.17
51	4.B Manure Management	N2O	690	351	0.23	-0.673	0.16
35	2.A.7 Glass, Bricks and Ceramics	CO2	326	424	0.28	0.521	0.15
27	1.A.5.b Mobile sources in Agriculture and Forestry	CO2	1 601	1 078	0.71	-0.194	0.14
47	3 Solvents and Other Product Use	CO2	550	298	0.20	-0.558	0.11
56	6.B Wastewater Handling	CH4	825	514	0.34	-0.314	0.11
32	2.A.1 Cement Production	CO2	2 489	2 043	1.35	0.073	0.10
38	2.B.2 Nitric Acid Production	N2O	1 127	773	0.51	-0.167	0.09
12	1.A.3.a Transport - Civil Aviation	CO2	149	32	0.02	-3.362	0.07
37	2.B.1 Ammonia Production	CO2	807	544	0.36	-0.191	0.07
57	6.B Wastewater Handling	N2O	162	201	0.13	0.488	0.07
11	1.A Stationary Combustion - Biomass	N2O	27	93	0.06	1.004	0.06
48	3 Solvents and Other Product Use	N2O	215	215	0.14	0.291	0.04
3	1.A Stationary Combustion - Solid Fuels	N2O	495	343	0.23	-0.151	0.03
40	2.B.5 Other	N2O	84	94	0.06	0.405	0.03
42	2.C.1 Iron and Steel Production	CH4	127	70	0.05	-0.529	0.02
21	1.A.3.d Transport - Navigation	CO2	56	16	0.01	-2.279	0.02
44	2.F.7 F-gases Use - Semiconductore Manufacture	PFC, SF6	0	16	0.01	1.291	0.01
9	1.A Stationary Combustion - Liquid Fuels	N2O	34	12	0.01	-1.485	0.01
16	1.A.3.b Transport - Road Transportation	CH4	25	32	0.02	0.508	0.01
5	1.A Stationary Combustion - Gaseous Fuels	CH4	21	28	0.02	0.556	0.01
46	2.F.9 F-gases Use - Other SF6	SF6	0	9	0.01	1.291	0.01
8	1.A Stationary Combustion - Liquid Fuels	CH4	14	3	0.00	-2.914	0.01
29	1.A.5.b Mobile sources in Agriculture and Forestry	N2O	20	21	0.01	0.379	0.01
45	2.F.8 F-gases Use - Electrical Equipment	SF6	78	65	0.04	0.088	0.00
28	1.A.5.b Mobile sources in Agriculture and Forestry	CH4	7	1	0.00	-3.553	0.00
6	1.A Stationary Combustion - Gaseous Fuels	N2O	7	9	0.01	0.542	0.00
36	2.A.7 Glass, Bricks and Ceramics	CH4	3	5	0.00	0.676	0.00
39	2.B.5 Other	CH4	8	9	0.01	0.341	0.00
14	1.A.3.a Transport - Civil Aviation	N2O	4	1	0.00	-1.555	0.00
31	1.B.1.b Fugitive Emission from Oil, Natural Gas and Other	CH4	896	692	0.46	-0.003	0.00
20	1.A.3.c Transport - Railways	N2O	8	5	0.00	-0.268	0.00
19	1.A.3.c Transport - Railways	CH4	1	0	0.00	-1.025	0.00
23	1.A.3.d Transport - Navigation	N2O	1	0	0.00	-1.264	0.00
26	1.A.3.e Transport - Other Transportation	N2O	0	0	0.00	-5.204	0.00
13	1.A.3.a Transport - Civil Aviation	CH4	0	0	0.00	-1.451	0.00
22	1.A.3.d Transport - Navigation	CH4	0	0	0.00	-2.791	0.00
25	1.A.3.e Transport - Other Transportation	CH4	0	0	0.00	-7.876	0.00
59	6.C Waste Incineration	N2O	0	4	0.00		0.00
	TOTAL		**194 712**	**150 823**	**100**		**43.90**

Table A2.5 Spreadsheet for Tier 1 KC Analysis, 1990 - Level Assessment including LULUCF

N	Cat	IPCC Source Categories	GHG	Em or Rem, Gg	Absol., Gg	LA, %	Cumul, %
1	1A	1.A Stationary Combustion - Solid Fuels	CO2	110 713	110 713	54.67	54.67
7	1A	1.A Stationary Combustion - Liquid Fuels	CO2	13 518	13 518	6.68	61.35
41	2	2.C.1 Iron and Steel Production	CO2	12 533	12 533	6.19	67.54
4	1A	1.A Stationary Combustion - Gaseous Fuels	CO2	12 438	12 438	6.14	73.68
30	1B	1.B.1.a Coal Mining and Handling	CH4	7 600	7 600	3.75	77.43
15	1A	1.A.3.b Transport - Road Transportation	CO2	5 995	5 995	2.96	80.40
60	5	5.A.1 Forest Land remaining Forest Land	CO2	-5 580	5 580	2.76	83.15
49	4	4.A Enteric Fermentation	CH4	4 869	4 869	2.40	85.56
52	4	4.D.1 Agricultural Soils, Direct Emissions	N2O	4 573	4 573	2.26	87.81
54	4	4.D.3 Agricultural Soils, Indirect Emissions	N2O	3 620	3 620	1.79	89.60
32	2	2.A.1 Cement Production	CO2	2 489	2 489	1.23	90.83
55	6	6.A Solid Waste Disposal on Land	CH4	1 663	1 663	0.82	91.65
27	1A	1.A.5.b Mobile sources in Agriculture and Forestry	CO2	1 601	1 601	0.79	92.44
33	2	2.A.2 Lime Production	CO2	1 337	1 337	0.66	93.10
2	1A	1.A Stationary Combustion - Solid Fuels	CH4	1 335	1 335	0.66	93.76
38	2	2.B.2 Nitric Acid Production	N2O	1 127	1 127	0.56	94.32
63	5	5.B.1 Cropland remaining Cropland	CO2	1 089	1 089	0.54	94.86
50	4	4.B Manure Management	CH4	1 009	1 009	0.50	95.35
31	1B	1.B.1.b Fugitive Emission from Oil, Natural Gas and Other	CH4	896	896	0.44	95.80
56	6	6.B Wastewater Handling	CH4	825	825	0.41	96.21
37	2	2.B.1 Ammonia Production	CO2	807	807	0.40	96.60
53	4	4.D.2 Pasture, Range and Padock Manure	N2O	706	706	0.35	96.95
51	4	4.B Manure Management	N2O	690	690	0.34	97.29
34	2	2.A.3 Limestone and Dolomite Use	CO2	678	678	0.33	97.63
18	1A	1.A.3.c Transport - Railways	CO2	647	647	0.32	97.95
47	3	3 Solvents and Other Product Use	CO2	550	550	0.27	98.22
3	1A	1.A Stationary Combustion - Solid Fuels	N2O	495	495	0.24	98.46
24	1A	1.A.3.e Transport - Other Transportation	CO2	494	494	0.24	98.71
68	5	5.A.2 Land converted to Forest Land	CO2	-407	407	0.20	98.91
35	2	2.A.7 Glass, Bricks and Ceramics	CO2	326	326	0.16	99.07
69	5	5.B.2 Land converted to Cropland	CO2	226	226	0.11	99.18
48	3	3 Solvents and Other Product Use	N2O	215	215	0.11	99.29
70	5	5.C.2 Land converted to Grassland	CO2	-187	187	0.09	99.38
57	6	6.B Wastewater Handling	N2O	162	162	0.08	99.46
12	1A	1.A.3.a Transport - Civil Aviation	CO2	149	149	0.07	99.53
42	2	2.C.1 Iron and Steel Production	CH4	127	127	0.06	99.60
61	5	5.A.1 Forest Land remaining Forest Land	CH4	97	97	0.05	99.64
72	5	5.E.2 Land converted to Settlements	CO2	85	85	0.04	99.69
40	2	2.B.5 Other	N2O	84	84	0.04	99.73
45	2	2.F.8 F-gases Use - Electrical Equipment	SF6	78	78	0.04	99.77
17	1A	1.A.3.b Transport - Road Transportation	N2O	71	71	0.03	99.80
64	5	5.C.1 Grassland remaining Grassland	CO2	59	59	0.03	99.83
10	1A	1.A Stationary Combustion - Biomass	CH4	56	56	0.03	99.86
21	1A	1.A.3.d Transport - Navigation	CO2	56	56	0.03	99.88
9	1A	1.A Stationary Combustion - Liquid Fuels	N2O	34	34	0.02	99.90
11	1A	1.A Stationary Combustion - Biomass	N2O	27	27	0.01	99.91
16	1A	1.A.3.b Transport - Road Transportation	CH4	25	25	0.01	99.93
71	5	5.D.2. Land converted to Wetlands	CO2	22	22	0.01	99.94
73	5	5.F.2. Land converted to Other Land	CO2	21	21	0.01	99.95
5	1A	1.A Stationary Combustion - Gaseous Fuels	CH4	21	21	0.01	99.96
29	1A	1.A.5.b Mobile sources in Agriculture and Forestry	N2O	20	20	0.01	99.97
8	1A	1.A Stationary Combustion - Liquid Fuels	CH4	14	14	0.01	99.98
62	5	5.A.1 Forest Land remaining Forest Land	N2O	10	10	0.00	99.98
20	1A	1.A.3.c Transport - Railways	N2O	8	8	0.00	99.98
39	2	2.B.5 Other	CH4	8	8	0.00	99.99
28	1A	1.A.5.b Mobile sources in Agriculture and Forestry	CH4	7	7	0.00	99.99
6	1A	1.A Stationary Combustion - Gaseous Fuels	N2O	7	7	0.00	100.00
14	1A	1.A.3.a Transport - Civil Aviation	N2O	4	4	0.00	100.00
36	2	2.A.7 Glass, Bricks and Ceramics	CH4	3	3	0.00	100.00
19	1A	1.A.3.c Transport - Railways	CH4	1	1	0.00	100.00
23	1A	1.A.3.d Transport - Navigation	N2O	1	1	0.00	100.00
13	1A	1.A.3.a Transport - Civil Aviation	CH4	0	0	0.00	100.00
26	1A	1.A.3.e Transport - Other Transportation	N2O	0	0	0.00	100.00
22	1A	1.A.3.d Transport - Navigation	CH4	0	0	0.00	100.00
25	1A	1.A.3.e Transport - Other Transportation	CH4	0	0	0.00	100.00
43	2	2.F.1-6 F-gases Use - ODS substitutes	HFC, PFC	0	0	0.00	100.00
58	6	6.C Waste Incineration	CO2	0	0	0.00	100.00
44	2	2.F.7 F-gases Use - Semiconductore Manufacture	PFC, SF6	0	0	0.00	100.00
46	2	2.F.9 F-gases Use - Other SF6	SF6	0	0	0.00	100.00
59	6	6.C Waste Incineration	N2O	0	0	0.00	100.00
65	5	5.D.1 Wetlands remaining Wetlands	CO2	0	0	0.00	100.00
66	5	5.E.1 Settlements remaining Settlements	CO2	0	0	0.00	100.00
67	5	5.F.1 Other Land remaining Other Land	CO2	0	0	0.00	100.00
		With LULUC		**190 147**	**202 496**		

Table A2.6 Spreadsheet for Tier 1 KC Analysis, 1990 - Level Assessment excluding LULUCF

