LATVIA'S

NATIONAL INVENTORY REPORT

Submitted under United Nations Convention on Climate Change

Common Reporting Formats (CRF)
1990 - 2004

2006

Data sheet

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EXECUTIVE SUMMARY

ES.1 Background Information on Climate Change Policy and Greenhouse Gas Inventories

Latvia takes part in the global climate change mitigation process and has acceded together with many other countries, to the United Nations (UN) Framework Convention on Climate Change (Convention) adopted by the UN Conference on Environment and Development held in Rio de Janeiro in 1992. The Convention gained its affect on March 21, 1994 [22].

The Parliament of the Republic of Latvia ratified the Convention on February 23, 1995 and since March 23, 1995 Latvia is a Party to the Convention thus undertaking to implement series of international commitments. On May 30, 2002 the Parliament also ratified the Kyoto Protocol. In accordance with the Kyoto Protocol Latvia, individually or in a joint action with other country, should reach the level when aggregate anthropogenic CO_2, CH_4, N_2O, HFC, PFC and SF_6 emissions by the years 2008-2012 are 8% below emission level of 1990.

On 29 October 2002, The Cabinet of Ministers of the Republic of Latvia approved the Strategy of Joint Implementation for 2002-2012 as defined in the Kyoto Protocol to the UN Framework Convention of Climate Change and passed Regulations of the Cabinet of Ministers No. 653 "On the Strategy of Joint Implementation (2002-2012) as defined in the Kyoto Protocol to the UN Framework Convention on Climate Change".

The newest climate change policy document which is approved on 6 April 2005 by the Cabinet of Ministers of the Republic of Latvia is "Climate change mitigation programme for 2005-2010" (Ordinance No 220). The goal of programme is to ensure that starting from 2008 the total GHG emission will not exceed 92% from level of 1990.

Latvia's climate change policy is based on Europe Union climate policy. Ministry of Environment, Climate and Renewable Energy Department coordinate questions related to climate change and renewable energy in Latvia.

In Latvia the national system was designated by the above mentioned Ordinance No 220 and Latvian Environment, Geology and Meteorology Agency (LEGMA), is general institution which prepares greenhouse gas (GHG) emission inventory co – operated with different other designated responsible institutions.

For GHG emission estimation is used Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 1996), IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories (IPCC GPG 2000) and IPCC Good Practice Guidance for Land Use, land Use Change and Forestry (IPPC GPG LULUCF 2003). The Common Reporting Format tables are used for emission figures reporting.

ES.2 Summary of national emissions and removals related to trends

Latvia's GHG emission inventory includes information on direct GHG (CO_2, CH_4, N_2O, HFCs, PFCs, SF_6) and indirect GHG (NOx, CO, NMVOC) emissions, as well as emissions of SO_2. Table 1 shows emissions expressed as CO_2 equivalents.

Table 1 Aggregated GHG emissions (1990 - 2004)

GREENHOUSE GAS EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
	CO_2 equivalent (Gg)														
CO_2 emissions including net CO_2 from LULUCF	-2093.5	-4887.7	-8386.1	-8896.9	-9844.4	-8885.9	-9824.2	-8125.7	-7350.1	-7135.9	-7263.7	-6814.3	-5836.6	-6198.3	-6357.2
CO_2 emissions excluding net CO2 from LULUCF	18597.5	16372.8	13201.5	11850.0	9983.4	8802.4	9081.1	8535.0	8156.7	7549.8	6908.2	7411.1	7332.5	7477.9	7584.5
CH_4	3504.2	3449.6	2929.7	2117.3	2052.9	2043.5	2005.4	1956.8	1905.0	1818.8	1797.9	1869.5	1900.2	1850.4	1891.4
N_2O	3812.0	3544.3	2758.5	2004.0	1759.5	1375.8	1409.3	1422.3	1366.2	1261.8	1275.9	1406.6	1396.1	1467.4	1439.5
HFCs	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	1.0	1.3	2.4	4.4	6.7	8.8	10.3	11.8	12.9	16.2
SF_6	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	0.3	0.3	0.5	0.7	1.0	1.3	2.0	3.4	4.4	4.8
Total (including net CO_2 from LULUCF)	5222.7	2106.2	-2697.9	-4775.5	-6032.1	-5465.4	-6407.8	-4743.7	-4073.7	-4047.6	-4181.0	-3526.9	-2545.2	-2929.6	-3158.4
Total (excluding net CO_2 from LULUCF)	25913.8	23366.7	18889.7	15971.3	13795.8	12222.9	12497.5	11917.1	11433.0	10638.1	9990.9	10698.5	10623.9	10746.6	10783.3

Latvia's total GHG emissions without LULUCF in 2004 showed a decrease of 58.4 % from the base. They rose by about 0.34 % compared to the total GHG emissions in 2003.

ES.3 Overview of source and sink category emission estimates and trends

The main sources of greenhouse gas emissions have been officially divided into the following sectors: Energy, Industrial processes, Solvent and other product use, Agriculture, Land use, Land use change and Forestry and Waste. GHG emissions by sectors are shown in the Figure 1.

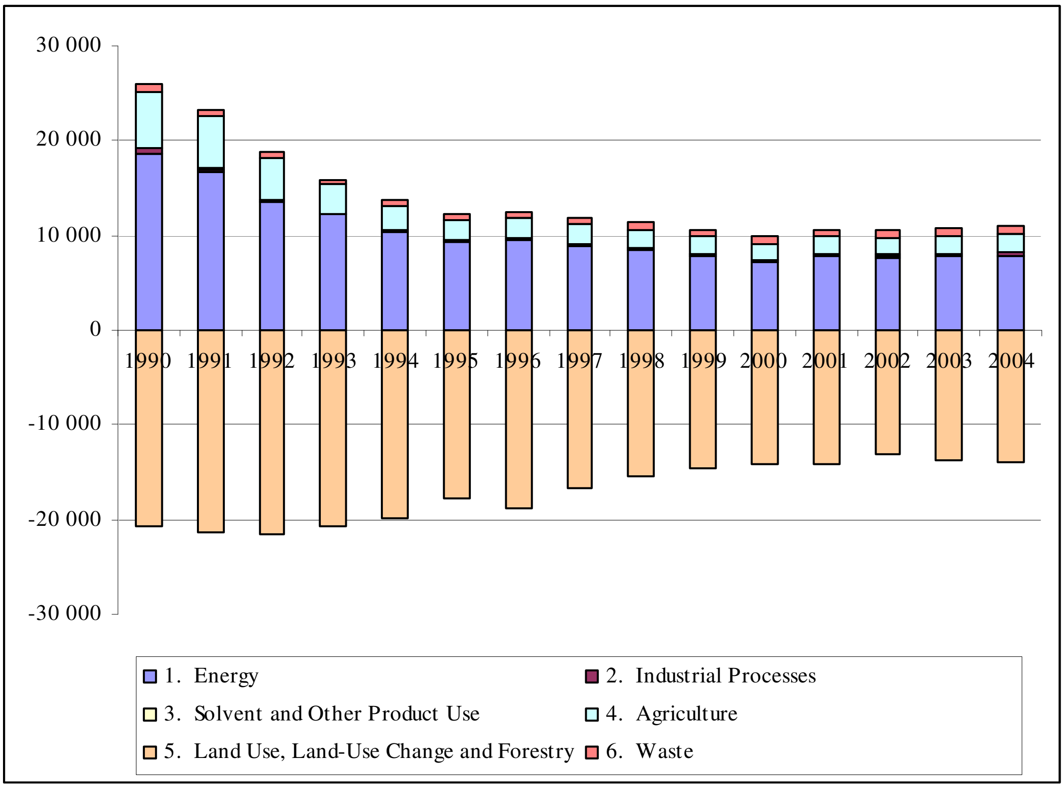


Figure 1 Latvia's greenhouse gas emission trends by sector, Gg CO_2 eqv.

The **Energy sector** is the most significant source of GHG emissions with over 72% share of the total emissions in the 2004. As proved by the data of annual reports, CO_2 emissions from the energy sector in the latest years are stable, but still CO_2 equivalent curve of energy sector has an increasing tendency. It could be explained with increasing number of vehicles in Latvia and wherewithal CO_2 emissions from transport sector. Transport is the most important energy sub - sector with 27 % of total CO_2 equivalent emissions and 37% of total CO_2 equivalent Energy sector emissions. Emissions from this sub-sector rose by 3.3% compared to last year. Also development of national industry caused CO_2 equivalent emissions increasing.

Agriculture is the second most significant source of GHG emissions, with approximately 17% of Latvia's total emissions. The total emissions from agriculture have a clearly stable trend in the latest years. The annual emissions have reduced approximately by 69% since 1990 due to decreases in the number of livestock and in nitrogen fertilisation.

The **Industrial processes** category contributes approximately 2.5% of the total GHG emissions. The largest decrease in emissions occurred between years 1991 and 1993, when industry was going through a crisis. Starting approximately year 2000 CO_2 equivalent emissions from industrial processes sector has a slightly increasing tendency. It could be explained with development of Latvian industry.

Solvent and other product use made only about 0.5% of Latvia's total GHG emissions. Emissions in the Solvent and other product use sector are linked with the economic situation of the country. Decrease in emissions occurred between years 1993 and 1995, when industry was going through a crisis.

The **Waste sector** accounts for 7.3% of Latvia's total GHG emissions. GHG emissions have increased by approximately 15% in the Waste sector in year 2004 in comparison to year 1990, which can be explained by the fact that there is increase in solid municipal waste amounts and first order decay method for methane estimation is used. Furthermore, the data for years 2001, 2002, 2003, 2004 were taken from LEGMA "3-Waste" database, while in the previous years data based on experts estimations. Compare to year 2003 in year 2004 emissions increase by 3.8 %. Emissions of CH_4 from wastewater treatment are more or less stable since year 1993, although the recovery of CH_4 was started in 1991. N_2O emissions from wastewater are stable in all inventory time. Emissions from waste incineration in 2004 are comparable with emissions in years 2002 and 2003, but much lower than in years 2001 and 2000. It is explained with relevant decrease of incinerated waste amount without energy recovery.

Land use, Land use change and forestry (LULUCF) is a net sink in Latvia CO_2 removals in 2004 were 13904.53 Gg CO_2 compared to 20670.3 Gg CO_2 in the base year, that is, 32.73% lower than in 1990.
The main sink in 2004 is subcategory Forest land with net removals of 13605.27 Gg CO_2.

1. INTRODUCTION

1.1 Background Information on Greenhouse Gas Inventories in Latvia

Research testifies the increase of anthropogenic GHG concentration in the atmosphere, which may result in regional and global climate change. Growth of GHG concentration causes additional warming up of the surface of the Earth and the atmosphere and has an adverse effect on climate. According to the Third Communication of the Intergovernmental Panel on Climate Change (IPCC), average temperature on the surface of the Earth in the 20th century has gone up by 0.6±0.2 ºC.

CO_2 concentration in the atmosphere since 1750 has increased by 31%, CH_4 concentration – by 151%, N_2O concentration – by 17%. These concentrations continue growing. In the last 20 years as the result of fossil fuel combustion there were generated approximately ¾ of anthropogenic CO_2 emissions in the atmosphere. At the moment the ocean and land together are able to sequestrate approximately one half of anthropogenic CO_2 emissions. Compared to 1980s, the annual CH_4 concentration growth in 1990s has slowed down. Slightly more than half of the present CH_4 emissions are of anthropogenic origin (fuel combustion, cattle, and household waste landfills). Moreover, with the increase of the amount of emitted CH_4 also CO concentration in atmosphere goes up. Approximately one third of the present N_2O emissions are of anthropogenic origin (agricultural soils, organic fertilisers, and chemical industry)[22].

Article 5.1 of the Kyoto protocol requires that the Parties have in place a National System by the end of 2006 at the latest for estimating anthropogenic GHG by sources and removals by sinks and for reporting. In decision of European Parliament and of the Council concerning a mechanism for monitoring community GHG (280/2004/EC) it is required that member countries establish a national GHG inventory system by the end of 2005. Latvia's inventory system was established during 2005.

According to the decision 3/CP.5, adopted by the Fifth Session of the Conference of Parties (COP) in November 1999, member states are required to submit to the COP a yearly National Inventory Report (NIR). The present NIR covers the time series from the base year 1990 till 2004. Latvia submits an annual inventory report of its anthropogenic greenhouse gas emissions to the UNFCCC Secretariat and Europe Environment Agency.

The EU's greenhouse gas monitoring mechanism Decision 280/2004/EC determine, that it is obligatory for member states submit GHG inventory to the Europe Commission. The Commission decision on the implementing provisions of the monitoring mechanism (29 October 2004) specifies in detail the content of the reports to be submitted to the Commission.

Pursuant to the Convention, the Parties, including Latvia, should annually present to the Conference of the Parties the report on GHG emissions and removals in the state from following sectors: Energy, Industrial processes, Solvent and other product use, Agriculture, Land use, Land use change and Forestry and Waste.

Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 1996), IPCC Good Practice Guidance and Uncertainty Management in National GHG Inventories (IPCC GPG 2000) and IPCC Good Practice Guidance for Land Use, land Use Change and Forestry (IPPC GPG LULUCF 2003) are used in producing greenhouse gas emissions inventories.
Common Reporting Format (CRF) tables are used in reporting the emission figures.

1.2 A description of the institutional arrangement for inventory preparation

The institutions responsible for the Latvian GHG inventory are designated by the Ordinance of the Cabinet of Ministers No 220 approving the Climate change mitigation programme 2005 – 2010. A schematic model for the national system (NIS) is shown in the Figure 1.1.

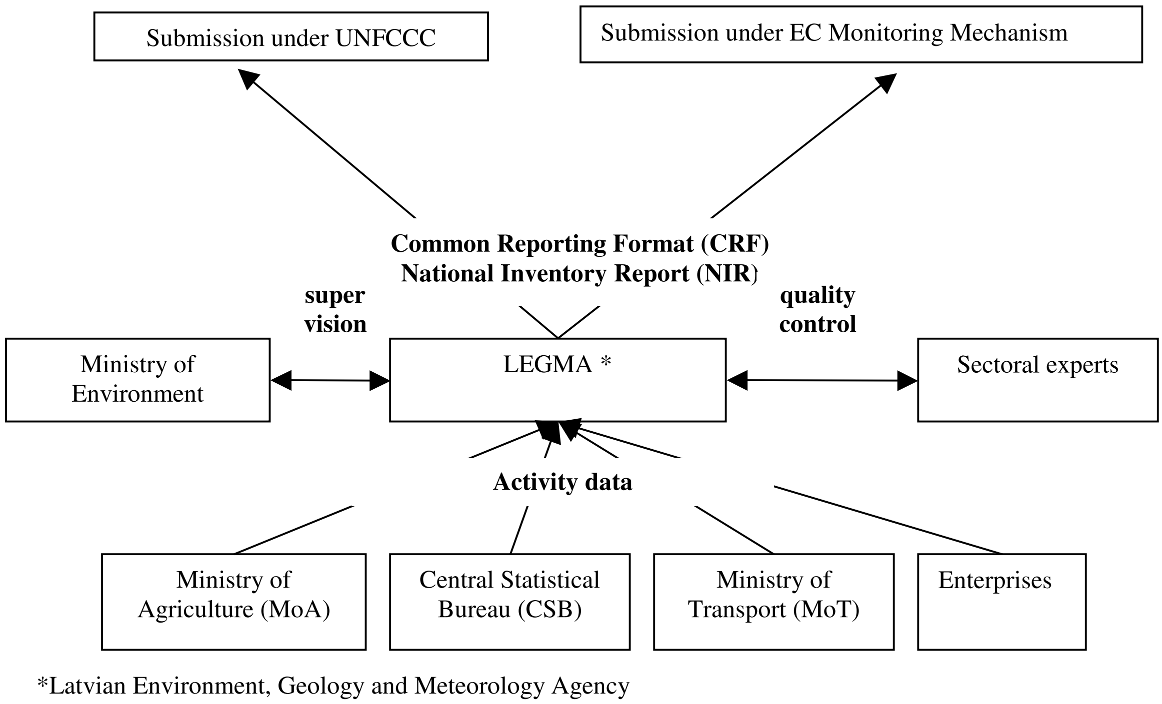


Figure 1.1 Latvian National Inventory system

LEGMA is a governmental institution under the supervision of the Ministry of Environment of the Republic of Latvia and is responsible for preparing GHG inventory. Activity data is mainly collected from other institutions and LEGMA uses it to calculate emissions. This is done at the Environment Quality Division of LEGMA (head Mr. Juris Fridmanis).

The main data supplier for the Latvian air emission inventory is the Central Statistical Bureau of Latvia (CSB) with which LEGMA has signed a special agreement about supplying the necessary data. According to the above mentioned Ordinance, Ministry of Agriculture (MoA) is responsible for performing emission calculations for the LULUCF sector.

The detailed responsibilities of the institutions involved in preparing activity data and calculating emissions are summarised in the Table 1.1.

Table 1.1 Main institutions responsible for activity data and calculation of emissions

CRF sectors	Data	Responsible institution
Table 1.A(a) - Fuel Combustion Activities (Sectoral Approach)	Activity data	CSB, MoT
	Calculations	LEGMA
Table 1.A(b) - CO2 from Fuel Combustion Activities - Reference Approach	Activity data	CSB
	Calculations	LEGMA
Table 1.A(d) - Feedstock's and Non-Energy Use of Fuels	Activity data	CSB
	Calculations	LEGMA
Table 1.B.2. - Fugitive Emissions from Oil and Natural Gas	Activity data	CSB
	Calculations	LEGMA
Table 1.C - International Bunkers and Multilateral Operations	Activity data	CSB
	Calculations	LEGMA
Table 2(I).A-G – Industrial processes	Activity data	CSB
	Calculations	LEGMA
Table 2(II) F - Industrial processes - HFCs, PFCs AND SF6	Activity data	LEGMA
	Calculations	LEGMA
Table 3 – Solvent and other product use	Activity data	CSB
	Calculations	LEGMA
Table 4.A – Agriculture, Enteric fermentation	Activity data	CSB
	Calculations	LEGMA
Table 4.B(a) - Agriculture, CH_4 emissions from animal waste management system	Activity data	CSB
	Calculations	LEGMA
Table 4.B(b) - Agriculture, N_2O emissions from animal waste management system	Activity data	CSB
	Calculations	LEGMA
Table 4.D - Agriculture, Agricultural Soils	Activity data	CSB
	Calculations	LEGMA
Tables 5. LULUCF	Activity data	MoA
	Calculations	
Table 6 A - Waste, Solid Waste Disposal on Land	Activity data	LEGMA
	Calculations	
Table 6 B - Waste, Wastewater Handling	Activity data	LEGMA
	Calculations	
Table 6 C - Waste, Waste Incineration	Activity data	LEGMA
	Calculations	

The deadline for submitting to LEGMA activity data and description of activity data as well as CO_2 removals and emissions from LULUCF for all institutions involved in NIS is 1st of November; only final data regarding fuel consumption was received until 30 of November when CSB prepared Energy balances for EUROSTAT according to additional agreement. For the submission of 2006 this process was done for the first time.

During 2005 three workshops were organized for experts from the institutions involved in NIS, explaining the procedure for preparing and submitting the necessary activity data for each sector and sub-sector, as well as providing information about quality assurance and quality control issues.

Starting from spring 2006 information about activity data, emissions, emission factors and other parameters in the sectors covered by the EU Emission Trading Scheme will be obtained directly from the participating facilities that have to submit annual emission reports verified by an independent accredited body. Therefore more precise data will be available using bottom – up method in these sectors.

In 2006 LEGMA plans to implement an internal quality management system.

According to the present NIS model the quality control function is covered by specially contracted independent sectoral experts. However, due to the lack of sufficiently qualified experts, in some sectors it is difficult to ensure that they have not been involved in the preparation of inventory.

1.3 Brief general description of methodologies and data sources

Latvia's GHG emissions inventories are based on the Revised 1996 IPCC Guidelines, partly on the Good Practice Guidelines (2000) and EMEP/CORINAIR Emission Inventory Guidebook – 3rd editions (2002) according to the UNFCCC recommendations for inventories.

Previously (Submission 2005), the reporting was facilitated by an Excel based CRF application according UNFCCC requests. In the COP 8 the secretariat was requested to develop a new software for reporting GHG inventories in the CRF as included in the reporting guidelines in order to facilitate Parties' reporting of their required annual inventory submissions. For Latvian submission 2006 CRF Reporter 2.17.a software was used to prepare GHG inventory for period 1990 – 2004.

The updated CRF Reporter version 2.30 is a complete revision of the earlier CRF application. It is a standalone application and cannot work on a network. The CRF Reporting Software is no longer based on MS Excel. It is developed as multi-tier desktop application.

Parties are able to generate the CRF tables in the MS Excel format of the reporting guidelines. These tables are filled with the corresponding data entered in the local database.

The XML transport format provides the data exchange interface, to link with various databases and other CRF Reporter installations.

This Software is friendlier for inventory compilers and easier to work with, but unfortunately some essential problems regarding software were identified – they are described in section 10 of this report.

To calculate GHG emissions, supplemental locally developed database in Excel format was used for all sectors except for Road transport and partly for Agriculture sector, where COPERT III and IPCC Software was used. Additional research was carried out, based on needs of recalculation, to compile data and investigate appropriate approach to fulfil IPCC requirements.

The main sources for emission factors are:

- National studies for country specific parameters and emission factors (e.g. CO_2 emission factor as well as factors influencing SO_2 emission factors, distribution of animal waste management systems, average N excretion and etc.);
- Revised IPCC (1996);
- IPCC GPG (2000);
- IPCC GPG LULUCF (2003);
- EMEP/CORINAIR Guidebook.

Where data of bottom – up method were available and plants had reported estimated data using plant specific emission factors and estimation methodologies for energy sector, these data were used in the submission. If these data were not available, Tier 1 method from IPCC Guidelines was used to estimate emissions. Emissions for the whole country fuel consumption were estimated by adding up fuel consumption of individual sectors multiplied by appropriate emission factors.

Tier 2 methods were used to estimate emissions from industrial processes. Information about used raw materials and production technologies as well as plant specific emission factors was used to estimate emissions.

Emissions from road transport sector were estimated by using COPERT III model, but emissions from other transport categories were calculated according to IPCC Guidelines.

Emissions from solvent and other product use were estimated according EMEP/CORINAIR Guidebook, expert research and judgement about activity data and emission factors.

Emissions from Agriculture sector were estimated according to IPCC methodologies additional using local researches related some parameters.

New IPCC GPG LULUCF Guidelines and emission factors were used to estimate emissions from LULUCF sector.

IPCC Guidelines were used to estimate emissions from Waste sector.

The Table 1.2 presents the main data sources used for activity data as well as information on who did the actual calculations:

Table 1.2 Main data sources for activity data and emission values

Sector	Data Sources for Activity Data	Emission Calculation
Energy	Energy balance from Latvian Central Statistical Bureau (CSB); IEA/AIE – EUROSTAT – UNECE Annual questionnaires; LEGMA "2-AIR" database; Research of experts	LEGMA; plant operators
Transport	Energy balance from Latvian CSB; IEA/AIE – EUROSTAT – UNECE Annual questionnaires; Data of Ministry of Transport and Communications; Research of experts	LEGMA
Industry	National production and sale statistics; Direct information from enterprises operating with pollutants; Register of chemicals; Assumption of experts	LEGMA; plant operators
Solvent	Central Statistical Bureau; Research of experts; LEGMA "2-AIR" database	LEGMA
Agriculture	National studies; National agricultural statistics obtained from CSB	LEGMA
LULUCF	Information from Ministry of Agriculture Central Statistical Bureau; State Firefighting & Rescue Service; National studies and expert judgment	Ministry of Agriculture
Waste	Latvian Environment, Geology and Meteorology Agency "3-Waste" and "2-Water" databases; Expert research was used for wastewater emissions calculations	LEGMA

1.4 Description of key source categories

Key sources are the emissions/removals, which have a significant influence on the total inventory in terms of the absolute level of emissions (2004) and the trend of emissions (change between 1990 and 2004) or both. IPCC GPG methodology offers two different methods for identifying key sources: Tier 1 and Tier 2. In the Tier 1 method, the emission sources are sorted according to their contribution to emission level or trend. In the Tier 2 method, the relative uncertainties of the source categories are also taken into account. The key sources are the emission categories, which represent together 90% of the inventory uncertainty.

Latvia uses Tier 1 method to identify key sources. The base year for CO_2, CH_4, N_2O greenhouse gas emissions was year 1990, but for Solvent and other product use, from waste incineration and for HFC and SF_6 the base year is 1995. In last submission Latvia estimated key sources without LULUCF sector, but in the report of the individual review of the greenhouse gas inventory of Latvia submitted in 2005, the expert review team encouraged to include the LULUCF estimates in the key category analysis. In this submission Latvia has analysed both key sources, with LULUCF and without LULUCF. The starting point for the choice of source categories without LULUCF is the one presented in the Good Practise Guidance as Table 7.A1 and with LULUCF is presented in Good Practise Guidance for LULUCF as Table 5.4.1.

The Level Assessment and Trend Assessment of the key source analysis is ranking of the source categories in accordance to their contributions to the National total of GHG calculated in CO_2 equivalent units. The key source are found from the ranked list with descending contributions as source categories which sum constitutes 95% of the National total.

The number of level assessment key sources without LULUCF identified in 1990 was 12 and with LULUCF was 11 but in the 2004 without LULUCF – 14 and with – 12. The key sources identified according to trend assessment without LULUCF was 12 with LULUCF – 13.

The key sources for 2004 without LULUCF are shown in Table 1.3 and Table 1.4, but for 1990 key sources are included in Annex 1 in the same way as key sources, which determined without LULUCF.

Table 1.3 Key sources –Level Assessment in 2004 with LULUCF

IPCC Source Categories	Direct GHG	2004, CO_2-eqv.	% Level Assessment	% Cumulative Total
Removals from Forest Land	CO_2	-13605,27	0,55	0,55
CO_2 Emissions from Stationary Combustion-gas	CO_2	3090,88	0,13	0,68
Mobile Combustion: Road Vehicles	CO_2	2491,79	0,10	0,78
CO_2 Emissions from Stationary Combustion-oil	CO_2	1025,13	0,04	0,82
Emissions from Agricultural Soils	Direct-N_2O	681,70	0,0277	0,85
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	561,78	0,0228	0,87
Emissions from Solid Waste Disposal Sites	CH_4	525,26	0,0213	0,89
Removals from Grassland	CO_2	-374,51	0,02	0,91
Emissions from Nitrogen Used in Agriculture	Indirect-N_2O	281,21	0,01	0,92
Non-CO_2 Emissions from Stationary Combustion-biomass	CH_4	265,32	0,01	0,93
Mobile Combustion: Railways	CO_2	255,04	0,01	0,94
CO_2 Emissions from Stationary Combustion-coal	CO_2	243,03	0,01	0,95

Table 1.4 Key sources -Trend assessment in 2004 with LULUCF

IPCC Source Categories	Direct GHG	Base year 1990	2004	Level Assessment	Trend Assessment	% Contribution to Trend	Cumulative Total
CO_2 Emissions from Stationary Combustion-oil	CO_2	7384,15	1025,13	0,04	0,22	0,27	0,27
Removals from Forest Land	CO_2	-20666,28	-13605,27	0,55	0,21	0,25	0,52
Mobile Combustion: Road Vehicles	CO_2	1947,67	2491,79	0,10	0,11	0,14	0,65
CO_2 Emissions from Stationary Combustion-coal	CO_2	2535,37	243,03	0,01	0,08	0,10	0,76
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	2057,23	561,78	0,02	0,04	0,05	0,81
Emissions from Solid Waste Disposal Sites	CH_4	278,67	525,26	0,02	0,03	0,04	0,84
Removals from Grassland	CO_2	-192,99	-374,51	0,02	0,02	0,03	0,87
Emissions from Nitrogen Used in Agriculture	Indirect-N_2O	1033,87	281,21	0,01	0,02	0,02	0,89
Emissions from Agricultural Soils	Direct-N_2O	1658,35	681,70	0,03	0,01	0,02	0,91
Non- CO_2 Emissions from Stationary Combustion-biomass	CH_4	161,93	265,32	0,01	0,01	0,02	0,93
Emissions from Manure Management	N_2O	551,63	152,12	0,01	0,01	0,01	0,94
CO_2 Emissions from Stationary Combustion-gas	CO_2	5679,91	3090,88	0,13	0,01	0,01	0,95
Emissions from Manure Management	CH_4	279,52	82,87	0,00	0,00	0,01	0,95

1.5 Uncertainties

The uncertainty estimate of the inventory 2006 has been done for the first time according to the Tier 1 method presented by the IPCC GPG (2000). The Tier 1 method is based on emission estimates and uncertainty coefficients for activity data and emission factors. In many cases uncertainty coefficients have been assigned based on expert judgement or on default uncertainty estimates according to IPCC GPG (2000). For each source, the uncertainty for activity data and emission factors was estimated and given in per cent. The uncertainty analysis was done for the all sectors: Energy, Industrial Processes, Solvent and Other Product Use, Agriculture and Waste, excluding LULUCF sector. Uncertainties are estimated for direct greenhouse gases, eg CO_2, CH_4, N_2O and F-gases only.

The overall uncertainty is calculated to be approximately 5% and the trend uncertainty is about 2%. The Tables 1; 2; 3 in the Annex 2 show the uncertainties separate for each direct GHG. The overall uncertainty for CO_2 is about 4%, for CH_4 – 16% and for N_2O – 27%. The trend uncertainty is calculated for CO_2 – 2%, for CH_4 – 8% and for N_2O – 12%. Uncertainties for CH_4 and N_2O are higher basically due to use default emission factors.

Further work considering uncertainties will focus on following improvements: there will be included more source categories, taken more notice on important source category analysis and more detailed uncertainty coefficients. This work may lead to changes in the calculated overall uncertainty, as well as providing uncertainty estimates for important individual source categories in Submission 2007.

1.6 Quality Assurance and Quality Control

Quality assurance and quality control (QA/QC) according to the IPCC GPG (2002) LEGMA plan to implement during 2006. Institutions which are involved in the NIS are informed about QA/QC procedures.
At the present generally for quality assurance and control we take into account how many activity data were available, how many were covered in emission calculation regarding methodology as well as how many assumptions and experts view were used.

1.7 General assessment of the completeness

All territory of Latvia is covered by the inventory. Emissions from large part of CRF tables have been estimated. Where this is not the case, notation keys: NE (not estimated), IE (include elsewhere), NA (not applicable) or NO (not occurred) are used. Admittedly data of some sectors have inconsistency in time series (e.g. in the some subdivisions of Energy sectors - for Manufacturing industries and construction sector, in Waste sector for Industrial wastewater output in years 1990, 1996).

Compared to last year's submission, some additional sources have been included in the inventory.

The Table 1.5 shows the Latvia's data submission completeness. The completeness compared to last submission in Energy has increased more than 17%, in Industrial processes it has grown by 20% and in Agriculture – 3%. Solvents and Waste sector is difficult to compare with last year, because there is difference in the source category positions. In the LULUCF sector the reporting format has changed and therefore this sector is not comparable with last submissions.

Table 1.5 Completeness in submission 2006

Sector	Submission 2006 Year 2004	
	NE	**Completeness**
Energy	15	92%
Industrial processes	14	92%
Solvents	4	80%
Agriculture	30	66%
LULUCF	59	20%
Waste	21	61%
Total	**143**	**75%**

2. TRENDS IN GREENHOUSE GAS EMISSIONS

Detailed information on emission trends is provided in the description of IPCC sectors in chapters 3-8 and in the CRF trend tables.

2.1 Description of emission trends for aggregated greenhouse gas emissions

The aggregated greenhouse gas emissions include the four gases defined in the Kyoto Protocol, carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and sulphur hexafluoride (SF_6). The emission levels are presented in Gg of carbon dioxide equivalents (Figure 2.1).

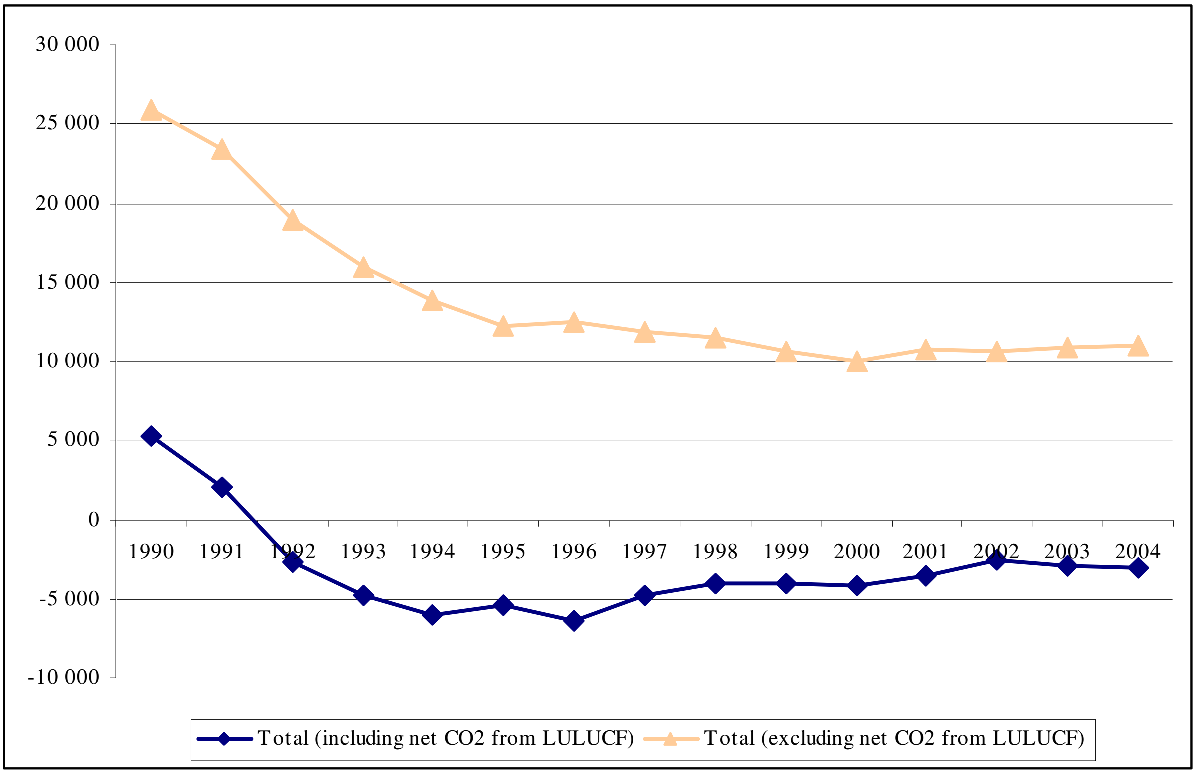


Figure 2.1 Latvia's aggregated greenhouse gas emissions in 1990-2004

As illustrated in Figure 2.1, Latvia's GHG emissions have decreased considerably since the 1990's. This decrease influenced the economical situation in the country. In Latvia the transition period to market economy started after 1991. This process provoked essential changes in all sectors of national economy and resulted in the decrease of GHG emissions after 1990.

In 2004, Latvia's total greenhouse gas emissions were 10783.31 Gg in CO_2 equivalents. This was about 58 % under the 1990 baseline level.

Latvia should limit its emissions during the Kyoto Agreement's first commitment period between 2008 and 2012 by 8% of 1990-year level. Figure 2.2 shows the trend in CO_2 equivalent emissions compared to the emission target of the Kyoto Protocol.