N	Cat	IPCC Source Categories	GHG	Emissions, Gg	Absol., Gg	LA, %	Cumul, %
1	1A	1.A Stationary Combustion - Solid Fuels	CO2	110 713	110 713	56.86	56.86
7	1A	1.A Stationary Combustion - Liquid Fuels	CO2	13 518	13 518	6.94	63.80
41	2	2.C.1 Iron and Steel Production	CO2	12 533	12 533	6.44	70.24
4	1A	1.A Stationary Combustion - Gaseous Fuels	CO2	12 438	12 438	6.39	76.63
30	1B	1.B.1.a Coal Mining and Handling	CH4	7 600	7 600	3.90	80.53
15	1A	1.A.3.b Transport - Road Transportation	CO2	5 995	5 995	3.08	83.61
49	4	4.A Enteric Fermentation	CH4	4 869	4 869	2.50	86.11
52	4	4.D.1 Agricultural Soils, Direct Emissions	N2O	4 573	4 573	2.35	88.46
54	4	4.D.3 Agricultural Soils, Indirect Emissions	N2O	3 620	3 620	1.86	90.32
32	2	2.A.1 Cement Production	CO2	2 489	2 489	1.28	91.60
55	6	6.A Solid Waste Disposal on Land	CH4	1 663	1 663	0.85	92.45
27	1A	1.A.5.b Mobile sources in Agriculture and Forestry	CO2	1 601	1 601	0.82	93.27
33	2	2.A.2 Lime Production	CO2	1 337	1 337	0.69	93.96
2	1A	1.A Stationary Combustion - Solid Fuels	CH4	1 335	1 335	0.69	94.64
38	2	2.B.2 Nitric Acid Production	N2O	1 127	1 127	0.58	95.22
50	4	4.B Manure Management	CH4	1 009	1 009	0.52	95.74
31	1B	1.B.1.b Fugitive Emission from Oil, Natural Gas and Other	CH4	896	896	0.46	96.20
56	6	6.B Wastewater Handling	CH4	825	825	0.42	96.63
37	2	2.B.1 Ammonia Production	CO2	807	807	0.41	97.04
53	4	4.D.2 Pasture, Range and Padock Manure	N2O	706	706	0.36	97.40
51	4	4.B Manure Management	N2O	690	690	0.35	97.76
34	2	2.A.3 Limestone and Dolomite Use	CO2	678	678	0.35	98.11
18	1A	1.A.3.c Transport - Railways	CO2	647	647	0.33	98.44
47	3	3 Solvents and Other Product Use	CO2	550	550	0.28	98.72
3	1A	1.A Stationary Combustion - Solid Fuels	N2O	495	495	0.25	98.97
24	1A	1.A.3.e Transport - Other Transportation	CO2	494	494	0.25	99.23
35	2	2.A.7 Glass, Bricks and Ceramics	CO2	326	326	0.17	99.40
48	3	3 Solvents and Other Product Use	N2O	215	215	0.11	99.51
57	6	6.B Wastewater Handling	N2O	162	162	0.08	99.59
12	1A	1.A.3.a Transport - Civil Aviation	CO2	149	149	0.08	99.67
42	2	2.C.1 Iron and Steel Production	CH4	127	127	0.07	99.73
40	2	2.B.5 Other	N2O	84	84	0.04	99.77
45	2	2.F.8 F-gases Use - Electrical Equipment	SF6	78	78	0.04	99.81
17	1A	1.A.3.b Transport - Road Transportation	N2O	71	71	0.04	99.85
10	1A	1.A Stationary Combustion - Biomass	CH4	56	56	0.03	99.88
21	1A	1.A.3.d Transport - Navigation	CO2	56	56	0.03	99.91
9	1A	1.A Stationary Combustion - Liquid Fuels	N2O	34	34	0.02	99.93
11	1A	1.A Stationary Combustion - Biomass	N2O	27	27	0.01	99.94
16	1A	1.A.3.b Transport - Road Transportation	CH4	25	25	0.01	99.95
5	1A	1.A Stationary Combustion - Gaseous Fuels	CH4	21	21	0.01	99.96
29	1A	1.A.5.b Mobile sources in Agriculture and Forestry	N2O	20	20	0.01	99.97
8	1A	1.A Stationary Combustion - Liquid Fuels	CH4	14	14	0.01	99.98
20	1A	1.A.3.c Transport - Railways	N2O	8	8	0.00	99.98
39	2	2.B.5 Other	CH4	8	8	0.00	99.99
28	1A	1.A.5.b Mobile sources in Agriculture and Forestry	CH4	7	7	0.00	99.99
6	1A	1.A Stationary Combustion - Gaseous Fuels	N2O	7	7	0.00	100.00
14	1A	1.A.3.a Transport - Civil Aviation	N2O	4	4	0.00	100.00
36	2	2.A.7 Glass, Bricks and Ceramics	CH4	3	3	0.00	100.00
19	1A	1.A.3.c Transport - Railways	CH4	1	1	0.00	100.00
23	1A	1.A.3.d Transport - Navigation	N2O	1	1	0.00	100.00
13	1A	1.A.3.a Transport - Civil Aviation	CH4	0	0	0.00	100.00
26	1A	1.A.3.e Transport - Other Transportation	N2O	0	0	0.00	100.00
22	1A	1.A.3.d Transport - Navigation	CH4	0	0	0.00	100.00
25	1A	1.A.3.e Transport - Other Transportation	CH4	0	0	0.00	100.00
43	2	2.F.1-6 F-gases Use - ODS substitutes	HFC, PFC	0	0	0.00	100.00
58	6	6.C Waste Incineration	CO2	0	0	0.00	100.00
44	2	2.F.7 F-gases Use - Semiconductore Manufacture	PFC, SF6	0	0	0.00	100.00
46	2	2.F.9 F-gases Use - Other SF6	SF6	0	0	0.00	100.00
59	6	6.C Waste Incineration	N2O	0	0	0.00	100.00
		Without LULUCF		**194 712**	**194 712**		

Annex 3

Uncertainty Analysis (Tier 1)

Table A3.1 Spreadsheet for Tier 1 Uncertainty Analysis, 2007

Input DATA						Uncertainty of Emissions		Uncertainty of Trend				
IPCC Source Category	Gas	Base year emissions (1990)	Year t emissions (2007)	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combine uncertainty as % of total national emissions in year t	Type A sensitivity	Type B sensitivity	Uncertainty in trend in national emissions introduced by EF unc.	Uncertainty in trend in national emissions introduced by a.d.	Uncertainty introduced into the trend in total national emissions
		Gg CO_2 ekv		%	%	%	%	%	%	%	%	%
1.A Stationary Combustion - Solid Fuels	CO2	110 713	75 313	4.0	4.0	5.66	2.82	-0.053	0.387	-0.21	2.19	2.20
1.A Stationary Combustion - Gaseous Fuels	CO2	12 438	16 618	4.0	3.0	5.00	0.55	0.036	0.085	0.11	0.48	0.49
1.A Stationary Combustion - Liquid Fuels	CO2	13 518	4 828	4.0	3.0	5.00	0.16	-0.029	0.025	-0.09	0.14	0.16
1.A.3.a Transport - Civil Aviation	CO2	149	32	4.0	3.0	5.00	0.00	0.000	0.000	0.00	0.00	0.00
1.A.3.b Transport - Road Transportation	CO2	5 995	18 039	4.0	3.0	5.00	0.60	0.069	0.093	0.21	0.52	0.56
1.A.3.c Transport - Railways	CO2	647	298	4.0	3.0	5.00	0.01	-0.001	0.002	0.00	0.01	0.01
1.A.3.d Transport - Navigation	CO2	56	16	4.0	3.0	5.00	0.00	0.000	0.000	0.00	0.00	0.00
1.A.3.e Transport - Other Transportation	CO2	494	76	4.0	3.0	5.00	0.00	-0.002	0.000	0.00	0.00	0.01
1.A.5.b Mobile sources in Agriculture and Forestry	CO2	1 601	1 078	4.0	3.0	5.00	0.04	-0.001	0.006	0.00	0.03	0.03
2.A.1 Cement Production	CO2	2 489	2 043	5.0	10.0	11.18	0.15	0.001	0.010	0.01	0.07	0.07
2.A.2 Lime Production	CO2	1 337	794	5.0	10.0	11.18	0.06	-0.001	0.004	-0.01	0.03	0.03
2.A.3 Limestone and Dolomite Use	CO2	678	1 106	5.0	10.0	11.18	0.08	0.003	0.006	0.03	0.04	0.05
2.A.7 Glass, Bricks and Ceramics	CO2	326	424	5.0	10.0	11.18	0.03	0.001	0.002	0.01	0.02	0.02
2.B.1 Ammonia Production	CO2	807	544	5.0	3.0	5.83	0.02	0.000	0.003	0.00	0.02	0.02
2.C.1 Iron and Steel Production	CO2	12 533	8 030	7.0	5.0	8.60	0.46	-0.009	0.041	-0.04	0.41	0.41
3 Solvents and Other Product Use	CO2	550	298	5.0	5.0	7.07	0.01	-0.001	0.002	0.00	0.01	0.01
6.C Waste Incineration	CO2	0	413	20.0	5.0	20.62	0.06	0.002	0.002	0.01	0.06	0.06
1.A Stationary Combustion - Solid Fuels	CH4	1 335	180	4.0	50.0	50.16	0.06	-0.004	0.001	-0.22	0.01	0.22
1.A Stationary Combustion - Gaseous Fuels	CH4	21	28	4.0	50.0	50.16	0.01	0.000	0.000	0.00	0.00	0.00
1.A Stationary Combustion - Liquid Fuels	CH4	14	3	4.0	50.0	50.16	0.00	0.000	0.000	0.00	0.00	0.00
1.A Stationary Combustion - Biomass	CH4	56	320	4.0	50.0	50.16	0.11	0.001	0.002	0.07	0.01	0.07
1.A.3.a Transport - Civil Aviation	CH4	0	0	20.0	50.0	53.85	0.00	0.000	0.000	0.00	0.00	0.00
1.A.3.b Transport - Road Transportation	CH4	25	32	7.0	50.0	50.49	0.01	0.000	0.000	0.00	0.00	0.00
1.A.3.c Transport - Railways	CH4	1	0	10.0	50.0	50.99	0.00	0.000	0.000	0.00	0.00	0.00
1.A.3.d Transport - Navigation	CH4	0	0	10.0	50.0	50.99	0.00	0.000	0.000	0.00	0.00	0.00
1.A.3.e Transport - Other Transportation	CH4	0	0	10.0	50.0	50.99	0.00	0.000	0.000	0.00	0.00	0.00
1.A.5.b Mobile sources in Agriculture and Forestry	CH4	7	1	20.0	50.0	53.85	0.00	0.000	0.000	0.00	0.00	0.00
1.B.1.a Coal Mining and Handling	CH4	7 600	4 567	5.0	40.0	40.31	1.22	-0.007	0.023	-0.27	0.17	0.32
1.B.1.b Fugitive Emission from Oil, Natural Gas and Ot	CH4	896	692	5.0	30.0	30.41	0.14	0.000	0.004	0.00	0.03	0.03
2.A.7 Glass, Bricks and Ceramics	CH4	3	5	5.0	50.0	50.25	0.00	0.000	0.000	0.00	0.00	0.00
2.B.5 Other	CH4	8	9	5.0	50.0	50.25	0.00	0.000	0.000	0.00	0.00	0.00
2.C.1 Iron and Steel Production	CH4	127	70	7.0	50.0	50.49	0.02	0.000	0.000	-0.01	0.00	0.01
4.A Enteric Fermentation	CH4	4 869	2 372	7.0	30.0	30.81	0.48	-0.007	0.012	-0.22	0.12	0.25
4.B Manure Management	CH4	1 009	490	7.0	60.0	60.41	0.20	-0.001	0.003	-0.09	0.02	0.09
6.A Solid Waste Disposal on Land	CH4	1 663	2 417	25.0	40.0	47.17	0.76	0.006	0.012	0.23	0.44	0.50
6.B Wastewater Handling	CH4	825	514	30.0	40.0	50.00	0.17	-0.001	0.003	-0.03	0.11	0.11
1.A Stationary Combustion - Solid Fuels	N2O	495	343	4.0	80.0	80.10	0.18	0.000	0.002	-0.02	0.01	0.02
1.A Stationary Combustion - Gaseous Fuels	N2O	7	9	4.0	80.0	80.10	0.00	0.000	0.000	0.00	0.00	0.00
1.A Stationary Combustion - Liquid Fuels	N2O	34	12	4.0	80.0	80.10	0.01	0.000	0.000	-0.01	0.00	0.01
1.A Stationary Combustion - Biomass	N2O	27	93	4.0	80.0	80.10	0.05	0.000	0.000	0.03	0.00	0.03
1.A.3.a Transport - Civil Aviation	N2O	4	1	20.0	70.0	72.80	0.00	0.000	0.000	0.00	0.00	0.00
1.A.3.b Transport - Road Transportation	N2O	71	722	7.0	70.0	70.35	0.34	0.003	0.004	0.24	0.04	0.24
1.A.3.c Transport - Railways	N2O	8	5	10.0	70.0	70.71	0.00	0.000	0.000	0.00	0.00	0.00
1.A.3.d Transport - Navigation	N2O	1	0	10.0	70.0	70.71	0.00	0.000	0.000	0.00	0.00	0.00
1.A.3.e Transport - Other Transportation	N2O	0	0	10.0	70.0	70.71	0.00	0.000	0.000	0.00	0.00	0.00
1.A.5.b Mobile sources in Agriculture and Forestry	N2O	20	21	20.0	70.0	72.80	0.01	0.000	0.000	0.00	0.00	0.00
2.B.2 Nitric Acid Production	N2O	1 127	773	10.0	25.0	26.93	0.14	-0.001	0.004	-0.01	0.06	0.06
2.B.5 Other	N2O	84	94	5.0	70.0	70.18	0.04	0.000	0.000	0.01	0.00	0.01
3 Solvents and Other Product Use	N2O	215	215	5.0	70.0	70.18	0.10	0.000	0.001	0.02	0.01	0.02
4.B Manure Management	N2O	690	351	7.0	250.0	250.10	0.58	-0.001	0.002	-0.24	0.02	0.24
4.D.1 Agricultural Soils, Direct Emissions	N2O	4 573	2 550	15.0	250.0	250.45	4.23	-0.005	0.013	-1.27	0.28	1.30
4.D.2 Pasture, Range and Padock Manure	N2O	706	271	15.0	250.0	250.45	0.45	-0.001	0.001	-0.35	0.03	0.35
4.D.3 Agricultural Soils, Indirect Emissions	N2O	3 620	1 803	15.0	250.0	250.45	2.99	-0.005	0.009	-1.28	0.20	1.30
6.B Wastewater Handling	N2O	162	201	20.0	50.0	53.85	0.07	0.000	0.001	0.02	0.03	0.04
6.C Waste Incineration	N2O	0	4	15.0	70.0	71.59	0.00	0.000	0.000	0.00	0.00	0.00
2.F.1-6 F-gases Use - ODS substitutes	FC, PF	0	1 612	20.0	20.0	28.28	0.30	0.008	0.008	0.17	0.23	0.29
2.F.7 F-gases Use - Semiconductore Manufacture	FC, SF	0	16	20.0	20.0	28.28	0.00	0.000	0.000	0.00	0.00	0.00
2.F.8 F-gases Use - Electrical Equipment	SF6	78	65	20.0	20.0	28.28	0.01	0.000	0.000	0.00	0.01	0.01
2.F.9 F-gases Use - Other SF6	SF6	0	9	20.0	20.0	28.28	0.00	0.000	0.000	0.00	0.00	0.00
	Total	**194 712**	**150 823**			**Total H =**	**6.25**				**Total M =**	**3.13**