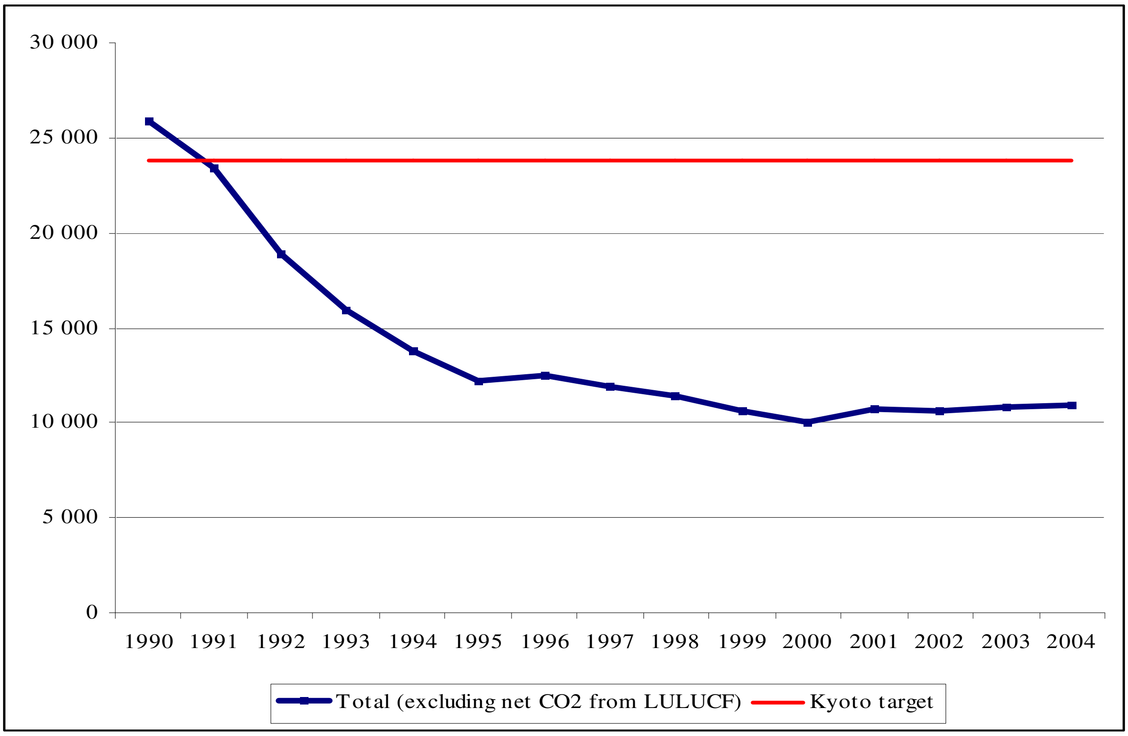


Figure 2.2 Trends in CO_2 equivalent emissions and emission target of the Kyoto Protocol

2.2 Description of emission trends by gas and source

In the Annex 3, Tables 1; 2; and 3 the trends of CO_2, CH_4, N_2O and HFCs, SF_6 emissions are shown.

Carbon dioxide (CO_2) is the main greenhouse gas causing the climate change. In 2004 CO_2 emissions contribute 69% of Latvia's total greenhouse gas emissions. In 2004 total CO_2 emissions had decreased by approximately 60% since 1990.

The most important source of CO_2 emissions (Gg) in 2004 was fossil fuel combustion – 96%, including energy industries – 28%; manufacturing industry and construction – 14%; transport – 37%, other sectors (agriculture, forestry, etc.) – 17%.

Other anthropogenic emission sources of CO_2 are industrial processes – 3%, solvent and other product use approximately 1% and tilling and liming of agricultural lands. CO_2 removals take place by green plants absorbing CO_2 in the process of photosynthesis. In 2004 forests in Latvia removed 13941.7 Gg.

Main sources of CH_4 emissions in Latvia are solid waste disposal sites, enteric fermentation of livestock and Energy sector. Other important sources of CH_4 emissions are leakage from natural gas pipeline systems and combustion of biomass. CH_4 emissions in the year 2004 contribute approximately 17% of total GHG emissions. The methane emissions (Gg) decreased by 47% in 2004 since 1990.

Agricultural soils are the main source of N_2O emission in Latvia generating 74% of all N_2O emissions (Gg) in 2004. Other N_2O emission sources are transport and biomass, combustion of liquid and other solid fuels in sectors of energy conversion and industry, waste and sewage. Total N_2O emissions had decreased by 62% in 2004 since 1990, mainly due the decrease in the emissions from agriculture.

Emissions from HFCs and sulphur hexafluoride (SF_6) consumption are reported for years 1995-2004. Total HFCs emissions (Gg CO_2 eqv.) increased by 21% in 2004 compared with 2003. The biggest emission source is HFC-134a from Mobile air- conditioning and contributes 65% from total HFCs emissions. SF_6 emissions only from electrical equipment are reported and contribute 4.82 Gg CO_2 eqv. in 2004.

Emissions by sources are illustrated in the following Figure 2.3. As it is shown, the energy sector covers the largest part of all greenhouse gas emissions in Latvia.

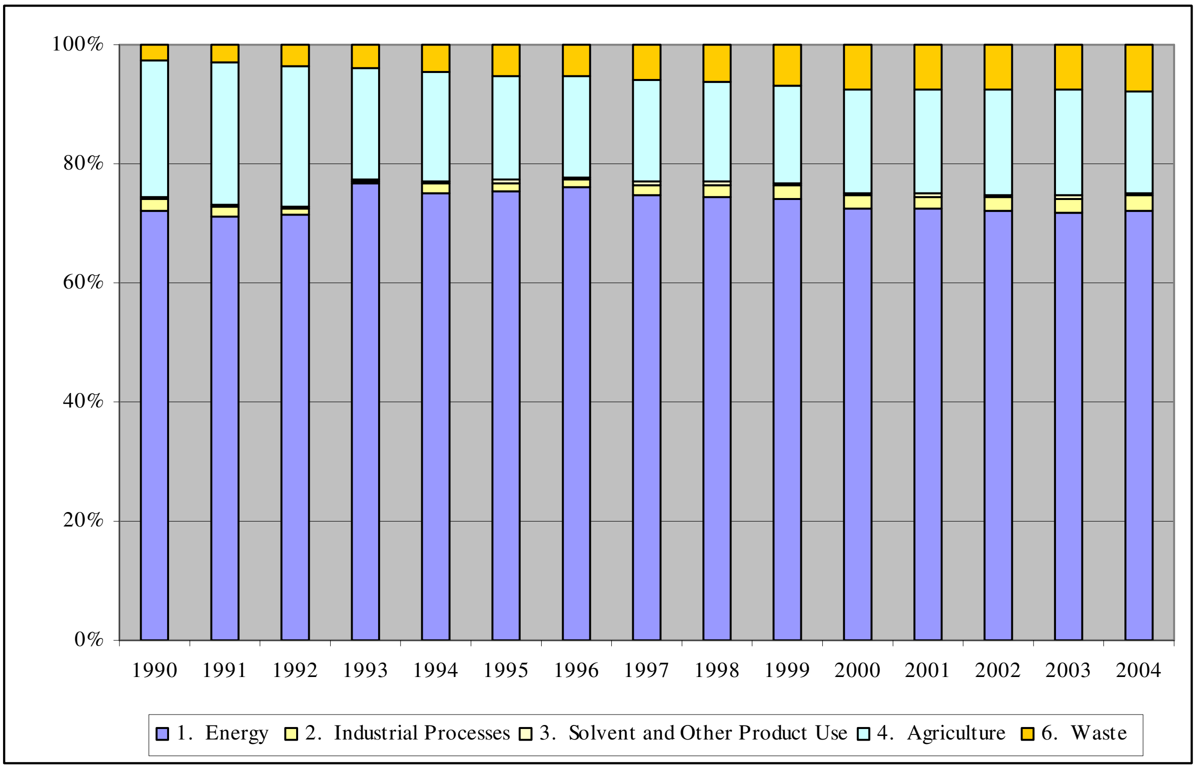


Figure 2.3 Latvia's greenhouse gas emissions by source 1990–2004 excluding LULUCF

2.3 Description of emission trends of indirect greenhouse gases and sulphur dioxide

The emissions trends of the indirect greenhouse gases, sulphur dioxide, nitrogen oxides, carbon monoxide and non-methane volatile organic compounds, are presented in Figure 2.4.

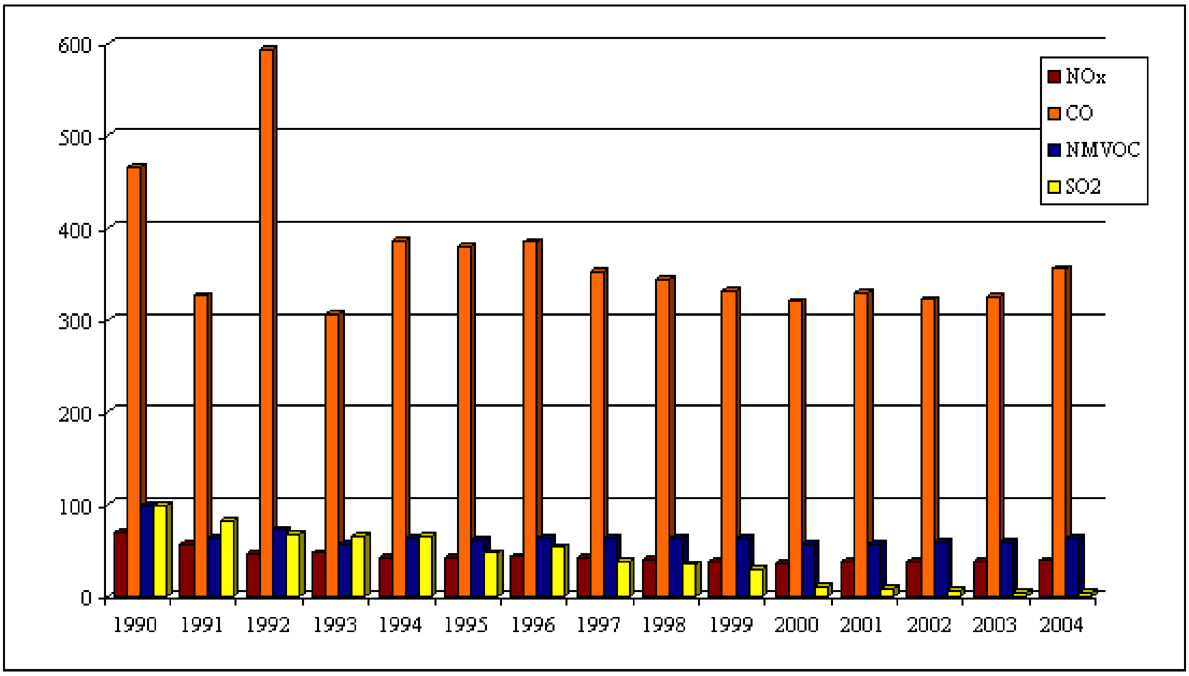


Figure 2.4 Total indirect greenhouse gas emissions trend 1990-2004, Gg

The sulphur **dioxide emissions** in 2004 were 3.90 Gg from which 97 % originated in the energy sector, where energy industries generated 39 % and other sectors 34 %.

Nitrogen oxides were generated generally in the energy sector 98.8 % and 0.05 % in the industrial processes. The total emissions were 39.37 Gg in 2004. The transport sector was responsible for 59 % of the total emissions. Energy industries, manufacturing industries and construction as well as other sectors generated 16 % and 9.3 % and 13.9 % of the emissions, respectively.

Carbon monoxide emissions, total 355.66 Gg, originated generally in the energy sector, where other sectors (including commercial/institutional, residential, forestry, agriculture and fishery) generated the biggest part of the total emissions 62 % and transport 26 %.

The total emissions of **non-methane volatile organic compounds** were 59.22 Gg in 2004 from which Energy sector were generated 59.8 % (other sectors contribute 69%, but transport 28% emissions from total energy emissions), solvent and other product use approximately 25.1 %, but industrial processes 15.14 %.

3. ENERGY (CRF 1)

3.1 Overview of sector (CRF 1)

General overview

Both the imported (natural gas, liquid gas, oil and oil products, coal) and local fuel (wood, peat, hydro resources) is used by the Energy sector in Latvia (Table 3.1.1). Mainly the imported fuels (natural gas and heavy oil) are used in heat generation. Smaller boiler houses burn local fuel and coal as well [17].

Table 3.1.1 Consumption of energy resources in Latvia* (ktce)**

Consumption of Energy Resources	1990	1995	2000	2001	2002	2003	2004
Energy consumption – total	9331	5399	4759	5106	5102	5215	5430
of which:							
Natural gas	2898	1237	1338	1543	1588	1654	1641
Light fuel products and other oil products	2464	1155	1249	1400	1410	1516	1579
Heavy oil, oil shale	1791	1059	349	225	197	142	113
Coal	765	210	81	106	85	78	75
Peat, coke and other types of fuel	131	131	81	45	37	32	8
Firewood	808	1297	1364	1488	1525	1549	1681
Electrical power (HPPs, wind generators)	474	310	298	299	261	244	333

* Source: CSB and Ministry of Economics
** 1 ktce = 0.02931 PJ

The use of natural gas as a primary energy resource has grown increasingly. The largest consumers of natural gas are combined heat and power plant (CHP) and heat generation enterprises.

Oil products have an important place in the Latvian energy resource market; their market share is about 31.2 %**,** including heavy fuel with about 2 %. The biggest consumers of heavy oil are heat supply (69.5 %) and industry (10 %). Its' consumption is basically concentrated in the biggest cities where natural gas is not available. The Ministry of Economics projects essential decrease of heavy oil share in energy balance in the next few years due to implementation of the EU Directive 1999/32/EC, which prescribes that sulphur content of heavy oil, must not exceed 1%.

Solid fuels used in Latvia are coal imported from Commonwealth of Independent States and local fuels – peat and peat briquettes. Peat briquettes is mainly produced inside country but not imported. CSB did not report local consumption of peat briquettes but enterprises reported these data but in quite small amount. Use of peat is decreasing.

Biomass fuels are composed of firewood, wood remains and biogas. Forecast of firewood consumption depends on the extent to which regions will manage to change from the extensive use of firewood to the rational use. In the total fuel consumption the share of firewood is quite substantial and has reached to 30.8 % in year 2004 by the side of year 1990 when firewood consumption was only about 9 % from total energy consumption. The biggest users of firewood are households – 50.8 %, heat supply companies – 14.8 %, industry (including autoproducers and mainly wood processing companies) – 21.1 % and other consumers (13.3 %). Firewood and coal are evenly used across all regions of Latvia.

Hydroelectric power plants (HPP) and combined heat and power plants (CHP) produce part of the electrical power, while part is imported (Table 3.1.2). Volume of *electricity* generation directly depends on the through-flow of the river Daugava. Also the import of electricity from Russia, Estonia and Lithuania has a quite substantial role in the electricity supply.

Table 3.1.2 Electricity and heat production and consumption in Latvia (TJ)

	1990		1995		2000		2001		2002		2003		2004	
	Electricity	**Heat**	**Electricity**	**Heat**	**Electricity**	**Heat**	**Electricity**	**Heat**	**Electricity**	**Heat**	**Electricity**	**Heat**	**Electricity**	**Heat**
Production	7747	99469	3752	46112	4727	31867	6779	33937	8453	33048	9479	33516	7549	31093
Own use and losses	6883	15171	6372	8215	5202	7160	5688	7567	5188	6732	5065	6671	4975	6512
Import	25700	NO	9529	NO	7589	NO	8424	NO	10217	NO	9616	NO	9839	NO
Export	12798	NO	1407	NO	1159	NO	1645	NO	1764	NO	137	NO	2290	NO
Final consumption														
CRF 1.A.2.	12492	32929	5130	1969	5159	659	5562	641	5493	630	5778	626	5882	608
CRF 1.A.4.	16542	51339	10268	35928	10410	24048	10314	25729	11563	25686	12455	26219	13072	23973
CRF 1 A.3.	918	NO	677	NO	548	NO	623	NO	519	NO	490	NO	501	NO
TOTAL	**29952**	**84268**	**16075**	**37897**	**16117**	**24707**	**16499**	**26370**	**17575**	**26316**	**18723**	**26845**	**19455**	**24581**

Source category description

Emissions from fuel combustion comprise all domestic fuel combustion, including point sources, transport and other fuel combustion. Direct and indirect GHG are reported.

The **Energy sector** is the most significant source of GHG emissions with over 72 % share of the total emissions in the 2004 (Figure 3.1.1).

Emissions from fuel combustion in the energy sector are divided into following subcategories:

- 1.A.1 Energy industries;
- 1.A.2 Manufacturing Industries and Construction;
- 1.A.3 Transport covers emissions from road transport, civil aviation, railways and domestic navigation;
- 1.A.4 Other (Commercial / Institutional, Residential, Agriculture / Forestry / Fisheries)

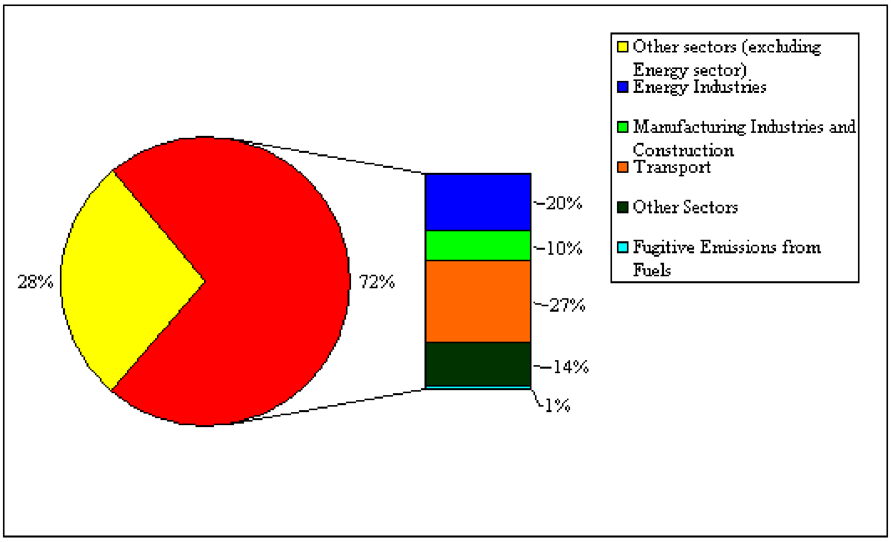


Figure 3.1.1 Emissions from the energy sector in 2004

As proved by the data of annual reports, CO_2 emissions from the energy sector in the latest years are stable, but still CO_2 equivalent curve of energy sector has an increasing tendency. It could be explained with increasing number of vehicles in Latvia and wherewithal CO_2 emissions from transport sector. Transport is the most important energy sub – sector with 28 % of total CO_2-eq energy emissions and 39,6 % of total CO_2 energy emissions and emissions from this sub-sector rose by 7 % compared to last year.

Emissions from the energy sector come from different sources. Emissions from fuel combustion include direct and indirect GHG emissions including point sources and transport sector, but direct fugitive emissions arise from natural gas transmission and distribution (Table 3.1.3).

Table 3.1.3 Emissions from energy sector in 1990 – 2004 by subcategories and gases (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
A Fuel combustion															
CO_2,	18 016.57	15 962.14	12 991.12	11 742.00	9 735.95	8 594.06	8 855.61	8 287.41	7 904.06	7 256.89	6 667.69	7 151.82	7 060.01	7 198.20	7 190.87
CH_4	24.90	25.58	19.10	18.50	23.30	22.87	22.86	21.58	21.22	20.73	19.41	20.24	20.35	18.37	20.09
N_2O	0.49	0.47	0.37	0.35	0.37	0.39	0.43	0.44	0.44	0.42	0.42	0.48	0.48	0.50	0.53
B Fugitive emissions from fuels															
CH_4	13.05	12.57	11.46	10.96	10.71	10.43	10.05	9.38	9.00	8.58	7.94	7.7	8.03	6.281	6.213

Total emissions from energy sector in Gg CO_2 equivalents are presented in Figure 3.1.2.

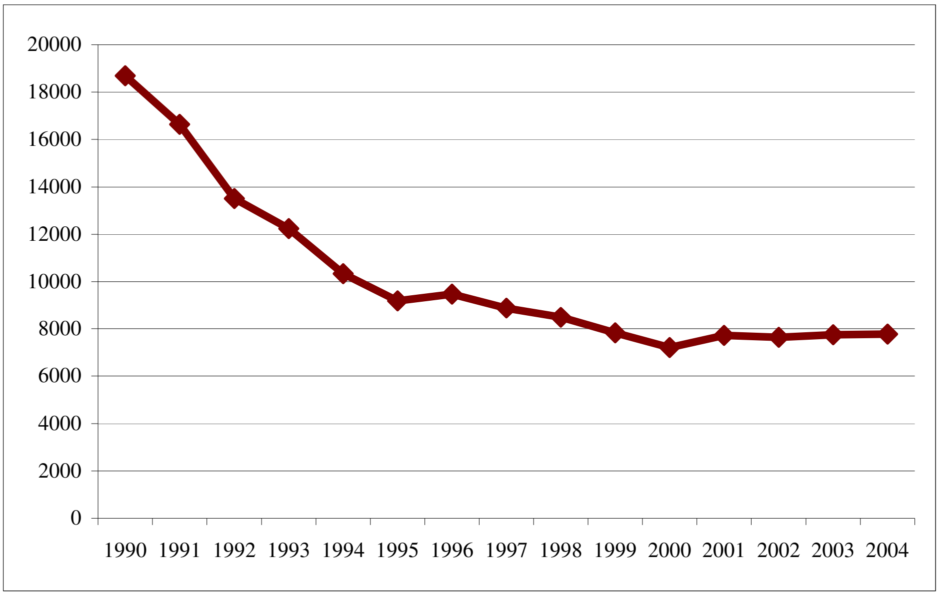


Figure 3.1.2 GHG emissions from energy sector 1990 – 2004 (Gg CO_2 equivalents)

It is seen that emissions expressed in CO_2 equivalents in Energy industries (CRF 1.A.1) sector decreased year by year. It was dependent from economical situation and fuel consumption by sectors.

CO_2 emissions from fuel combustion were 7190.87 Gg (including Transport sector) and accounted 96.07 % of the total emissions in 2004.

CH_4 emissions from fuel combustion were 13.88 Gg (including Transport sector). The biggest part of CH_4 emissions contributes other sectors, respective 12.53 Gg. It is related with wood fuel combustion, especially in the Residential sector. Until now Latvia used IPCC Default CH_4 emission factor for wood combustion in Residential sector and it is quite high as noticed Review Team in the Report of the individual review of GHG inventory submitted in the 2003/2004.

Latvia should reassess CH_4 emission factor as advised Review Team, but due to lack of financial resources it is further work.

N_2O emissions from fuel combustion were 0.53 Gg (including Transport sector) and accounted 11.48 % of the total emissions in 2004.

Emissions from fuel combustion are presented in the Figure 3.1.3.

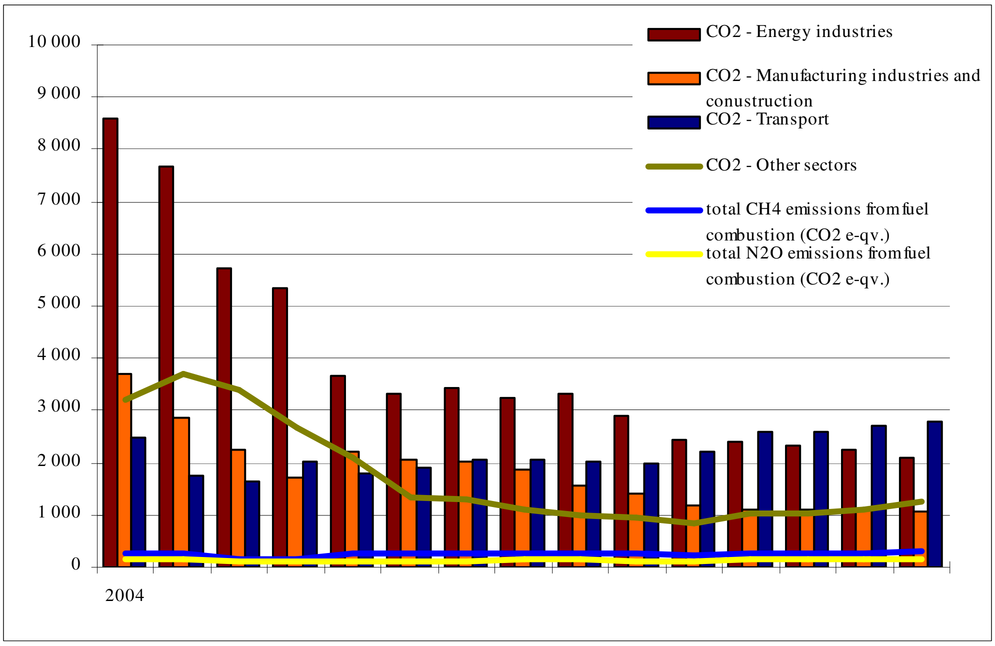


Figure 3.1.3 Total direct GHG emissions from fuel combustion in 1990 – 2004 (Gg)

The following indirect greenhouse gases NOx, CO, NMVOC, SO_2 are calculated. Total emissions from energy sectors for 2004 are presented in Figure 3.1.4.

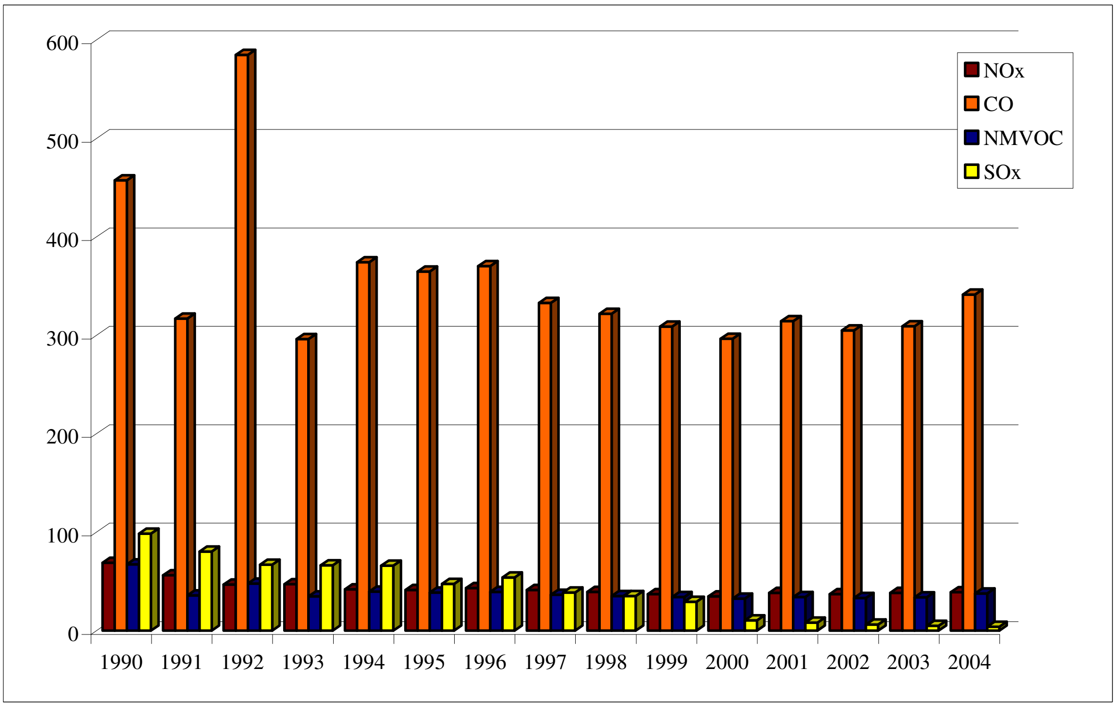


Figure 3.1.4 Total indirect emissions from fuel combustion in 2004 (Gg)

The largest part of indirect emissions contributes CO, but then NOx and NMVOC emissions in year 2004. Most CO and NMVOC emissions come from wood combustion in the residential sector. The biggest decrease could be observed in SO_2 emissions where emissions decreased form almost 100 Gg in year 1990 to approximately 4 Gg emissions in year 2004. it could be explained in changes in type of fuels combusted in energy sector.

3.2 Description of Key Source Categories

The Energy Sector and CO_2 emission from Stationary Fuel Combustion Activities contributes 3 key source categories with respect to level assessment and trend assessment. These 3 key sources by level assessment are the major fuels natural gas, liquid fuel and coal for year 2004. Natural gas according to the key source level assessment for year 2004 is the most contributing category with 29 % of the national total. Liquid fuel is the third largest contributor with 10 % in 2004, and coal is the tenth largest contributor with a level of 2 % in 2004.

CH_4 stationary combustion, biomass is assessed as key source with contribution of 2 % in 2004 with respect of trend and level assessment.

N_2O stationary combustion of biomass is assessed as 1 % by trend assessment.

Fugitive emissions from natural gas have been identified as key source category in 2004 (Tier 1, Level assessment) and contribute 1% of level and trend assessment.

The Energy Sector and the category CO_2 emissions from Mobile Fuel Combustion Activities contribute 2 key source categories with respect to level and trend assessment. Road Vehicles is the second largest contributor with a level contribution of in 24 % 2004. Railway is ninth largest contributor with a level of 2 %.

3.3 Energy industries and Manufacturing Industries and Construction (CRF 1.A.1, CRF 1.A.2)

3.3.1 Source category description

Energy industries (CRF 1.A 1) and Manufacturing industries and construction (CRF 1.A. 2) include emissions from fuel combustion in point sources in energy production and industrial sectors including emissions from off – road. The emissions from Energy industries by relevant subcategories and gases in time period 1990 – 2004 are presented in Table 3.3.1.

The emissions from Manufacturing industries and construction by relevant subcategories and gases in 1990 – 2004 are presented in Table 3.3.1 below.

Table 3.3.1 Emissions from Energy industries and Manufacturing Industries and Construction sub-sectors in 1990 – 2004 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1.A.1 Energy industries															
CO_2,	8591.32	7708.11	5706.79	5347.61	3648.00	3302.18	3452.85	3240.85	3317.23	2912.29	2452.88	2406.38	2321.71	2267.09	2088.20
CH_4	0.30	0.28	0.31	0.33	0.22	0.21	0.24	0.30	0.32	0.28	0.28	0.27	0.30	0.32	0.30
N_2O	0.05	0.05	0.05	0.05	0.04	0.03	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04
1.A.2 Manufacturing industries and construction															
CO_2,	3710.82	2872.40	2270.43	1698.65	2200.19	2068.97	2028.55	1882.85	1567.60	1412.15	1186.04	1109.17	1120.24	1110.17	1066.12
CH_4	0.36	0.24	0.24	0.17	0.24	0.36	0.41	0.39	0.35	0.33	0.31	0.34	0.36	0.38	0.33
N_2O	0.04	0.02	0.02	0.02	0.03	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04

Emissions from these two sectors are decreasing year by year (Figure 3.3.2). In the beginning of nineteenths it could be explained with economical crisis caused by political and social situation in the country. In the middle of nineteenths curve of direct GHG emissions fluctuated. At the end of nineteenths it started to decrease again and continued till 2004. Decreasing in the end of nineteenths could be explained with economical crisis in Russian Federation with whom Latvia has close economical collaboration. Lasting decrease of emissions could be explained with high standards of physical characterization of fuels and fuel switching to the kind of fuels with lower costs and emissions level.

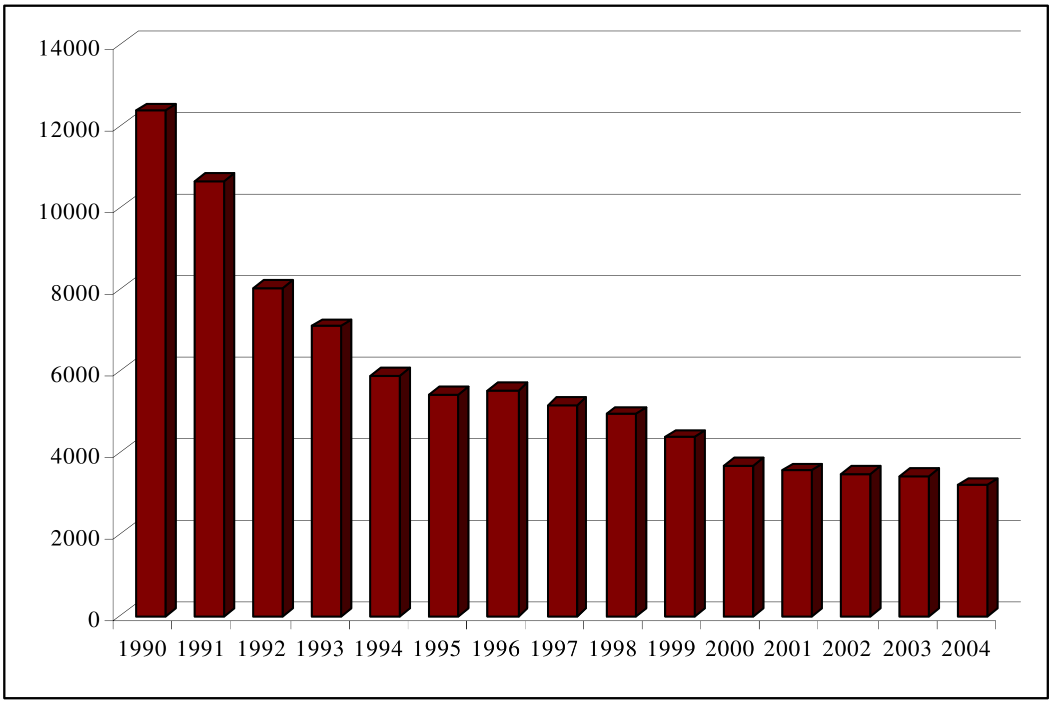


Figure 3.3.2 Total direct GHG emissions of Energy industries and Manufacture industries and construction (Gg CO_2 equivalent)

Also indirect GHG emissions from Energy industries and Manufacturing industries and Construction sub-sectors were estimated (Figure 3.3.3). As it is seen from Figure 3.3.3 SO_2 had biggest decrease in time period 1990 – 2004. It could be explained with fuel switching to natural gas and biomass where sulphur dioxide emissions did not occurred.

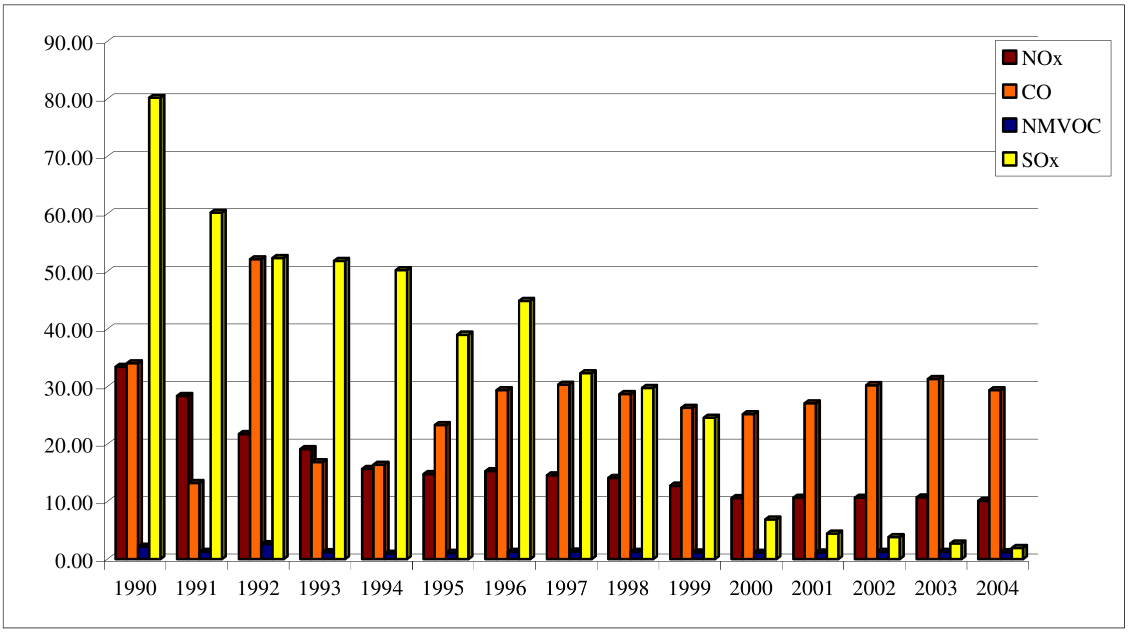


Figure 3.3.3 Total indirect GHG emissions of Energy industries and Manufacture industries and construction in 2004 (Gg)

3.3.2 Methods, emission factors, activity data and uncertainties

Methods

Both the Revised 1996 IPCC Guidelines for National Greenhouse gas Inventories Tier 1 Sectoral approach and Reference approach for the comparison of CO_2 emissions were used to calculate GHG emissions from the Energy sector. Calculation of all emissions from fuel combustion is done with Excel databases developed by experts from LEGMA. CRF Reporter software developed by experts from UNFCCC was used to report emission data.