Appendix I

2007 Emission Inventory Tables

Part I – Sectoral tables

TABLE 1 SECTORAL REPORT FOR ENERGY
(Sheet 1 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
	(Gg)						
Total Energy	116 297,73	277,38	3,90	280,61	501,10	78,35	213,46
A. Fuel Combustion Activities (Sectoral Approach)	116 297,49	26,95	3,90	280,36	500,91	77,86	207,20
1. Energy Industries	61 315,77	0,86	0,89	103,89	11,04	6,78	144,24
a. Public Electricity and Heat Production	58 994,29	0,79	0,85	96,29	8,90	6,44	130,03
b. Petroleum Refining	969,17	0,04	0,01	0,57	0,09	0,02	0,96
c. Manufacture of Solid Fuels and Other Energy Industries	1 352,31	0,03	0,03	7,04	2,05	0,32	13,24
2. Manufacturing Industries and Construction	24 939,67	2,87	0,34	38,07	173,50	2,58	35,55
a. Iron and Steel	3 723,79	0,37	0,04	7,69	149,20	0,23	11,80
b. Non-Ferrous Metals	203,17	0,01	0,00	0,18	0,21	0,02	0,32
c. Chemicals	4 322,42	0,33	0,05	8,97	1,47	0,44	12,82
d. Pulp, Paper and Print	574,27	0,40	0,05	1,67	0,98	0,05	1,52
e. Food Processing, Beverages and Tobacco	1 112,80	0,10	0,00	1,03	0,90	0,13	1,68
f. Other *(as specified in table 1.A(a) sheet 2)*	15 003,22	1,67	0,20	18,53	20,74	1,72	7,40
Other non-specified	15 003,22	1,67	0,20	18,53	20,74	1,72	7,40
3. Transport	18 461,49	1,56	2,35	90,48	203,51	39,95	0,61
a. Civil Aviation	32,13	0,01	0,00	0,14	0,27	0,07	0,00
b. Road Transportation	18 039,44	1,53	2,33	86,66	201,20	39,41	0,60
c. Railways	298,11	0,02	0,02	3,22	1,87	0,45	0,01
d. Navigation	15,69	0,00	0,00	0,17	0,10	0,02	0,00
e. Other Transportation *(as specified in table 1.A(a) sheet 3)*	76,12	0,00	0,00	0,29	0,07	0,00	0,00
Pipeline transport	76,12	0,00	0,00	0,29	0,07	0,00	0,00

TABLE 1 SECTORAL REPORT FOR ENERGY
(Sheet 2 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_2
				(Gg)			
4. Other Sectors	10 502,72	21,60	0,24	13,15	85,81	20,70	26,70
a. Commercial/Institutional	3 142,34	0,54	0,01	3,24	3,71	1,05	3,28
b. Residential	7 132,16	20,69	0,23	9,66	81,53	19,51	23,02
c. Agriculture/Forestry/Fisheries	228,23	0,36	0,00	0,25	0,58	0,14	0,41
5. Other *(as specified in table 1.A(a) sheet 4)*	1 077,84	0,07	0,07	34,78	27,05	7,84	0,10
a. Stationary	NO	NO	NO	0,03	0,05	0,01	0,07
Other non-specified	NO	NO	NO	0,03	0,05	0,01	0,07
b. Mobile	1 077,84	0,07	0,07	34,75	26,99	7,83	0,03
Other mobile sources not included elsewhere	84,09	0,01	0,01	1,45	3,13	0,64	0,00
Agriculture, Forestry and Fishing	993,75	0,06	0,06	33,30	23,87	7,19	0,03
B. Fugitive Emissions from Fuels	0,24	250,43	0,00	0,25	0,19	0,49	6,26
1. Solid Fuels	IE,NA,NE	217,46	NA,NO	0,00	0,01	NA,NE,NO	0,00
a. Coal Mining and Handling	NE	217,46	NO	NA	NA	NE	
b. Solid Fuel Transformation	IE	IE	NA	0,00	0,01	NO	0,00
c. Other *(as specified in table 1.B.1)*	NA	NA	NA	NA	NA	NA	NA
2. Oil and Natural Gas	0,24	32,97	0,00	0,25	0,19	0,49	6,26
a. Oil	IE,NA,NE,NO	0,42	NA,NO	NA	NA	0,49	NA
b. Natural Gas	NO	32,55				NE	NE
c. Venting and Flaring	0,24	0,00	0,00	0,25	0,19	0,00	6,26
Venting	0,00	0,00				NE	NE
Flaring	0,24	0,00	0,00	0,25	0,19	0,00	6,26
d. Other *(as specified in table 1.B.2)*	NO	NO	NA	NA	NA	NA	NA
Other non-specified	NO	NO	NA	NA	NA	NA	NA
Memo Items: [(1)]							
International Bunkers	1 091,41	0,21	0,15	4,03	0,76	0,53	0,07
Aviation	1 091,41	0,21	0,15	4,03	0,76	0,53	0,07
Marine	NA,NO	NA,NO	NA,NO	NO	NO	NO	NO
Multilateral Operations	NO	NO	NO	NE	NE	NE	NE
CO_2 Emissions from Biomass	8 465,43						

[(1)] Countries are asked to report emissions from international aviation and marine bunkers and multilateral operations, as well as CO_2 emissions from biomass, under Memo Items. These emissions should not be included in the national total emissions from the Energy sector. Amounts of biomass used as fuel are included in the national energy consumption but the corresponding CO_2 emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net CO_2 emissions are accounted for as a loss of biomass stocks in the Land Use, Land-Use Change and Forestry sector.

Documentation Box: Parties should provide detailed explanations on the Energy sector in Chapter 3: Energy (CRF sector 1) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
1 Energy:Detailed comparison of the results from Sectoral and Reference Approach (SA and RA), respectively, is given in NIR Annex 1 Reference Approach and Comparison with Sectoral Approach.
1.AA.2 Manufacturing Industries and Construction:The whole source category 1A2 "Manufacturing Industries and Construction" for the time period 1990 - 2002 is reported under 1A2f. However, since 2003 this category has been disaggregated to relevant subcategories and so now 1A2f covers only: Non-Metallic Minerals,Transport Equipment Machinery, Mining and Quarrying Wood and Wood Products, Construction,Textile, Leather and other non-specified.
1.AA.4 Other Sectors:Stationary sources from Agriculture/Forestry/Fishing are reported under 1A4c, while mobile sources from Agriculture/Forestry/Fishing are reported under 1A5b.
1.B Fugitive Emissions from Fuels:Emissions from underground reservoirs are reported under CRF-Reporter code 1.B.2.B.5.1 (Natural gas - other leakage), which corresponds IPCC sub-category 1.B.2.b.iii - Transmission item involves also an international transit pipelines.
1.B.1 Solid Fuels:Solid fuel transformation, IE: CH4 and precursors reported in 2.C.1 - Iron and Steel (IE) Production, CO2 reported in 1.A.2.

TABLE 2(I) SECTORAL REPORT FOR INDUSTRIAL PROCESSES
(Sheet 1 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
Total Industrial Processes	12 941,15	3,96	2,80	3 884,78	1 605,62	27,57	20,16	0,01	0,00	2,73	7,36	0,89	3,48
A. Mineral Products	4 367,07	0,23	NA							0,39	2,99	0,14	0,04
1. Cement Production	2 043,08												NO
2. Lime Production	794,07												
3. Limestone and Dolomite Use	1 105,73												
4. Soda Ash Production and Use	NO												
5. Asphalt Roofing	NE										NE	NE	
6. Road Paving with Asphalt	NE									NE	NE	NE	NE
7. Other *(as specified in table 2(I).A-G)*	424,19	0,23	NA							0,39	2,99	0,14	0,04
Glass Production	236,32	NA	NA							0,39	2,99	0,14	0,04
2.A.7.2 Bricks and ceramics	187,87	0,23	NA							IE	IE	IE	IE
B. Chemical Industry	544,38	0,41	2,80	NA	NA	NA	NA	NA	NA	1,07	0,22	0,34	2,94
1. Ammonia Production	544,38	NA	NA							0,00	0,00	NE	NE
2. Nitric Acid Production			2,49							0,22			
3. Adipic Acid Production	NO		NO							NO	NO	NO	
4. Carbide Production	NO	NO								NO	NO	NO	NO
5. Other *(as specified in table 2(I).A-G)*	IE,NA	0,41	0,30	NA	NA	NA	NA	NA	NA	0,85	0,22	0,34	2,94
Carbon Black		NE											
Ethylene	IE	0,41	NA										
Dichloroethylene		NE											
Styrene		NE											
Methanol		NE											
Other Chemical Industry	NA	NA	0,30	NA	NA	NA	NA	NA	NA	0,85	0,22	0,34	2,94
C. Metal Production	8 029,70	3,33	NA	NA	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,33	3,78	0,41	0,18
1. Iron and Steel Production	8 029,70	3,33								0,05	2,46	NO	0,08
2. Ferroalloys Production	NE	NE								IE	IE	IE	IE
3. Aluminium Production	NO	NO				NO	NO			NO	NO	NO	NO
4. SF_6 Used in Aluminium and Magnesium Foundries								NO	NO				
5. Other *(as specified in table 2(I).A-G)*	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,28	1,32	0,41	0,10
Other non-specified	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,28	1,32	0,41	0,10

Note: P = Potential emissions based on Tier 1 approach of the IPCC Guidelines. A = Actual emissions based on Tier 2 approach of the IPCC Guidelines. This applies only to source categories where methods exist for both tiers.

(1) The emissions of HFCs and PFCs are to be expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II).

TABLE 2(I) SECTORAL REPORT FOR INDUSTRIAL PROCESSES
(Sheet 2 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs[(1)]		PFCs[(1)]		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
D. Other Production	NA									0,90	0,36	0,00	0,32
1. Pulp and Paper										0,90	0,36	0,00	0,32
2. Food and Drink[(2)]	NA											0,00	
E. Production of Halocarbons and SF_6					NA,NO		NO		NO				
1. By-product Emissions					NA,NO		NA,NO		NO				
Production of HCFC-22					NO								
Other					NA,NO		NA,NO		NO				
2. Fugitive Emissions					NA,NO		NA,NO		NO				
3. Other *(as specified in table 2(II))*					NA,NO		NA,NO		NO				
Other non-specified					NO		NO		NO				
F. Consumption of Halocarbons and SF_6				3 884,78	1 605,62	27,57	20,16	0,01	0,00				
1. Refrigeration and Air Conditioning Equipment				3 747,97	1 518,32	7,64	6,31	NO	NO				
2. Foam Blowing				NO	3,25	NO	NO	NO	NO				
3. Fire Extinguishers				71,34	27,01	NO	IE,NO	NO	NO				
4. Aerosols/ Metered Dose Inhalers				56,94	50,77	NO	NO	NO	NO				
5. Solvents				7,12	5,87	NO	NO	NO	NO				
6. Other applications using ODS[(3)] substitutes				NO	NO	NO	NO	NO	NO				
7. Semiconductor Manufacture				1,40	0,40	19,92	13,85	0,00	0,00				
8. Electrical Equipment				NO	NO	NO	NO	0,00	0,00				
9. Other *(as specified in table 2(II)*				NO	NA,NO	NO	NA,NO	0,00	0,00				
Sound-proof windows				NO	NO	NO	NO	0,00	0,00				
laboratories				NO	NO	NO	NO	NA	NO				
G. Other *(as specified in tables 2(I).A-G and 2(II))*	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,04	0,01	0,01	0,00
Other non-specified	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,04	0,01	0,01	0,00

Note: P = Potential emissions based on Tier 1 approach of the IPCC Guidelines. A = Actual emissions based on Tier 2 approach of the IPCC Guidelines. This applies only to source categories where methods exist for both tiers.

(1) The emissions of HFCs and PFCs are to be expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II).