Generally emissions from fuel combustion are calculated by multiplying fuel consumption with country specific or IPCC default emission factor. Calculating CO_2 emissions oxidation factor is included.

All emissions within CRF 1.A 1 and 1.A 2 are based on bottom-up data.

The general method for preparing inventory data was used:

$$\text{Emissions} = \text{EF} \times \text{Activity data}_{ab}$$

where:
Emissions – total emissions of fuel type in sub-sector (Gg)
EF – emission factor (Gg/PJ; Mg/PJ)
Activity – energy input (TJ, PJ)
a – fuel type;
b – sector activity

Emission factors and other parameters

The main sources for emission factors are:
- National studies for country specific parameters and emission factors;
- Revised IPCC 1996 Guidelines;
- EMEP/CORINAIR Guidebook.

In 2004 research by local expert was made regarding CO_2 emissions factors for Latvia in concern with IPCC Guidelines and used fuel type of physical characteristics [12].

To calculate carbon dioxide (CO_2) and sulphur dioxide (SO_2) emissions country specific emission factors were used.

National expert assessed indices that influences CO_2 emission factor and calculated CO_2 emission factor in the research "Methodological instructions for CO_2 emissions determination". This research was made considering United Nations framework convention of climate change, recommendations of Intergovernmental Panel of Climate Change and physical characterizations of types of fuels used in Latvia (Table 3.3.2).
For calculating CO_2 emissions factors was used following equation [12]:

$$E_{CO_2} = \frac{C^d \times M_{CO_2} \times 1000}{Q_z^d \times M_C \times 100} = \frac{C^d}{Q_z^d} \times 36,6413$$

where:
EF_{CO2} – emission factor for CO_2 (kg CO_2/MJ)
Q_z^d – net calorific value of fuel (MJ/kg (m^3))
C^d – carbon content in fuel (%)
M_{CO2} – molecule weight for CO_2 – 44,0098 (g/mcl)
Mc – molecule weight for C – 12,011 (g/mcl)

Oxidation factor is used according IPCC.

Table 3.3.2 CO_2 emission factors, oxidation factors and net caloric values by fuel

Type of fuel	NCV (Q_z^d) MJ/kg	Emission factor without oxidation factor (E CO_2) kg/GJ	Oxidation factor (p)	Emission factor with oxidation factor (E'CO_2) kg/GJ
Coal	26,22	94,08	0,98	**92,20**
Peat, W^{d*} = 40%	10,05	105,99	0,98**	**103,87**
Peat briquettes***	15.49	97,00	0.98	**95,06**
Coke	26,37	88,75	0,98	**86,98**
Motor gasoline (for off-roads)	43,96	69,29	0,99	**68,60**
Diesel oil	42,49	74,74	0,99	**74,00**
LPG	45,54	62,75	0,995	**62,44**
Residual fuel oil	40,60	77,36	0,99	**76,59**
Jet fuel	43,60	71,58	0,99	**70,86**
Shale oil	39,35	76,19	0,99	**75,43**
Lubricants	41,86	73,33	0,99	**72,60**
Other kerosene	43,20	72,24	0,99	**71,52**
Natural gas	33,66****	56,10	0,995	**55,82**
Wood, W^{d*} = 55%	6,70*****	109,98	0,98	**107,78**
Biogas******	33,66	56,10	0,995	**55,82**

* moisture content
** for electricity production p = 0,99
*** emission factor was taken from GHG inventory of Finland
**** natural gas – Q_z^d ir MJ/m^3
***** for wood – Q_z^d ir TJ/1000m^3
****** emission factor was equate to natural gas emission factor

SO_2 emissions factors were calculated by formula taken from IPCC Guidelines and were calculated by national expert considering physical characterizations of types of fuels used in Latvia and national and international legislation.

Emission factors for SO_2 are calculated:

$$2\times\left(\frac{s}{100}\right)\times\frac{1}{Q}\times10^6\times\left(\frac{100-r}{100}\right)\times\left(\frac{100-n}{100}\right)$$

where:
EF – emission Factor (kg/TJ)
2 – SO_2 / S (kg/kg)
s – sulphur content in fuel (%)
r – retention of sulphur in ash (%)
Q – net calorific value (TJ/kt)
10^6 – (unit) conversion factor
n – efficiency of abatement technology and/or reduction efficiency (%).

The default CH_4, N_2O, NOx, CO, NMVOC emission factors used in estimation of emission were taken from IPCC Guidelines (Table 3.3.3).

Table 3.3.3 CH_4, N_2O, NOx, CO, NMVOC emission factors

	IMPLIED EMISSION FACTORS					
	CO_2 (Gg/PJ)	CH_4 (Mg/PJ)	N_2O (Mg/PJ)	NOx (Mg/PJ)	CO (Mg/PJ)	NMVOC (Mg/PJ)
1.A.1 Energy Industries						
Gasoline	68.60	50.00	2.00	210.00	27000.00	1000.00
Diesel oil	74.00	3.00	0.60	200.00	15.00	5.00
RFO	76.59	3.00	0.60	200.00	15.00	5.00
LPG	62.44	3.00	0.60	200.00	15.00	5.00
Jet fuel	70.86	3.00	0.60	200.00	15.00	5.00
Other kerosene	71.52	3.00	0.60	200.00	15.00	5.00
Other liquid	72.60	3.00	0.60	200.00	15.00	5.00
Shale oil	75.43	3.00	0.60	200.00	15.00	5.00
Coal	92.20	1.00	1.40	300.00	20.00	5.00
Coke	86.98	10.00	1.40	300.00	150.00	20.00
Peat briquettes	95.06	30.00	4.00	100.00	1000.00	50.00
Peat	103.87	30.00	4.00	100.00	1000.00	50.00
Natural gas	55.82	1.00	0.10	150.00	20.00	5.00
Wood	107.78	30.00	4.00	100.00	1000.00	50.00
Biogas	55.82	1.00	0.10	150.00	20.00	5.00
1.A.2 Manufacturing Industries and Construction						
Gasoline	68.60	50.00	2.00	210.00	27000.00	1000.00
Diesel oil	74.00	2.00	0.60	200.00	10.00	5.00
RFO	76.59	2.00	0.60	200.00	10.00	5.00
LPG	62.44	2.00	0.60	200.00	10.00	5.00
Jet fuel	70.86	2.00	0.60	200.00	10.00	5.00
Other kerosene	71.52	2.00	0.60	200.00	10.00	5.00
Other liquid	72.60	2.00	0.60	200.00	10.00	5.00
Shale oil	75.43	2.00	0.60	200.00	10.00	5.00
Coal	92.20	10.00	1.40	300.00	150.00	20.00
Coke	86.98	10.00	1.40	300.00	150.00	20.00
Peat briquettes	95.06	30.00	4.00	100.00	1000.00	50.00
Peat	103.87	30.00	4.00	100.00	1000.00	50.00
Natural gas	55.82	5.00	0.10	150.00	30.00	5.00
Wood	107.78	30.00	4.00	100.00	2000.00	50.00
Biogas	55.82	5.00	0.10	150.00	30.00	5.00

SO_2 emission factors for fuel combustion are presented in Table 1 in Annex 4.

Activity data

Mainly emissions from fuel combustion are calculated using data from the CSB – Energy Balance for Latvia and Annual questionnaires sent to EUROSTAT by CSB. The activity data (fuel consumption) for 1990, 1991 and 1994 – 2004 are taken from CSB.

The CSB data collection system is based on a detailed compulsory survey 1- EK. This form "Survey on stocks, receipts and consumption of energy recourses"(Quarterly) is collected from about 10000 enterprises and organizations (with all kind of economic activity) that are included in the lists of suppliers of statistical information. 1 – EK represents the basic tool for creating energy balances at a country level.

For years 1992 – 1993 activity data are taken from Energy resource balance prepared as a part of the project *Implementation of requirements of international conventions on air protection* (2002) [4].

CSB is working to update statistical data for time period 1992 – 1993. Data for these years are not divided in sub-sectors of Manufacturing Industries and Construction sector because official statistical data are not available. Problems of statistical information for this time period occurred because of changes of enumerative classification of statistical information and so many data were lost. It takes quite long time to restore all needed data.

Table 3.3.4 Fuel consumption in Energy industries (CRF 1.A.1) and Manufacturing industries and construction (CRF 1.A.2) in 1990 – 2004 (PJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1.A.1 Energy industries															
Liquid fuels	57.17	46.24	37.75	37.06	30.78	20.27	27.21	17.40	20.66	17.49	7.90	5.28	4.91	3.61	3.16
Solid fuels	3.68	3.44	3.88	4.54	3.61	4.08	3.14	3.14	2.28	1.44	2.58	1.57	1.28	0.87	0.28
Gaseous fuels	69.54	67.99	43.93	37.07	16.76	24.07	18.85	28.49	27.10	25.75	28.51	33.05	32.55	34.10	32.57
Biomass	0.44	0.59	1.92	3.43	1.30	1.41	2.14	4.67	5.87	5.74	5.43	6.24	7.41	8.61	8.59
Other Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.06
1.A.2 Manufacturing industries and construction															
Liquid fuels	18.90	11.87	6.40	5.98	17.81	17.32	16.29	15.86	12.15	10.55	6.49	4.01	3.69	3.65	3.95
Solid fuels	13.67	9.97	11.30	8.96	2.91	1.77	2.22	1.33	0.76	0.62	0.53	0.42	0.34	0.38	0.19
Gaseous fuels	18.44	18.99	13.42	7.51	10.24	10.47	10.37	9.86	10.23	9.83	11.38	13.43	14.11	14.00	13.12
Biomass	1.56	0.27	0.12	0.21	3.57	8.07	9.64	9.46	8.52	8.49	7.54	8.59	9.11	9.81	8.42
Other Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.04	0.13	0.25	0.33	0.29	0.31

Biggest decrease in time period 1990 – 2004 was for liquid fuel consumption (Table 3.3.4, Figure 3.3.4). It could be explained with fuel switching processes when liquid fuels were switch to other more low-costs fuels. Also stronger legislation contributed fuel switching to the type of fuels with lower level of emissions. And that's why also consumption of solid fuels decreased.

Consumption of gaseous fuels and biomass fuel increased in the time period 1990 – 2004. These are types of fuels with lower cost to whom liquid and solid fuels were switched.

The fuel switching was caused mainly by economical crisis in industry in country so facilities needed to use fuels with lower costs.

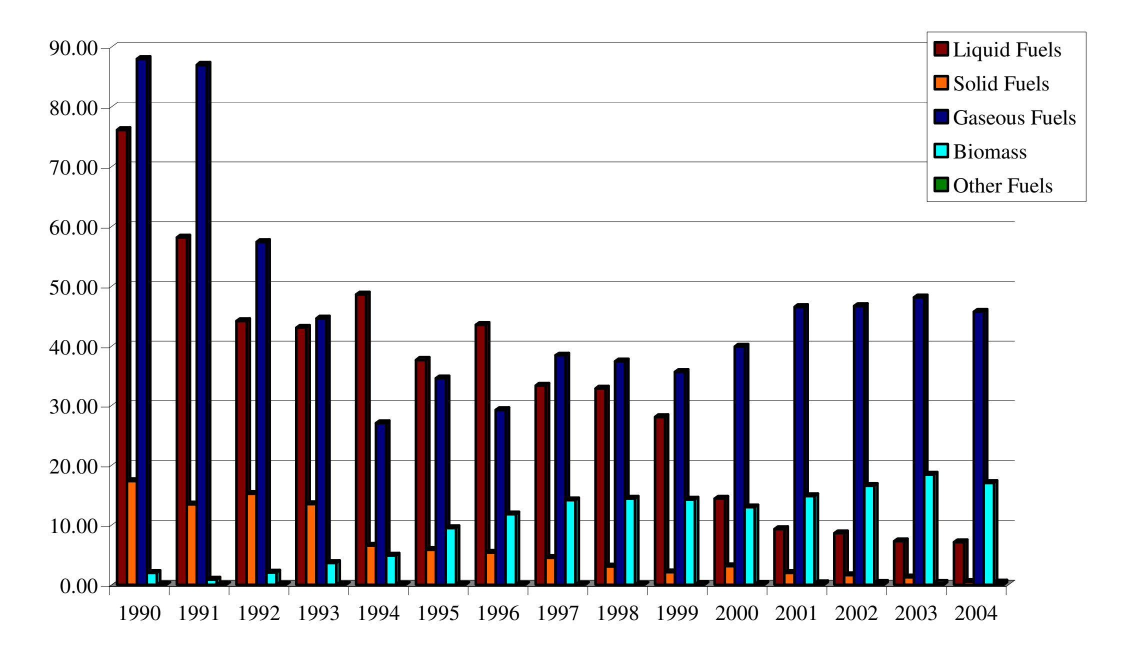


Figure 3.3.4 Total fuel consumption in Energy industries and Manufacture industries and Construction (PJ)

Uncertainties

Uncertainty in activity data of fuel combustion in sectors CRF 1.A.1, CRF 1.A.2 is ±2% in 2004. CSB gives approximately 2 % statistical frame mistake for statistical data. In Latvia all fossil fuels (oil, natural gas, and coal) are imported, and import and export statistics are fairly accurate.

Uncertainty of activity data for biomass combustion was assigned as 15 % because biomass activity data were collected by CSB with questionnaires sent by enterprises consumed biomass and enquiry to find out biomass use in residential sector.

In fuel combustion, the CO_2 emission factor mainly depends on the carbon content of the fuel instead of on combustion technology. Therefore, uncertainty in CO_2 emissions was calculated at a rather aggregated level, i.e. by fuel type rather than by sector.

CO_2 emission factor was estimated by national expert according physical characterization of used fuels in country so uncertainty was assigned as quite low about 5 %. For combustion of solid fuels uncertainty of CO_2 emission factor was assigned higher to 10 % because CO_2 emission factor of peat briquettes was taken from GHG inventories of Finland.

CH_4 and N_2O emission factor used in estimation of emissions was taken from IPCC Guidelines so uncertainty was assigned as very high about 50 % according IPCC Good Practice Guidance.

3.4. Transport (CRF 1.A 3)

3.4.1 Source category description

The Transport sector is the fastest growing sector in Latvia and amount of the emissions is increased compared to year 1990. Emissions from Transport sector include following sectors: road transport, railway, civil aviation and in this submission there is included also domestic navigation (Table 3.4.1). The most important reason of this growing tendency is that the economics and the welfare of population are developing and this is also the reason that the number of vehicles and private boats are growing and the number of flights is growing.

Table 3.4.1 Emissions from the Transport sector in 1990-2004 by sub-categories (CO_2 eqv. Gg)

	1990	1995	2000	2001	2002	2003	2004
Total Transport	**2584,89**	**1959,07**	**2276,40**	**2681,73**	**2677,18**	**2802,43**	**2896,68**
Civil Aviation	0,066	0,470	1,647	1,882	2,089	2,235	2,353
Road transportation	1975,40	1642,17	1993,59	2391,65	2378,24	2469,08	2558,63
Railways	589,94	265,31	226,90	233,87	244,36	279,25	286,22
Domestic navigation	19.49	51.12	54.24	54.32	52.49	51.86	49.48

In the year 2004 Transport sector contributed 27% from total CO_2 equivalent emissions, excluding LULUCF, and 37 % CO_2 equivalent from the total energy sector. The biggest part of transport emissions take up road transport then follows railways; domestic aviation and navigation contribute a very small part of transport emissions. Emissions from road transport increase yearly (Figure 3.4.1), it could be explained with increase number of vehicles (Table 3.4.6). Emissions from railway became stable for the last time (Figure 3.4.1). Emissions from domestic aviation are increasing since 1990, because the numbers of flights are increased, also the emissions from domestic navigation are increasing.

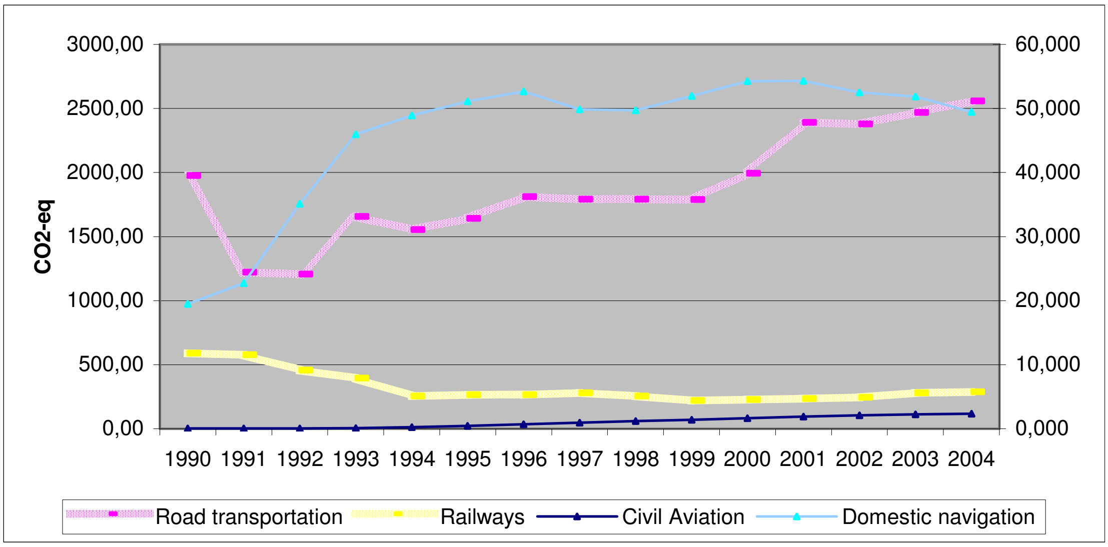


Figure 3.4.1 Emissions from the Transport sector in 1990-2004 by sub sectors (Gg CO_2 eqv.)
(Road transport and Railway – primary axis, Civil aviation and Domestic navigation – secondary axis)

Road transport includes all transportation types of vehicles with combustion engines on roads in Latvia: passenger cars, light duty vehicles, buses, heavy-duty vehicles and motorcycles. Only mopeds are not included, because the RTSD started to collect these data just in year 2004. The source category does not cover farm and forest tractors driving occasionally on the roads because they are included in other sectors (agriculture, forestry etc.) and military vehicles are included in Commercial/Institutional. Railway transport in Latvia includes railway transport operated by diesel locomotives. Domestic aviation includes helicopters, airplanes with turbojet engine and airplanes with piston engines. Domestic navigation includes all domestic waterway transport – leisure boats, sea-going ships and towboats.

The main indirect GHG emission source in this sector is road transport. Emissions from CO and NMVOC are decreasing because of CO exhaust gas limitation from vehicles in Latvian legislation and due to number of new vehicles with catalysts are growing. NOx and SO_2 emission trends are more or less stables. Figure 3.4.2 presents indirect GHG emissions from transport sector.

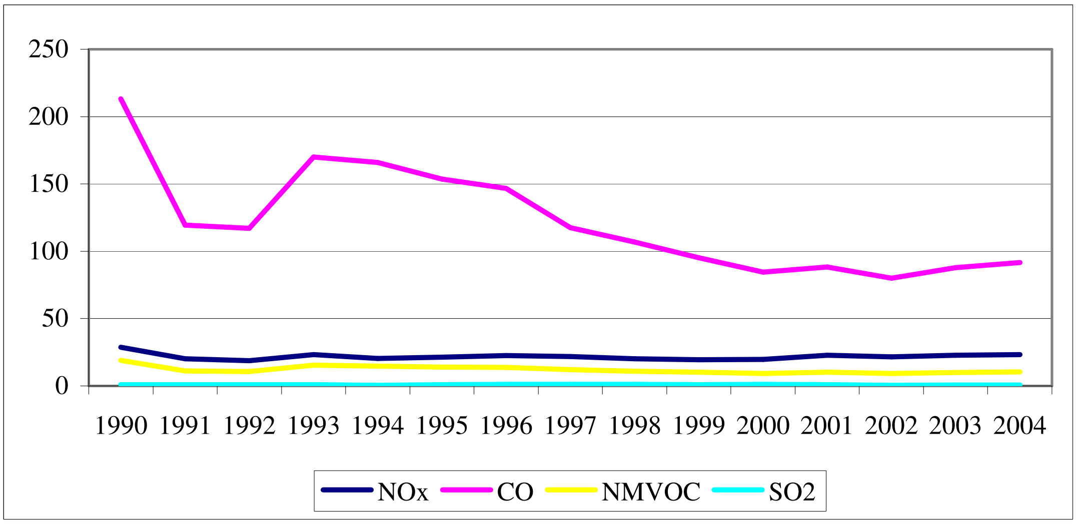


Figure 3.4.2 Indirect GHG emissions from Transport sector (Gg)

3.4.2 Methods, activity data, emission factors and uncertainties

Methods

Emission calculation from **road transport** are made using the Computer Programme to calculate Emissions from Road Transportation (COPERT III), which is proposed to be used by EEA member countries for the compilation of CORINAIR emission inventories. COPERT III methodology can be applied for the calculation of traffic emission estimates at a relatively high aggregation level, both temporally and spatially.
Calculation of emissions is based on fuel consumption of road vehicles and the fixed emission factors. Road traffic in Latvia uses three different fuels, gasoline, diesel oil and LPG. Emissions are calculated for gasoline and diesel vehicles separately. Emissions from LPG are calculated using Tier 1 method from Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, due to problems concerned to inconsistency in statistical data, this problem is described in part activity data about road transportation. The mileage (km/a) of each automobile type and model year on different road types and in different speed classes are multiplied with corresponding emission factors (g/km). Emissions factors are a sum of hot driving and cold start-ups. Finally all emissions are summed up.

To calculate emissions from **railway, civil aviation and domestic navigation** are used the Tier 1 method from Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. The calculation includes CO_2, N_2O and CH_4 emissions and also indirect GHG emissions.

Emissions = Activity Data x Emissions Factor

Emission factors and other parameters

Emission factors in **road transport** are Default EMEP/CORINAIR emissions factors that are included in COPERT III model.

Estimation of evaporative emissions of hydrocarbons and the inclusion of cold start emission effects are dealt with in the Latvian inventory by using LEGMA meteorological input data for ambient temperature variations during months; the distribution of evaporate emissions in the driving modes are used default by COPERT III.

Default emission factors for **railway** (Table3.4.2) are taken from Revised 1996 IPCC Guidelines and are presented in Table 3.4.2. The SO2 emissions factors are used consistent with sulphur content in diesel oil (Table 3.4.3).

Table 3.4.2 Emission factors used in the calculation of emissions from Railway

	CO_2	CH_4	N_2O	NOx	CO	NMVOC
	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ
Diesel oil	73,2	0,00415	0,0286	0,93	0,25	0,11

Table 3.4.3 SO_2 Emission factors used in the calculation of SO_2 emissions from Railway

Diesel oil	Sulphur content	NCV	EF (Gg/PJ)
1990-1998	0,2	42,49	0,0941
1999-2003	0,05	42,49	0,0235
2004	0,035	42,49	0,0165

Default emission factors for **civil aviation and domestic navigation** are taken from Revised 1996 IPCC Guidelines and are presented in Table 3.4.4 and Table 3.4.5.

Table 3.4.4 Emission factors used in the calculation of emissions from Civil Aviation

	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ
Jet fuel	72,1	0,0005	0,002	0,25	0,10	0,05	0,023
Aviation petrol	70,2	0,0005	0,002	0,25	0,10	0,05	0,023

Table 3.4.5 Emission factors used in the calculation of emissions from Domestic Navigation

	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ
Gasoline	69,7	0,04	0,00	0,22	23,24	0,78	0,01
Diesel oil	74,0	0,00	0,03	1,00	0,25	0,11	0,02

Activity data

Road transportation

Last five years the number of vehicles is increased by 26%, but the number of passenger cars is increased more quickly. But still it is not so much compared to other EU countries and the projection is that next ten years the number of vehicles will grow. In year 2004 there were 270 vehicles per 1000 populations, but in other EU countries this number is even two times greater.

In the time period between 1996 and 2004 the number of vehicles registered in the RTSD has grown by an average 7% per year (Table 3.4.6).

Table 3.4.6 Total number of vehicles (without sidecars) in 1996-2004*

1996	1997	1998	1999	2000	2001	2002	2003	2004
488 851	546 749	598 865	647 759	686 441	718 932	755 488	787 734	834 698

*Data from the RTSD

Due to transition to a market economy the vehicle fleet was restructured. Many old trucks and buses with gasoline engines were replaced by diesel fuelled ones. A modern register of road vehicles was created in 1993, and registration process was begun. Unfortunately reliable data are only available starting 1997 and even these are not in line with the requirements of the EU (there are no statistics providing the car engine sizes, legislation classes, ages and fuel use). Therefore there are used many assumptions to get the right distribution to use the COPERT III computer program.
Year by year the RDSD improve the vehicle statistics and from year 2001 there are available the distribution per vehicle ages, but still there is not available the distribution per legislation classes, therefore is used in stead of legislation classes the distribution per vehicle ages.

Legislation classes of vehicles:

PRE ECE vehicles	up to 1971
ECE 15 00 & 01	1972 to 1977
ECE 15 02	1978 to 1980
ECE 15 03	1981 to 1985
ECE 15 04	1985 to 1992
EURO I	1992 to 1996
EURO II	1996 to 2000
EURO III	2000 to 2005
Conventional	cars without catalytic converter

The Figure 3.4.3, 3.4.4 and 3.4.5 present the distributed data which Latvia use to calculate emissions from passenger cars. From year 1998 there dominated the ECE 15/04 gasoline passenger cars what correspond to vehicle production year from 1985 to 1992 (Figure 3.4.3).

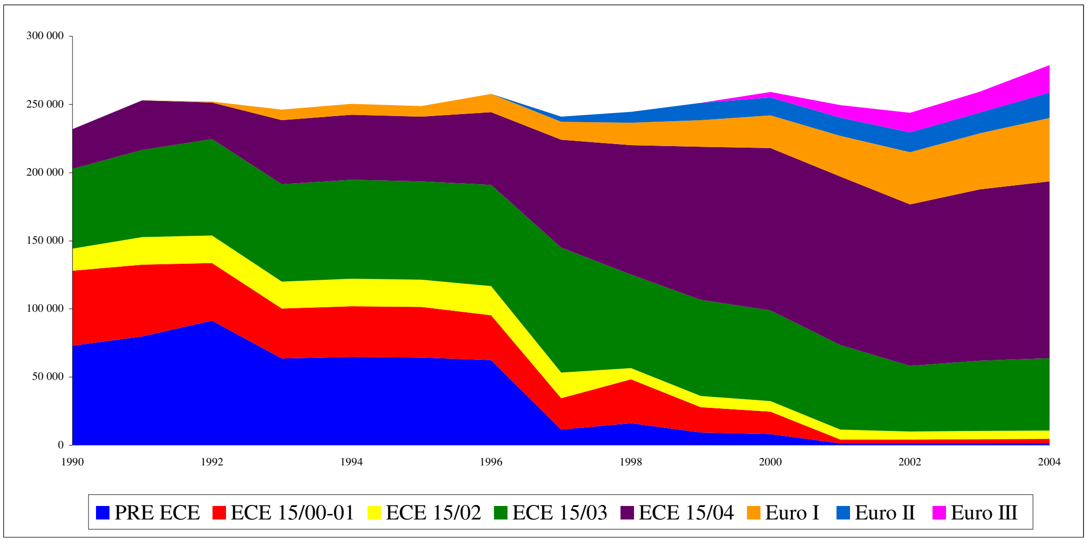


Figure 3.4.3 The number of gasoline passenger cars

The most part of diesel passenger cars are Conventional, which corresponds to cars without catalytic converter (Figure 3.4.4). And the average age of diesel passenger cars is also likewise gasoline passenger cars about 1985 to 1992. But last years are growing the number of new cars.

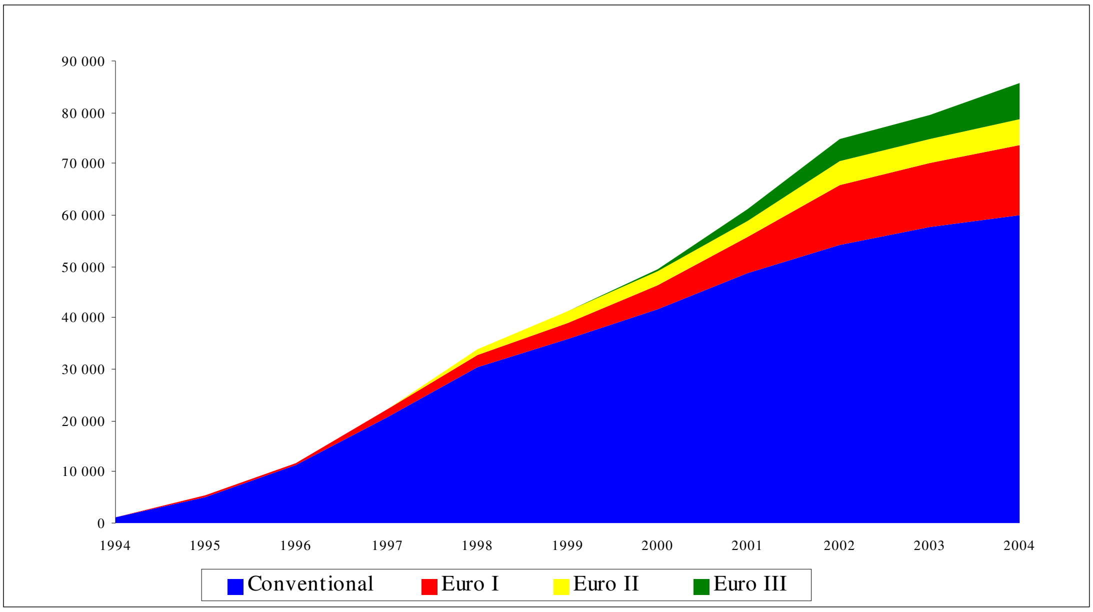


Figure 3.4.4 The number of diesel passenger cars

The statistics about LPG passenger cars is not so precise as statistics about diesel and gasoline cars. It is because most part of LPG cars from production is gasoline cars, but LPG is cheaper then gasoline and the owners decides to equip their gasoline cars with LPG installation, but not all owners register it in RTSD. In its turn CSB collect the fuel data about sold LPG (Annex 4, Table 2) and this figure is not in line with registered number of LPG passenger cars. But it is clear that the number of LPG passenger cars is growing (Figure 3.4.5).

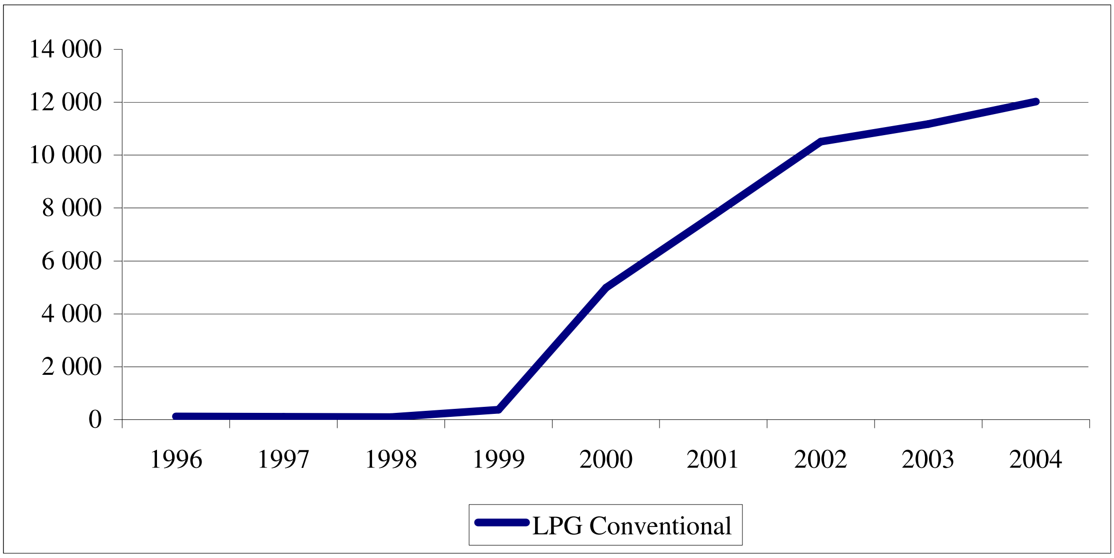


Figure 3.4.5 The number of LPG passenger cars

Fuel consumption in road transport in year 2004 was about 24% from total energy consumption. In last years the consumption of gasoline becomes stable, while the consumption of diesel oil since year 1999 is increased by 40%.

Till recently the main fuel used by road transport in Latvia was gasoline (Table 2, Annex 4). Volume of trading in leaded gasoline has significantly decreased lately. In 1997 a differentiated excise tax on fuel was introduced, but since 1999 trading in leaded fuel with lead content >0.15 g/l has been prohibited. By 2004 there is a full transfer to trading in non-leaded fuel.

The majority of cargo and passengers in domestic traffic are carried by road transport. The structure of transportation by road has not essentially changed for several years.

To facilitate computations in road transport some assumptions regarding vehicle report has been made due to lack of data. As regard LPG trucks it is decided to leave out this vehicle category from the calculations due to missing knowledge in emission factors. Gasoline buses are included in the gasoline truck category, and mileage figures for gasoline buses and trucks underpin the Latvian COPERT III runs.

Efforts have been made to classify heavy-duty vehicles more precise. In this way trucks with gross vehicle weights > 32 tons are also present in the list of vehicle data used, instead of just appearing in the 16-32 tons class. This division in vehicle categories has improved the fuel balance for diesel considerably for the latest years.

Railway

Emissions are calculated using Energy balance for 1990 – 1991 and 1994 -2004 prepared by CSB of Latvia, but for time period 1992 – 1993 data were interpolated. Now CSB is being worked on specification of activity data in interpolated years.

Passenger carriage in 2004 continued growing for the year 2000, before this growth passenger carriage had steadily decreased since the beginning of 1990s. The number of passengers carried by rail amounted to 23.9 million and has increased by 3.8% in comparison with 2003. Cargo traffic by rail also is increasing from year 1994. The amount of cargo carried by rail reach to 55901 thousand tonnes and has increased by 11% in comparison with 2004. Therefore the energy consumption in railway transport increased in the latest years, (Table 3.4.7).

Table 3.4.7 Fuel consumption in railway transport, TJ*

1990	1995	1999	2000	2001	2002	2003	2004
7181	3229	2677	2762	2847	2974	3399	3484

*Data from Central Statistical bureau of Latvia, 2005

Civil Aviation

The fuel consumption in domestic aviation is very small. Therefore Latvian Statistical Bureau does not collect the data from this sector yet. But the passenger and cargo carriage year to year became greater and this is the reason why the consumption in domestic aviation could grow.

Therefore end of year 2005 there was a research "Research about fuel consumption in domestic navigation and aviation 1990-2004" [11]. This research came by good results to year 2004. The expert had collected the data from all available planes, which are included in Register of Latvian Aircrafts, all domestic airplanes, helicopters and even sailplanes have been included in this calculation. Also the precise information from the enterprise Latvian Air Traffic about registered flights in Latvian airspace in biggest airports "Rīga", "Liepāja" and "Ventspils" are taken into account. Additionally was used the information about number of flayed hours from all Latvian enterprises and individual persons linked with domestic aviation. The fuel consumption for other years was extrapolated. But the fuel consumption and emissions from domestic aviation is still insignificant (Table 3.4.8).

Table 3.4.8 Fuel consumption in civil aviation, TJ*

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
0.76	0.78	0.8	1.3	2.7	5.4	8.0	10.7	13.4	16.1	18.8	21.4	23.7	25.5	26.8

* Data from research "Research about fuel consumption in domestic navigation and aviation 1990-2004"

Domestic Navigation

Until year 1998 there happened the gradually registration of ships from Latvian flags to other country flags. Therefore Latvian Statistical Bureau does not collect the fuel consumption from this sector.

End of year 2005 there was a research "Research about fuel consumption in domestic navigation and aviation 1990-2004" [11]. The research was dealt to two parts – inland waterways and maritime navigation. There were difficulties to get the data from inland waterways, because the biggest part of this contributes the private boats and motorcycles. CSB does not collect any fuel consumption data from individual persons. On the bases of this calculation was taken the data from RTSD about the registered small navigation (Table 3.4.9). The power of engines presented in table 3.4.5 is the assumption based on expert judgment. The main factors, which define the fuel consumption, are the specific fuel consumption per hour and the number of hours spent for navigation. Also the number of hours spent for navigation is not known, therefore this quantity was simulated, based on some assumptions about seasonality. The gasoline consumption was simulated for year 2004, the consumption for other years was extrapolated (Table 3.4.11).

Table 3.4.9 The number of small navigation in year 2004

Navigation type	The power of engine, KW	Number, 2004
Rowboats with engine	0.5 - 2	650
	2 - 3.5	793
Motorboats	3.5 - 5	1900
	5 – 7.5	1500
	7.5 - 15	580
Launches	15 - 30	106
	30 - 45	180
	45 - 80	90
	80 - 120	30
Water craft		636

To get the fuel consumption from maritime navigation was more easily. The CSB collect data about ships that is registered under all kind of flags in Latvia (Table 3.4.10). The expert decided to include in calculation all towboats and supporter fleet, because other ships aren't classified under domestic navigation. The all needed ships were split up per horsepower and so can define the specific fuel consumption per horsepower. The assumption was made about worked hours to ships. In this regard was calculating the fuel consumption from maritime navigation (Table 3.4.11).

Table 3.4.10 The number of domestic ships

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Towboats	58	60	56	55	60	64	64	60	58	55
Big towboats, >100t	25	26	26	26	26	26	26	26	27	25
Small towboats, <100t	33	34	30	29	34	38	38	34	31	30
Supporter fleet	186	186	168	174	166	170	170	173	170	169

Table 3.4.11 Fuel consumption in domestic navigation, TJ*

	1990	1995	1999	2000	2001	2002	2003	2004
Gasoline	24,9	29,0	32,8	33,8	34,8	35,9	37,0	38,2
Diesel oil	212,5	588,3	595,1	621,7	621,7	598,9	590,4	560,8

* Data from Research "Research about fuel consumption in domestic navigation and aviation 1990-2004"

Uncertainties

The activity data uncertainty for **road transportation** is 10% for the estimation of CO_2, N_2O and CH_4, because the data is not distributed like in COPERT III model, and there are made some assumptions. The default uncertainties are used for emissions factors presented by IPCC Good Practise Guidance.

The CSB has quite precise data about fuel consumption used in **railway**, therefore the uncertainty used for activity data for the estimation of CO_2, N_2O and CH_4 is 2%. The default uncertainties are used for emissions factors presented by IPCC Good Practise Guidance.

Very precise activity data in 2004 was obtained from research in **civil aviation**, therefore the uncertainty is small – 2%. The default uncertainties are used for emissions factors presented by IPCC GPG (2000).

The uncertainty in domestic navigation is high – 50%, because the activity data are simulated. The default uncertainties are used for emissions factors presented by IPCC GPG (2000).

3.5 Other sectors (CRF 1.A.4)

3.5.1 Source category description

Sub-category CRF 1.A.4 includes emissions from the small combustion of fuels in commercial, institutional, residential sectors and agriculture / forestry / fisheries. In addition, emissions from mobile machinery used in commercial, residential and agriculture and forestry sectors are included here as off-road.

Table 3.5.1 Emissions from Energy industries and Manufacturing Industries and Construction sub-sectors in 1990 – 2004 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1.A.1 Other sectors															
CO_2.	3223,60	3697,30	3385,43	2671,63	2087,83	1325,43	1311,77	1115,79	995,73	940,97	827,29	1044,93	1031,58	1116,27	1243,22
CH_4	10,49	12,07	6,68	6,43	11,54	11,31	11,57	10,94	11,00	11,00	10,36	11,34	11,06	10,72	12,53
N_2O	0,14	0,16	0,10	0,08	0,15	0,15	0,16	0,15	0,15	0,15	0,14	0,15	0,15	0,15	0,17

Starting years 1990 – 1991 decreasing of emissions in Other sectors can be observed and it could be explained with crisis in economical situation caused by changes of political situation in country (Table 3.5.1.).

As it can be seen in Figure 3.5.1 emissions from Other sectors are increasing starting year 2000. It can be explained with development of this sector but mostly with development with Commercial / Institutional sector and Residential sector in second place.

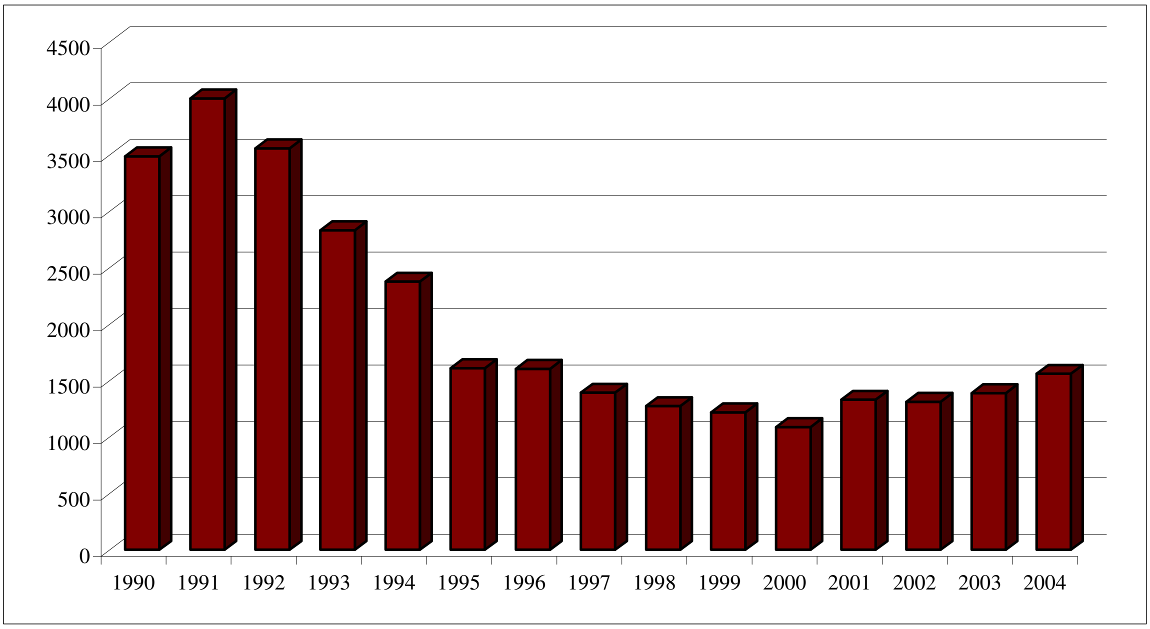


Figure 3.5.1 Total direct GHG emission from Other sectors (Gg CO_2 equivalent)

Also indirect GHG emissions from Energy industries and Manufacturing industries and Construction sub-sectors were estimated (Figure 3.5.2.). As it can be seen in Figure 3.5.2 SO_2 had biggest decrease in time period 1990 – 2004. It could be explained with fuel switching to natural gas and biomass where sulphur dioxide emissions did not occurred. CO and NMVOC emissions fluctuated but only in small ranges. For year 1992 CO emission jumped because of big amount of gasoline used as off-road in Commercial / Institutional sub-sector. Data of 1992 – 1993 are not official so it is possible that this curve would change.

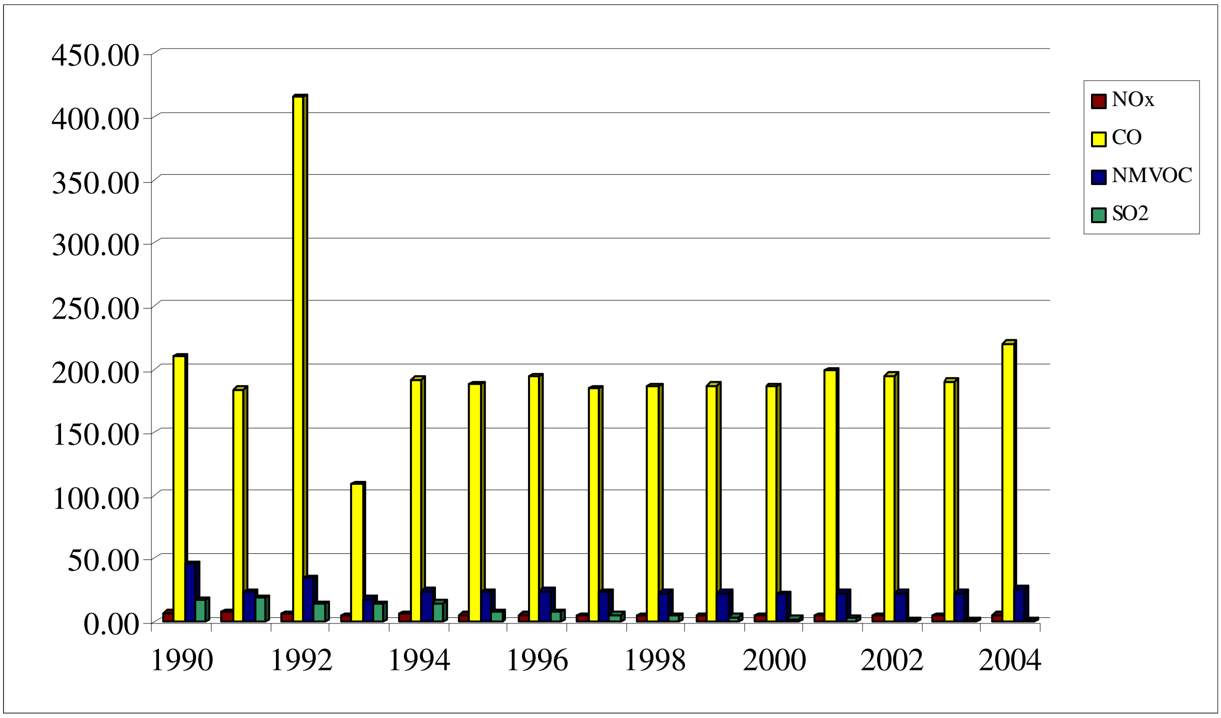


Figure 3.5.2 Total indirect GHG emissions of Other sectors (Gg)

3.5.2 Methods, emission factors, activity data and uncertainties

Methods

Method of emission estimation in Other Sectors (CRF 1.A.4) did not differ from emission estimation in CRF 1.A.1 and CRF 1.A.2 sectors (see chapter 3.3.2).

Emission factors and other parameters

To calculate Carbon dioxide (CO_2) and sulphur dioxide (SO_2) emissions country specific emission factors were used.

The default CH_4, N_2O, NOx, CO, NMVOC emission factors used in estimation of emission were taken from IPCC Guidelines (Table 3.5.2).

Table 3.5.2 CH_4, N_2O, NOx, CO, NMVOC emission factors for Other sectors (CRF 1.A.4)

Sectors	CH_4	N_2O	NOx	CO	NMVOC
	(Mg/PJ)	(Mg/PJ)	(Mg/PJ)	(Mg/PJ)	(Mg/PJ)
1.A.4.a Commercial/Institutional					
Gasoline	50.0	2.0	210.0	27000.0	1000.0
Disel oil	10.0	0.6	100.0	20.0	5.0
RFO	10.0	0.6	100.0	20.0	5.0
LPG	10.0	0.6	100.0	20.0	5.0
Jet fuel	10.0	0.6	100.0	20.0	5.0
Other kerosene	10.0	0.6	100.0	20.0	5.0
Other liquid	10.0	0.6	100.0	20.0	5.0
Shale oil	10.0	0.6	100.0	20.0	5.0
Coal	10.0	1.4	100.0	2000.0	200.0
Coke	10.0	1.4	300.0	150.0	20.0
Peat briquettes	300.0	4.0	100.0	5000.0	600.0
Peat	300.0	4.0	100.0	5000.0	600.0
Natural gas	5.0	0.1	50.0	50.0	5.0
Biogas	5.0	0.1	50.0	50.0	5.0
Wood	300.0	4.0	100.0	5000.0	600.0
1.A.4.b Residential and Agriculture/Forestry/Fishery					
Gasoline	50.0	2.0	210.0	27000.0	1000.0
Diesel oil	10.0	0.6	100.0	20.0	5.0
RFO	10.0	0.6	100.0	20.0	5.0
LPG	10.0	0.6	100.0	20.0	5.0
Jet fuel	10.0	0.6	100.0	20.0	5.0
Other kerosene	10.0	0.6	100.0	20.0	5.0
Other liquid	10.0	0.6	100.0	20.0	5.0
Shale oil	10.0	0.6	100.0	20.0	5.0
Coal	300.0	1.4	100.0	2000.0	200.0
Coke	10.0	1.4	300.0	150.0	20.0
Peat briquettes	300.0	4.0	100.0	5000.0	600.0
Peat	300.0	4.0	100.0	5000.0	600.0
Natural gas	5.0	0.1	50.0	50.0	5.0
Biogas	5.0	0.1	50.0	50.0	5.0
Wood	300.0	4.0	100.0	5000.0	600.0

Activity data

The activity data for sub-category CRF 1.A 4 is taken from annual energy statistics. The fuel consumption data for CRF 1.A 4 is presented in Table 3.5.3. It covers fuel used for the heating of commercial, institutional and residential buildings as well as fuel consumption in agriculture / forestry / fisheries sector.

CSB collects and assesses fuel consumption data with annual questionnaires. Official statistical information is available for all years in time series except years 1992, 1993.

For years 1992 – 1993 activity data are taken from Energy resource balance prepared as a part of the project *Implementation of requirements of international conventions on air protection* (2002) [4].

Table 3.5.3 Fuel consumption in Other sectors (CRF 1.A.4) in 1990–2004 (PJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1.A.4 Other Sectors															
Liquid fuels	22.43	28.04	28.53	20.63	12.40	7.05	7.16	5.84	5.39	5.41	4.93	6.44	5.98	6.82	6.91
Solid fuels	11.69	11.92	6.95	7.01	8.84	4.76	4.70	4.37	3.40	2.77	2.06	2.89	2.31	2.10	2.15
Gaseous fuels	9.36	9.83	12.12	9.17	6.54	6.66	6.36	5.22	5.32	5.28	5.02	5.59	6.87	7.54	9.68
Biomass	25.50	30.21	13.61	14.54	32.46	34.76	35.62	33.96	35.17	35.46	33.56	35.93	35.50	34.43	40.41
Other Fuels	NO	NO	NO	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.07	0.12	0.23	0.16

Significant differences in time series for Other sectors (CRF 1.A.4.) are for year 2004 because significant amount of fuel consumption from autoproducers are excluded from Energy industries sector and included in Commercial – Institutional sector where they are actually consumed. So curve of fuel consumption makes significant jump in time period 2003 – 2004 (Figure 3.5.3.).

Starting from year 1994 biomass as fuel dominates in Other sectors. Biggest part of biomass consumption goes to Residential sector where biomass is main fuel in small capacity burning installations.

Starting year 2000 consumption of gaseous fuels increased. Consumption of natural gas in many commercial and residential installations is increasing because of fuel switching. Use of natural gas is more cost effective and with low level of emissions.

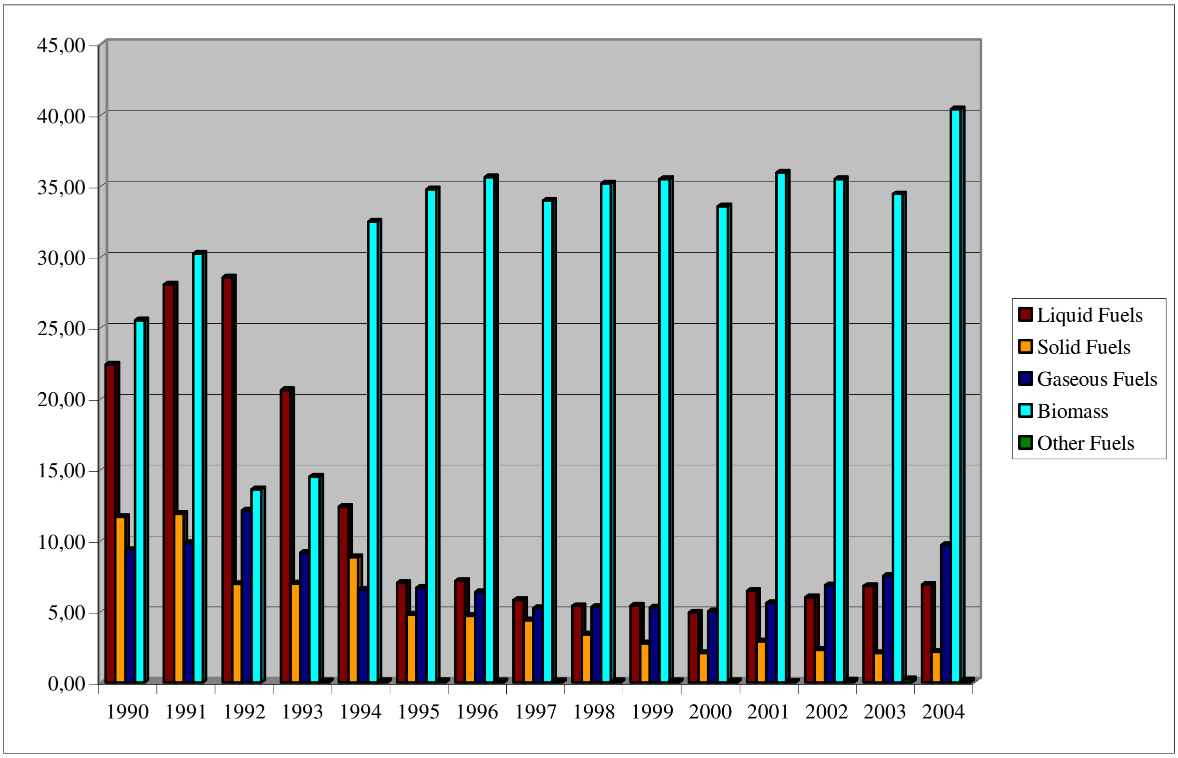


Figure 3.5.3 Fuel consumption for time period 1990 – 2004 for Other sectors (PJ)

Uncertainties

Uncertainty in activity data of fuel combustion in sectors CRF 1.A.4 is ±2% in Latvia in 2004. CSB gives approximately 2 % statistical frame mistake for statistical data. In Latvia all fossil fuels (oil, natural gas, and coal) are imported, and import and export statistics are fairly accurate.

Uncertainty of activity data for biomass combustion was assigned as 15 % because biomass activity data were collected by CSB with questionnaires sent by enterprises consumed biomass and enquiry to find out biomass use in residential sector.

National expert according physical characterization of used fuels in country estimated CO_2 emission factor so uncertainty was assigned as quite low about 5 %. For combustion of solid fuels uncertainty of CO_2 emission factor was assigned higher to 10 % because CO_2 emission factor of peat briquettes was taken from GHG inventories of Finland.

CH_4 and N_2O emission factor used in estimation of emissions was taken from IPCC Guidelines so uncertainty was assigned as very high about 50 % according to IPCC GPG (2000).

3.6 Reference approach (CRF 1. A, C)

Reference approach (RA) is carried out using import, export, production and stock change data from the energy balance (EB) sheet published in the annual energy statistics. However, the RA table requires liquid fuels reported to a more disaggregated level than in the EB sheet. This data was taken from the background data of the EB. Another difference is that in the EB sheet stock changes and statistical differences are combined for certain fuels, whereas in the RA table only stock changes are reported.

For emissions estimation by Reference approach CRF Reporter software were used.

Total difference between Sectoral and Reference approaches of fuel consumption and CO_2 emissions can be seen in Table 3.6.1. For some years difference between Sectoral and Reference approach is quite significant. It could be explained that emission estimation of road transport COPERT model was used; statistical difference appears in Latvian statistics and difference in methodology of estimation.

During preparation of submission 2006 some discrepancies in net calorific values reported by CSB of Latvia to EUROSTAT were found, for example, for coal.

Table 3.6.1 Difference between Sectoral and Reference approach data

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Fuel consumption														
271.07	250.96	192.17	166.45	144.51	131.86	127.42	123.25	118.89	104.30	97.42	107.92	104.87	111.22	112.86
259.30	232.25	186.69	166.01	134.84	122.71	124.75	119.74	115.15	106.66	98.79	108.58	106.53	109.84	110.02
4.54	8.05	2.94	0.27	7.17	7.45	2.14	2.93	3.25	-2.22	-1.39	-0.61	-1.56	1.25	2.58
CO_2 emissions														
18546.96	16935.94	13270.73	11767.91	10227.64	9065.82	8833.48	8283.05	7877.11	6805.38	6205.30	6857.34	6534.28	6869.86	6958.28
18016.57	15962.14	12991.12	11742.00	9735.95	8594.06	8855.61	8287.41	7904.06	7256.89	6667.69	7151.82	7060.01	7198.20	7190.87
2.94	6.10	2.15	0.18	5.00	5.43	-0.31	-0.11	-0.40	-6.33	-7.17	-4.45	-7.92	-5.07	-3.76

3.7 Fugitive Emissions from fuels (CRF 1.B)

3.7.1 Source category description

Under fugitive emissions from fuels, Latvia reports following CRF categories:

- 1.B.2 Fugitive emissions from oil and natural gas include CH_4 emissions from category 1.B.2.b ii. Transmission/Distribution; iii. Other Leakage (in residential and commercial sectors) and 1.B.2.d. Other – underground storage;
- 1.B.2 Fugitive emission from oil and natural gas includes NMVOC emissions from category 1.B.2.a. Oil storage.

Fugitive CH_4 emissions decreases comparing with 1990 – 2001, only started from 2002 it fluctuates and continues to decrease (Table 3.7.1). The general reasons were modernization of gas transport system, expansion process of distribution system, increase of infiltration and consumption of gas amount from underground storage.

Table 3.7.1 Fugitive CH_4 emissions from natural gas 1990 – 2004 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Fugitive Emissions from Fuels	13.05	12.57	11.46	10.96	10.71	10.43	10.05	9.38	9.00	8.58	7.94	7.7	8.03	6.28	6.21

There are no oil refineries in Latvia; therefore NMVOC emissions from fuel storage (Table 3.7.2) were only calculated. For the years 1990 till 1999 it was impossible to acquire precise data on fuel storage technologies (vapour filters, vapour storage, etc.), therefore experts' opinion was taken into consideration. Experts concluded that most of the fuel was stored incorrectly until 2000, when most fuel storage facilities had fuel vapour storage, but not vapour filters and pumps.

Crude oil through area of Latvia is transported via pipelines or by railway transport from Russian Federation to Mažeiķi oil terminal in Lithuania or Ventspils oil terminal in Latvia. CH_4 or NMVOC emissions are not estimated due to problems of data acquisition and lack of methodology and precise emission factors of emissions.

Crude oil transportation via pipelines assures one company and according information they reported to LEGMA CH_4 emissions are not occurring during transportation process.

Table 3.7.2 Fugitive NMVOC emissions from gasoline storage 1990 – 2004 (Gg)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Fugitive emissions from gasoline storage	2.98	2.53	2.41	2.34	2.24	2.02	1.99	1.83	1.72	1.66	0.23	0.24	0.23	0.22	0.23

CRF category 1.B.1 Fugitive emissions from solid fuels aren't included in inventory. It is possible to get data from hard coal transportation via railways but it is not possible to estimate any emissions from this kind of source due to lack of methodology and emission factors.

Latvia hasn't categories 1.B.1.a Coal Mining and Handling, but emissions from categories 1.B.1.b Solid Fuel Transformation aren't estimated due to lack of capacity.

3.7.2 Methods, emission factors, activity data and uncertainties

Methods

LEGMA received data about CH_4 emissions from the natural gas holding company "Latvijas Gāze" for the time period 1990 - 2004. Consequently company "Latvijas Gāze" calculates emissions by itself. LEGMA has methodological material, which describes how these emissions are calculated, but due to lack of financial resources it is not possible to translate them. Brief essences of the in methods are given below.

CH_4 leaks were calculated from:

- End user internal gas provision systems;
- Distribution systems;
- Gas transport pipeline systems;
- Underground gas storage facility (in Inčukalns);
- Below more detailed information on these systems is provided.

<u>End user internal gas provision systems</u>

Natural gas leaks from the imperfections in the internal provision systems in residential buildings with gas stoves are calculated, the following equation being applied:

$$\mathbf{Q_{gas} = q \times N \times n}$$

where
Q_{gas} – leaks from the imperfections in the internal provision systems in residential buildings with gas stoves (m^3);
N – number of days;
n – number of apartments;
q – daily leakage from the imperfections in the internal gas provision systems in residential buildings with gas stoves; q = 0.044 m^3 per day per apartment

Additional natural gas leaks in gas heaters and/or hot water preparation devices are calculated, the following equation being applied:

$$\mathbf{Q_{gas} = 0.7 \times q \times N \times n}$$

where
Q_{gas} – additional natural gas leaks in gas heaters and/or hot water preparation devices, (m^3);
0.7 – coefficient that takes into account the condition of the devices;
N – number of days;
n – number of devices;
q – amount of leakage in the gas heaters and/or hot water preparation devices; q = 0.556 m^3 per day.

<u>Gas distribution systems and gas transport pipeline systems</u>

Natural gas leaks are classified as follows:

- Leaks of unburned gas;
- Amounts of burned gas;
- Gas leaks from the system's imperfections;
- Leaks without emission to atmosphere;
- Leaks from emergencies.

EMEP/CORINAIR methodology was used to estimate fugitive NMVOC emissions from operations with gasoline.

Emission factors and other parameters

CH_4 emission calculation from natural gas is described above.

NMVOC emission factors for oil (Table 3.7.3) were used from EMEP/CORINAIR Atmospheric emission inventory guidebook.

Table 3.7.3 NMVOC emission factors

	1990-1999	2000-2003
EF, g/kg	4.9	0.67

Activity data

CH_4 emissions are obtained from the holding company "Latvijas Gāze".

Activity data for NMVOC emission calculation was used from CSB Energy Balance (Table 3.7.4).

Table 3.7.4 Used activity data for NMVOC emission calculation (PJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Gasoline	26.73	22.73	21.63	20.97	20.09	18.11	17.89	16.44	15.39	14.86	14.81	15.52	15.21	14.68	15.34

Uncertainties

Uncertainty of methane emission from natural gas consumption is assigned as quite low so emissions were estimated by only enterprise operated with natural gas in Latvia – "Latvijas Gāze" by methodology developed for enterprise. So activity data and emission factor have to be very precise.

Activity data for fugitive emissions from operations with gasoline were taken from CSB and uncertainty was assumed as very low for about 2 % as statistical frame mistake.

3.8 International bunkers

International bunkers cover international aviation and navigation according to the IPCC Guidelines. Emissions from international aviation and navigation were not included into national total emissions.

The emission factors are shown in Table 3.8.2. Fuel consumption is obtained from CSB (Table 3.8.1).

Table 3.8.1 Energy consumption in international transport, TJ*

	1990	1995	1999	2000	2001	2002	2003	2004
Aviation								
Jet Fuel	3 067	1 080	1 253	1 123	1 123	1 166	1 685	2 030
Navigation								
RFO	16 727	5 156	ND	ND	3 938	4 994	4 750	5 278
Diesel oil	5 014	1 105	425	340	4 249	3 612	3 102	3 187

* data from Central Statistical Bureau of Latvia, 2005

As it was wrote in the section 3.4.1 due to the latest available activity data from CSB (Energy balance), all fuel consumption that previously was included in national Transport sector, regarding navigation, now are included in international fuel consumption for navigation. Therefore emissions from international aviation and navigation have increased significantly, especially for period 1990 – 1996.

Table 3.8.2 Emission factors used in the calculation of emissions from International Bunkering

	CO_2	CH_4	N_2O	NOx	CO	NMVOC
	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ	Gg/PJ
Diesel oil	74	0,004	0,03	1,0	0,25	0,11
RFO	76,6	0,005	0,002	1,6	0,5	0,11
Jet fuel	72,1	0,0005	0,002	0,25	0,1	0,05

The SO_2 emissions factors are used consistent with sulphur content in diesel oil (Table 3.8.3 and 3.8.4).

Table 3.8.3 SO_2 Emission factors used for Diesel oil in the SO_2 calculation of emissions International Bunkering

Diesel oil	Fuel content	NCV	EF (Gg/PJ)
1990-1998	0,2	42,49	0,094
1999-2003	0,05	42,49	0,024
2004	0,035	42,49	0,016

Table 3.8.4 SO_2 Emission factors used for RFO in the SO_2 calculation of emissions International Bunkering

RFO	Fuel content	NCV	EF (Gg/PJ)
1990-1999	2,8	40,6	1,352
2000-2004	0,2	40,6	0,097

3.9 Recalculations

Overall activity data changes in all sub-sectors of Energy industries, Manufacturing industries and construction and Other sectors for all years from time period 1990 – 2003. Changes occurred due to the updated statistical information, mistaken input data correction. Data of fuel consumption from IEA/AIE - EUROSTAT - UNECE Annual questionnaires were used.

Data for year 1991 were reassessed during research made by experts from CSB and were included in sectors they belong. It means that for year 1991 notation key IE used in preceding submission were changed to activity data and all relevant emissions were calculated.

For years 1992 – 1993 only data of solid fuels are updated and divided to sub-sectors by CSB.

For this submission emissions from autoproducers heat plants and autoproducers combined heat and power plants are excluded from Energy industries sector and included in that sectors were emission are produced. For year 2004 emissions from autoproducers are divided to that sectors they are produced. For time period 1990 – 2003 emissions from autoproducers are included in 1.A.2.f sector. Division to the concrete sub-sectors for time period 1990 – 2003 was no possible due to lack of precised statistical information.

Some types of fuels were included in this submission for all years – peat briquettes were excluded from total peat consumption. Emission from peat briquettes were estimated using emission factor related to peat briquettes emission factor. Previously emissions from peat briquettes use were estimated using emission factor related to peat. Peat briquettes are used mainly in autoproducers heat plants and autoproducers combined heat and power plants as well as in Commercial / Institutional and Residential sectors. Biggest part of peat briquettes consumption went from Energy industries sector to other sectors. So consumption of solid fuels change significantly in Energy industries sector and emissions from solid fuels use decreased for time period 1990 – 1999. Peat briquettes were used as fuel in Energy industries only till year 1999. CSB did not report data of peat briquettes starting year 2000.

Also emissions from biogas use were estimated for this year. Biomass includes sludge gas and landfill gas. Biogas as fuel first time in Energy industries sector (CRF 1.A.1) was used in year 2004. Biogas as fuel in Other sectors (CRF 1.A.4) was used starting year 1993.

Emissions from Manufacture of solid fuel and other energy industries were reassessed because previously combusted raw materials – input peat – of peat briquettes production were reported as activity data. But according to IPCC Guidelines consumption of fuel that produced emissions during the manufacture of secondary and tertiary products from solid fuels including production of charcoal should be reported under this sector.

So activity data for 1.A.1.c previously reported were replaced by notation key IE – data are included in 1.A.1.a sector, and only data for year 2004 were reported in sector 1.A.1.c because CSB provided LEGMA with this kind of data. CSB will prepare data of fuel consumption in manufacture of solid fuels sector during year 2006 and data will be included in further submissions.

Emissions from road transport were recalculated for years 2002 and 2003, because distribution of vehicle fleet was changed. In road transport there was recalculated the emissions from LPG passenger cars, because there are inconsistencies in activity data as it is described in part 3.4 - road transportation activity data. In the last submission 2005 these emissions was calculated with COPERT III model, but in this submission these emissions are calculated using Tier 1 method according to Revised 1996 IPCC Guidelines.

For submission 2006 there is included the emissions from domestic navigation. In 15th January 2006 there have been calculated the emissions just from gasoline in domestic navigation, but now in the final report there is calculated also emissions from diesel oil in this sector.

The emissions from civil aviation are recalculated using the data from new research "Research about fuel consumption in domestic navigation and aviation 1990-2004".

Fuel consumption data from CSB was changed for years 1991 and 1994 regarding Railway and International Bunkering as well as fuel consumption for years 1992 and 1993 was interpolated as encouraged Expert Review Team in the Centralised review (2005).

Also emission factor of CH_4 emissions from solid fuels in 1.A.4.a Commercial / Institutional sub-sector mistake occurred in previous submissions were corrected and so final emission changed.

SO_2 emission factor for solid fuels changes according to LEGMA database "2 – AIR" where plants reports sulphur content of fuel used for combustion. Average sulphur content for coal, peat and shale oil was used to estimate emissions from solid fuel combustion according this database. Also SO_2 emissions for gasoline, diesel oil and residual fuel oil changes according to Latvian national legislation.

For the submission 2006 Lubricants were reported in feedstock and non – energy use of fuels sector for the first time.

3.10 Improvements

For next submission it is planned to use Emission Trading Scheme data in GHG inventories for these facilities that takes part in ETS. Emissions from other facilities are planned to estimate as it was done before or by using experts developed specific methodology (see example in chapter 3.11).

Unfortunately reliable data in Road transport are only available since 1997 and even these data are not in line with the requirements of the EU (there are no statistics providing the car emissions legislation classes; only from year 2001 an available statistic about engine sizes, age and fuel use exists). For that reason there will be changes till the next submission, because a lot of assumptions were made about statistics of road vehicles. Data will be made more precise.

Regarding Road transport is planned to improve distribution of vehicle fleet for period 1990 – 2001 and it is necessary to harmonize LPG activity data.

Latvia could report emissions from underground and surface peat mining and handling as well as fugitive emissions from peat transformation and processing. But due to lack of precise statistical information as well as lack of methodological issues it was not possible to report emissions from peat mining in GHG submission 2006. These emission data will be reported in further submissions.

The summarized necessary improvements are:

- Official activity data for period 1992 – 1993;
- More detailed research on sectors that create fugitive emissions;
- Précised information of fuel consumption in solid fuel manufacturing;
- Researches on use of the national emission factors;
- QC/QA implementation.

3.11 Data consistency between national GHG emission inventories and reporting under the European Union Emission Trading Scheme

Emissions from fuel combustion are by far the largest source of greenhouse gas emissions in Latvia, and most of the point source in the category is part of the EU Emission Trading Scheme. Monitored data for CO_2 emissions from these sources will become available from the emission trading system for the inventory year 2005 in spring 2006. Future national greenhouse gas inventories will utilize also this data. The data from the emission trading will be checked and revised as necessary; to ensure consistency with previously reported data.

Main problem relevant to use of ETS data in the GHG emission estimations is discrepancy in reported sources. Emission Trading Scheme does not include all point sources that produce air pollution and so ETS do not cover all facilities of Energy and Manufacturing industries.

That's why experts from LEGMA are established one possible scheme to use Emission Trading Scheme data in national GHG inventory.

Data reported by facilities under EU ETS could be used in GHG inventories. But fuel consumption data reported by facilities under ETS need to be excluded from total CSB reported fuel consumption of specific industry sector where facility belongs.

Emissions from sectors and facilities that ETS did not cover could be estimated by equation:

$$\mathbf{Emissions_i = \Sigma a - ((b_i - \Sigma c_i) \times EF_i)}$$

where
Emissions $_i$ – total CO_2 emissions in country for fuel type i in stationary fuel combustion;
a – CO_2 emission data in facility reported under ETS and certified correct;
b – total fuel consumption in country for fuel type i taken from Energobalances prepared and summarized by CSB and Annual Questionnaires;
c – fuel consumption in facility reported under ETS and certified correct;
Ef_i – country specific average emission factor for fuel type i estimated taking account net calorific value and oxidation factor.