(2) CO_2 from Food and Drink Production (e.g. gasification of water) can be of biogenic or non-biogenic origin. Only information on CO_2 emissions of non-biogenic origin should be reported.

(3) ODS: ozone-depleting substances.

Documentation box:
Parties should provide detailed explanations on the industrial processes sector in Chapter 4: Industrial processes (CRF sector 2) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
2.A Mineral Products:Calculation of emission from lime production is based on activity data, country specific EF (reflect production of dolomitic lime), purity and lime use. It is supposed that 35% of emission is removed by the lime use (e.g. building industry).
2.A.2 Lime Production:Calculation of emission from lime production is based on activity data, country specific EF (reflect production of dolomitic lime), purity and lime use. It is supposed that 35% of emission is removed by the lime use (building industry).
2.B.5 Other Chemical Industry:2..B.5. Other / Other CH I = caprolactam production
2.C.1 Iron and Steel Production:Amounts of fuels consumed in 2C1 (Iron and Steel) and in 2B1 (Ammonia production) are reported in NIR.For 2C1 the relevant value of fuel is amount of metallurgical coke supplied to blast furnace, for 2B1 the relevant value is amount of residual oil gasified for hydrogen / ammonia production.All CO2 emissions from 2C1 (coming from metallurgical coke supplied to blast furnace) are reported under 2C1.1 "steel".Coke reported under 2C1.4 represents overall coke produced in coke ovens.

TABLE 3 SECTORAL REPORT FOR SOLVENT AND OTHER PRODUCT USE
(Sheet 1 of 1)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	N_2O	NMVOC
		(Gg)	
Total Solvent and Other Product Use	297,65	0,69	94,71
A. Paint Application	118,40		37,67
B. Degreasing and Dry Cleaning	53,49	NA	17,02
C. Chemical Products, Manufacture and Processing	44,16		14,05
D. Other	81,60	0,69	25,96
1. Use of N_2O for Anaesthesia		0,35	
2. N_2O from Fire Extinguishers		NO	
3. N_2O from Aerosol Cans		0,35	
4. Other Use of N_2O		NO	
5. Other *(as specified in table 3.A-D)*	81,60	NA	25,96
Other solvent use (SNAP 0604)	81,60	NA	25,96

Note: The quantity of carbon released in the form of NMVOCs should be accounted for in both the NMVOC and the CO_2 columns. The quantites of NMVOCs should be converted into CO_2 equivalent emissions before being added to the CO_2 amounts in the CO_2 column.

Documentation box:
• Parties should provide detailed explanations about the Solvent and Other Product Use sector in Chapter 5: Solvent and Other Product Use (CRF sector 3) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
• The IPCC Guidelines do not provide methodologies for the calculation of emissions of N_2O from Solvent and Other Product Use. If reporting such data, Parties should provide in the NIR additional information (activity data and emission factors) used to derive these estimates, and provide in this documentation box a reference to the section of the NIR where this information can be found.

TABLE 4 SECTORAL REPORT FOR AGRICULTURE
(Sheet 1 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH_4	N_2O	NO_x	CO	NMVOC
	(Gg)				
Total Agriculture	**136,29**	16,05	NA,NO	NA,NO	NA,NE,NO
A. Enteric Fermentation	112,94				
1. Cattle [1]	106,83				
Option A:					
Dairy Cattle	65,16				
Non-Dairy Cattle	41,67				
Option B:					
Mature Dairy Cattle					
Mature Non-Dairy Cattle					
Young Cattle					
2. Buffalo	NO				
3. Sheep	1,35				
4. Goats	0,08				
5. Camels and Llamas	NO				
6. Horses	0,43				
7. Mules and Asses	NO				
8. Swine	4,25				
9. Poultry	NA				
10. Other *(as specified in table 4.A)*	NA				
Other non-specified	NA				
B. Manure Management	23,35	1,13			NE,NO
1. Cattle [1]	12,87				
Option A:					
Dairy Cattle	7,91				
Non-Dairy Cattle	4,96				
Option B:					
Mature Dairy Cattle					
Mature Non-Dairy Cattle					
Young Cattle					
2. Buffalo	NO				
3. Sheep	0,03				
4. Goats	0,00				
5. Camels and Llamas	NO				
6. Horses	0,03				
7. Mules and Asses	NO				
8. Swine	8,49				
9. Poultry	1,92				
10. Other livestock *(as specified in table 4.B(a))*	NA				
Other non-specified	NA				

Note: All footnotes for this table are given at the end of the table on sheet 2.

TABLE 4 SECTORAL REPORT FOR AGRICULTURE
(Sheet 2 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CH_4	N_2O	NO_x	CO	NMVOC
	(Gg)				
B. Manure Management (continued)					
11. Anaerobic Lagoons		NO			NO
12. Liquid Systems		0,16			NE
13. Solid Storage and Dry Lot		0,83			NE
14. Other AWMS		0,15			NE
C. Rice Cultivation	NO				**NO**
1. Irrigated	NO				NO
2. Rainfed	NO				NO
3. Deep Water	NO				NO
4. Other *(as specified in table 4.C)*	NO				NO
Other non-specified	NO				NO
D. Agricultural Soils [2]	NA,NE	14,92			NA,NE
1. Direct Soil Emissions	NE	8,23			NE
2. Pasture, Range and Paddock Manure [3]		0,87			NE
3. Indirect Emissions	NA	5,82			NE
4. Other *(as specified in table 4.D)*	NA	NA			NA
Other non-specified	NA	NA			NA
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO
1 . Cereals	NO	NO	NO	NO	NO
2. Pulses	NO	NO	NO	NO	NO
3 . Tubers and Roots	NO	NO	NO	NO	NO
4 . Sugar Cane	NO	NO	NO	NO	NO
5 . Other *(as specified in table 4.F)*	NO	NO	NO	NO	NO
Other non-specified	NO	NO	NO	NO	NO
G. Other *(please specify)*	**NA**	**NA**	**NA**	**NA**	**NA**
Other non-specified	NA	NA	NA	NA	NA

(1) The sum for cattle would be calculated on the basis of entries made under either option A (dairy and non-dairy cattle) or option B (mature dairy cattle, mature non-dairy cattle and young cattle).

(2) See footnote 4 to Summary 1.A of this common reporting format. Parties which choose to report CO_2 emissions and removals from agricultural soils under 4.D Agricultural Soils of the sector Agriculture should report the amount (in Gg) of these emissions or removals in table Summary 1.A of the CRF. References to additional information (activity data, emissions factors) reported in the NIR should be provided in the documentation box to table 4.D. In line with the corresponding table in the IPCC Guidelines (i.e. IPCC Sectoral Report for Agriculture), this table does not include provisions for reporting CO_2 estimates.

(3) Direct N_2O emissions from pasture, range and paddock manure are to be reported in the "4.D Agricultural Soils" category. All other N_2O emissions from animal manure are to be reported in the "4.B Manure Management" category. See also chapter 4.4 of the IPCC good practice guidance report.

Note: The IPCC Guidelines do not provide methodologies for the calculation of CH_4 emissions and CH_4 and N_2O removals from agricultural soils, or CO_2 emissions from prescribed burning of savannas and field burning of agricultural residues. Parties that have estimated such emissions should provide, in the NIR, additional information (activity data and emission factors) used to derive these estimates and include a reference to the section of the NIR in the documentation box of the corresponding Sectoral background data tables.

Documentation box:
• Parties should provide detailed explanations on the agriculture sector in Chapter 6: Agriculture (CRF sector 4) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table. • If estimates are reported under "4.G Other", use this documentation box to provide information regarding activities covered under this category and to provide reference to the section in the NIR where background information can be found.
4 Agriculture:N2O emissions from Agriculture (manure, soils, direct, indirect) are estimated by Tier 1 approach using default parameters for Western Europe.
4.A Enteric Fermentation:Methane EF from Enteric Fermentation for cows is calculated for both dairy and sucker cows, respectively. Resulting EF is located in "Dairy Cattle" cell.Methane EF from Enteric Fermentation for other cattle than cows is calculated for 7 subcategories from calves to mature heifers (excluding sucker cows). Resulting EF is located in "Non-dairy Cattle" cell.Methane EFs from Enteric Fermentation for other animals than cattle (sheep, pigs….) are estimated by Tier 1 approach, default EFs are taken for Western Europe.Average Gross Energy (GE) was accounted by equation described in NIR (chapter 6.2.1.). Unit of GE is MJ/day.Feeding situation is determined on based expert estimation for diary cows.Since year 2002 number of goats does not include animals from a private sector (only agricultural sector is implied).
4.B Manure Management:Methane EFs from Manure Management for all kinds of livestock are estimated by Tier 1 approach, default EFs are taken for Western Europe N2O emissions from Agriculture (manure, soils, direct, indirect) are estimated by Tier 1 approach using default parameters for Western Europe.

TABLE 5 SECTORAL REPORT FOR LAND USE, LAND-USE CHANGE AND FORESTRY
(Sheet 1 of 1)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals[(1), (2)]	CH_4 [(2)]	N_2O [(2)]	NO_x	CO	NMVOC
	(Gg)					
Total Land-Use Categories	**-1 919,07**	**8,32**	**0,08**	**2,07**	**72,77**	**NA,NE,NO**
A. Forest Land	**-1 775,03**	**8,32**	**0,06**	**2,07**	**72,77**	**NO**
1. Forest Land remaining Forest Land	-1 347,31	8,32	0,06	2,07	72,77	
2. Land converted to Forest Land	-427,72	NO	NO	NO	NO	NO
B. Cropland	**127,12**	**NO**	**0,02**	**NO**	**NO**	**NO**
1. Cropland remaining Cropland	54,77	NO	NO	NO	NO	NO
2. Land converted to Cropland	72,34	NO	0,02	NO	NO	NO
C. Grassland	**-383,47**	**NO**	**NO**	**NO**	**NO**	**NO**
1. Grassland remaining Grassland	3,81	NO	NO	NO	NO	NO
2. Land converted to Grassland	-387,29	NO	NO	NO	NO	NO
D. Wetlands	**19,43**	**NA,NO**	**NA,NO**	**NO**	**NO**	**NE,NO**
1. Wetlands remaining Wetlands [(3)]	NO	NO	NO	NO	NO	NE
2. Land converted to Wetlands	19,43	NA,NO	NA,NO	NO	NO	NO
E. Settlements	**92,89**	**NE,NO**	**NE,NO**	**NO**	**NO**	**NO**
1. Settlements remaining Settlements [(3)]		NE	NE	NO	NO	NO
2. Land converted to Settlements	92,89	NE	NE	NO	NO	NO
F. Other Land	**NO**	**NA,NO**	**NA,NO**	**NA**	**NA**	**NA**
1. Other Land remaining Other Land [(4)]						
2. Land converted to Other Land	NO	NA	NA	NA	NA	NA
G. Other *(please specify)* [(5)]	**NE**	**NE**	**NE**	**NE**	**NE**	**NE**
Harvested Wood Products [(6)]	NE	NE	NE	NE	NE	NE
Information items[(7)]						
Forest Land converted to other Land-Use Categories						
Grassland converted to other Land-Use Categories						

(1) According to the Revised 1996 IPCC Guidelines, for the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).
(2) For each land-use category and sub-category, this table sums net CO_2 emissions and removals shown in tables 5.A to 5.F, and the CO_2, CH_4 and N_2O emissions showing in tables 5(I) to 5(V).
(3) Parties may decide not to prepare estimates for these categories contained in appendices 3a.3 and 3a.4 of the IPCC good practice guidance for LULUCF, although they may do so if they wish.
(4) This land-use category is to allow the total of identified land area to match the national area.
(5) The total for category 5.G Other includes items specified only under category 5.G in this table as well as sources and sinks specified in category 5.G in tables 5(I) to 5(V).
(6) Parties may decide not to prepare estimates for this category contained in appendix 3a.1 of the IPCC good practice guidance for LULUCF, although they may do so if they wish and report in this row.
(7) These items are listed for information only and will not be added to the totals, because they are already included in subcategories 5.A.2 to 5.F.2.

Documentation box:
• Parties should provide detailed explanations on the Land Use, Land-Use Change and Forestry sector in Chapter 7: Land Use, Land-Use Change and Forestry (CRF sector 5) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.

• If estimates are reported under 5.G Other, use this documentation box to provide information regarding activities covered under this category and to provide reference to the section in the NIR where background information can be found.