Data reported under ETS need to be assessed and scrutinized to make them useful for GHG emission inventories. Estimation or measurements of emissions should be observed and analyzed at least in 1 or 2 years transition period to assess data reliability and accuracy

4. INDUSTRIAL PROCESSES (CRF 2)

4.1 Overview of sector

General overview

Output growth of manufacturing in the last 6 years (1999 – 2004) equalled to approximately 8 % annually, by 0.8 percentage points lagging behind the average growth indicator of the whole national economy. It should be taken into consideration, that year 1999 was unfavourable for industry as production outputs declined under the impact of the Russian crisis (Figure 4.1.1).

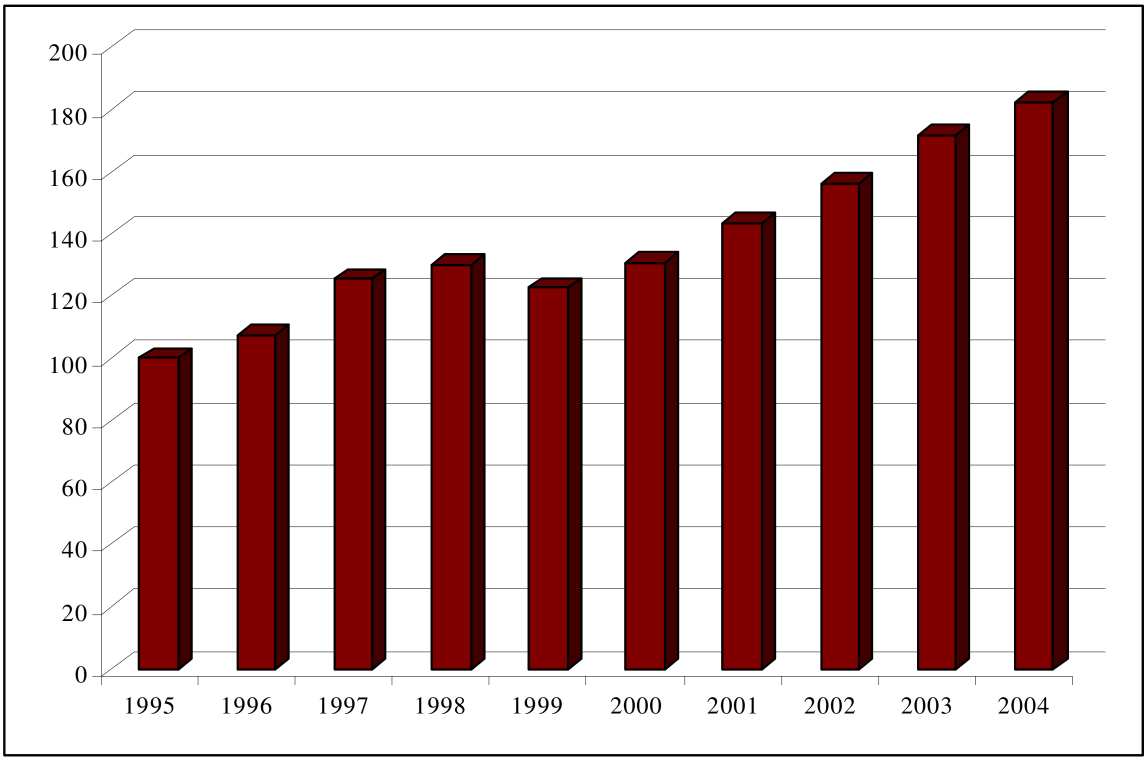


Figure 4.1.1 Manufacturing output, (1995 = 100%)

In the last three years stable growth of manufacturing output is observed and average annual growth rates are reaching 10 % considerably exceeding the average growth rate of the national economy (Table 4.1.1).

Table 4.1.1 Key indicators of manufacturing

	2000	2001	2002	2003	2004
Share in GDP (%)	13.7	13.9	13.7	13.3	13.4
Share in total employment (%)*	18.07	16.94	16.89	17.28	16.01
Growth rates (% change against the preceding year)	20.47	10.30	10.08	11.05	16.27
Share in fixed investment (%)**	13.76	15.53	16.04	15.18	16.01
Investment (% change against the preceding year)**	20.46	14.71	15.46	13.77	25.43
Share in foreign direct investment stock (%)	21.8	16.6	16.3	21.1	17.8

* data of labour survey (aged 15 – 74 years)
** long-term investment in intangible and fixed assets

Tendencies of stable manufacturing growth continued also in 2004. Growth was mostly encouraged by expansion of exports, which in turn was positively influenced by appreciation of the euro.

The share of industry in the whole structure of the national economy in Latvia is smaller than in the majority of EU member states and candidate countries. The share of industry in GDP of Latvia in 2004 was only 13.4 %. Despite the fact that growth rates of industry in Latvia are faster than the average growth of economy the share of industry is not growing as the producer prices lag behind the general price rise [17].

Food industry is the biggest sector of manufacturing in Latvia (24.8 % of the total manufacturing output).

Approximately 3/4 of the total output of the sector is consumed in the domestic market; the remaining part is exported, mainly to Russia, Lithuania and Estonia.

In 2004 sales of food products increased both in the internal and external markets, with faster growth of export. As a contrast to 2000 and 2001 when expansion of exports was basically determined by the growth of exports to Russia, in 2002 and 2003 exports of food increased more to other countries including the EU member states.

Light industry (textile industry and production of clothing) constitutes approximately 6.3 % of the manufacturing value added. The majority of produced output (72% of export) is exported to the EU member states.

Chemical industry in Latvia has stable traditions, highly qualified specialists, long history of production of a wide range of products both for final and intermediary consumption. There is also a good base for chemical research. The share of the chemical industry in the total manufacturing output constitutes 5.9 %. Exports of chemical products go in almost equal shares to all major trading partners of Latvia (EU, Lithuania, Estonia and CIS), which still demonstrates the weak competitiveness of the sector in the markets of the developed countries.

Manufacturing of other non-metal mineral products (mainly building materials) had high growth rates in 2003 and 2004 (17 % and 13% respectively).

Increase of domestic demand is the main incentive for growth of the sector. Also growth of exports should be noted, it is very favourably influenced by increase of exports prices.

Manufacture of other no-mineral products basic is influenced by amount of construction. For the last year construction is sector with very fast developing and demand for building materials is growing very quickly.

Manufacturing of metal and metal products constituted almost 22.4 % of the manufacturing output. Recent tendency is that the domestic market share goes up. With the development of construction also the demand for ready-made metal goods is going up [17].

Sector description

Industrial greenhouse gas emissions contribute more than 2% (2.36%) to the total anthropogenic greenhouse gas emissions in Latvia in year 2004 (Table 4.1.2). The most important emission source in the Industrial processes in 2004 is CO_2 emissions from Mineral products with the 1.78 %, CO_2 emissions from Metal production with 0.42 % and F-gases with 0.14 % of the total greenhouse gas emissions.

Sources of emissions from industrial processes are:

- Mineral products (CRF 2.A);
- Metal production (CRF 2.C);
- Consumption of halocarbons and SF_6 (CRF 2.F);
- Other production (CRF 2.D).

Under Mineral products emissions from cement production (clinker production), lime production, asphalt roofing, road paving with asphalt and other – use of mineral products in glass, ceramics and metal production are reported. Under Metal production carbon dioxide emissions from coke use as a reducing agent and emissions from use of crude iron as input material are reported as well as methane emissions from total iron and steel production. The CRF category 2.F includes F-gases emissions from refrigeration, fire extinguishers, aerosols, electric equipment and other (SF_6 from shoes). Under Other production Latvia reports NMVOC emissions from food and drink production as well as SO_2 emissions from Pulp and Paper production for time period 1990 – 1996.

Table 4.1.2 Greenhouse gas emission trend (Gg CO_2 eqv.)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Industrial Processes - total	**525.29**	**359.20**	**161.24**	**61.85**	**202.24**	**167.92**	**183.98**	**207.08**	**213.41**	**254.73**	**203.52**	**222.56**	**240.02**	**248.49**	**265.89**
A. Mineral Products	481.04	348.17	155.66	41.84	169.56	139.58	156.72	159.72	160.91	201.18	147.92	165.75	180.25	187.00	197.64
C. Metal Production	44.25	11.03	5.58	20.01	32.68	27.14	25.67	44.43	47.36	45.83	45.54	44.55	44.57	44.22	47.24
HFCs	NO	NO	NO	NO	NO	0.95	1.30	2.42	4.42	6.74	8.78	10.29	11.82	12.86	16.19
SF_6	NO	NO	NO	NO	NO	0.25	0.29	0.51	0.71	0.98	1.28	1.98	3.38	4.41	4.82

Emissions in the Industrial Processes sector are linked with the economic situation of the country as well as availability of statistical data. The largest decrease in emissions occurred between years 1993 and 1995 (Figure 4.1.2), when industry was going through a crisis. It has to be noted that in the beginning of 1990's during the countrywide change in government system statistics was not well kept. Therefore there is lack of statistical data regarding industry during this time period or they are vague.

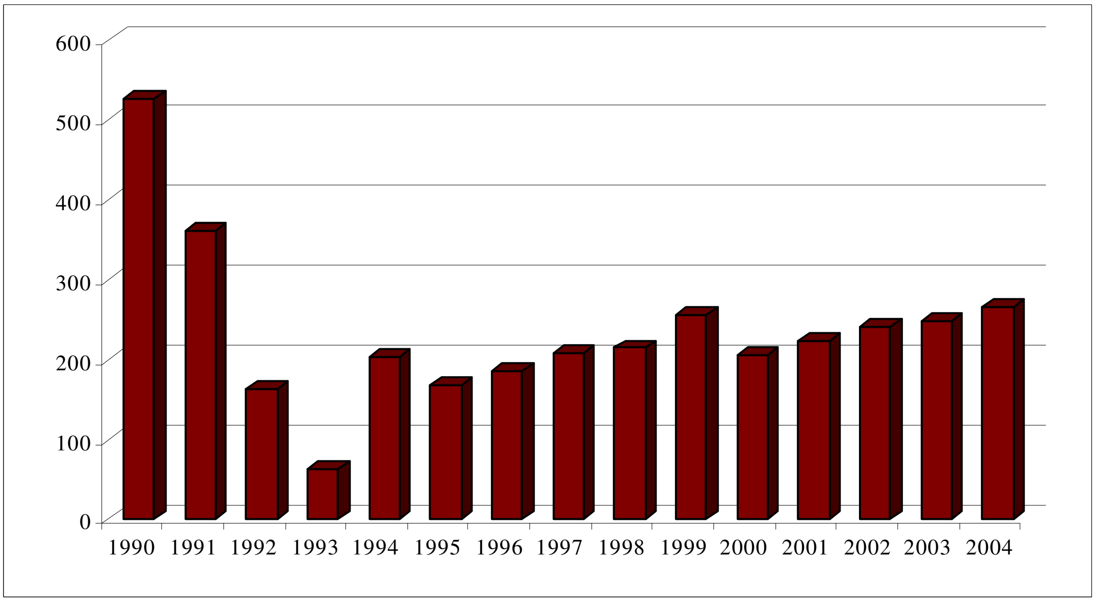


Figure 4.1.2 Total greenhouse gas emissions from Industrial Processes sector ($Gg\ CO_2$ eq.)

4.2 Description of Key Source Categories

Industrial processes key sources in 2004 identified by the IPCC Tier 1 method were CO_2 emissions from cement production with respect to level and trend assessment. Accordingly both assessments of key source for 2004 CO_2 emissions from cement production contribute approximately 1%.

4.3 Mineral Products (CRF 2.A)

4.3.1 Source category description

At the moment the most important non-energy industrial process for non-energy CO_2 emission sources are cement, lime production, bricks and tiles production and limestone use for glass and metal production. Emissions from mineral products contribute 75.7% from all emissions in Industrial processes sector.

The NMVOC emissions from road paving and asphalt roofing are included. Emissions from glass fibre production are included.

The SO_2 emissions from cement production are reported.

CO_2 emissions are strongly influenced by economic situation in country. Emission curve reflects economic crisis in time period 1991 – 1993 after changes in political and social situation in country (Figure 4.3.1). Also radical decrease of CO_2 emissions from year 1999 to year 2000 are influenced by economical crisis in neighbourhood country Russian Federation whom Latvia had strong foreign trade linkage.

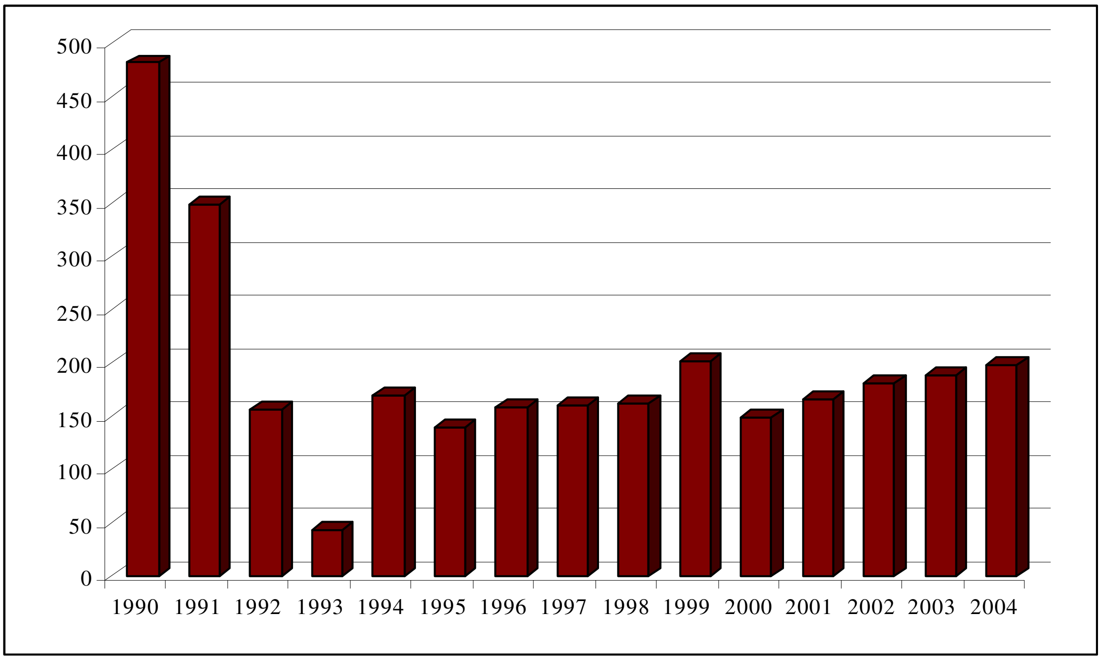


Figure 4.3.1 Carbon dioxide emissions from mineral products, 1990 - 2004 (Gg)

4.3.2 Methods, emission factors, activity data and uncertainties

Methods

Both the Revised 1996 IPCC Guidelines for National Greenhouse gas Inventories Tier2 and EMEP/CORINAIR are used to calculate GHG emissions from the Industrial Processes sector. Calculation of all emissions from processes is done with Excel databases developed by experts from LEGMA. CRF Reporter software developed by experts from UNFCCC was used to report emission data.

Emissions were estimated in view of used raw materials and technology of production processes. For CH4 emissions of steel production as well as NOx and NMVOC emissions from cement clinker production EMEP/CORINAIR Guidebook methodology was used for the first time in submission 2006.

CO_2 emissions from cement are calculated based on data of clinker production.

CO_2 emissions from **Lime production** are calculated based on data of dolomite use in lime production.

CORINAIR methodology (simple approach) was used to estimate NMVOC emissions from the 2.A.6. Road Paving with Asphalt. It was assumed that content of bitumen in bitumen composite, which is used for road paving and in the construction, is 45%, and that it is applied as rapid cure of cutback (Table 4.3.2).

Emission factors

The main sources for emission factors are:

- Plant specific emissions factor for CO_2 emission estimations reported by facilities during development of 1. National Allocation Plan
- Revised IPCC 1996 Guidelines;

The emission factors of **Clinker Production** are the plant specific and value of emission factor changes for different years.

The used CO_2 emission factor of dolomite use in **Lime production** is considered as plant specific as there is taken into account CaO and CaO*MgO content.

According to laboratory measurements made in only lime producer plant in Latvia average content of dolomite is:

$CaCO_3$ – 51.83%
$MgCO_3$ – 40.80 %
SiO_2; Fe_2O_3; Al_2O_3 – 5.88 %
Others – 1.49 %.

According to laboratory data average content of water in dolomite is 5.24 % and average content of CO_2 in lime is 16.99 %.

Estimation of CO_2 emission from Lime production

Content of dolomite (dry) is 94.76 % or 947.6 $_{kg\ dolomite}$.
947.6 $_{kg\ dolomite}$ contain:
491.14 $_{kg\ CaCO3}$ (51.86 %)
386.62 $_{kg\ MgCO3}$ (40.80 %)
55.72 $_{kg\ SiO2;\ Fe2O3;\ Al2O3}$ (5.88 %)
14.12 $_{kg\ Others}$ (1.49 %)
947.6 $_{kg\ dolomite}$ complete decomposes and pullulates:
491.14 $_{kg\ CaCO3}$ × 0.440 (emission factor) = 216.10 $_{kg\ CO2}$
386.62 $_{kg\ MgCO3}$ × 0.522 (emission factor) = 201.82 $_{kg\ CO2}$.
Oxides capture:
491.14 $_{kg\ CaCO3}$ × 0.560 (emission factor) = 275.04 $_{kg\ CaO}$
(or 491.14 $_{kg\ CaCO3}$ – 216.10 $_{kg\ CO2}$ = 275.04 $_{kg\ CaO}$)
386.62 $_{kg\ MgCO3}$ × 0.478 (emission factor) = 184.80 $_{kg\ MgO}$
(or 386.62 $_{kg\ MgCO3}$ – 201.82 $_{kg\ CO2}$ = 184.80 $_{kg\ MgO}$)
216.10 $_{kg\ CO2}$ + 201.82 $_{kg\ CO2}$ + 275.04 $_{kg\ CaO}$ + 184.80 $_{kg\ MgO}$ = 877.76 $_{kg}$
947.6 $_{kg}$ – 877.76 $_{kg}$ = 69.84 $_{kg\ ballast}$
Lime is made (theoretical):
275.04 $_{kg\ CaO}$ + 184.80 $_{kg\ MgO}$ + 69.84 $_{kg\ ballast}$ = 529.69 $_{kg\ lime}$
CO_2 content in lime is 16.99 % (practical):
529.69 $_{kg\ lime}$ = 83.01%
Lime is made (practical):
638.09 $_{kg\ lime\ +\ CO2}$ = 100 %
CO_2 content in lime is:
638.09 $_{kg\ lime\ +\ CO2}$ – 529.69 $_{kg\ lime}$ = 108.41 $_{kg\ CO2}$
CO2 emissions (1 tonne complete decomposition) pullulate:
216.10 $_{kg\ CO2}$ + 201.82 $_{kg\ CO2}$ – 184.80 $_{kg\ MgO}$ = 309.51 $_{kg\ CO2}$
0.3095 $_{t\ CO2}$ proceed from practical decomposition of 1 tonne of dolomite.

Emission factors of limestone and dolomite use in production of glass and metal are plant specific and reported by facilities during development of 1.st National Allocation Plan under European Unions Emission Trading Scheme.

Emission factors used in **Mineral Production** sub-sector are shown in Table 4.3.1.

Table 4.3.1 CO_2 emission factors (t CO_2 / t product or raw material)

Production \ EF	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Clinker	0.525	0.525	0.525	0.525	0.525	0.502	0.525	0.53	0.521	0.54	0.539	0.526	0.525	0.511	0.525
Lime (prod)	0.3095	0.3095	0.3095	0.3095	0.3095	0.3095	0.3095	0.3095	0.3095	0.3095	0.3095	0.3095	0.3095	0.3095	0.3095
Limestone (used)	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
Dolomite (used)	0.477	0.477	0.477	0.477	0.477	0.477	0.477	0.477	0.477	0.477	0.477	0.477	0.477	0.477	0.477
Soda use	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415	0.415

The **NMVOC emissions from road paving and asphalt roofing** are calculated at the LEGMA. The emission factor used was 32%.

Activity data

Activity data were taken from the CSB of Latvia and enterprises. Activity data on production and output by manufacturing companies are freely available until year 1999. CSB gives only restricted information on production and output of goods since that year, the information being classified as confidential. To get the necessary information, permission from the enterprises should be asked to use their data. It is fortune if specialist who makes the GHG inventory knows how many such enterprises there are in Latvia. Afterwards it is possible to ask them to provide the necessary information. If not, there is possibility to omit some companies and to get incomplete activity data.

Main problem of activity data used in estimations of emissions is confidentiality. LEGMA has signed an agreement with CSB to get data of total production of products from sectors from what data are confidential. So LEGMA don't have rights to report confidential data and therefore activity data are replaced with notation key "C".

Latvia has simpler situation in activity data of mineral production sector because only some or even one facility operates in each sub-category of Mineral production sector. There is only one facility of cement production, one facility of lime production, two facilities of glass production and five facilities of tiles and bricks production.

Due to Latvia participate in EU GHG emission trading system; it was possible to obtain more accurate and complete activity data and emission factors from enterprises, which are involved in the trading system.

The activity data to calculate **NMVOC emissions from road paving and asphalt roofing** are from the CSB (Table 4.3.2).

Table 4.3.2 Activity data for road paving with asphalt and asphalt roofing production

Year	Amount of bitumen (Gg)*	57 % for road paving (Gg)	Volatile part (Gg) (45%)	43 % for construction (Gg)
1990	39.00	22.23	10.00	16.77
1995	11.48	6.54	2.94	4.94
1999	56.41	32.15	14.47	24.26
2000	48.00	27.36	12.31	20.64
2001	36.00	20.52	9.23	15.48
2002	50.00	28.50	12.83	21.50
2003	52.00	29.64	13.34	22.36
2004	48.00	27.36	12.312	20.64

* data from the CSB

Emissions from dolomite and limestone use are reported under glass production. Data on dolomite and soda use are available only from year 2000 as new enterprise went into a business. Data of soda ash use in glass production are reported under Soda ash sub-sector (CRF 2.A.4.)

Uncertainties

Uncertainties of activity data of cement and lime production as well as raw materials used in glass, metal production is very low because activity data were reported by industrial facilities.

CO_2 emission factors of mineral production are reported by industrial facilities for cement and lime production and bricks and tiles production as well as raw materials used in iron and steel industry. CO_2 emission factors for raw materials used glass production were taken from IPCC Guidelines and uncertainty was assigned as about 15 %.

4.3.3 Recalculations

According contract between LEGMA and CSB updated information of industrial production was available for time series 1999 – 2004, so clinker and shoes production data as well as pulp and paper and food and drink data were changed.

Soda use are excluded for sub-sector Other (CRF 2.A.7) and included in Soda ash use (CRF 2.A.4.b) according to recommendation from "Report of the individual review of the greenhouse gas inventory of Latvia submitted in 2005".

For Lime production sector data of raw material use were taken as activity data and plant specific emission factor of dolomite use were used to estimate CO_2 emissions. This caused recalculation back to year 1990.

Emission factors for some Industrial processes sub-sectors was reassessed or newly introduced, for example, emission factors for NOx and NMVOC for clinker production. Also plant specific CO_2 emission factor of clinker production were used in estimations and emission factor changes for different years. So carbon dioxide emissions changes for this sub-sector for all years from time period 1995 – 2003.

The comparison between previous and current submission is shown in Figure 4.3.2.

The emissions submitted in 2006 are higher as in the previous submission due to changes of statistical data of glass production industry and changes of methodology of emission estimations of Lime production.

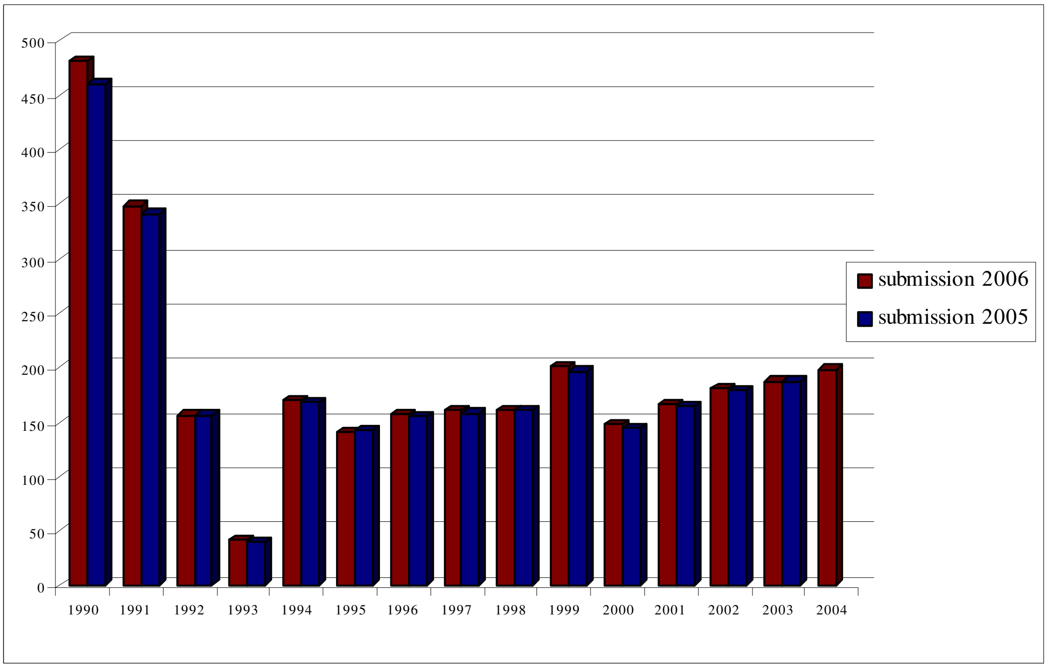


Figure 4.3.2 Comparison of CO_2 emissions for mineral products (Gg)

4.3.4 Improvements

Information reported for the first time under Emission Trading Scheme are planned to use in further submissions so data will be more precise and accurate. It is planned to procure that facilities will be able to use plant specific measurements and laboratory data even if laboratory is not accredited.

4.4 Chemical Industry (CRF 2.B)

Although we have stable traditions on chemical industry, at the moment no production of in the Revised 1996 IPCC Guidelines mentioned substances are occurred.

4.5 Metal Production (CRF 2.C)

4.5.1 Source category description

Emissions from metal production contribute 18 % from all emissions in Industrial processes sector. CO_2 emissions from coke use as reducing agent and crude iron as input material (since year 1993) in iron and steel production are included in the inventory.

The indirect GHG emission sources are also included under iron and steel production.

4.5.2 Methods, emission factors, activity data and uncertainties

Methods

Both the Revised 1996 IPCC Guidelines for National Greenhouse gas Inventories Tier2 used to calculate GHG emissions from the Industrial Processes sector. Calculation of all emissions from processes is done with Excel databases developed by experts from LEGMA. CRF Reporter software developed by experts from UNFCCC was used to report emission data.

CO_2 emissions from coke use and crude iron as input material are calculated in the frame of EU Directive 2003/87/EC on emissions trading by an enterprise. Activity data and emission factor for the calculation is obtained from the enterprise.

The NMVOC, CO, NOx and SO_2 emissions from iron and steel production estimates are calculated at the LEGMA based on activity data from the CSB Energy balance and State statistical survey "2 – Air".

Emission factors

The main sources for emission factors are:

- Plant specific emissions factor for CO_2 emission estimations reported by facilities during development of 1. National Allocation Plan
- Revised IPCC 1996 Guidelines;
- EMEP/CORINAIR Guidebook.

CO_2 emission factors used to estimate emission from iron and steel production were reported by metal produced enterprise. Emission factors of indirect GHG emissions were taken from IPCC Guidelines (Table 4.5.1).

Table 4.5.1 Emission factors of metal production

	CO_2	CH_4	N_2O	NOx	CO	NMVOC	SO_2
	(t/t)	(t/t)	(t/t)	(t/t)	(t/t)	(t/t)	(t/t)
1. Iron and Steel Production							
Steel		0,000005		0,00004	0,000001	0,00003	0,000045
Use of coke	3,489						
Crude iron	0,147						

Emission factor - 3.489 tCO_2/t used coke is in line with the Revised 1996 IPCC Guidelines and IPCC GPG (2000).

Activity data

Activity data were taken from the CSB of Latvia and enterprises. Activity data on production and output by manufacturing companies are freely available until year 1999. CSB gives only restricted information on production and output of goods since that year, the information being classified as confidential. To get the necessary information, permission from the enterprises should be asked to use their data. It is fortune if specialist who makes the GHG inventory knows how many such enterprises there are in Latvia. Afterwards it is possible to ask them to provide the necessary information. If not, there is possibility to omit some companies and to get incomplete activity data.

Main problem of activity data used in estimations of emissions is confidentiality. LEGMA has signed an agreement with CSB to get data of total production of products from sectors from what data are confidential. So LEGMA don't have rights to report confidential data and therefore activity data are replaced with notation key "C".

Due to Latvia participate in EU GHG emission trading system; it was possible to obtain more accurate and complete activity data and emission factors from enterprises, which are involved in the trading system.

Activity data and emissions for crude iron are available since 1993, as this year was pointed as base year for emission trading. It is planned that data for 1990-1992 will be available as well in the future.

Uncertainty

Uncertainty of activity data of iron and steel industry is very low and assumed 2 %. Only one enterprise operates in iron and steel industry category in Latvia and this facility reports data of production and raw materials used in production processes. Also statistical data were used in emission estimations and statistical frame mistake is assumed as 2 %.

Uncertainty of CO_2 emission factors is assigned also low about 2 % because they are reported by industrial facility.

Uncertainty of CH_4 emission factor taken from CORINAIR methodologies is assigned as 10 % so it is apposite for open – heat furnaces – technology mainly used in facility operated in iron and steel industry in Latvia.

4.5.3 Recalculations

CH_4 emission factor for steel production were innovated according to EMEP/CORINAIR Emission Inventory Guidebook – 3rd edition (2002).

Significant recalculations were not done for this sub-category. Methods and emission factors used in estimations were the same as in previous submission. Activity data were taken from same source as previously.

4.5.4 Improvements

Information reported for the first time under Emission Trading Scheme are planned to use in further submissions so data will be more precise and accurate. It is planned to procure that facilities will be able to use plant specific measurements and laboratory data even if laboratory is not accredited.

4.6 Other Production (CRF 2.D)

4.6.1 Source category description

Other Production sub-sector includes indirect emissions from:

- Pulp and Paper industry
- Food and drink industry.

NMVOC emissions from the food and drink industries are included. Emissions for 1999 – 2003 from food and drink industries were recalculated due to obtaining more reliable statistical data.

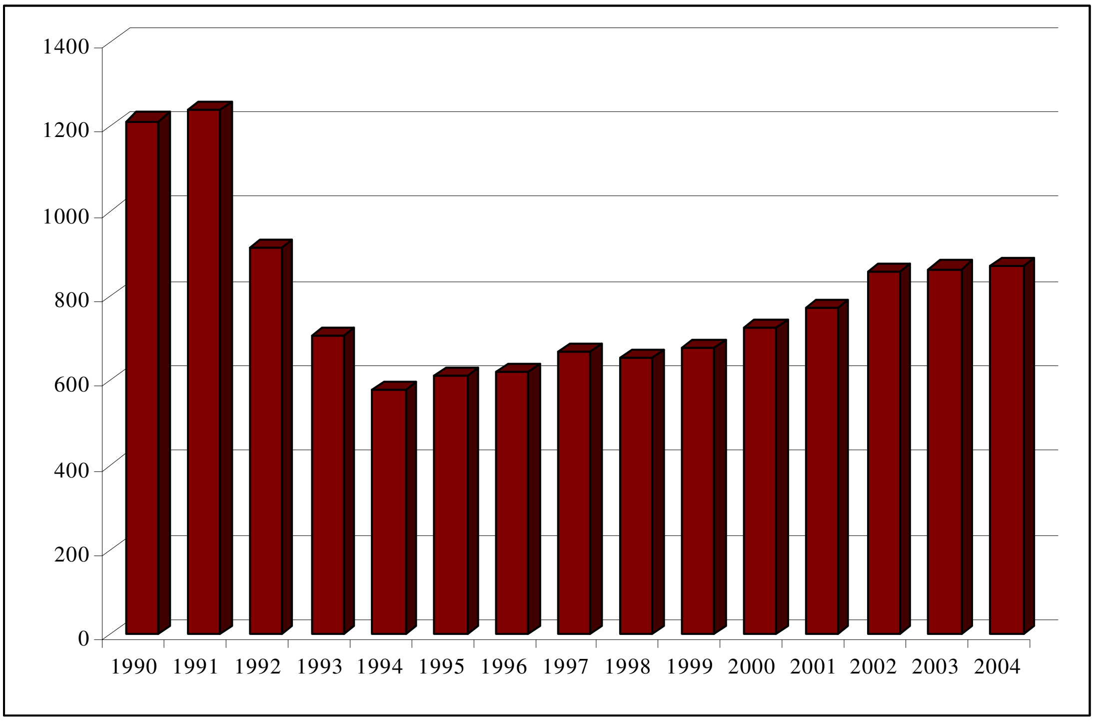


Figure 4.6.1 Total NMVOC emissions from Other production (Gg)

For last 3 years NMVOC emissions are stable, biggest fluctuations occurred in time period 1991 – 1994 due to changes in economical situation in country (Figure 4.6.1).

4.6.2 Methods, emission factors, activity data and uncertainties

Methods

Calculation of all emissions from processes is done with Excel databases developed by experts from LEGMA. CRF Reporter software developed by experts from UNFCCC was used to report emission data.

NMVOC emissions from the food and drink industry are calculated at the LEGMA. Methodology of IPCC 1996 Revised Guidelines was used in estimations.

Emission factors

The emission factors (Table 4.6.1) are taken from the Revised 1996 IPCC Guidelines.

Table 4.6.1 NMVOC emission factors for food and drink industries

Production	Emission factor, IPCC Workbook
Wine	0.08 kg/hl
Beer	0.035 kg/hl
Spirits	15 kg/hl
Meet, fish, poultry	0.3 kg/t
Sugar	10 kg/t
Cakes, biscuits, breakfast cereals	1 kg/t
Bread	8 kg/t
Animal forage	1 kg/t

Activity data

Activity data for calculation of the NMVOC emissions from the food and drink industry is obtained from the CSB. Activity data of pulp and paper sub-sector also were taken from CSB (Table 4.6.2). LEGMA has signed an agreement with CSB to get data of total production of products from sectors from what data are confidential.

Table 4.6.2 Activity data of Other Production sub-sector (CRF 2.D)

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1. Pulp and Paper	tonnes	36.6	44.7	30.8	4.7	0.2	1.5	1.5	NO	NO	NO	NO	NO	NO	NO	NO
2. Food and Drink		**1600.9**	**2880.4**	**2080.7**	**1469.6**	**1556.5**	**1649.8**	**1680.3**	**1825.7**	**1767.2**	**1967.2**	**1877.3**	**1865.5**	**2200.1**	**2311.1**	**2321.8**
Wine	hectolitres	19.9	197.5	179.8	87.7	134.2	159.2	154.7	114.7	99.6	65.9	68.9	52.5	56.8	45.9	59.7
Beer	hectolitres	87.4	1295.3	858.9	545.9	637.9	652.8	644.9	714.8	721.0	953.2	945.1	996.6	1199.2	1336.6	1313.1
Spirits	hectolitres	324.5	330.0	259.3	217.4	314.8	341.5	379.6	456.4	417.4	416.0	269.5	168.5	237.9	226.6	238.8
Met, fish, poultry	tonnes	569.3	490.4	281.6	154.0	95.6	82.8	100.5	129.1	110.9	166.9	197.3	244.6	262.9	264.4	262.5
Sugar	tonnes	31.0	35.0	39.0	26.0	15.8	29.3	31.2	41.2	64.9	66.5	62.8	56.0	76.8	74.9	67.0
Cakes, biscuits, breakfast cereals	tonnes	54.8	39.2	22.1	15.8	22.7	24.4	30.6	35.9	28.2	32.7	38.6	39.3	42.6	37.3	49.6
Bread	tonnes	314.0	293.0	240.0	177.4	161.5	145.4	137.1	132.1	124.8	121.5	121.1	123.1	122.6	124.0	119.3
Animal forage	tonnes	200.0	200.0	200.0	245.4	174.0	214.4	201.7	201.5	200.4	144.5	173.8	184.9	201.3	201.4	211.8

Uncertainty

Uncertainty of activity data was assumed as 2 % because statistical data from CSB were used.

4.6.3 Recalculations

In this submission data on food and drink consumption was recalculated due to actualised and revised activity data obtained from the CSB according an agreement between LEGMA and CSB. The comparison between current and previous submission is shown in Figure 4.6.2.

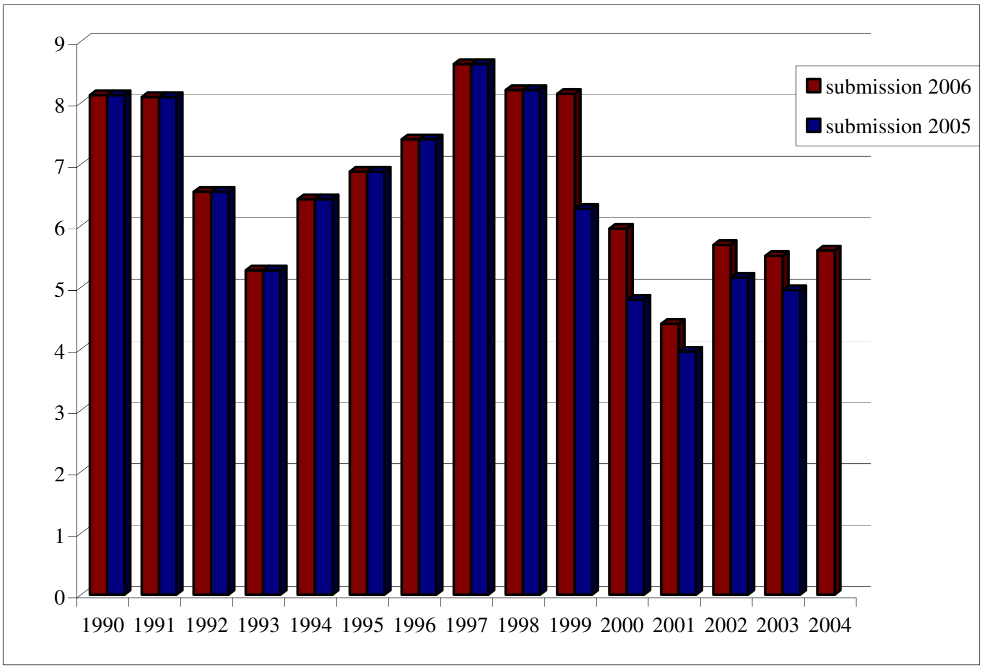


Figure 4.6.2 Comparison of submissions for NMVOC emissions (Gg)

4.6.4 Improvements

Currently no future improvements are foreseen for this category.

4.7 Production of Halocarbons and SF_6 (CRF 2.E)

Halocarbons and SF_6 are not produced in Latvia.

4.8 Consumption of Halocarbons and SF_6 (CRF 2.F)

4.8.1 Source category description

Latvia has ratified *Convention for the Protection of the Ozone Layer* (Vienna, 1985) and its *Protocol o+n Substances Depleting the Ozone Layer* (Montreal, 1987). These documents are aimed to take out the circulation of completely halogenated alkenes (CFC-11, CFC-12, CFC-113, CFC-114), partly halogenated alkenes (CFC-22, CFC-21) and halons, and to substitute them with alternative substances like hydro fluorocarbons (HFC), per fluorocarbons (PFC) and sulphur hex fluoride (SF_6).

In the framework of the project first time in Latvia the pilot inventory of HFC, PFC and SF_6 emissions was carried out covering data for period from year 1995 till 2003.

The identification of areas and users of HFC, PFC and SF_6 gases in Latvia was carried out; further, the sources of emissions (in accordance with IPCC methodology) and availability of activity and consumption data were assessed.

Continued project started for submission 2005 enterprises not using F – gases as they responded to LEGMA during interrogatory were excluded from list of total F – gases consumers. Questionnaire was sent to 120 enterprises operate with F – gases and response were extremely low about 28 %. So experts from LEGMA had to find other ways to collect necessary data.

The calculation of emissions was carried out for that F – gases, namely: SF_6, HFC –134 a, HC – 23, HFC – 125, HFC – 143 a, HFC – 152 and HFC-227 ea. The mostly used gas is HFC-134a (used in mobile air conditioners). It is possible, that emissions from stationary industrial refrigeration potentially might be greater, but not enough activity data and research about F – gases used in this sector are available during inventory.

The emissions of F-gases are linearly increasing since 1995. In 1995 GWP, CO_2 equiv. thousand tons was 0.54, but in 2004 – 21.01 thousand tons (Figure 4.8.1, Table 4.8.8). The reasons for this increase are related to the growth of activity data (for example, more new cars with MAC) and replacement of freons with F-gases, as well as adoption of new technologies [16].

Table 4.8.1 Actual emissions of SF_6

Source	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
3.5.1.	10.51	12.02	21.26	29.69	40.89	53.35	82.71	141.50	184.66	201.77
GWP (CO_2 e-qv Gg)	0.25	0.29	0.51	0.71	0.98	1.28	1.98	3.38	4.41	4.82

Table 4.8.2 Actual emissions of HFC – 134a

Source	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
3.7.1.				240.07	732.95	995.32	995.85	1535.95	1088.69	673.84
3.7.4.	65.38	87.43	99.00	110.20	133.94	155.82	179.10	213.15	259.95	317.3238
3.7.4.				10.34	19.26	29.88	72.46	98.29	137.04	234.95
3.7.4.					2.55	7.58	24.05	21.56	25.67	38.01
3.7.5.	29.10	864.72	1717.87	3001.38	4281.17	5366.56	6192.96	7144.18	8173.34	10850.98
3.7.5.								0.07	2.19	4.60
3.7.7.	50.30	44.97	39.67	47.65	34.85	34.27	39.63	31.11	40.51	39.75
Total emissions (kg)	144.78	997.12	1856.54	3409.63	5204.72	6589.43	7504.05	9044.31	9727.38	12159.46
GWP (CO_2 e-qv Gg)	0.19	1.30	2.41	4.43	6.77	8.57	9.76	11.76	12.65	15.81

Table 4.8.3 Actual emissions of HFC – 23

Source	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
3.7.4.	8.30	1.99	4.15	14.94	0.00	0.83	0.83	1.66	9.96	0.00
GWP (CO_2 e-qv Gg)	0.10	0.02	0.05	0.17	0.00	0.01	0.01	0.02	0.12	0.00

Table 4.8.4 Actual emissions of HFC – 32

Source	2004
3.7.4.	40.15
GWP (CO_2 e-qv Gg)	0.03

Table 4.8.5 Actual emissions of HFC – 125

Source	2004
3.7.4.	54.69
GWP (CO_2 e-qv Gg)	0.15

Table 4.8.6 Actual emissions of HFC – 143a

Source	2004
3.7.4.	7.25
GWP (CO_2 e-qv Gg)	0.03

Table 4.8.7 Actual emissions of HFC – 227ea

Source	2001	2002	2003	2004
3.7.6.	12.18	12.18	30.43	61.60
GWP (CO_2 e-qv Gg)	0.04	0.04	0.09	0.18

Table 4.8.8 Total actual emissions of F – gases

Source	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
3.5.1.	0.25	0.29	0.51	0.71	0.98	1.28	1.98	3.38	4.41	4.82
3.7.1.	0.00	0.00	0.00	0.31	0.95	1.29	1.29	2.00	1.42	0.88
3.7.4.	0.18	0.14	0.18	0.33	0.20	0.26	0.37	0.45	0.67	0.97
3.7.5.	0.04	1.12	2.23	3.90	5.57	6.98	8.05	9.29	10.63	14.11
3.7.6.	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.09	0.18
3.7.7.	0.07	0.06	0.05	0.06	0.05	0.04	0.05	0.04	0.05	0.05

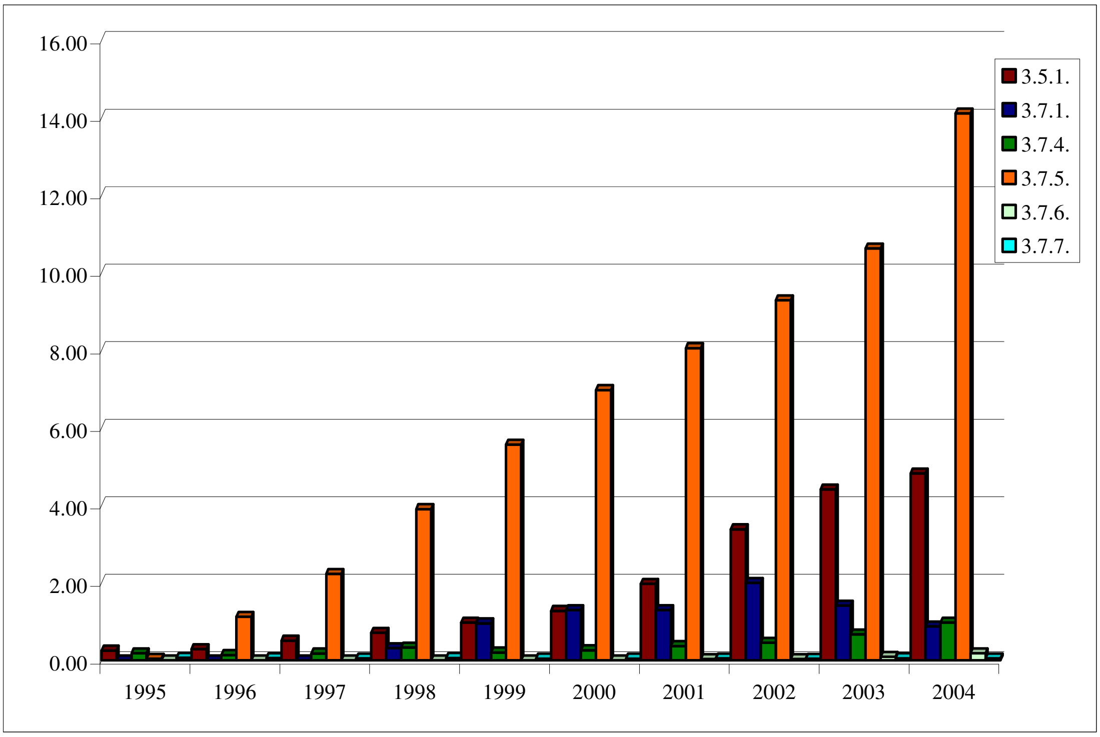


Figure 4.8.1 F-gases emissions in GWP (Gg)*

There are no emissions from halocarbons and SF_6 from metal production / Production of halocarbons and SF_6 in Latvia.

4.8.2 Methods, emission factors, activity data and uncertainties

Methods

The calculation of actual emissions was done in accordance with IPCC methodology.

* According to IPCC Good Practice Guidance:

- 3.5.1 – Emissions of SF_6 from electrical equipment;
- 3.7.1- Aerosols;
- 3.7.4 – Stationary refrigeration;
- 3.7.5 – Mobile air conditioning;
- 3.7.6 – Fire protection;
- 3.7.7 – Other applications

SF_6 emission from electrical equipment

There is one enterprise where huge amount of SF_6 is used in commutation and control installations. It consumes small amount of SF_6 in electrical equipment since year 1992, but since year 1995 used amount radical increase.

Tier 3a equation given in IPCC Guideline:

$$\mathbf{E_{total} = \Sigma E_r + \Sigma E_i + \Sigma E_l + \Sigma E_{liq}}$$

where
E_{total} – total emissions
E_r – emission from production
ΣE_i – emission from installation
ΣE_l – emission from usage
ΣE_{liq} – emission from liquidation of installation

Since installations are not produced in Latvia and installations are eliminated because installations are used only since year 1992 and only percentage leakage is known Tier 2b was chosen to estimate SF_6 emissions:

$$\mathbf{Et = 2\% \text{ from } E_{total} + 95\ \% \text{ from } E_{liq}}$$

where:
Et – emission (tonnes / year)
E_{total} – total emissions from total amount of SF6 used in installations considering that total amount is sum of new equipment installed in year and working equipment
E_{likv} – emissions from equipment that operates more that 30 years

Since E_{liq} is 0 it was assumed that emission factor is 2% or 0.02 to estimate emissions from consumption and installation of SF_6.

Emissions from Metered Dose Inhalers

Emissions are possible to estimate only from gases usage in medicine. Amount of inhalers contained HFC – 134a were clarified. It was presumed that 100 % of HFC – 134a from medicine inhalers used mainly by asthma patient is emitted. So only amount of HFC – 134a in inhalers were used in estimations of actual emissions from Metered Dose Inhalers.

Emissions from Stationary Refrigeration

Equation from IPCC Guidelines methodologies and emission factors:

$$\mathbf{E_{total} = It \times Gs + Itj \times Ge + It\text{-}d \times Gu}$$

where:
E_{total} – total emissions;
It – amount of new installations in year;
Gs – amount of gas in new installations;
Itj – installations stock
Ge – emissions of gas from working installations;
It-d – density of filling of installations;
Gu – amount of gas used in filling.

Mobile and Stationary Air Conditioning

IPCC Guidelines offer 2 ways of estimation: bottom – up and top – down. It was assumed to use top – down method due to lack of precise information about imported, produced and filled mobile air conditioners and consumed amount of gas.

According top – down method amount of gas could be estimated using coefficients of methodology and total statistical data of amount of cars or stationary air conditioning installations.

Emissions were estimated by top – down method by equation:

$$\mathbf{E_{total} = E_i \times 0,3 + E_l \times \mathit{0,5} + E_{liq} \times E8\%}$$

where:
E_{total} – total emissions;
E*i* – emissions from amount of gas in market in year, emission is 30 %;
E*l* – emissions from filling, emission 0.5 %;
E*liq* – emission from liquidation of installation, emissions from 8% of cars.

Fire extinguishers

The equation for portable fire extinguishers should be used to estimate amount of HFCs:

$$\mathbf{Et = 5\%\ from\ E_{total}}$$

where:
Et – emission (tonnes / year)
E_{total} – total emissions in furniture.

Emissions from shoes production

Danish methodology was used to estimate emissions from shoes production [15]:

$$\mathbf{E_{total} = E_r + E_l + E_{liq}}$$

where:
E_{total} – total emissions;
E_r – emission from production of shoes
E_l – emission from usage of shoes
E*liq* – emission from liquidation of shoes (E*liq* – 0)

Emission factors

Emission factors of estimation of actual F – gases emissions were taken from IPCC Guidelines as well as research and assumptions of Danish experts (Table 4.8.9).

Table 4.8.9 Emission factors of F – gases

Source	Implied emission factors		
	Product manufacturing factor	Product life factor	Disposal loss factor
	(% per annum)		
Domestic Refrigeration			
HFC-134a		1.00	
Commercial Refrigeration			
HFC-134a	3.50	3.00	5.30
HFC-32	3.50	3.00	5.30
HFC-125	3.50	3.00	5.30
HFC-143a	3.50	3.00	5.30
Transport Refrigeration			
HFC-23		3.00	5.30
HFC-134a		3.00	5.30
HFC-125	3.50	3.00	5.30
Stationary Air Conditioning			
HFC-134a	3.50	3.00	5.30
Mobile Air Conditioning			
HFC-134a	0.50	30.00	8.00
Fire Extinguishers			
HFC-227ea		5.00	
Electric Equipment			
SF6	2.00	2.00	
Production of shoes			
HFC-134a	15.00	1.50	

Activity data

Information from completed questionnaires and data from CSB and The Customs Service of Latvia were also summarized as well as data from Division of Chemicals Register within LEGMA. Data from Registry were used to estimate F – gases potential emissions.

Uncertainties

Activity data for this sub-sector were obtained of questionnaires where activity of respondents was very low and data collection from other sources so it could be assumed that uncertainty could arise to 100 %.

More precised is data of SF_6 use in electrical equipment because only one facility used this gas and reported it to LEGMA. Estimation of emissions also is quite precise.

Uncertainty of emission factors is not so high because emission factors from IPCC Guidelines and Danish research were used.

4.8.3 Recalculations

Recalculations were made due to changes in statistical information about light duty cars imported in Latvia. CSB provides changed information of production of shoes that affects production data since year 1999.

Information about stationary air conditioners was included in submission 2006 for time period 2002 – 2004 because one enterprise reports this kind of data to LEGMA.

Mistake in total HFC – 134a amount in Domestic Refrigeration sub-sector was change in submission 2006.

Emissions from HFC – 32, HFC – 125, HFC – 143a were included in submission 2006 for year 2004 because LEGMA were provided by this kind of data.

4.8.4 Improvements

Latvia is accepted *Regulation of the European Parliament and of the Council on certain fluorinated greenhouse gases*. Ministry is accepted *Regulations of ozone depleting substances and fluorinated greenhouse gases that is freezing agents* with whom producers, importers, exporters and operators need to account for F – gases for previous year till next year 1 February. These data will be available for LEGMA to estimate actual emissions of F – gases. So it is presumable that estimated emissions would be more reliable and accurate.

4.9 Potential emissions of Halocarbons and SF_6 (CRF 2.F)

4.9.1 Source category description

Potential emissions were calculated only for year 2004 in submission 2006 due to lack of statistical information regarding import and export of F – gases (Figure 4.9.1). Data for estimations were obtained from Division of Chemicals Registry of LEGMA where enterprises had to report data of F – gases with whom enterprises operated in current year.

Only two biggest enterprises that imported F – gases are reported to the Chemicals Registry and these data are used in estimations of potential emissions.

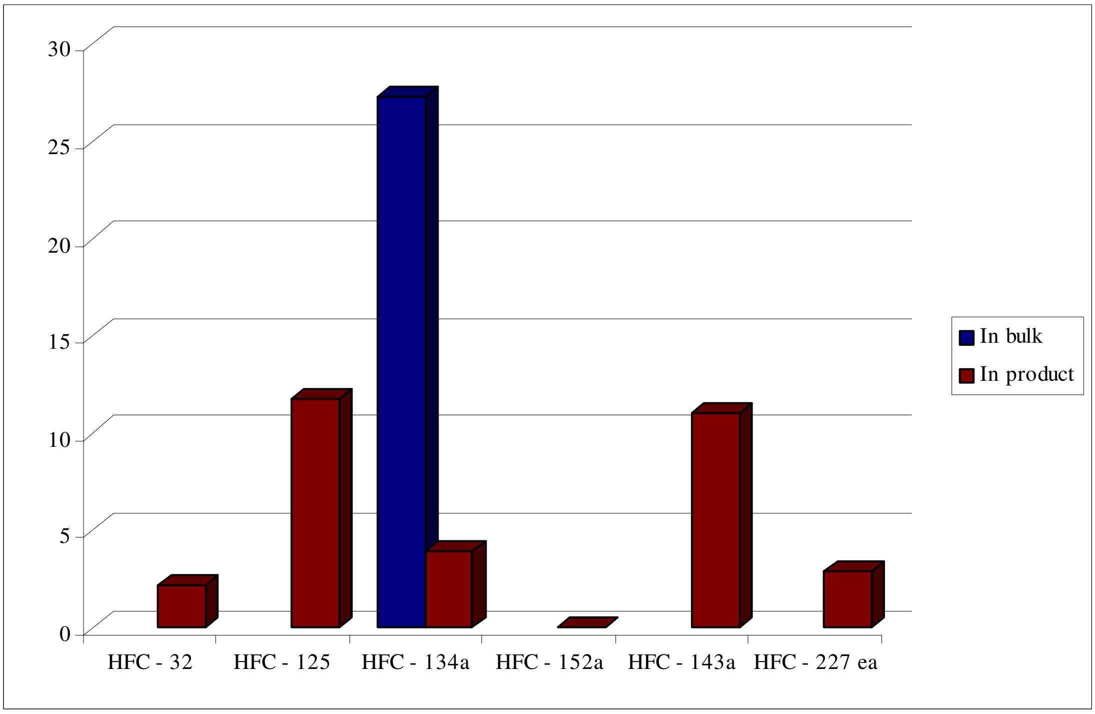


Figure 4.9.1 Total potential emissions, 2004 (tonnes)

4.9.2 Methods, emission factors, activity data and uncertainties

Methods

It was assumed that 100 % of imported amount of gas in current year could emit in air, so imported amount of gas is potential emissions of that gas.

Activity data

According to percentage amount of chemicals in imported freezing agents amount of chemicals were estimated and reported as potential emissions.

Table 4.9.1 Imported amounts of chemicals or chemical products, 2004

Chemicals, products	Imported amount (t)
R 410a	1.5
R 407c	6.1
R 404a	19.8
R 507	1.5
R 134a	27.3
SUVA MP 39	0.5
Tecfoam SP-27-B5/365/245	2.9

Table 4.9.2 Percentage amounts of chemicals in imported products, 2004

Chemicals, products	HFC-32	HFC-125	HFC-134a	HFC-143a	HFC-152a	HFC-227ea
R 410a	50%	50%				
R 407c	23%	25%	52%			
R 404a		44%	4%	52%		
R 507		50%		50%		
R 134a			100%			
SUVA MP 39					13%	
Tecfoam SP-27-B5/365/245						100%

Uncertainties

Activity data for this sub-sector were obtained from one source and used data were very inaccurate so uncertainties could arise to 100 %.

4.9.3 Recalculations

Potential emissions of F – gases were estimated for the first time for submission 2006.

4.9.4 Improvements

Since estimation of potential emissions is based on assumption it is very necessary to use official or approved methodology to make estimations more credible.

4.10 Other (CRF 2.G)

No emission sources are included in this sector and assessed as NO – not occurred.

4.11 Further improvements to the Industrial Processes sector inventory

The necessary improvements are:

- Following the IPCC Good Practice Guidance in emission calculation;
- Co-operation with appropriate experts in industrial enterprises and other institutions to develop national methods and emission factors;
- Development and improvement of data link between GHG inventories and Emission Trading Scheme;
- Estimation improvement of potential emissions of HFCs, PFCs and $SF_{6;}$
- Development of QA/QC for Industrial processes sector.

4.12 Data consistency between national GHG emission inventories and reporting under the European Union Emission Trading Scheme

Data linkage between GHG emission inventories and Emission Trading Scheme is more possible in Industrial Processes sector than in Energy industries sector because ETS covers almost all sectors in GHG inventories:

- Cement clinker and lime production industry;
- Iron and steel industry;
- Glass production industry;
- Tiles and bricks production industry;
- Pulp and paper industry.

Only sub-sector not covered by ETS is food and drink industry - the biggest sector of manufacturing industries in Latvia.

Latvia has well-disposed situation to use ETS data to GHG inventories because not so many facilities are working in ETS sub-sectors. So ETS covers almost all industry in Latvia.

For submissions 2005 and 2006 ETS data is already used in Industrial Processes sub-sectors:

- Mineral Production;
- Iron and Steel production.

So it is no problem to use ETS data to GHG emission estimations for Industrial Processes for further submissions.

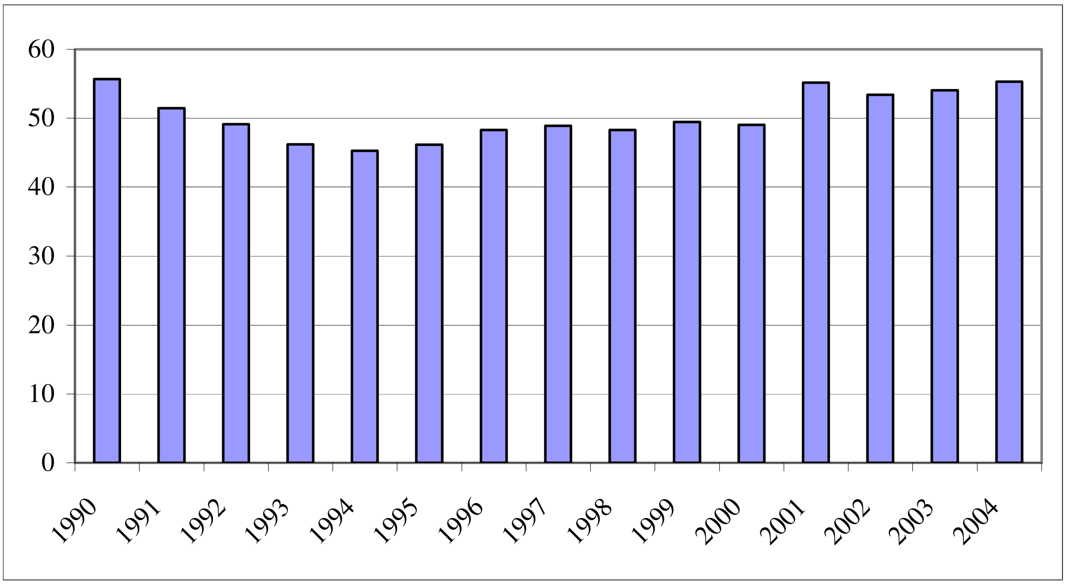
5. SOLVENT AND OTHER PRODUCT USE (CRF SECTOR 3)

5.1 Overview of sector

Solvent and Other Product Use sector emissions contribute only about 0.5% of the total anthropogenic greenhouse gas emissions in Latvia.

This sector contains CO_2 and N_2O and NMVOC emissions.

In the Solvent and Other Product Use sector main attention is being paid to the calculation of NMVOC emissions from the use of paints and lacquers, degreasing and dry cleaning, as well as printing, glues, and household solvents. Emissions in the Solvent and other product use sector are linked with the economic situation of the country. Decrease in emissions occurred between years 1993 and 1995, when industry was going through a crisis (Figure 5.1).



5.1 Total emissions from Solvent and other product use in Gg CO2 eqv.

The NMVOC emissions from pharmacy are included under Chemical Products, Manufacture and Processing for years 1997-2004. The NMVOC emissions are based on emission data from the enterprises and collected by REB and LEGMA.

5.2 Solvent and other product use

5.2.1 Source category description

The most important source in this sector is paint application and it has tendency to increase due to increased paint demand (Figure 5.2). The number of inhabitants has decreased since year 1990 [20], and consequently NMVOC emissions for degreasing and dry cleaning and other decreased also.

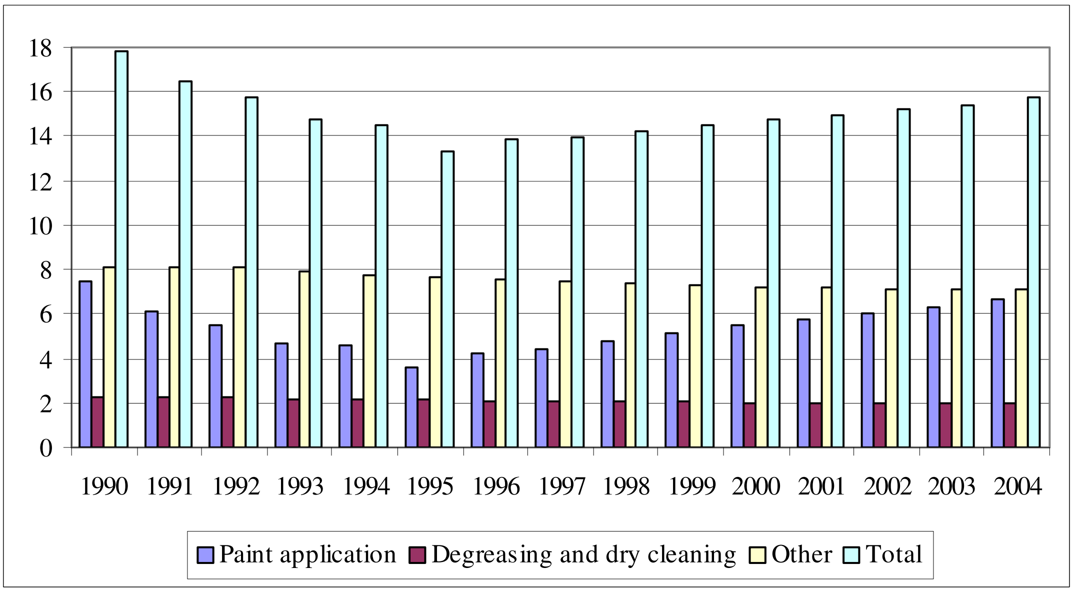


Figure 5.2 NMVOC emissions 1990-2004, Gg

The data for the use of N_2O as anaesthetic are available since year 1995. The activity data are taken from enterprises and the emission factor is assumed to be 1.00 taking into account that all gas is emitted into air. Other sources of N_2O emissions are not estimated due to lack of activity data. N_2O emissions from anaesthesia are negligible and contribute only about 0,5% from total N_2O emissions (Figure 5.3).

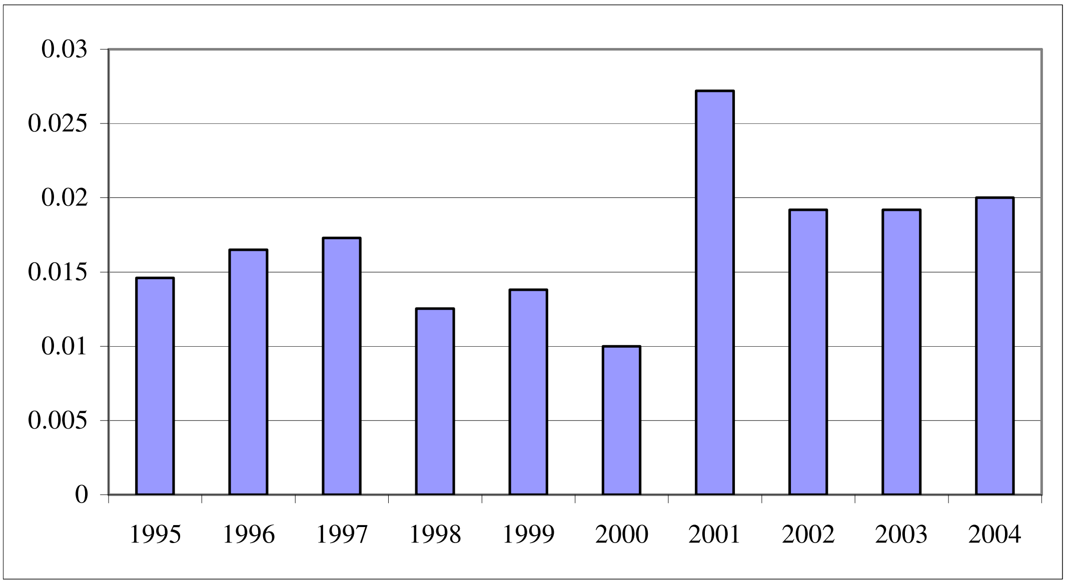


Figure 5.3 N_2O emissions 1995 – 2004, Gg

CO_2 emissions were estimated based on EMEP/CORINAIR methodology, which allows multiplying NMVOC emissions to carbon content conversion factor.
Methodology for estimation of CO_2 emissions is given in section 5.2.2. Emissions are shown in Figure 5.4 and CRF Table 3.

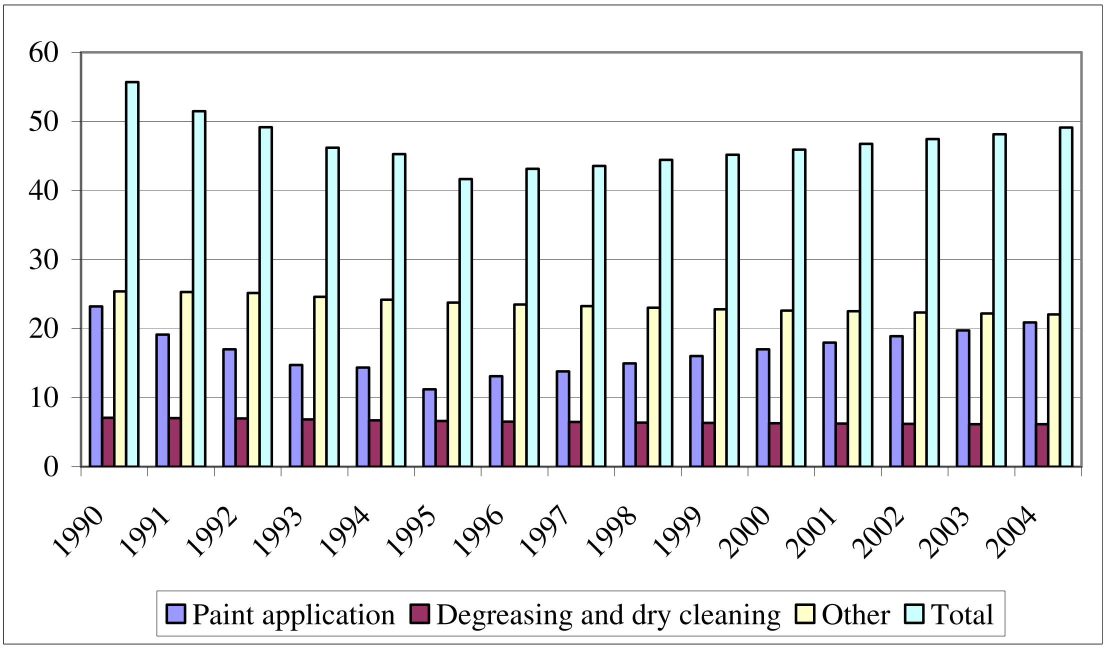


Figure 5.4 CO_2 emissions 1990-2004, Gg

5.2.2 Methods, emission factors, activity data and uncertainties

The Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories, Reference Manual (Volume 3), and Module 3: Solvent and Other product Use [19] allows using two basic approaches for emission estimation depending on the available activity data and emission factors: Production-based approach and Consumption- based approach. According EMEP/CORINAIR emissions can occur during production, during actual use and during disposal. In this IPCC sector only emissions from actual use are calculated.

CO_2 emissions were estimated based on EMEP/CORINAIR methodology, the following equation being applied:

$$CO_2 \text{ emissions} = 0{,}85 \times (44/12) \times \text{emissions of NMVOC},$$

Where 0, 85 is carbon content conversion factor.

EMEP/CORINAIR methodology provides two approaches to calculate NMVOC emissions – simple methodology and detailed methodology. In the simpler methodology NMVOC emissions from solvent use is calculated based on per capita data for the source category. To get the emissions for a source category one has to select a per capita factor and multiply it by the number of inhabitants of the country. In case of the detailed method one needs to gather very detailed information on main solvents used, contributing more than 90% of the total NMVOC emissions. It is allowed to combine simpler method with the detailed one if more precise data in some sub-sectors are available.

The IPCC/OECD has not suggested the methodology to estimate emissions of NMVOC therefore EMEP/CORINAIR methodology the simpler approach was used.

$$\text{NMVOC emissions/per year} = D \times I,$$

where
D – per capita factor, kg/cap/year;
I – number of inhabitants

In Latvia NMVOC emissions for the Paint application sub-sector was calculated, making use of activity data available from expert made judgement on realized paint amount and national emission factor. Expert divided realized paint amount in two parts – paint on water base and paint on solvent base. Emission factors used for paint application calculations are shown in Table 5.1.

Table 5.1 Emission factors for paint application

Paint type	Emission factor, t/t
Paint on water base	0.2
Paint on solvent base	0.5

NMVOC emissions from other sub-sectors like Industrial degreasing, Graphic arts, printing, Glues & adhesives and Domestic solvent use were calculated, using simpler method as described above. Workbook provides per capita emission factors for all sub-sectors if there are no locally available data and emission factors to apply detailed methodology. Emission factors used for other sub-sectors calculations are shown in Table 5.2.

Table 5.2 Emission factors*

Sectors	Emission factor, kg/cap/year
Industrial degreasing	0.85
Graphic arts, printing	0.65
Glues & adhesives	0.6
Domestic solvent use	1.8

*Data from the Emission Inventory Guidebook B600-5

The emissions from Chemical products, Manufacture and Processing come from State statistical survey "2-air" on production of pharmaceutical formulations and perfumery products.

The uncertainty of the statistical data (the number of inhabitants) was assumed to be negligible (2%) compared to the other uncertainties. Activity data and emission factor for paint application were taken from expert research; we assumed that uncertainty for these activity data and emission factors is 50%.