TABLE 6 SECTORAL REPORT FOR WASTE
(Sheet 1 of 1)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 (1)	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
	(Gg)						
Total Waste	**413,39**	**139,58**	**0,66**	**0,44**	**0,05**	**0,01**	**0,02**
A. Solid Waste Disposal on Land	**NA,NO**	**115,09**		**NA,NO**	**NA,NO**	**NA,NO**	
1. Managed Waste Disposal on Land	NA	115,09		NA	NA	NA	
2. Unmanaged Waste Disposal Sites	NO	NO		NA	NA	NA	
3. Other *(as specified in table 6.A)*	NO	NO		NO	NO	NO	
Other non-specified	NO	NO		NO	NO	NO	
B. Waste Water Handling		**24,49**	**0,65**	**NE**	**NE**	**0,00**	
1. Industrial Wastewater		12,28	NE	NE	NE	0,00	
2. Domestic and Commercial Waste Water		8,96	0,65	NE	NE	NE	
3. Other *(as specified in table 6.B)*		3,26	IE,NA	NE	NE	NE	
Treatment on site (latrines)		3,26	IE,NA	NE	NE	NE	
C. Waste Incineration	**413,39**	**NE**	**0,01**	**0,44**	**0,05**	**0,01**	**0,02**
D. Other *(please specify)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Other non-specified	NA	NA	NA	NA	NA	NA	NA

(1) CO_2 emissions from source categories Solid waste disposal on land and Waste incineration should only be included if they derive from non-biological or inorganic waste sources.

Documentation box:
• Parties should provide detailed explanations on the waste sector in Chapter 8: Waste (CRF sector 6) of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and/or further details are needed to understand the content of this table.
• If estimates are reported under "6.D Other", use this documentation box to provide information regarding activities covered under this category and to provide reference to the section in the NIR where background information can be found.

Part II – Summary tables

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)
(Sheet 1 of 3)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**128 030,84**	**565,53**	**24,18**	**3 884,78**	**1 605,62**	**27,57**	**20,16**	**0,01**	**0,00**	**285,86**	**581,27**	**173,97**	**216,96**
1. Energy	**116 297,73**	**277,38**	**3,90**							**280,61**	**501,10**	**78,35**	**213,46**
A. Fuel Combustion — Reference Approach [2]	126 204,40												
Sectoral Approach [2]	116 297,49	26,95	3,90							280,36	500,91	77,86	207,20
1. Energy Industries	61 315,77	0,86	0,89							103,89	11,04	6,78	144,24
2. Manufacturing Industries and Construction	24 939,67	2,87	0,34							38,07	173,50	2,58	35,55
3. Transport	18 461,49	1,56	2,35							90,48	203,51	39,95	0,61
4. Other Sectors	10 502,72	21,60	0,24							13,15	85,81	20,70	26,70
5. Other	1 077,84	0,07	0,07							34,78	27,05	7,84	0,10
B. Fugitive Emissions from Fuels	0,24	250,43	0,00							0,25	0,19	0,49	6,26
1. Solid Fuels	IE,NA,NE	217,46	NA,NO							0,00	0,01	NA,NE,NO	0,00
2. Oil and Natural Gas	0,24	32,97	0,00							0,25	0,19	0,49	6,26
2. Industrial Processes	**12 941,15**	**3,96**	**2,80**	**3 884,78**	**1 605,62**	**27,57**	**20,16**	**0,01**	**0,00**	**2,73**	**7,36**	**0,89**	**3,48**
A. Mineral Products	4 367,07	0,23	NA							0,39	2,99	0,14	0,04
B. Chemical Industry	544,38	0,41	2,80	NA	NA	NA	NA	NA	NA	1,07	0,22	0,34	2,94
C. Metal Production	8 029,70	3,33	NA				NA,NO		NA,NO	0,33	3,78	0,41	0,18
D. Other Production [3]	NA									0,90	0,36	0,00	0,32
E. Production of Halocarbons and SF_6					NA,NO		NO		NO				
F. Consumption of Halocarbons and SF_6				3 884,78	1 605,62	27,57	20,16	0,01	0,00				
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,04	0,01	0,01	0,00

Note: **A** = Actual emissions based on Tier 2 approach of the IPCC Guidelines.
P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

Note: All footnotes for this table are given at the end of the table on sheet 3.

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)
(Sheet 2 of 3)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs (1)		PFCs(1)		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
3. Solvent and Other Product Use	**297,65**		**0,69**							**NA**	**NA**	**94,71**	**NA**
4. Agriculture		**136,29**	**16,05**							**NA,NO**	**NA,NO**	**NA,NE,NO**	**NA**
A. Enteric Fermentation		112,94											
B. Manure Management		23,35	1,13									NE,NO	
C. Rice Cultivation		NO										NO	
D. Agricultural Soils(4)		NA,NE	14,92									NA,NE	
E. Prescribed Burning of Savannas		NO	NO							NO	NO	NO	
F. Field Burning of Agricultural Residues		NO	NO							NO	NO	NO	
G. Other		NA	NA							NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	(5) **-1 919,07**	**8,32**	**0,08**							**2,07**	**72,77**	**NA,NE,NO**	**NE**
A. Forest Land	(5) -1 775,03	8,32	0,06							2,07	72,77	NO	
B. Cropland	(5) 127,12	NO	0,02							NO	NO	NO	
C. Grassland	(5) -383,47	NO	NO							NO	NO	NO	
D. Wetlands	(5) 19,43	NA,NO	NA,NO							NO	NO	NE,NO	
E. Settlements	(5) 92,89	NE,NO	NE,NO							NO	NO	NO	
F. Other Land	(5) NO	NA,NO	NA,NO							NA	NA	NA	
G. Other	(5) NE	NE	NE							NE	NE	NE	NE
6. Waste	**413,39**	**139,58**	**0,66**							**0,44**	**0,05**	**0,01**	**0,02**
A. Solid Waste Disposal on Land	(6) NA,NO	115,09								NA,NO	NA,NO	NA,NO	
B. Waste-water Handling		24,49	0,65							NE	NE	0,00	
C. Waste Incineration	(6) 413,39	NE	0,01							0,44	0,05	0,01	0,02
D. Other	NA	NA	NA							NA	NA	NA	NA
7. Other ***(please specify)*** (7)	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Other non-specified	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Note: All footnotes for this table are given at the end of the table on sheet 3.

SUMMARY 1.A SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7A)
(Sheet 3 of 3)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/removals	CH_4	N_2O	HFCs		PFCs		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
Memo Items: [8]													
International Bunkers	**1 091,41**	**0,21**	**0,15**							**4,03**	**0,76**	**0,53**	**0,07**
Aviation	1 091,41	0,21	0,15							4,03	0,76	0,53	0,07
Marine	NA,NO	NA,NO	NA,NO							NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**8 465,43**												

(1) The emissions of HFCs and PFCs are to be expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.

(2) For verification purposes, countries are asked to report the results of their calculations using the Reference approach and to explain any differences with the Sectoral approach in the documentation box to Table 1.A.(c). For estimating national total emissions, the results from the Sectoral approach should be used, where possible.

(3) Other Production includes Pulp and Paper and Food and Drink Production.

(4) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(5) For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(6) CO_2 from source categories Solid Waste Disposal on Land and Waste Incineration should only be included if it stems from non-biogenic or inorganic waste streams. Only emissions from Waste Incineration Without Energy Recovery are to be reported in the Waste sector, whereas emissions from Incineration With Energy Recovery are to be reported in the Energy sector.

(7) If reporting any country-specific source category under sector "7. Other", detailed explanations should be provided in Chapter 9: Other (CRF sector 7) of the NIR.

(8) Countries are asked to report emissions from international aviation and marine bunkers and multilateral operations, as well as CO_2 emissions from biomass, under Memo Items. These emissions should not be included in the national total emissions from the energy sector. Amounts of biomass used as fuel are included in the national energy consumption but the corresponding CO_2 emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net CO_2 emissions are accounted for as a loss of biomass stocks in the Land Use, Land-use Change and Forestry sector.

SUMMARY 1.B SHORT SUMMARY REPORT FOR NATIONAL GREENHOUSE GAS INVENTORIES (IPCC TABLE 7B) (Sheet 1 of 1)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emisions/removals	CH_4	N_2O	HFCs[1]		PFCs[1]		SF_6		NO_x	CO	NMVOC	SO_2
				P	A	P	A	P	A				
	(Gg)			CO_2 equivalent (Gg)						(Gg)			
Total National Emissions and Removals	**128 030,84**	**565,53**	**24,18**	**3 884,78**	**1 605,62**	**27,57**	**20,16**	**0,01**	**0,00**	**285,86**	**581,27**	**173,97**	**216,96**
1. Energy	**116 297,73**	**277,38**	**3,90**							**280,61**	**501,10**	**78,35**	**213,46**
A. Fuel Combustion — Reference Approach[2]	126 204,40												
Sectoral Approach[2]	116 297,49	26,95	3,90							280,36	500,91	77,86	207,20
B. Fugitive Emissions from Fuels	0,24	250,43	0,00							0,25	0,19	0,49	6,26
2. Industrial Processes	**12 941,15**	**3,96**	**2,80**	**3 884,78**	**1 605,62**	**27,57**	**20,16**	**0,01**	**0,00**	**2,73**	**7,36**	**0,89**	**3,48**
3. Solvent and Other Product Use	**297,65**		**0,69**							**NA**	**NA**	**94,71**	**NA**
4. Agriculture [3]		**136,29**	**16,05**							**NA,NO**	**NA,NO**	**NA,NE,NO**	**NA**
5. Land Use, Land-Use Change and Forestry	[4] **-1 919,07**	**8,32**	**0,08**							**2,07**	**72,77**	**NA,NE,NO**	**NE**
6. Waste	**413,39**	**139,58**	**0,66**							**0,44**	**0,05**	**0,01**	**0,02**
7. Other	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Memo Items: [5]													
International Bunkers	**1 091,41**	**0,21**	**0,15**							**4,03**	**0,76**	**0,53**	**0,07**
Aviation	1 091,41	0,21	0,15							4,03	0,76	0,53	0,07
Marine	NA,NO	NA,NO	NA,NO							NO	NO	NO	NO
Multilateral Operations	**NO**	**NO**	**NO**							**NE**	**NE**	**NE**	**NE**
CO_2 Emissions from Biomass	**8 465,43**												

Note: A = Actual emissions based on Tier 2 approach of the IPCC Guidelines.
P = Potential emissions based on Tier 1 approach of the IPCC Guidelines.

(1) The emissions of HFCs and PFCs are to be expressed as CO_2 equivalent emissions. Data on disaggregated emissions of HFCs and PFCs are to be provided in Table 2(II) of this common reporting format.

(2) For verification purposes, countries are asked to report the results of their calculations using the Reference approach and to explain any differences with the Sectoral approach in the documentation box to Table 1.A.(c). For estimating national total emissions, the result from the Sectoral approach should be used, where possible.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(5) Countries are asked to report emissions from international aviation and marine bunkers and multilateral operations, as well as CO_2 emissions from biomass, under Memo Items. These emissions should not be included in the national total emissions from the energy sector. Amounts of biomass used as fuel are included in the national energy consumption but the corresponding CO_2 emissions are not included in the national total as it is assumed that the biomass is produced in a sustainable manner. If the biomass is harvested at an unsustainable rate, net CO_2 emissions are accounted for as a loss of biomass stocks in the Land Use, Land-use Change and Forestry sector.

SUMMARY 2 SUMMARY REPORT FOR CO_2 EQUIVALENT EMISSIONS
(Sheet 1 of 1)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [(1)]	CH_4	N_2O	HFCs [(2)]	PFCs [(2)]	SF_6 [(2)]	Total
	CO_2 equivalent (Gg)						
Total (Net Emissions) [(1)]	**128 030,84**	**11 876,19**	**7 494,77**	**1 605,62**	**20,16**	**75,85**	**149 103,44**
1. Energy	**116 297,73**	**5 824,99**	**1 207,76**				**123 330,48**
A. Fuel Combustion (Sectoral Approach)	116 297,49	566,01	1 207,76				118 071,26
1. Energy Industries	61 315,77	17,96	275,59				61 609,31
2. Manufacturing Industries and Construction	24 939,67	60,35	106,76				25 106,78
3. Transport	18 461,49	32,73	729,27				19 223,48
4. Other Sectors	10 502,72	453,51	74,66				11 030,89
5. Other	1 077,84	1,46	21,49				1 100,78
B. Fugitive Emissions from Fuels	0,24	5 258,99	0,00				5 259,22
1. Solid Fuels	IE,NA,NE	4 566,60	NA,NO				4 566,60
2. Oil and Natural Gas	0,24	692,39	0,00				692,63
2. Industrial Processes	**12 941,15**	**83,26**	**866,96**	**1 605,62**	**20,16**	**75,85**	**15 593,00**
A. Mineral Products	4 367,07	4,78	NA				4 371,85
B. Chemical Industry	544,38	8,58	866,96	NA	NA	NA	1 419,92
C. Metal Production	8 029,70	69,90	NA	NA,NO	NA,NO	NA,NO	8 099,61
D. Other Production	NA						NA
E. Production of Halocarbons and SF_6				NA,NO	NO	NO	NA,NO
F. Consumption of Halocarbons and SF_6 [(2)]				1 605,62	20,16	75,85	1 701,63
G. Other	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	**297,65**		**214,52**				**512,17**
4. Agriculture		**2 862,02**	**4 975,72**				**7 837,74**
A. Enteric Fermentation		2 371,72					2 371,72
B. Manure Management		490,30	351,40				841,70
C. Rice Cultivation		NO					NO
D. Agricultural Soils[(3)]		NA,NE	4 624,32				4 624,32
E. Prescribed Burning of Savannas		NO	NO				NO
F. Field Burning of Agricultural Residues		NO	NO				NO
G. Other		NA	NA				NA
5. Land Use, Land-Use Change and Forestry[(1)]	**-1 919,07**	**174,64**	**24,55**				**-1 719,88**
A. Forest Land	-1 775,03	174,64	17,72				-1 582,67
B. Cropland	127,12	NO	6,83				133,95
C. Grassland	-383,47	NO	NO				-383,47
D. Wetlands	19,43	NA,NO	NA,NO				19,43
E. Settlements	92,89	NE,NO	NE,NO				92,89
F. Other Land	NO	NA,NO	NA,NO				NA,NO
G. Other	NE	NE	NE				NE
6. Waste	**413,39**	**2 931,28**	**205,25**				**3 549,92**
A. Solid Waste Disposal on Land	NA,NO	2 416,93					2 416,93
B. Waste-water Handling		514,35	201,14				715,50
C. Waste Incineration	413,39	NE	4,10				417,50
D. Other	NA	NA	NA				NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**

Memo Items: [(4)]							
International Bunkers	1 091,41	4,37	46,00				1 141,78
Aviation	1 091,41	4,37	46,00				1 141,78
Marine	NA,NO	NA,NO	NA,NO				NA,NO
Multilateral Operations	**NO**	**NO**	**NO**				**NO**
CO_2 Emissions from Biomass	**8 465,43**						**8 465,43**

Total CO_2 Equivalent Emissions without Land Use, Land-Use Change and Forestry	150 823,32
Total CO_2 Equivalent Emissions with Land Use, Land-Use Change and Forestry	149 103,44

(1) For CO_2 from Land Use, Land-use Change and Forestry the net emissions/removals are to be reported. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).

(2) Actual emissions should be included in the national totals. If no actual emissions were reported, potential emissions should be included.

(3) Parties which previously reported CO_2 from soils in the Agriculture sector should note this in the NIR.

(4) See footnote 8 to table Summary 1.A.

Part III – Trend tables

TABLE 10 EMISSION TRENDS
CO_2
(Part 1 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**145 612,75**	**139 911,80**	**124 194,19**	**123 103,75**	**113 312,29**	**117 652,77**	**125 200,17**	**117 784,65**	**111 052,44**	**109 287,13**
A. Fuel Combustion (Sectoral Approach)	145 612,75	139 911,80	124 194,19	123 103,75	113 312,29	117 652,77	125 200,17	117 784,65	111 052,44	109 287,13
1. Energy Industries	57 706,66	57 400,85	51 270,07	53 501,99	53 657,57	56 621,14	59 256,65	59 032,84	55 694,43	52 504,14
2. Manufacturing Industries and Construction	46 616,29	49 139,71	41 105,52	41 996,55	32 609,49	32 765,53	36 626,06	29 068,62	28 588,10	29 956,40
3. Transport	7 342,31	6 674,71	7 437,88	7 333,96	7 615,37	9 454,39	10 475,67	11 118,57	11 656,63	11 876,65
4. Other Sectors	32 346,58	25 287,53	23 060,06	18 995,23	18 144,68	17 799,10	17 749,97	17 424,76	13 855,75	13 713,06
5. Other	1 600,90	1 409,00	1 320,66	1 276,02	1 285,19	1 012,61	1 091,82	1 139,85	1 257,53	1 236,88
B. Fugitive Emissions from Fuels	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO
1. Solid Fuels	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE
2. Oil and Natural Gas	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO
2. Industrial Processes	**18 169,32**	**13 598,67**	**14 888,07**	**11 957,66**	**12 682,71**	**13 004,17**	**12 720,53**	**13 321,55**	**12 497,86**	**10 721,39**
A. Mineral Products	4 829,84	4 035,32	3 851,96	3 513,84	3 610,47	3 602,45	3 908,44	4 035,98	4 187,14	4 082,17
B. Chemical Industry	806,81	781,92	806,14	753,81	841,62	743,05	799,72	732,91	755,54	643,56
C. Metal Production	12 532,67	8 781,42	10 229,96	7 690,01	8 230,63	8 658,67	8 012,37	8 552,67	7 555,18	5 995,65
D. Other Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	550,31	513,53	476,47	436,02	401,53	381,79	372,11	370,24	365,89	363,97
4. Agriculture										
A. Enteric Fermentation										
B. Manure Management										
C. Rice Cultivation										
D. Agricultural Soils										
E. Prescribed Burning of Savannas										
F. Field Burning of Agricultural Residues										
G. Other										
5. Land Use, Land-Use Change and Forestry(2)	**-4 693,25**	**-10 180,06**	**-11 973,30**	**-10 601,53**	**-8 252,98**	**-8 315,61**	**-8 785,12**	**-7 849,47**	**-8 169,78**	**-8 302,33**
A. Forest Land	-5 987,49	-10 516,98	-12 191,32	-10 883,17	-8 343,82	-8 354,18	-8 635,21	-7 852,26	-8 453,85	-8 363,58
B. Cropland	1 314,97	547,50	305,37	299,39	268,52	273,29	268,75	247,95	368,13	200,07
C. Grassland	-128,23	-294,40	-199,90	-196,11	-305,50	-331,45	-544,18	-380,86	-284,15	-361,44
D. Wetlands	22,47	33,05	18,56	8,60	7,95	9,87	11,33	16,23	24,49	23,78
E. Settlements	85,03	50,77	93,99	169,76	119,87	86,87	114,20	119,47	175,60	198,84
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**IE,NA,NE,NO**	**357,00**	**357,00**	**357,00**	**357,00**	**357,00**	**357,00**	**357,00**	**357,00**	**357,00**
A. Solid Waste Disposal on Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
B. Waste-water Handling										
C. Waste Incineration	IE,NE	357,00	357,00	357,00	357,00	357,00	357,00	357,00	357,00	357,00
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CO_2 emissions including net CO_2 from LULUCF	**159 639,14**	**144 200,95**	**127 942,42**	**125 252,90**	**118 500,55**	**123 080,12**	**129 864,70**	**123 983,97**	**116 103,40**	**112 427,15**
Total CO_2 emissions excluding net CO_2 from LULUCF	**164 332,38**	**154 381,00**	**139 915,72**	**135 854,43**	**126 753,53**	**131 395,73**	**138 649,82**	**131 833,43**	**124 273,19**	**120 729,49**
Memo Items:										
International Bunkers	**616,82**	**554,67**	**491,11**	**484,20**	**448,78**	**453,02**	**491,92**	**498,31**	**541,62**	**513,07**
Aviation	616,82	554,67	491,11	484,20	448,78	453,02	491,92	498,31	541,62	513,07
Marine	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass	2 303,56	2 350,34	2 308,62	2 267,34	2 220,18	2 351,76	2 436,65	2 670,55	2 906,02	3 110,41

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
CO_2
(Part 2 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**114 437,92**	**116 934,86**	**113 266,02**	**113 658,51**	**113 303,69**	**113 934,15**	**114 948,37**	**116 297,73**	**-20,13**
A. Fuel Combustion (Sectoral Approach)	114 437,92	116 934,86	113 266,02	113 658,51	113 303,69	113 934,15	114 948,37	116 297,49	-20,13
1. Energy Industries	59 616,47	58 809,89	57 121,61	57 856,36	57 277,30	57 275,39	59 077,30	61 315,77	6,25
2. Manufacturing Industries and Construction	28 184,82	29 431,57	27 912,26	26 365,26	26 002,87	26 631,64	24 398,66	24 939,67	-46,50
3. Transport	12 159,19	12 981,11	13 532,99	15 306,80	16 021,65	17 329,48	17 655,21	18 461,49	151,44
4. Other Sectors	13 244,36	14 500,95	13 555,31	13 064,89	12 889,59	11 600,77	12 751,42	10 502,72	-67,53
5. Other	1 233,08	1 211,33	1 143,84	1 065,20	1 112,28	1 096,87	1 065,78	1 077,84	-32,67
B. Fugitive Emissions from Fuels	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	0,24	100,00
1. Solid Fuels	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	IE,NA,NE	0,00
2. Oil and Natural Gas	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	IE,NA,NE,NO	0,24	100,00
2. Industrial Processes	**11 989,23**	**11 091,35**	**11 026,01**	**11 980,73**	**13 097,65**	**11 783,45**	**12 982,08**	**12 941,15**	**-28,77**
A. Mineral Products	4 166,32	3 859,00	3 602,76	3 700,82	3 908,16	3 855,82	3 975,64	4 367,07	-9,58
B. Chemical Industry	736,48	619,87	540,77	703,91	698,65	609,30	581,10	544,38	-32,53
C. Metal Production	7 086,43	6 612,49	6 882,48	7 576,00	8 490,83	7 318,33	8 425,34	8 029,70	-35,93
D. Other Production	NA	NA	NA	NA	NA	NA	NA	NA	0,00
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
3. Solvent and Other Product Use	354,04	335,44	325,13	310,64	304,76	299,25	298,41	297,65	-45,91
4. Agriculture									
A. Enteric Fermentation									
B. Manure Management									
C. Rice Cultivation									
D. Agricultural Soils									
E. Prescribed Burning of Savannas									
F. Field Burning of Agricultural Residues									
G. Other									
5. Land Use, Land-Use Change and Forestry(2)	**-8 679,89**	**-9 016,48**	**-8 791,29**	**-6 896,54**	**-7 343,87**	**-7 834,61**	**-4 607,44**	**-1 919,07**	**-59,11**
A. Forest Land	-8 612,80	-8 919,00	-8 694,49	-6 878,81	-7 284,00	-7 762,90	-4 479,77	-1 775,03	-70,35
B. Cropland	199,90	179,70	155,22	161,36	141,47	144,24	133,99	127,12	-90,33
C. Grassland	-419,29	-399,96	-395,94	-380,29	-393,40	-388,80	-394,34	-383,47	199,05
D. Wetlands	27,39	11,59	33,32	22,51	19,04	20,28	19,74	19,43	-13,56
E. Settlements	124,92	111,19	110,61	178,69	173,02	152,56	112,95	92,89	9,24
F. Other Land	NO	NO	NO	NO	NO	NO	NO	NO	0,00
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	0,00
6. Waste	**357,00**	**357,00**	**357,00**	**368,31**	**326,55**	**358,47**	**386,46**	**413,39**	**100,00**
A. Solid Waste Disposal on Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
B. Waste-water Handling									
C. Waste Incineration	357,00	357,00	357,00	368,31	326,55	358,47	386,46	413,39	100,00
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total CO_2 emissions including net CO_2 from LULUCF	**118 458,30**	**119 702,18**	**116 182,86**	**119 421,65**	**119 688,78**	**118 540,71**	**124 007,89**	**128 030,84**	**-19,80**
Total CO_2 emissions excluding net CO_2 from LULUCF	**127 138,19**	**128 718,65**	**124 974,15**	**126 318,20**	**127 032,65**	**126 375,32**	**128 615,33**	**129 949,92**	**-20,92**
Memo Items:									
International Bunkers	**571,86**	**614,34**	**664,12**	**771,19**	**993,40**	**1 032,61**	**1 062,02**	**1 091,41**	**76,94**
Aviation	571,86	614,34	664,12	771,19	993,40	1 032,61	1 062,02	1 091,41	76,94
Marine	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass	3 254,40	3 270,45	3 833,42	7 158,38	7 846,68	8 678,59	7 402,62	8 465,43	267,49