An important data source for N_2O used for anaesthesia is report from enterprises witch import and/or realise this gas. It is assumed that uncertainty is negligible (2%).

5.3 Recalculations

In this submission was recalculated data on paint application due to expert judgment on realized paint amount and national emission factor. In the previous submissions data were used from CSB, but these data were not complete.
The main role of emission calculation from paint and varnishes is realized amount, not produced, imported and exported amount. If paint is produced or imported that doesn't mean that this paint amount is realized immediately because realization term is quite long. Expert estimate paint consumption per capita for each year, but from CSB we could get only data on produced, imported and exported amount of paints and varnishes and not for all time period. The comparison between current and previous submission is shown in Figure 5.5.

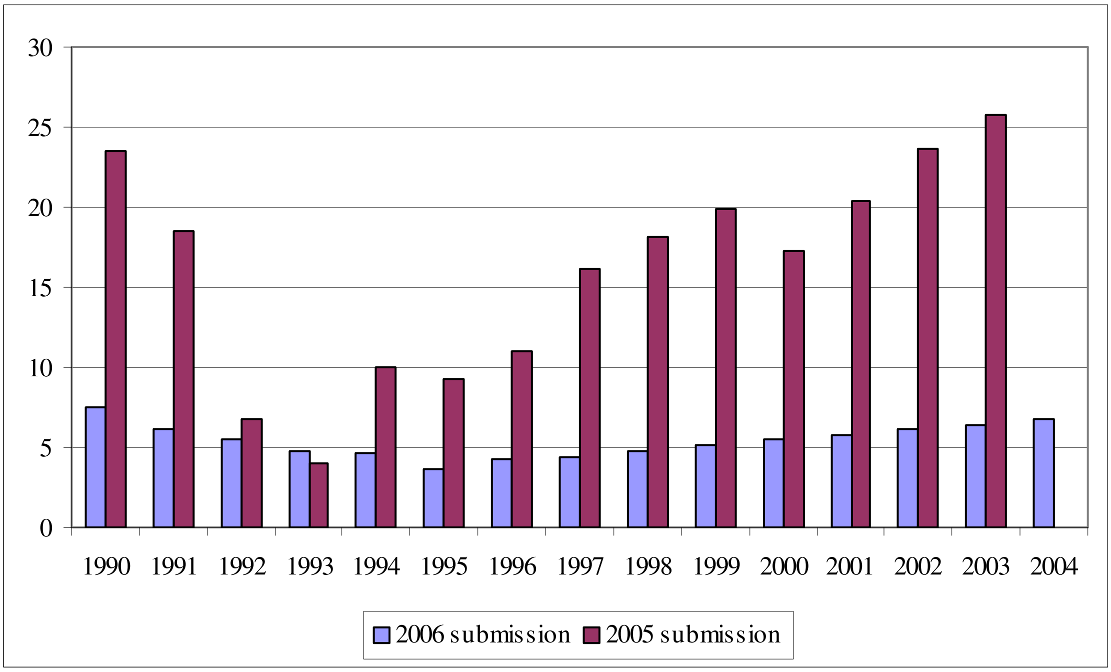


Figure 5.5 Comparison of submissions for NMVOC emissions, Gg

5.4 Further improvements to the Solvent and other Product Use sector inventory

Currently no future improvements are foreseen for this category.

6. AGRICULTURE (CRF 4)

6.1 Overview of sector

General overview

Agriculture is one of the significant branches of economy in Latvia and dominates among the primary sectors. According to the CSB data, in 2004 the volume of gross domestic product increased by 8,5% against the previous year, and increased by 3,5 % in Agriculture (Figure 6.1).

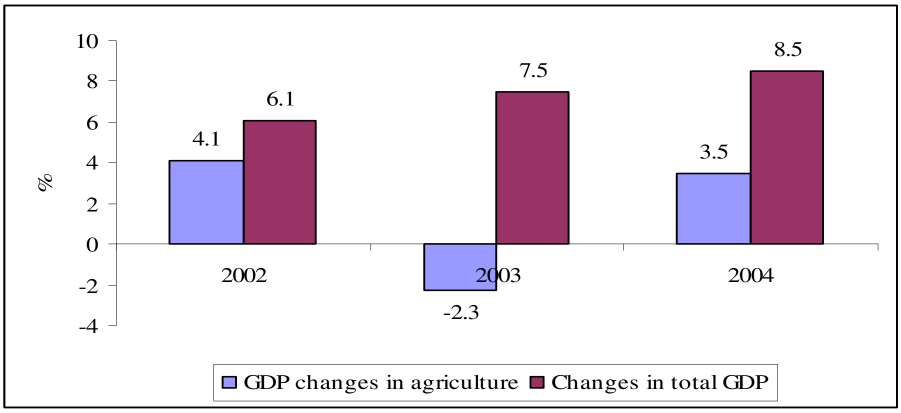


Figure 6.1 Changes of GDP added value in 2002 – 2004 [2]

Productiveness of people employed in agriculture is low. The added value per person employed in agriculture was lower than the average indication of the EU countries by 10%. Despite the decrease of the share of people employed in agriculture and the share of agricultural gross product in the total added value, the productiveness coefficient of the industry remained at the level of the previous year.

Sector description

The emissions of greenhouse gases from the Agricultural sector include emissions of CH_4 from enteric fermentation and manure management and emissions of N_2O from manure management and agricultural soils. Direct N_2O emissions from agricultural soils include emissions from synthetic fertilizers, manure applied to soils, biological nitrogen fixation of N-fixing crops, crop residues and cultivation of organic soils. Indirect N_2O emission sources include atmospheric deposition and nitrogen leaching and run-off to watercourses.

Improvements in the calculation system affected emission amount compared to the previous submission. The most important updating was related: manure management system, nitrogen excretion, area of histosoils and mostly important crops.

Rise isn't cultivated in Latvia and savannas don't exit. Field burning of agricultural residues is determined as negligible, because such actions are observed occasionally. Emissions from previous grass burning are included under LULUCF sub sector Grassland.

The Agriculture sector contributes 17% from total national emissions in 2004. Total GHG emissions from agriculture have declined approximately 69% over the period of 1990 – 2004 (Figure 6.2). Fluctuation of emissions has observed in the time series (Table 6.1). The general reason for this is economical crisis during 1991-1995, when significantly were decreased amount of livestock in farms as well as use of nitrogen fertilisers.

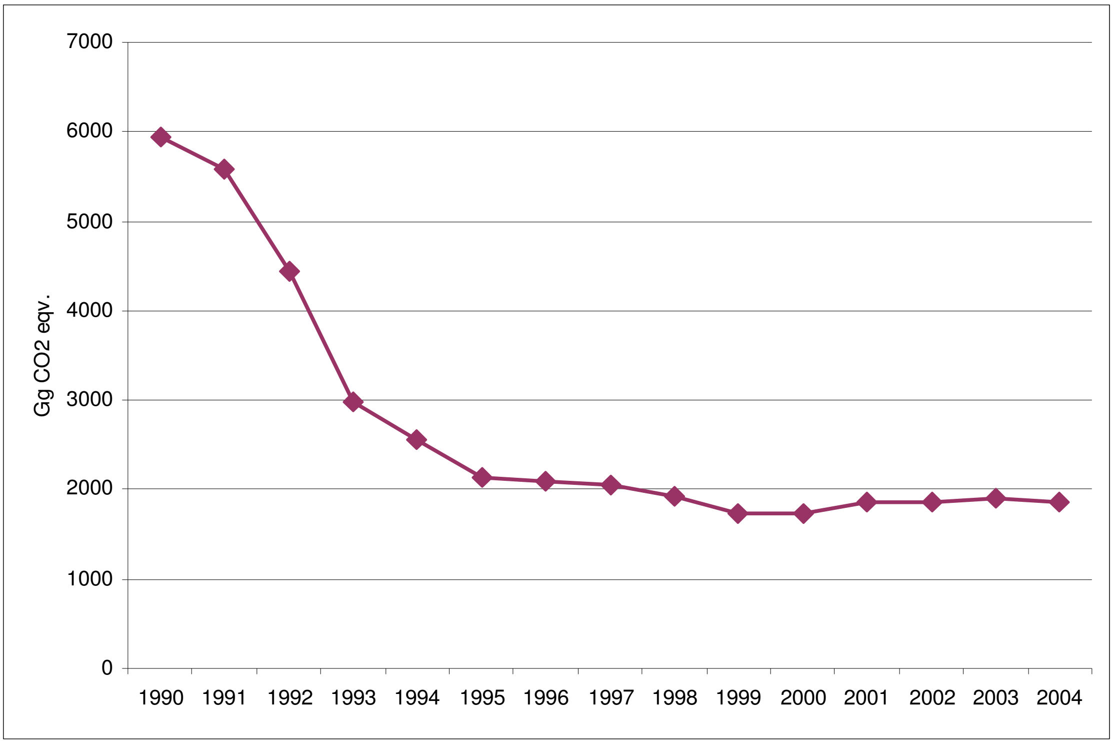


Figure 6.2 Trend in agricultural emissions in 1990 – 2004 Gg CO_2 equivalents

The proportion of manure managed in different manure systems affects N_2O emissions from manure management. N_2O emissions from agricultural soils are influenced by different points - use of synthetic fertilizers annually, changes of animal numbers between years, fluctuation of arable land, area of cultivated organic soils, pulses and cereal crops data.

Table 6.1 Agricultural greenhouse gas emissions by source and gas in 1990 - 2004

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
CH_4 (Gg)															
Total	111.27	107.11	88.77	54.60	45.79	44.61	41.79	39.19	35.86	31.35	30.60	32.07	32.31	31.21	30.70
Enteric Fermentation	97.96	94.64	79.27	48.88	40.61	39.31	37.02	34.72	31.67	27.52	26.88	28.08	28.20	27.20	26.75
Manure management	13.31	12.47	9.50	5.72	5.17	5.30	4.77	4.47	4.19	3.83	3.73	3.99	4.11	4.01	3.95
N_2O (Gg)															
Total	11.62	10.78	8.34	5.93	5.13	3.85	3.92	3.95	3.77	3.45	3.50	3.86	3.83	4.04	3.92
Manure management	1.78	1.71	1.37	0.85	0.73	0.70	0.67	0.63	0.58	0.51	0.50	0.53	0.54	0.52	0.49
Agricultural Soils	9.84	9.07	6.98	5.07	4.40	3.14	3.25	3.32	3.19	2.93	3.00	3.33	3.29	3.52	3.43

6.2 Description of Key Source Categories

Agricultural key sources in 2004 identified by the IPCC GPG (2000) Tier 1 method were N_2O emissions from agricultural soils and CH_4 emissions from enteric fermentation.
Accordingly level and trend assessment (including LULUCF) of key source for 2004 direct N_2O emissions from agricultural soils consist 3% and 1% respectively; indirect N_2O emissions from agricultural soils consist 1% and 2%, CH_4 emissions from enteric fermentation contribute 2% and

4% respectively. According trend assessment N_2O from manure management was key source and contributes 1%.
Key source, which was identified without LULUCF, are shown in Annex 1.

6.3 Enteric Fermentation (CRF 4.A)

6.3.1 Source category description

The emission sources cover domestic livestock. Latvia reports emissions from cattle (including dairy cows), swine, horses, goats, and sheep. Emissions from poultry have not been estimated.
Methane emissions from enteric fermentation of domestic livestock comprised 30 % of total agricultural emission, expressed in CO_2 equivalents, in 2004. CH_4 emissions were 26.75Gg and decreased 27% since 1990 due to decreasing number of cattle (Figure 6.3).

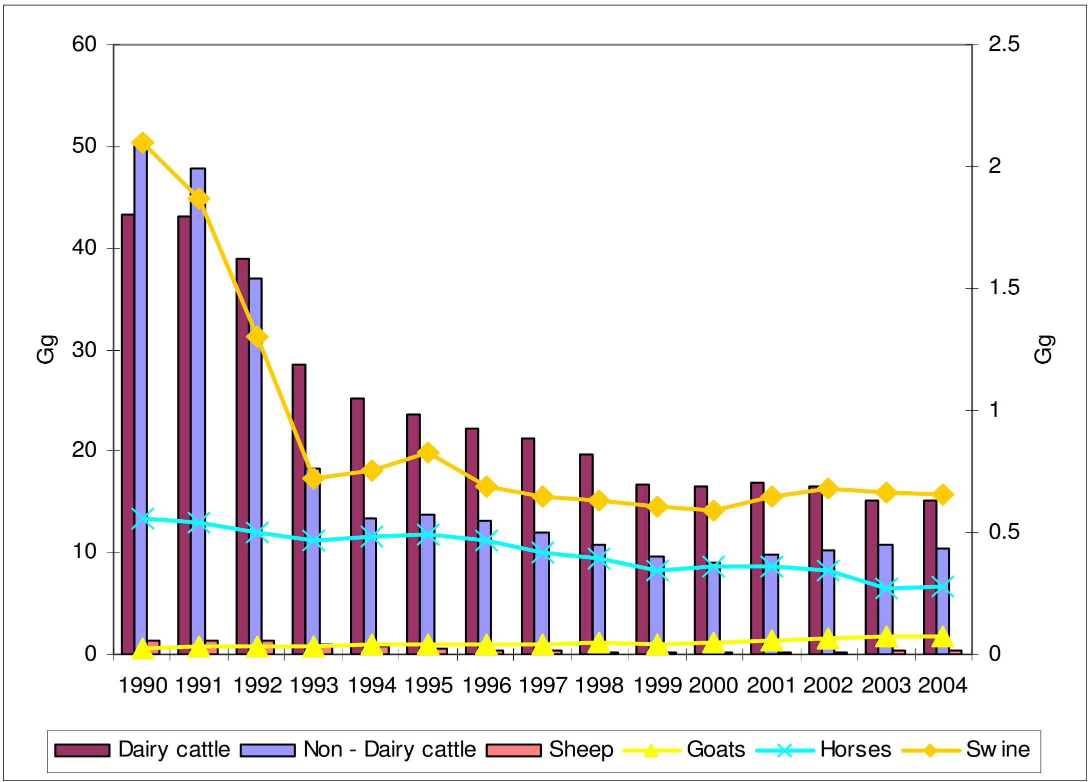


Figure 6.3 Methane emissions from enteric fermentation in 1990 – 2004 by animal category

6.3.2 Methods, emission factors, activity data and uncertainties

Methods

Calculation of emissions is based on methods described in the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories and IPCC GPG (2000). CH_4 emissions from enteric fermentation have been estimated using the Tier 1 methodology.
In Tier 1 method, total emissions have been calculated by multiplying the number of the animals in each category with the IPCC default emission factor of each animal category. The total emission is the sum of emissions from each category.
For emission calculation was used IPCC Tool and then data was put in the new CRF software for each year.

Emission factors and other parameters

To calculate CH_4 emissions from enteric fermentation the default emission factors were used from Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (Table 6.2).

Table 6.2 CH_4 emission factors from enteric fermentation

Types of animals	EF (kg/head/year)
Dairy cattle	81
Other cattle	56
Sheep	8
Goats	5
Horses	18
Swine	1.5

Activity data

The number of cattle, sheep, horses, swine and goats were obtained from the Statistical yearbooks of Latvia (Table 6.3).

Table 6.3 Number of livestock for 1990 -2004
at the end of the year (thousand heads)

	Dairy cattle	Non - Dairy cattle	Sheep	Goats	Horses	Swine	Poultry
1990	535	904	165	5	31	1401	10321
1991	531	852	184	6	30	1247	10395
1992	482	662	165	6	28	867	5438
1993	351	327	114	6	26	482	4124
1994	312	239	86	7	27	501	3700
1995	292	245	72	9	27	553	4198
1996	277	233	56	8	26	460	3791
1997	263	214	41	9	23	430	3551
1998	242	192	29	11	22	421	3209
1999	206	172	27	8	19	405	3237
2000	205	162	29	10	20	394	3105
2001	209	176	29	12	20	429	3621
2002	205	183	32	13	19	453	3882
2003	186	193	39	15	15	444	4003
2004	186	185	39	15	16	436	4050

The source of data on the number of livestock in state farms and statutory companies is statistical surveys while sample surveys are used to collect information from peasant farms, household plots and private subsidiary farms. The sample survey was first launched in 1995 and since then it is conducted twice a year. The sample for 2004 covers a total of 10.0 thsd. Farms selected by economical size and specialisation. To determine the economic size of the farm, the total gross coverage of the surveyed farms to all private farms, attention was paid to how many farms of a similar kind were represented by the farms in the sample as well as to the actual response rate in each of the surveyed territories [3].

Uncertainties

For estimating uncertainty for this category was used following assumptions:

- CSB assessed that for number of livestock uncertainty could be 2-3%;
- For emission calculation was used Tier1 method and default emission factors therefore selected average value 40% from 30-50% (Source: IPCC GPG).

6.4 Manure Management (CRF 4.B)

6.4.2 Source category description

The emission sources cover management of manure from domestic livestock. Latvia reports CH_4 and N_2O emissions from cattle (including dairy cows), swine, horses, goats, sheep and poultry.
Total emissions from manure management of domestic livestock consisted approximately 13% of total agricultural emissions (expressed in CO_2 equivalents) in 2004. Methane emissions from manure management were 3.95 Gg. CH_4 emissions from manure management have decreased 30 % during the time period 1990 - 2004 (Figure 6.4).

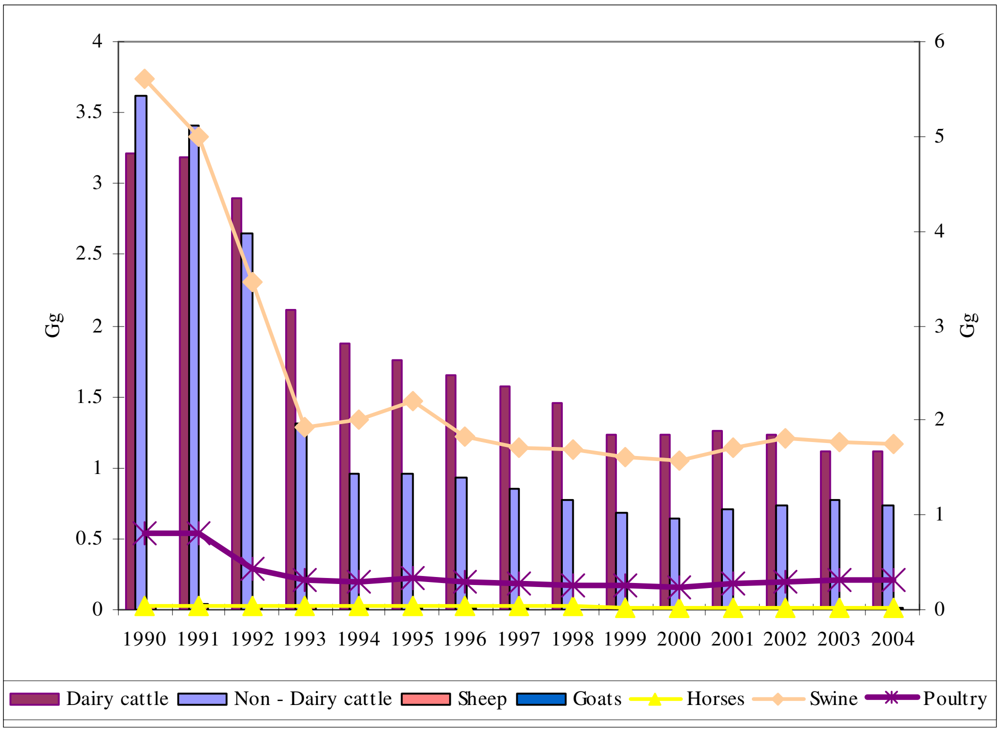


Figure 6.4 Methane emissions from manure management in 1990 – 2004 by livestock type

Nitrous oxide emissions from manure management were 0.49 Gg in 2004. It is observed, that emissions from manure management have decreased 28% from 1990 to 2004 (Figure 6.5).

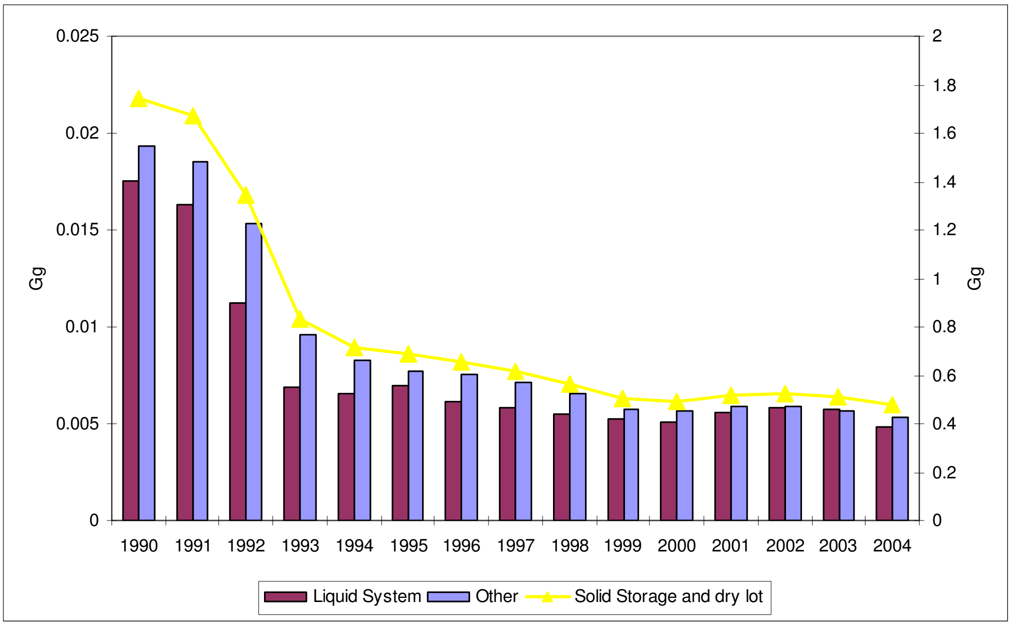


Figure 6.5 Nitrous oxide emissions from manure management in 1990 – 2004 by manure management system

The fluctuations in emissions (Figure 6.4. and Figure 6.5) are related changes in animal numbers and changes in the distribution of manure management systems.

6.4.2 Methods, emission factors, activity data and uncertainties

Methods

The Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories Tier 1 approach was applied to evaluate emissions from manure management.

Methane emissions from manure management are calculated multiplying the number of the animals in each category with the emission factor for each category.

Nitrous oxide emissions from manure management have been calculated by using IPCC methodology and local expert assumptions. The amount of nitrogen excreted annually per animal has been divided between different manure management systems and multiplied with a specific emission factor (IPCC default value) for each manure management system. Manure management systems reported in the inventory are liquid system, daily spread, solid storage and dry lot, pasture range and paddock and other. N excretion during the year per each animal and the distribution of manure management systems are national calculated values (for some livestock type's N excretion are the same as in the IPCC default).

For emission calculation was used IPCC Tool and then data was put in the new CRF software for each year.

Emission factors and other parameters

IPCC default emission factors for CH_4 were used (Table 6.4).

Table 6.4 CH_4 emission factors from manure management

Types of animals	EF (kg/head/year)
Dairy cattle	6
Other cattle	4
Sheep	0.19
Goats	0.12
Horses	1.4
Swine	4
Poultry	0.078

Calculation of nitrous oxide emissions from manure management is also based on the IPCC default emission factors (Table 6.5).

Table 6.5 IPCC default emission factors for N_2O from manure management

Manure management system	Emission factor (kg N2O – N/kg)
Liquid system	0.001
Solid storage and dry lot	0.02
Other	0.005

Activity data

Animal numbers were obtained from CSB (Table 6.3) and directly, statistical bulletins for each year. The distribution of different manure management systems received from Research made by LSIAE (2005) is shown in the Table 6.6 and 6.7 [18].

Table 6.6 Distribution of different manure management systems for 1990-2003

	Liquid system, %	Solid storage and dry lot, %	Pasture range and paddock, %	other, %
Dairy cattle	3.5	53.5	40	3
Non - Dairy cattle	2.1	50.69	45.21	2
Sheep		57.5	42.5	
Goats		57.5	42.5	
Horses		49.3	50.7	
Swine	46	51		3
Poultry	39	61		

Table 6.7 Distribution of different manure management systems for 2004

	Liquid system, %	Solid storage and dry lot, %	Pasture range and paddock, %	other, %
Dairy cattle	3.5	52.5	41	3
Non - Dairy cattle	2.1	49.32	46.58	2
Sheep		56.16	43.84	
Goats		56.16	43.84	
Horses		47.95	52.05	
Swine	46	51		3
Poultry	39	61		

Detailed description from research about AWMS is presented in the Annex 5.

Data about annual N excretion per animal obtained from Research made by LSIAE (2005). National expert made an account, based on a research, in which livestock manure amount and nitrogen amount was analysed over a long time period as well as different available information (Table 6.8).

Table 6.8 Average N excretion per head of animal [18]

Types of animals	N, kg/year (CS)
Other cattle	50
Dairy cattle	71
Sheep	6
Swine	10*
Horse	46
Poultry	0.6

*Until 2003, starting from 2004 – 7.3 kg /year

**For goats the same N emission factor was used as for sheep and it was 6 N, kg/year.

Some information related N excretion per head of animal from research is shown in the Annex 5.

Uncertainties

For estimating uncertainty for this category was used following assumptions:

- CSB assessed that for number of livestock uncertainty could be 2-3%;
- For emission calculation was used default emission factors (Tier 1) and in the IPCC GPG is described that they are with very large uncertainty, therefore was used 30% uncertainty.

6.5 Rice Cultivation (CRF 4.C)

Rice is not cultivated in Latvia.

6.6 Agricultural Soils (CRF 4.D)

6.6.1 Source category description

This source category includes direct and indirect nitrous oxide emissions from agricultural soils. Direct N_2O emissions include emissions from synthetic fertilizers, animal manure, biological nitrogen fixation, crop residues, and cultivation of histosols. The emissions from nitrogen excreted to pasture range and paddocks by animals are reported under "animal production" in CRF tables. Indirect N_2O emissions from atmospheric deposition of NH_4 and NO_x as well as from leaching and run-off of the applied or deposited nitrogen are included in the inventory.

N_2O emissions from agricultural soils contribute 57 % of total agricultural emissions (expressed in CO_2 equivalents) in 2004. Nitrous oxide emissions from agricultural soils were 3.43Gg in 2004. Emissions have decreased and fluctuated over the period 1990 – 2004 (Figure 6.6). It is so because decreased animal numbers that affected the amount of nitrogen excreted annually to soil and fluctuate use of synthetic fertilizers. In the latest years can observed that emissions have increased. The main reason is increasing use of synthetic fertilizers.

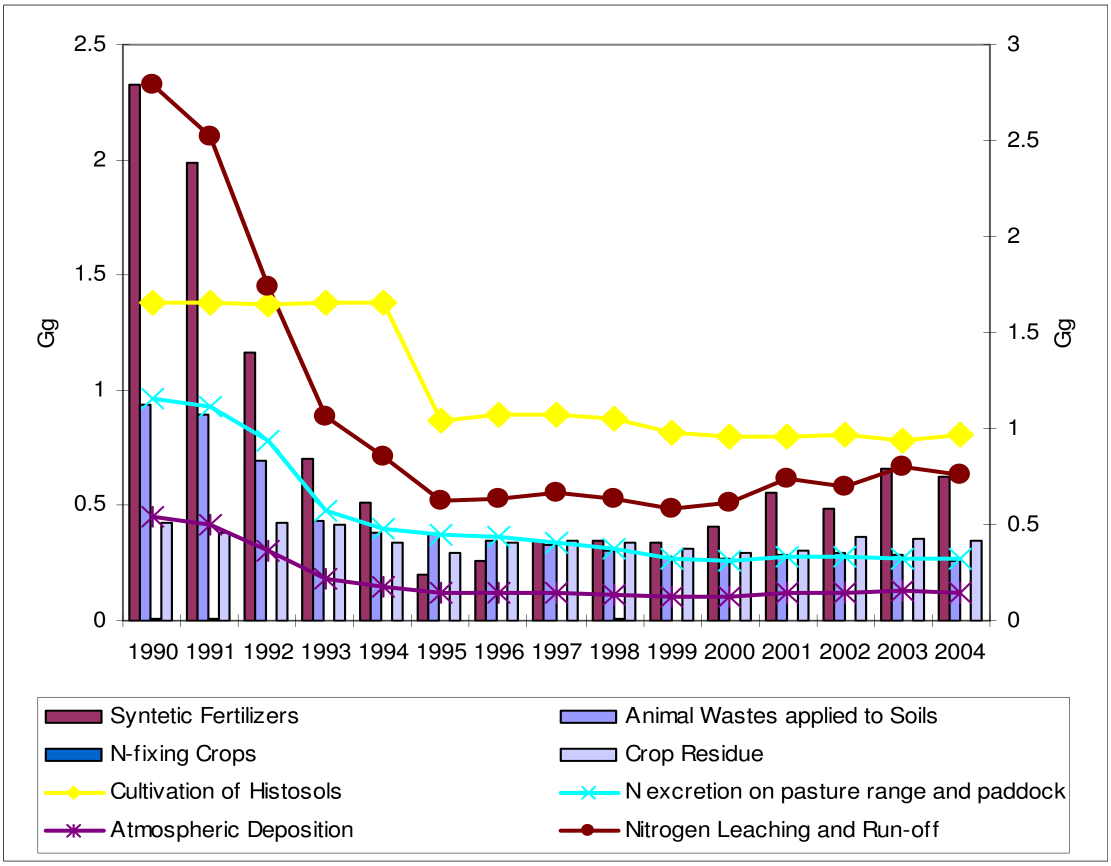


Figure 6.6 Direct and indirect N_2O emissions from agricultural soils by source category

6.6.2 Methods, emission factors, activity data and uncertainties

Methods

Calculation of emissions is relating with the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories and IPCC GPG (2000). Generally Tier T1/T1a and IPCC default emission factors were applied.

Emission factors and other parameters

IPCC default emission factors, national values and other parameters have been used. Emission factors and other parameters are presented in Table 6.9 and 6.10.

Table 6.9 N_2O emission factors for emissions calculation from agricultural soils*

Categories	Emission factors
Synthetic fertilizers	1.25%
AWAS	1.25%
N-fixing Crops	1.25%
Crop residue	1.25%
Organic soils	8 kg N_2O – N/ha
Atmospheric deposition	1% of N deposition
N-leaching and run-off	2.5% of N leaching

* IPCC default values used

Table 6.10 Dry matter fraction and nitrogen content of crops included in inventory

	FracDM*	Frac NCRBF*
Wheat	0.81	0.0028
Barley	0.81	0.0043
Oats	0.92	0.007
Rye	0.9	0.0048
Rape	0.75	0.015
Potatoes	0.75	0.011
Sugar beet	0.77	0.015
Vegetable	0.8	0.015
Peas and beans	0.87	0.0142

* IPCC default values used

Activity data

Activity data obtained from the CSB (animal numbers – used the same as for calculating CH_4 and N_2O emissions from enteric fermentation and CH_4 and N_2O emissions from manure management (Table 6.3)), use of N synthetic fertilizers (Table 6.11) and productions of crops (Table 6.12)). Other data sources are LSIAE (distribution of different manure management systems are shown in the Table 6.6 and 6.7 and researches made by local experts (area of cultivated organic soils).

Table 6.11 Amount of use of N synthetic fertilizers

Year	N synthetic fertilizers (thsd.t)
1990	131.4
1991	112.4
1992	66
1993	39.7
1994	29
1995	11.5
1996	14.5
1997	19.4
1998	19.6
1999	19
2000	23
2001	31.6
2002	27.6
2003	37.4
2004	35.2

Table 6.12 Productions of crops, thsd. t

Year	Wheat	Barley	Oats	Rye	Rape	Potatoes	Sugar beet	Vegetables	Peas and beans
1990	402.5	697	176.1	323.6	3.7	1016.1	439.1	169.4	22.7
1991	190.2	761.9	177.2	145.8	ND	944	377.9	209.2	20.7
1992	332.4	426.3	60	295	ND	1167.4	462.6	250.8	8.6
1993	338.3	445.8	73.7	340.7	ND	1271.7	298	284.8	4.3
1994	199.4	476.8	88.9	113.4	ND	1044.9	228.2	233.2	4.5
1995	260.5	284	73.2	71.3	0.9	863.7	250	223.7	4.7
1996	374.9	371.5	101.4	112.9	1.3	1081.9	257.8	179.5	7.8
1997	424.6	359.8	116.5	133.5	0.5	946.2	387.5	162.5	8.3
1998	428.8	321.7	103.6	104.8	1.6	694.1	597	119.6	11.3
1999	396	232.6	66.1	88.7	11.7	795.5	451.5	130.1	3.6
2000	472.2	261.1	79.6	107.2	10	747.1	407.7	105.8	3.9
2001	507.3	231.1	82.4	107.2	13	615.3	491.2	159.3	4
2002	584.9	262.4	79.7	101.5	32.7	768.4	622.3	148.2	4.2
2003	519.9	246.6	78.3	87.6	37.4	739	532.4	217.5	5
2004	571.8	283.5	107.4	96.8	103.6	628.4	505.6	180.8	4.5

The nitrogen excreted per animal is the same used for calculating nitrous oxide emissions from manure management (Table 6.8).

Area of cultivated organic soils (histosols)

Latvia reassessed area of histosols in the framework of local research made by local expert (2005) as recommended Expert Review team in the Centralized review (2005). For assessing approximate area of histosols were used materials from Ministry of Agriculture, Central Statistical Bureau, foreign and Latvian scientific, and publications specialists.

Some information from research is described below:
The biggest part of histosols consists in the fallow land and it mean in the area which isn't used for agriculture. Since '90s proportion of histosols isn't changed, because practically wasn't actions for new area drainage. It is observed that increased agricultural area which isn't used for agricultural

actions. As well as number of farm animals essentially decreased and therefore decreased area of cultivated meadows and pastures. Proportion of cultivated meadows and pastures in the histosols for period 1990 -2004 is shown in the Table 6.13. An assumption was made using CSB surveys.

Table 6.13 Proportion of cultivated meadows and pastures in the histosols for period 1990 -2004

Years	%
1990 - 2002	18.6
2003	15.8
2004	13

As noted in the research histosols consist 7% from cultivated agricultural area. Results related to assessment of approximate cultivated histosols are shown in the Table 6.14.

Table 6.14 Approximate area of Histosols 1990 – 2004 [14]

	Arable land, thsd.ha	Permanent crops, thsd.ha	Meadows and pastures, thsd.ha	*of which cultivated, thsd.ha*	Cultivated area, thsd.ha	Histosols, 7% from cultivated area, thsd.ha
1990	1687.40	35.40	844.20	*157.02*	*1879.82*	***131.59***
1991	1689.10	35.30	843.40	*156.87*	*1881.27*	***131.69***
1992	1691.90	24.60	825.10	*153.47*	*1869.97*	***130.90***
1993	1710.50	23.90	803.40	*149.43*	*1883.83*	***131.87***
1994	1710.50	23.90	803.40	*149.43*	*1883.83*	***131.87***
1995	*1002.30*	*29.30*	800.50	*148.89*	*1180.49*	***82.63***
1996	1059.90	16.20	798.10	*148.45*	*1224.55*	***85.72***
1997	1078.60	15.10	677.90	*126.09*	*1219.79*	***85.39***
1998	1058.60	12.10	677.90	*126.09*	*1196.79*	***83.78***
1999	987.40	11.70	617.70	*114.89*	*1113.99*	***77.98***
2000	969.90	11.50	605.70	*112.66*	*1094.06*	***76.58***
2001	958.20	12.10	611.30	*113.70*	*1084.00*	***75.88***
2002	972.80	12.20	610.30	*113.52*	*1098.52*	***76.90***
2003	956.40	12.00	613.10	*96.87*	*1065.27*	***74.57***
2004	1008.60	12.40	620.90	*80.72*	*1101.72*	***77.12***

Uncertainties

For estimating uncertainty for this category was used following assumptions:

- CSB assessed that uncertainty of statistical data which is used for this category is with 2-3%, but total uncertainty related activity data is used 40% (Source: IPCC GPG, expert opinion).
- For emission calculation was used default emission factors (Tier 1) and nationally determined distribution of AWMS as well as N excretion per animal in year. Uncertainty was chosen from IPCC GPG - 25%.