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
CH_4
(Part 1 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	474,10	409,31	388,88	370,86	349,15	341,13	333,52	324,46	311,24	285,05
A. Fuel Combustion (Sectoral Approach)	69,53	51,97	49,47	40,38	35,39	32,76	30,64	27,21	22,67	21,37
1. Energy Industries	0,67	0,68	0,60	0,64	0,63	0,70	0,72	0,80	0,78	0,73
2. Manufacturing Industries and Construction	4,31	4,88	3,91	4,22	3,34	3,30	3,69	3,26	2,98	3,01
3. Transport	1,27	1,09	1,26	1,31	1,43	1,59	1,62	1,52	1,36	1,25
4. Other Sectors	62,96	45,02	43,43	33,95	29,72	26,95	24,39	21,45	17,40	16,28
5. Other	0,34	0,29	0,27	0,26	0,26	0,21	0,21	0,18	0,15	0,10
B. Fugitive Emissions from Fuels	404,57	357,35	339,41	330,48	313,76	308,37	302,88	297,25	288,57	263,68
1. Solid Fuels	361,90	320,98	305,97	298,00	281,99	276,61	268,48	263,47	253,05	228,96
2. Oil and Natural Gas	42,67	36,36	33,45	32,49	31,77	31,76	34,40	33,78	35,52	34,72
2. Industrial Processes	**6,59**	**5,61**	**4,33**	**4,41**	**4,53**	**4,78**	**4,85**	**4,41**	**4,29**	**3,74**
A. Mineral Products	0,14	0,12	0,12	0,13	0,14	0,14	0,16	0,18	0,20	0,18
B. Chemical Industry	0,39	0,29	0,33	0,33	0,39	0,37	0,39	0,40	0,45	0,47
C. Metal Production	6,06	5,20	3,88	3,95	4,00	4,26	4,30	3,84	3,64	3,09
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use										
4. Agriculture	**279,95**	**264,61**	**238,09**	**207,96**	**182,15**	**176,46**	**175,26**	**164,68**	**154,85**	**157,27**
A. Enteric Fermentation	231,88	218,47	195,78	169,36	148,31	144,39	143,04	133,43	125,11	127,78
B. Manure Management	48,07	46,14	42,31	38,61	33,83	32,07	32,22	31,26	29,74	29,49
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**4,64**	**3,44**	**3,62**	**4,19**	**4,32**	**4,03**	**5,31**	**5,72**	**4,95**	**4,56**
A. Forest Land	4,64	3,44	3,62	4,19	4,32	4,03	5,31	5,72	4,95	4,56
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
F. Other Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**118,48**	**120,66**	**120,93**	**121,12**	**125,43**	**127,36**	**126,15**	**125,36**	**126,80**	**127,45**
A. Solid Waste Disposal on Land	79,17	82,79	85,97	89,48	92,95	96,20	97,12	95,20	97,30	100,01
B. Waste-water Handling	39,31	37,88	34,96	31,64	32,48	31,16	29,02	30,16	29,50	27,43
C. Waste Incineration	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total CH_4 emissions including CH_4 from LULUCF	**883,76**	**803,63**	**755,85**	**708,55**	**665,58**	**653,76**	**645,08**	**624,64**	**602,13**	**578,07**
Total CH_4 emissions excluding CH_4 from LULUCF	**879,12**	**800,19**	**752,23**	**704,36**	**661,26**	**649,73**	**639,77**	**618,91**	**597,18**	**573,50**
Memo Items:										
International Bunkers	0,13	0,11	0,10	0,10	0,09	0,09	0,10	0,10	0,11	0,10
Aviation	0,13	0,11	0,10	0,10	0,09	0,09	0,10	0,10	0,11	0,10
Marine	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
CH_4
(Part 2 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	292,68	297,98	289,72	280,11	273,62	276,89	299,12	277,38	-41,49
A. Fuel Combustion (Sectoral Approach)	20,70	22,30	20,41	22,94	24,72	23,27	30,04	26,95	-61,24
1. Energy Industries	0,73	0,74	0,68	0,87	0,96	0,76	0,82	0,86	28,09
2. Manufacturing Industries and Construction	3,03	3,21	3,25	3,17	3,02	3,41	2,75	2,87	-33,31
3. Transport	1,74	1,77	1,68	1,73	1,64	1,64	1,55	1,56	23,20
4. Other Sectors	15,11	16,50	14,72	17,10	19,02	17,39	24,85	21,60	-65,70
5. Other	0,09	0,08	0,08	0,07	0,08	0,08	0,07	0,07	-79,35
B. Fugitive Emissions from Fuels	271,98	275,69	269,31	257,17	248,90	253,62	269,08	250,43	-38,10
1. Solid Fuels	239,00	244,74	237,48	228,21	222,00	221,44	236,18	217,46	-39,91
2. Oil and Natural Gas	32,99	30,95	31,83	28,96	26,90	32,18	32,90	32,97	-22,73
2. Industrial Processes	**3,94**	**4,01**	**4,03**	**4,02**	**4,22**	**3,98**	**4,06**	**3,96**	**-39,79**
A. Mineral Products	0,25	0,25	0,20	0,20	0,22	0,22	0,21	0,23	62,58
B. Chemical Industry	0,41	0,44	0,41	0,40	0,50	0,50	0,46	0,41	5,29
C. Metal Production	3,28	3,32	3,42	3,42	3,50	3,25	3,38	3,33	-45,04
D. Other Production									
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
3. Solvent and Other Product Use									
4. Agriculture	**150,60**	**151,33**	**147,31**	**143,33**	**138,37**	**137,62**	**135,19**	**136,29**	**-51,32**
A. Enteric Fermentation	122,72	123,61	120,71	117,53	113,80	113,97	111,84	112,94	-51,29
B. Manure Management	27,88	27,72	26,60	25,80	24,57	23,64	23,35	23,35	-51,43
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	0,00
D. Agricultural Soils	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	NA,NE	0,00
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	0,00
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	0,00
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
5. Land Use, Land-Use Change and Forestry	**4,20**	**4,36**	**4,71**	**5,91**	**5,40**	**5,16**	**6,40**	**8,32**	**79,26**
A. Forest Land	4,20	4,36	4,71	5,91	5,40	5,16	6,40	8,32	79,26
B. Cropland	NO	NO	NO	NO	NO	NO	NO	NO	0,00
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	0,00
D. Wetlands	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	0,00
F. Other Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	0,00
6. Waste	**128,24**	**129,50**	**132,79**	**131,26**	**133,69**	**136,02**	**137,55**	**139,58**	**17,81**
A. Solid Waste Disposal on Land	102,48	104,68	106,15	106,69	109,25	111,70	112,69	115,09	45,37
B. Waste-water Handling	25,75	24,82	26,64	24,57	24,44	24,32	24,86	24,49	-37,69
C. Waste Incineration	NE	NE	NE	NE	NE	NE	NE	NE	0,00
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total CH_4 emissions including CH_4 from LULUCF	**579,66**	**587,19**	**578,55**	**564,63**	**555,31**	**559,66**	**582,32**	**565,53**	**-36,01**
Total CH_4 emissions excluding CH_4 from LULUCF	**575,46**	**582,83**	**573,84**	**558,72**	**549,90**	**554,50**	**575,92**	**557,22**	**-36,62**
Memo Items:									
International Bunkers	0,11	0,12	0,13	0,15	0,19	0,20	0,20	0,21	65,96
Aviation	0,11	0,12	0,13	0,15	0,19	0,20	0,20	0,21	65,96
Marine	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass									

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
N_2O
(Part 1 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
1. Energy	**2,15**	**2,14**	**1,99**	**2,08**	**2,01**	**2,27**	**2,47**	**2,52**	**2,77**	**2,96**
A. Fuel Combustion (Sectoral Approach)	2,15	2,14	1,99	2,08	2,01	2,27	2,47	2,52	2,77	2,96
1. Energy Industries	0,81	0,80	0,72	0,75	0,74	0,79	0,82	0,83	0,79	0,74
2. Manufacturing Industries and Construction	0,58	0,65	0,52	0,54	0,43	0,42	0,46	0,39	0,36	0,37
3. Transport	0,27	0,31	0,40	0,52	0,57	0,83	0,96	1,09	1,42	1,64
4. Other Sectors	0,43	0,32	0,29	0,22	0,21	0,19	0,19	0,16	0,13	0,13
5. Other	0,06	0,06	0,05	0,05	0,05	0,04	0,04	0,05	0,08	0,08
B. Fugitive Emissions from Fuels	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
2. Oil and Natural Gas	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO
2. Industrial Processes	**3,90**	**2,64**	**3,25**	**2,54**	**3,21**	**3,64**	**3,33**	**3,60**	**3,86**	**3,22**
A. Mineral Products	NA,NE	NA	NA	NA	NA	NA	NA	NA	NA	NA
B. Chemical Industry	3,90	2,64	3,25	2,54	3,21	3,64	3,33	3,60	3,86	3,22
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
D. Other Production										
E. Production of Halocarbons and SF_6										
F. Consumption of Halocarbons and SF_6										
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Solvent and Other Product Use	0,69	0,69	0,69	0,69	0,69	0,69	0,69	0,69	0,69	0,69
4. Agriculture	**30,93**	**26,31**	**22,43**	**19,61**	**18,76**	**18,95**	**17,72**	**17,89**	**17,23**	**17,09**
A. Enteric Fermentation										
B. Manure Management	2,23	2,14	1,98	1,84	1,62	1,54	1,55	1,51	1,45	1,44
C. Rice Cultivation										
D. Agricultural Soils	28,70	24,17	20,45	17,77	17,14	17,41	16,17	16,38	15,79	15,65
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
5. Land Use, Land-Use Change and Forestry	**0,10**	**0,09**	**0,09**	**0,09**	**0,08**	**0,08**	**0,08**	**0,07**	**0,07**	**0,06**
A. Forest Land	0,03	0,02	0,02	0,03	0,03	0,03	0,04	0,04	0,03	0,03
B. Cropland	0,07	0,07	0,06	0,06	0,05	0,05	0,04	0,03	0,04	0,03
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Wetlands	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO
F. Other Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
6. Waste	**0,52**	**0,52**	**0,52**	**0,52**	**0,52**	**0,52**	**0,52**	**0,52**	**0,52**	**0,52**
A. Solid Waste Disposal on Land										
B. Waste-water Handling	0,52	0,52	0,52	0,52	0,52	0,52	0,52	0,52	0,52	0,52
C. Waste Incineration	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
Total N_2O emissions including N_2O from LULUCF	**38,30**	**32,39**	**28,96**	**25,54**	**25,28**	**26,15**	**24,81**	**25,30**	**25,14**	**24,54**
Total N_2O emissions excluding N_2O from LULUCF	**38,20**	**32,30**	**28,88**	**25,45**	**25,19**	**26,08**	**24,73**	**25,22**	**25,07**	**24,48**
Memo Items:										
International Bunkers	**0,09**	**0,08**	**0,07**	**0,07**	**0,07**	**0,07**	**0,07**	**0,07**	**0,08**	**0,07**
Aviation	0,09	0,08	0,07	0,07	0,07	0,07	0,07	0,07	0,08	0,07
Marine	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
CO_2 Emissions from Biomass										

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
N_2O
(Part 2 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
1. Energy	**2,69**	**2,85**	**3,00**	**3,38**	**3,57**	**3,72**	**3,74**	**3,90**	**81,39**
A. Fuel Combustion (Sectoral Approach)	2,69	2,85	3,00	3,38	3,57	3,72	3,74	3,90	81,39
1. Energy Industries	0,83	0,83	0,80	0,83	0,84	0,81	0,85	0,89	10,40
2. Manufacturing Industries and Construction	0,37	0,39	0,39	0,38	0,36	0,41	0,32	0,34	-40,23
3. Transport	1,28	1,42	1,61	1,91	2,08	2,22	2,25	2,35	770,23
4. Other Sectors	0,12	0,13	0,12	0,19	0,21	0,21	0,25	0,24	-44,37
5. Other	0,08	0,08	0,08	0,07	0,08	0,07	0,07	0,07	9,66
B. Fugitive Emissions from Fuels	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0,00	100,00
1. Solid Fuels	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
2. Oil and Natural Gas	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0,00	100,00
2. Industrial Processes	**3,63**	**3,59**	**3,14**	**3,13**	**3,73**	**3,53**	**3,26**	**2,80**	**-28,37**
A. Mineral Products	NA	NA	NA	NA	NA	NA	NA	NA	0,00
B. Chemical Industry	3,63	3,59	3,14	3,13	3,73	3,53	3,26	2,80	-28,37
C. Metal Production	NA	NA	NA	NA	NA	NA	NA	NA	0,00
D. Other Production									
E. Production of Halocarbons and SF_6									
F. Consumption of Halocarbons and SF_6									
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
3. Solvent and Other Product Use	0,69	0,69	0,69	0,69	0,69	0,69	0,69	0,69	0,00
4. Agriculture	**16,85**	**17,45**	**16,97**	**15,36**	**16,55**	**15,72**	**15,58**	**16,05**	**-48,11**
A. Enteric Fermentation									
B. Manure Management	1,36	1,35	1,30	1,26	1,20	1,15	1,14	1,13	-49,09
C. Rice Cultivation									
D. Agricultural Soils	15,49	16,10	15,67	14,10	15,36	14,57	14,45	14,92	-48,03
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	0,00
F. Field Burning of Agricultural Residues	NO	NO	NO	NO	NO	NO	NO	NO	0,00
G. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
5. Land Use, Land-Use Change and Forestry	**0,06**	**0,06**	**0,06**	**0,07**	**0,06**	**0,06**	**0,07**	**0,08**	**-21,05**
A. Forest Land	0,03	0,03	0,03	0,04	0,04	0,04	0,04	0,06	79,26
B. Cropland	0,03	0,03	0,03	0,03	0,02	0,02	0,02	0,02	-67,81
C. Grassland	NO	NO	NO	NO	NO	NO	NO	NO	0,00
D. Wetlands	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
E. Settlements	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	NE,NO	0,00
F. Other Land	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
G. Other	NE	NE	NE	NE	NE	NE	NE	NE	0,00
6. Waste	**0,65**	**0,64**	**0,64**	**0,66**	**0,66**	**0,66**	**0,66**	**0,66**	**27,05**
A. Solid Waste Disposal on Land									
B. Waste-water Handling	0,65	0,64	0,64	0,64	0,64	0,64	0,65	0,65	24,51
C. Waste Incineration	NE	NE	NE	0,02	0,01	0,01	0,01	0,01	100,00
D. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
7. Other *(as specified in Summary 1.A)*	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**	**0,00**
Total N_2O emissions including N_2O from LULUCF	**24,57**	**25,28**	**24,50**	**23,29**	**25,26**	**24,38**	**24,00**	**24,18**	**-36,87**
Total N_2O emissions excluding N_2O from LULUCF	**24,51**	**25,22**	**24,44**	**23,23**	**25,20**	**24,32**	**23,93**	**24,10**	**-36,91**
Memo Items:									
International Bunkers	**0,08**	**0,08**	**0,09**	**0,10**	**0,14**	**0,14**	**0,14**	**0,15**	**65,96**
Aviation	0,08	0,08	0,09	0,10	0,14	0,14	0,14	0,15	65,96
Marine	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Multilateral Operations	NO	NO	NO	NO	NO	NO	NO	NO	0,00
CO_2 Emissions from Biomass									

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF_6
(Part 1 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)
Emissions of HFCs(3) - (Gg CO_2 equivalent)	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**0,73**	**101,31**	**244,81**	**316,56**	**267,59**
HFC-23	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00
HFC-32	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-125	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,01	0,00	0,02
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,07	0,16	0,23	0,11
HFC-152a	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,00
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-143a	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,02
HFC-227ea	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	IE,NA,NO	IE,NA,NO	IE,NA,NO
HFC-236fa	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed HFCs(4) - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of PFCs(3) - (Gg CO_2 equivalent)	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**NA,NE,NO**	**0,12**	**4,11**	**0,89**	**0,89**	**2,55**
CF_4	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00
C_2F_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_3F_8	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	IE,NA,NO	IE,NA,NO	0,00
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
$c\text{-}C_4F_8$	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_5F_{12}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
C_6F_{14}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Unspecified mix of listed PFCs(4) - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
Emissions of SF6(3) - (Gg CO_2 equivalent)	**77,68**	**77,32**	**76,96**	**76,60**	**76,24**	**75,20**	**77,52**	**95,48**	**64,19**	**76,98**
SF_6	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
HFCs, PFCs and SF_6
(Part 2 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	(Gg)	%
Emissions of HFCs(3) - (Gg CO_2 equivalent)	**262,50**	**393,37**	**391,29**	**590,14**	**600,30**	**594,22**	**872,35**	**1 605,62**	**100,00**
HFC-23	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
HFC-32	0,00	0,00	0,00	0,00	0,00	0,02	0,02	0,05	100,00
HFC-41	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-43-10mee	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-125	0,01	0,02	0,02	0,04	0,05	0,05	0,09	0,14	100,00
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-134a	0,16	0,14	0,20	0,25	0,21	0,21	0,25	0,58	100,00
HFC-152a	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
HFC-143	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
HFC-143a	0,01	0,04	0,01	0,03	0,05	0,04	0,07	0,11	100,00
HFC-227ea	IE,NA,NO	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
HFC-236fa	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
HFC-245ca	NA,NO	NA,NO	NA,NO	NA,NO	0,00	0,00	0,00	0,00	100,00
Unspecified mix of listed HFCs(4) - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Emissions of PFCs(3) - (Gg CO_2 equivalent)	**8,81**	**12,35**	**13,72**	**24,53**	**17,33**	**10,08**	**22,56**	**20,16**	**100,00**
CF_4	0,00	0,00	0,00	NA,NO	NA,NO	NA,NO	0,00	0,00	100,00
C_2F_6	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
C_3F_8	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	100,00
C_4F_{10}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
$c\text{-}C_4F_8$	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C_5F_{12}	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
C_6F_{14}	NA,NO	NA,NO	NA,NO	0,00	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Unspecified mix of listed PFCs(4) - (Gg CO_2 equivalent)	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0,00
Emissions of SF6(3) - (Gg CO_2 equivalent)	**141,92**	**168,73**	**67,72**	**101,25**	**51,89**	**85,88**	**83,07**	**75,85**	**-2,35**
SF_6	0,01	0,01	0,00	0,00	0,00	0,00	0,00	0,00	-2,35

Note: All footnotes for this table are given at the end of the table on sheet 5.

TABLE 10 EMISSION TRENDS
SUMMARY
(Part 1 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS EMISSIONS	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
CO_2 emissions including net CO_2 from LULUCF	159 639,14	144 200,95	127 942,42	125 252,90	118 500,55	123 080,12	129 864,70	123 983,97	116 103,40	112 427,15
CO_2 emissions excluding net CO_2 from LULUCF	164 332,38	154 381,00	139 915,72	135 854,43	126 753,53	131 395,73	138 649,82	131 833,43	124 273,19	120 729,49
CH_4 emissions including CH_4 from LULUCF	18 558,89	16 876,25	15 872,90	14 879,57	13 977,11	13 729,00	13 546,68	13 117,39	12 644,68	12 139,37
CH_4 emissions excluding CH_4 from LULUCF	18 461,46	16 804,07	15 796,87	14 791,60	13 886,40	13 644,30	13 435,26	12 997,20	12 540,68	12 043,57
N_2O emissions including N_2O from LULUCF	11 871,89	10 040,47	8 978,80	7 916,21	7 836,06	8 107,79	7 691,62	7 841,71	7 794,28	7 608,73
N_2O emissions excluding N_2O from LULUCF	11 840,80	10 012,50	8 951,31	7 888,74	7 810,01	8 084,00	7 667,58	7 818,99	7 772,22	7 588,69
HFCs	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0,73	101,31	244,81	316,56	267,59
PFCs	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0,12	4,11	0,89	0,89	2,55
SF_6	77,68	77,32	76,96	76,60	76,24	75,20	77,52	95,48	64,19	76,98
Total (including LULUCF)	**190 147,59**	**171 194,99**	**152 871,07**	**148 125,28**	**140 389,97**	**144 992,97**	**151 285,93**	**145 284,25**	**136 924,00**	**132 522,38**
Total (excluding LULUCF)	**194 712,32**	**181 274,88**	**164 740,86**	**158 611,37**	**148 526,18**	**153 200,08**	**159 935,59**	**152 990,80**	**144 967,72**	**140 708,86**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Base year (1990)	1991	1992	1993	1994	1995	1996	1997	1998	1999
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)
1. Energy	156 234,78	149 169,27	132 978,31	131 538,11	121 268,09	125 521,00	132 970,92	125 379,74	118 447,30	116 189,61
2. Industrial Processes	19 595,67	14 611,85	16 061,93	12 915,61	13 848,36	14 310,50	14 037,31	14 872,62	14 165,78	12 145,53
3. Solvent and Other Product Use	764,83	728,05	690,99	650,54	616,05	596,31	586,63	584,76	580,41	578,49
4. Agriculture	15 467,44	13 714,07	11 952,29	10 445,45	9 641,51	9 579,73	9 173,83	9 003,53	8 593,94	8 601,55
5. Land Use, Land-Use Change and Forestry[(5)]	-4 564,72	-10 079,90	-11 869,79	-10 486,09	-8 136,21	-8 207,11	-8 649,67	-7 706,55	-8 043,72	-8 186,49
6. Waste	2 649,59	3 051,64	3 057,34	3 061,66	3 152,16	3 192,54	3 166,90	3 150,15	3 180,29	3 193,68
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Total (including LULUCF)[(5)]	**190 147,59**	**171 194,99**	**152 871,07**	**148 125,28**	**140 389,97**	**144 992,97**	**151 285,93**	**145 284,25**	**136 924,00**	**132 522,38**

(1) The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the COP. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.
(2) Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).
(3) Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as CO_2 equivalent emissions.

(4) In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs, respectively. Note that the unit used for this row is Gg of CO_2 equivalent and that appropriate notation keys should be entered in the cells for the individual chemicals.
(5) Includes net CO_2, CH_4 and N_2O from LULUCF.

TABLE 10 EMISSION TRENDS
SUMMARY
(Part 2 of 2)

Inventory 2007
Submission 2009 v1.1
CZECH REPUBLIC

GREENHOUSE GAS EMISSIONS	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(%)
CO_2 emissions including net CO_2 from LULUCF	118 458,30	119 702,18	116 182,86	119 421,65	119 688,78	118 540,71	124 007,89	128 030,84	-19,80
CO_2 emissions excluding net CO_2 from LULUCF	127 138,19	128 718,65	124 974,15	126 318,20	127 032,65	126 375,32	128 615,33	129 949,92	-20,92
CH_4 emissions including CH_4 from LULUCF	12 172,86	12 330,99	12 149,45	11 857,29	11 661,44	11 752,94	12 228,65	11 876,19	-36,01
CH_4 emissions excluding CH_4 from LULUCF	12 084,68	12 239,33	12 050,63	11 733,15	11 547,97	11 644,51	12 094,30	11 701,55	-36,62
N_2O emissions including N_2O from LULUCF	7 617,00	7 835,66	7 595,58	7 220,53	7 829,72	7 557,49	7 439,97	7 494,77	-36,87
N_2O emissions excluding N_2O from LULUCF	7 598,18	7 817,37	7 577,16	7 199,98	7 810,71	7 539,28	7 419,30	7 470,22	-36,91
HFCs	262,50	393,37	391,29	590,14	600,30	594,22	872,35	1 605,62	100,00
PFCs	8,81	12,35	13,72	24,53	17,33	10,08	22,56	20,16	100,00
SF_6	141,92	168,73	67,72	101,25	51,89	85,88	83,07	75,85	-2,35
Total (including LULUCF)	**138 661,39**	**140 443,27**	**136 400,62**	**139 215,39**	**139 849,45**	**138 541,31**	**144 654,49**	**149 103,44**	**-21,59**
Total (excluding LULUCF)	**147 234,28**	**149 349,80**	**145 074,67**	**145 967,26**	**147 060,83**	**146 249,28**	**149 106,92**	**150 823,32**	**-22,54**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	2000	2001	2002	2003	2004	2005	2006	2007	Change from base to latest reported year
	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	CO_2 equivalent (Gg)	(%)
1. Energy	121 418,44	124 074,77	120 280,21	120 589,24	120 155,71	120 902,20	122 390,02	123 330,48	-21,06
2. Industrial Processes	13 609,83	12 862,64	12 557,57	13 752,77	15 011,04	13 649,92	15 054,87	15 593,00	-20,43
3. Solvent and Other Product Use	568,56	549,96	539,65	525,16	519,28	513,77	512,93	512,17	-33,04
4. Agriculture	8 387,14	8 587,08	8 352,94	7 771,76	8 037,49	7 764,64	7 669,69	7 837,74	-49,33
5. Land Use, Land-Use Change and Forestry(5)	-8 572,88	-8 906,53	-8 674,04	-6 751,86	-7 211,39	-7 707,98	-4 452,42	-1 719,88	-62,32
6. Waste	3 250,32	3 275,35	3 344,30	3 328,33	3 337,30	3 418,75	3 479,41	3 549,92	33,98
7. Other	NA	NA	NA	NA	NA	NA	NA	NA	0,00
Total (including LULUCF)(5)	**138 661,39**	**140 443,27**	**136 400,62**	**139 215,39**	**139 849,45**	**138 541,31**	**144 654,49**	**149 103,44**	**-21,59**

(1) The column "Base year" should be filled in only by those Parties with economies in transition that use a base year different from 1990 in accordance with the relevant decisions of the COP. For these Parties, this different base year is used to calculate the percentage change in the final column of this table.
(2) Fill in net emissions/removals as reported in table Summary 1.A. For the purposes of reporting, the signs for removals are always negative (-) and for emissions positive (+).
(3) Enter actual emissions estimates. If only potential emissions estimates are available, these should be reported in this table and an indication for this be provided in the documentation box. Only in these rows are the emissions expressed as CO_2 equivalent emissions.
(4) In accordance with the UNFCCC reporting guidelines, HFC and PFC emissions should be reported for each relevant chemical. However, if it is not possible to report values for each chemical (i.e. mixtures, confidential data, lack of disaggregation), this row could be used for reporting aggregate figures for HFCs and PFCs,
(5) Includes net CO_2, CH_4 and N_2O from LULUCF.

Documentation box:
• Parties should provide detailed explanations on emissions trends in Chapter 2: Trends in Greenhouse Gas Emissions and, as appropriate, in the corresponding Chapters 3 - 9 of the NIR. Use this documentation box to provide references to relevant sections of the NIR if any additional information and further details are needed to understand the content of this table.
• Use the documentation box to provide explanations if potential emissions are reported.

Notation Keys

The Sectoral and Summary Report Tables summarize final inventory results. Where countries have opted not to estimate (NE) a particular source of each greenhouse gas. this should be shown. Data problems may limit the possibility of separating out each source individually; in this case it is included elsewhere (IE) and this should also be included in the table with a footnote indicating where the emission source/sink has been reported. Finally. countries may report a particular category as not occurring (NO) in their country.

Table - Notification Keys

NE	Not estimated
IE	Estimated but included elsewhere
NO	Not occurring
NA	Not applicable