6.7 Burning of Savannas (CRF 4.E)

Burning of savannas does not occur in Latvia.

6.8 Field Burning of Agricultural Residues (CRF 4.F)

Field burning of agricultural residues is taking place in Latvia on small scale and the emissions from this source (cereals and pulse) aren't estimated, but emissions from categories tuber and roots are estimated as now applicable.

6.9 Recalculations

Area of cultivated organic soils (histosols) for 1990 – 2003 was reassessed according to national research project at the end of 2005.

Average nitrogen excretion per head of animal was reassessed according national project which was carried out by the LSIAE (2005). The changes were for:

- Other cattle from 51 to 50 kg/year what is the same as in IPCC methodology described;
- Poultry from 0.9 to 0.6 kg/year what is the same as in IPCC methodology described;
- Horse from 51 to 46 kg/year;
- Swine until 2003 – 10 and started from 2004 – 7.3 kg/year.

Animal waste management systems (AWMS) for 1990 - 2003 were reassessed according to the above mentioned national research project.
The general changes:

- Anaerobic lagoons were excluded from AWMS distribution for 1990 -1992 (dairy cattle, other cattle, poultry), but for swine for all years. As explained national expert then anaerobic lagoons in 90's were planed as experiment, but this experiment wasn't work in reality, because manure wasn't consist with enough amount of dry matter and therefore can't obtained biogas. It could be in the nearest future that some of local farmers will plan anaerobic lagoons as AWMS for swine.
- The proportion of AWMS – Other was reassessed and biggest part accounted to the AWMS - Solid storage and dry lot. As clarify national expert then according to IPCC GPG (2003) definitions it is more correctly.

N_2O emissions from N-fixing Crops and Crop Residue were calculated using Tier 1a method and default emission factors from IPCC GPG Table 1.16, Equation 4.28.

6.10 Improvements to the agriculture sector inventory

National expert has started work to update national CH_4 emission factors for enteric fermentation and manure management, but admission that while aren't precise data related weight of livestock, loss of energy, energy for animal activity MJ is better used IPCC default values. Necessary continue work on detailed parameters and it means additional research.

In submission 2006 firstly was assessed uncertainties for agriculture sector and this assessment is very incomplete and necessary to work together with national experts for improving data.

Implement QA/QC for emission calculation regarding Agriculture.

7. LAND-USE CHANGE AND FORESTRY (CRF 5)

7.1 Overview of sector

General overview

This category comprises CO_2 emissions and removals arising from Land use, Land use change and Forestry (LULUCF). LULUCF sector in GHG balance is very important in Latvia. Latvia is rich with forests. Total forestland area was 2944 thsd. ha in 2004 and it covers 45% of total land area of Latvia.

In 2006 submission Latvia reports carbon stock changes and GHG emissions from Forest land, Cropland and Grassland using the new CRF tables. In the Forest land category only living biomass and dead organic mater was reported and firstly calculations were done by MoA. CO_2 removals of

Forest land, Cropland and Grassland category were reported as well as emissions from organic soils (Cropland, Grassland), liming of agricultural soils (under category Cropland) and burning (Forest land, Grassland) were reported.

In submission 2006 does not include emission estimate from Wetlands and Settlements as well as Other land categories. N_2O emissions from drainage of soils are not reported due to lack of the activity data.

Land areas and land categories used in Latvian Inventory

For representing land areas are used Approach 1: Basic land-use data. National division of land categories mainly consist with IPCCC GPG LULUCF (2003). Main source for land use data is State Land Service. Specific information about forest land is taken from State Forest Register.

According Forest Law forestland is land covered by forest, land under forest infrastructure facilities, as well as adjacent overflowing clearings, marches and glades.
A forest is an ecosystem in all stages of its development, dominated by trees the height of which at the particular location may rich at least seven meters and the present or potential projection of crown of which is at least 20 per cent of area occupied by the forest stand.

The following shall not be regarded as forest:

1) Area separate from forest, covered by trees, the size of which does not exceed 0.1 hectare;
2) Rows of trees of artificial or natural origin, the width of which is less than 20 meters;
3) Orchards, parks, cemeteries and forest tree seed orchards.

For reporting according to IPCCC GPG LULUCF (2003) forest land is divided in tree categories: Unmanaged forest land, Forest land remaining Forest land and Land converted to Forest land.

Cropland includes arable land and orchards.

Grassland includes meadows and pastures, as well as abandoned managed land and bush land.

Change of dynamics of Forest land, Cropland and Grassland area is shown in Figure 7.1.

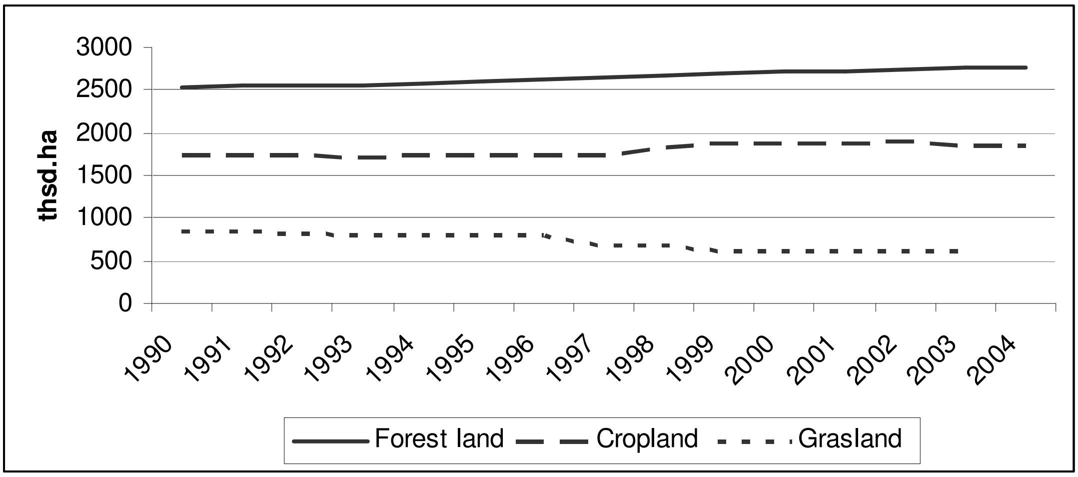


Figure 7.1 Dynamics of Forest land, Cropland and Grassland

Sector overview

The LULUCF sector in Latvia in 2004 is a sink because total sector emissions are smaller as removals (Table 7.1).

Table 7.1 Total CO_2 emissions and removals from LULUCF sector in 1990-2004

	Forest land	Cropland	Grassland	Total
1990	-20666	168	-193	**-20691**
1991	-21236	169	-193	**-21260**
1992	-21663	269	-194	**-21588**
1993	-20812	259	-194	**-20747**
1994	-19847	213	-194	**-19828**
1995	-17469	23	-243	**-17688**
1996	-18678	37	-264	**-18905**
1997	-16431	47	-277	**-16661**
1998	-15254	43	-295	**-15507**
1999	-14404	32	-314	**-14686**
2000	-13875	31	-328	**-14172**
2001	-13892	22	-355	**-14225**
2002	-12848	40	-360	**-13169**
2003	-13371	48	-353	**-13676**
2004	-13605	38	-375	**-13942**

The total GHG emissions from LULUCF sector are shown in the Figure 7.2.

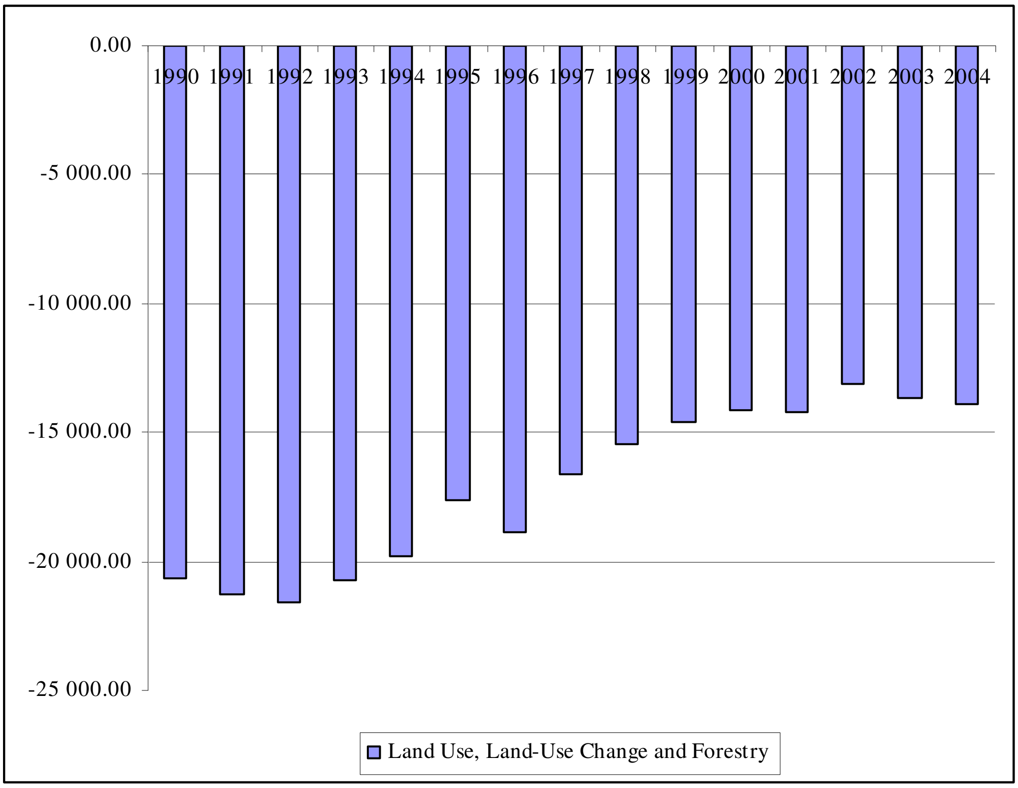


Figure 7.2 Total GHG emissions from LULUCF, Gg CO2 eqv.
(negative figures – GHG removals)

If compared CO_2 removal changes from 1990 and 2004 then CO_2 removals was decreased approximately by 33%.

7.2 Description of Key Source Categories

For the first time were assessed key sources for LULUCF sector according to IPCC GPG LULUCF (2003). For LULUCF were estimated three key sources with respect to level and trend assessment. Forest land is general key source by the level assessment for 2004 with 55%, but regarding trend assessment as second key source with 21%. CO_2 removal from Grassland was assessed as eighth key source regarding level assessment (2%), but seventh as trend assessment (3%).

7.3 Forest Land (CRF 5.A)

Forest land is divided in tree categories: Unmanaged forest land, Forest land remaining Forest land and Land converted to Forest land. Unmanaged forests are strict protected nature reserves. This land area is 13,7 thsd.ha. Unmanaged forest area not changed in period from 1990 year to 2004 unlike of total forest area (Forest land remaining Forest land).

Land converted to forest land is included under Grassland converted to Forest land.

7.3.1 Forest Land remaining Forest Land (CRF 5 A 1)

7.3.1.1 Source category description

Forest land remaining Forest land changes in carbon stock are estimated in 3 pools (above-ground biomass, below-ground biomass and dead wood) on forest areas which have been forest for at least the past 20 years. There is used activity data from Forest statistics and State Forest Register. Two pools – litter and soil organic matter not estimated because of lack of activity data.
This sector covers annual growth carbon uptake increment, which is calculated relating with average annual growth rate per category and carbon release from commercial harvest.

In this sector are shown emissions from on – site burning in the forests.

7.3.1.2 Methodology, activity data and emissions factors

Methods

Changes in carbon stock and GHG emissions are estimated according to IPCC GPG LULUCF. Tier 1 and 2 are used. Method 1 (Default method), which requires the biomass carbon loss to be subtracted from the biomass carbon increment for the reporting year. The following equation is used for change in carbon stock in living biomass:

$$\Delta C_{FF_{LB}} = \left(\Delta C_{FF_G} - \Delta C_{FF_L}\right),$$

where:
$\Delta C_{FF_{LB}}$ - annual change in carbon stocks in living biomass (includes above and belowground biomass) in forest remaining forest land, t C /yr;
ΔC_{FF_G} - annual increase in carbon stocks due to biomass growth, tonnes C /yr;
ΔC_{FF_L} - annual decrease in carbon stock due to biomass loss, tones C/ yr.

CO_2 removals and emissions from burning on - site in the forest were calculated according IPCC GPG LULUCF.

Emission factors and other parameters

Assumptions have been made for calculation are shown in table 7.3.1

Table 7.3.1 Factors and parameters used for calculations of change in carbon stock in living biomass

Basic wood density	0.5 (t dry/m3)
Biomass expansion factor for conversion of merchantable volume to aboveground tree biomass	1.30 (dimensionless)
Root-to-shoot ratio appropriate to increments	0.32 (dimensionless)
Carbon fraction of dry matter	0.5 (t C /t d.m.)

For emission calculation from burning on site in the forest were used default emission factors according IPCC GPG (Table 7.3.2).

Table 7.3.2 Emission factors and ratios for burning

Emission factors for open burning of cleared forests	
CH_4	0.012
CO	0.06
N_2O	0.007
NOx	0.121
Fractions, factors, ratios	
Biomass Oxidised On Site	0.9
Carbon fraction	0.5
Nitrogen Carbon Ratio of Biomass burned	0.01

Amount of slash was assumed as 20.2% from annual cutting volume according national research [10].
The following assumptions have been made for slash calculation, which was burned (Source: State Forest Service):

- Slash on-site burning 50% in period from 1990 to 1999, the rest 50% left to decay;
- In 2000 – slash on-site burning 30% and 70% left to decay.

From the slash burned on-site, 2/3 is actually burned on-site, and 1/3 is gathered by population and used as fuel wood.

Activity data

Activity data are used from Forest statistics (collected by MoA) and State Forest Register (SFS). The data are shown in the Tables 7.3.3 and 7.3.4.

Table 7.3.3 Area of forest land, thsd.ha

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total forest area	2778	2789	2799	2810	2820	2870	2882	2884	2871	2877	2887	2902	2932	2923	2944
Unmanaged forestland	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7	13.7
Forest land remaining forest land	2535.7	2547.3	2558.9	2565.2	2585.5	2605.8	2626.1	2646.4	2666.8	2687.1	2707.4	2727.7	2748.0	2768.3	2763.3
Land converted to forest land	228.7	227.5	226.4	230.6	220.8	250.5	242.2	223.9	190.6	176.2	165.9	160.6	170.3	141.0	167.0

Table 7.3.4 Timber Harvesting Volume (m^3)

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
5000	4400	4000	4800	5700	6900	6800	8900	10000	10800	11000	11200	12200	11700	10800

7.3.2 Land use Changes to and from Forest Land (CRF 5A2 and 5B2.1, 5C, 5D2.1, 5E2.1, 5F2.1)

Forest area is increasing due to natural factors favouring forest growth (soils, climatic conditions, and human activities), less land used for farming, and more forests established on abandoned managed land (mainly grassland).

7.3.2.1 Source category description

Land use change to forest land changes in carbon stock are estimated in 2 pools (above-ground biomass, below-ground biomass) on forest areas which is younger as 20 years.
This sector covers annual growth carbon uptake increment, which is calculated relating with average annual growth rate per category. There no estimated carbon release from commercial harvest because it is not allowed in this age.

7.3.2.2 Methodology, activity data and emissions factors

Methods

IPCC GPG LULUCF (2003) Method 1 (Default method), which requires the biomass carbon loss to be subtracted from the biomass carbon increment for the reporting year, is used.

Emission factors and other parameters

Following assumptions have been made for calculation:
- basic wood density – 0.5 (t dry/m3);
- biomass expansion factor for conversion of merchantable volume to aboveground tree biomass – 1.30 (dimensionless);
- root-to-shoot ratio appropriate to increments – 0.32 (dimensionless);
- carbon fraction of dry matter – 0.5 (t C /t d.m.)

Activity data

Activity data is used from Forest statistics (collected by MoA) and State Forest Register (SFS).

7.4 Cropland (5 B)

7.4.1 Source category description

Under category Grassland is included CO_2 removals from Orchards and consist 60.48 Gg C and 221.76 CO_2 Gg in 2004. CO_2 emissions are released from agricultural soils during different management practices and liming of agricultural soils. In submission 2006 are include emissions only from organic soils witch were 70.6 Gg C in 2004. Emissions from agricultural liming were 0.26 Gg C in 2004.

7.4.2 Methodology, activity data and emissions factors

Methods

CO_2 removals from orchards were calculated according to IPCC GPG LULUCF (2003).
CO_2 emissions from cropland remaining cropland were calculated using IPCC GPG LULUCF (2003).
Emissions from organic soils are calculated using equation 3.3.5 (IPCC GPG LULUCF 2003):

$$\Delta C_{ccOrganic} = \sum c\ (A \times EF)_c$$

where
$\Delta C_{ccOrganic}$ – CO_2 emissions from cultivated organic soils in cropland remaining cropland, tonnes C yr^{-1}
A – land area, ha
EF – emission factor, tonnes C ha^{-1} yr^{-1}

The amount of carbon released is converted to CO_2 by multiplying with 44/12

CO_2 emissions from liming have been calculated using IPCC GPG LULUCF (2003). In inventory was included data about limestone (CaCO3). Carbon is converted to CO2 by multiplying with 44/12.

Emission factors and other parameters

For CO_2 emission calculation regarding organic soils and agricultural lime application were used default emissions factors and rate (Table 7.4.1) from IPCC GPG (2003).

Table 7.4.1 Fractions and emission factors

Annual loss rate for Upland crops (Mg/ha/yr)	1.0
C conversion factor for Limestone $Ca(CO_3)$	0.12
Annual emission factor for cultivated organic soils	1 tonnes C ha^{-1} yr^{-1}

Activity data

Activity data regarding total cropland and orchards area (Table 7.4.2) were obtained from State Land Service and information from MoA.

Table 7.4.2 Area of orchards

1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
73,5	73,5	46,2	50,4	63,0	65,1	65,1	63,0	63,0	60,9	60,6	61,1	61,2	60,4	60,5

Activity data about limestone was obtained from CSB (Table 7.4.3). The used lime very fluctuated as it is shown in the Table 7.4.3. The fluctuation could be related due to farms submitted information to CSB.

Table 7.4.3 Limes used per ha of area treated

90-95	1996	1997	1998	1999	2000	2001	2002	2003	2004
3.5	3.1	1.2	1.9	2	3.3	6.1	10.2	13.9	2.9

The development of the area estimate for organic soils for period 1990 – 2004 is described in Chapter 6 Agriculture.

7.5 Grassland (CRF 5.C)

7.5.1 Source category description

This source category includes CO_2 removals and emissions from grassland remaining grassland.
There are presented CO_2 removals from bush land and abandoned managed land, and CO_2 emissions from cultivated organic soils and emissions from burning of last year's grass.

More than 500 thsd.ha of abandoned managed land is in Latvia. These lands (mainly grasslands) naturally become overgrown with trees and bushes. CO_2 emissions/removals from category Grassland remaining grassland consist 374.51Gg in 2004.

7.5.2 Methodology, activity data and emissions factors

Methods

For CO_2 removals calculation was used IPCC GPG LULUCF (2003).
CO_2 emissions regarding cultivated organic soils and burning were determined according to IPCC GPG LULUCF (2003) too.

Emission factors and other parameters

Average annual growth rate 2 ths.dry/ha/year was used for CO_2 removal calculation.

For organic soils the default emission factor of IPCC (IPCC GPG LULUCF 2003 Table 3.4.6) 0.25 t C/ha/yr for grassland was used.

Emission factors for emission calculation regarding burning of last year's grass (g/kg dry matter combusted) are shown in the Table 7.5.1 (IPCC GPG LULUCF 2003).

Table 7.5.1 Default emission factors for emission calculation related burning of last year's grass

CO_2	1498
CO	59
CH_4	2
NOx	4
N_2O	0.1

Mass of available fuel is used as 4100 kg d.m. ha $^{-1}$according to IPCC GPG LULUCF (2003). Fraction of the biomass combusted, dimensionless is used 0.5 according to IPCC GPG LULUCF (2003).

Activity data

Activity data regarding bush land and abandoned area were obtained from State Land Service and information from MA.

Area of burning of last year's grass from SFRS (Table 7.5.2) and data are available started from 1993.

Table 7.5.2 Area of last years grass

Year	Area, ha
1993	20.9802
1994	98.083
1995	525.9604
1996	1224.2331
1997	576.146
1998	1254.8425
1999	2685.3597
2000	2261.5262
2001	4800.3708
2002	11547.4701
2003	14335.0432
2004	6717.027
Total	**46047.0422**

7.6 Recalculations

Recalculations were done for all years due to:

- Emissions/Removals was calculated by MoA according NIS;
- Change of carbon stock at category forest land remaining forest land is calculated in three pools – aboveground biomass, belowground biomass and dead wood;
- Change of carbon stock first time is calculated from biomass change in orchards;
- Emissions from burning of last year's grass were included started from 1993 when appeared such actions.

7.7 Further improvements

The necessary improvements are:

- Improvement of activity data according IPCC GPG LULUCF;
- Researches on default emission factors given in the IPCC GPG, for adaptation to Latvia's circumstances;
- Uncertainties analyses regarding this sector;
- QC/QA implementation.

8 WASTE (CRF 6)

8.1 Overview of sector

General overview

Waste management has acquired priory significance in the environmental protection policy as one of the instruments for sustainable use of natural resources. In fact, waste means lost materials and energy and it shows how efficiently the public uses resources, stock and materials. The legislation in the waste sector has been harmonized in conformity with the requirements of the European Union (EU) environmental legislation. The main directions in the waste management are the development of a common waste registration system, the construction of polygons for municipal waste and the development of system for the collection and treatment of hazardous waste. At the moment four non-hazardous waste polygons and one polygon for hazardous waste asbestos got A category permit according IPPC directive. According to Latvian Waste management plan for 2006-2012 there will be 11 waste polygons in Latvia.

Sector overview

Main data sources for GHG emissions calculations in waste sector are "3-Wastes" and "2-Water" databases.

Data on hazardous waste in Latvia have been collected and compiled by LEGMA since 1997, but data on municipal waste since 2001. Until then the waste volume was determined on the basis of separate pilot projects implemented in the biggest cities in the middle of 90-ies and on the basis of the assessment and projections by waste management experts. Since year 2002 data bases about hazardous and municipal wastes are combined in one database "3-Wastes". Data in this database are taken from State Statistical survey about wastes, which occurs annually. Statistical survey about wastes must fill all enterprises, which have permits on pullulating activities (A and B category, and in which C acknowledgement is obligation to report on wastes) and all enterprises, which have permits on waste management operations. To estimate disposed waste amounts in preliminary years; data about population and Gross domestic product (GDP) are taken from CSB.

"2-Water" database is developed by LEGMA also. Data of wastewater treatment and discharge have been collected since 1991 in the frame of state statistical survey "2 – Water". However, for calculation of the emission data about population from CSB were used as activity data.

Due to recalculation and methodology changes for this submission, GHG emissions from waste sector have been increase since year 1990. Emissions in year 2004 are by 15,33 % higher than in year 1990. Emissions from the waste sector were 787,40 CO_2 equivalent Gg in 2004, its contribute about 7,3% of total GHG emissions in 2004.

Total emissions from Waste sector are shown in Figure 8.1.

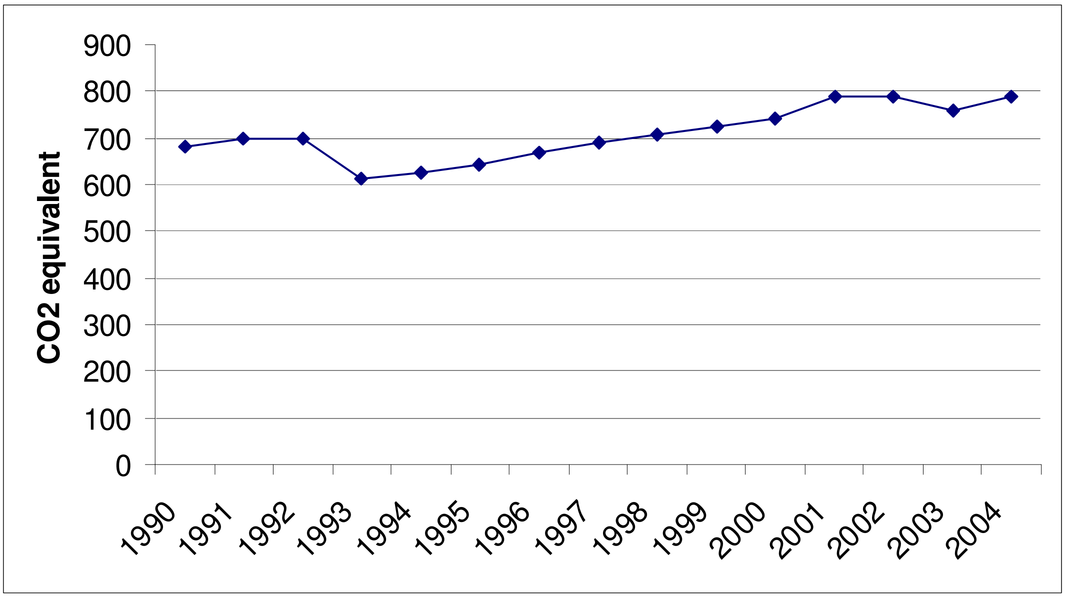


Figure 8.1 Total emissions from waste sector in CO_2 equivalent (Gg)

Emissions from solid waste disposal (SWD) and wastewater handling (WWH) in year 1990 do not have big difference. In year 1993 methane collection from wastewaters was started and emissions from wastewaters decrease. Every year emissions from waste disposal on land increased equable, because First Order Decay (Tier2) method for calculations is used and methane collection and recovery in landfills is not well developed. Emissions from waste incineration (WI) are very small in comparison with other sectors (Figure 8.2).

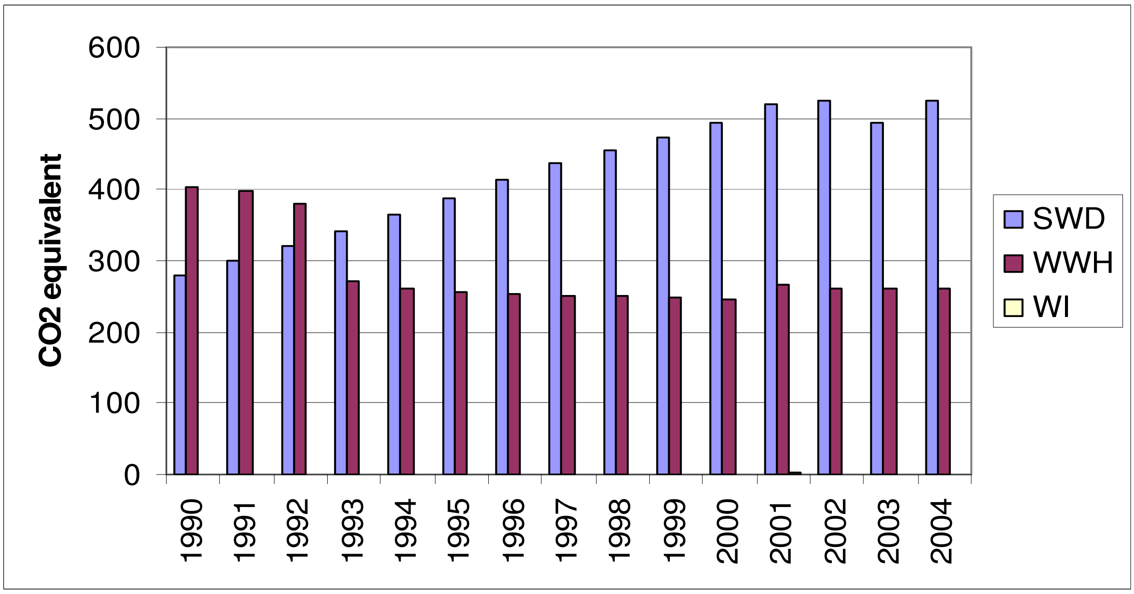


Figure 8.2 Emissions from sectors in CO_2 equivalent (Gg)

According to the information from LEGMA the total generated volume of waste are shown in Table 8.1.

Table 8.1 Generated wastes in Latvia (Gg)

Year	Municipal wastes	Hazardous wastes	Total
2001	1102,6	82,13	1184,73
2002	1147	72,26	1219,26
2003	1257	25,77	1282,77
2004	1136,7	27,49	1164,19

Volume of hazardous waste generated in Latvia is decreasing. To a great extent it has been influenced by the legislative changes in the Waste sector, particularly, by setting strict criteria for waste classification. Amount of municipal waste do not show big difference in last four years.

To properly evaluate CH_4 emissions from wastewater according the IPCC methodology and Good Practice Guidance, the project *Wastewater Management in Latvia and the Formation of Methane* (2003) was worked out. Equation for calculation is given in section 8.4.2.

N_2O is emitted as the release from sewage purification system and waste incineration. N_2O emissions are estimated only from wastewater treatment plants releases, because N_2O emissions from waste incineration are not possible to estimate without direct measurements. In Latvia that kind of measurements in waste incineration facilities are not done. Incinerated wastes were classified like clinical and hazardous (industrial) wastes. IPCC good practice guidance 1996 and EMEP/CORINAIR methodology do not provide useful factors for N_2O emission calculation.

Data on CO_2 emissions from waste incineration were available only starting year 1999. Methodology used is presented in section 8.5.2. Calculation of indirect GHG emissions from cremation is shown in section 8.5.3.

8.2 Description of key source categories

According to level assessment in year 2004, when LULUCF not included, CH_4 emissions from solid waste disposal on land (5%) and wastewater handling (2%) are the key sources in waste sector. If LULUCF is included, then key source only is CH_4 emissions from solid waste disposal on land (2%)

According to trend assessment in year 2004, when LULUCF not included, CH_4 emissions from solid waste disposal on land (7%) and wastewater handling (1%) are the key sources in waste sector. If LULUCF is included, then key source is CH_4 emissions from solid waste disposal on land (4%).

8.3 Solid Waste Disposal on Land (CRF 6.A)

8.3.1 Description of source categories

To estimate CH_4 emissions with First Order Decay (Tier2) method from landfills, time series for disposed waste amounts till year 1970 was developed. Disposed amounts for years 1970 – 1989 were estimated taking into account population and Grand domestic product (GDP). These values were compared with base year (1990) values and time series was developed for disposed amounts. Landfills from 1970 – 1979 are estimated as uncategorised, from 1980 – 1989 landfills estimated as 50% - uncategorised and 50% - managed. Since year 1990 all waste disposal sites are estimated as managed sites, because waste levelling taking place in Latvia's landfills. Some small landfills do not have waste levelling in these years, but waste amount, which are disposed in these landfills, are very small. All calculations are done for unsorted wastes, because waste composition is hard to estimate for previous years.

Data from Regional Environmental Boards for years 1989-1990 and from the project *Municipal Solid Waste Management Strategy for Latvia 1998-2010* (1997) were used. According to information, which is received from Regional environmental boards (REB), number of waste disposal sites decreased from 558 in year 1997 to 148 in 2004. Disposed amount and landfill type for years 1990 – 2000 are expert estimation. Data about waste disposal on land for years 2001 - 2004 are taken from database "3-Wastes". Data comparison between "3-Wastes" and REB delivered information was done. Difference was only within 10%.

According to Waste management plan 2003 – 2012, in Latvia will be only 11 waste disposing polygons, all other waste disposal sites are planned to close. When this plan will be realized, data collection about disposed municipal wastes amounts and its composition will become more accurate. Disposed waste amounts in Latvia are shown in Figure 8.3.

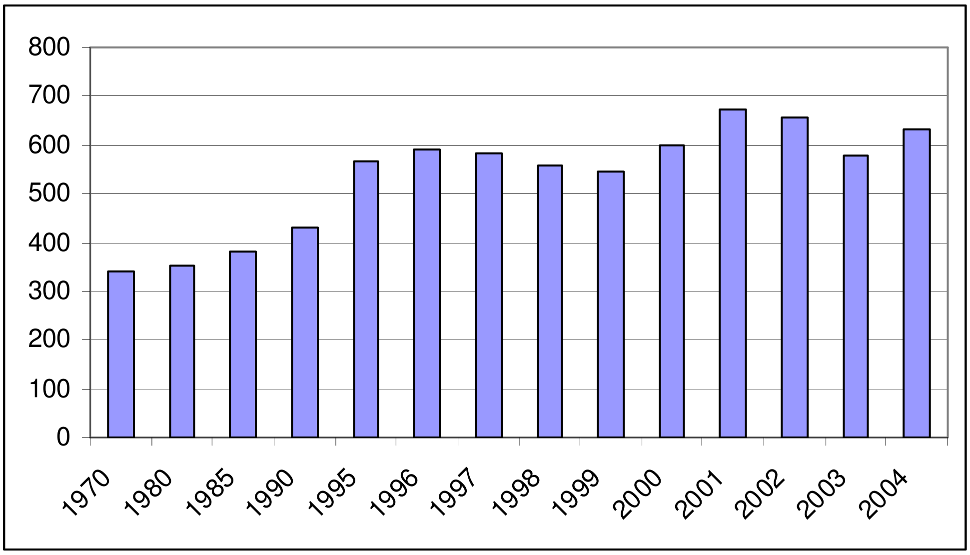


Figure 8.3 Disposed waste amounts in Latvia (Gg)

Since October 2002 CH_4 recovery from landfills are in progress. For year 2004 only in two waste polygons (Getlini EKO, Skede) CH_4 recovery was realised. 2,57 Gg of CH_4 was recovered. According to Latvia's Waste Management plan 2003-2012, CH_4 recovery from landfills is one of priorities. CH_4 emissions from waste landfilling are presented in Figure 8.4.

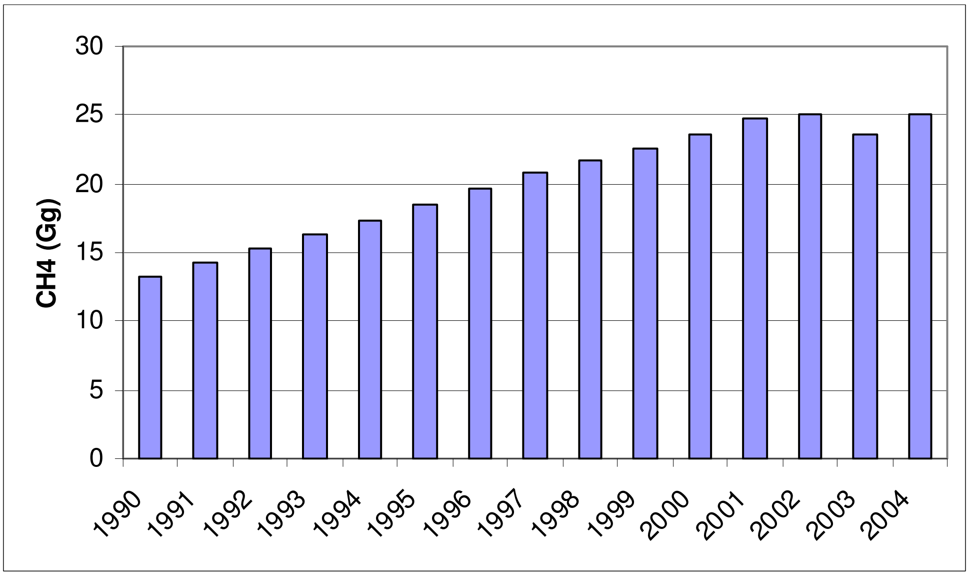


Figure 8.4 CH_4 emissions from waste landfilling (Gg)

8.3.2 Methods, activity data and emissions factors

Methods and emissions factors

IPCC Tier 2.method is used for CH_4 emissions calculation.
It based on equations:

$$Lo\ CH_{4\ potential\ emission} = MSW_L \times MCF \times DOC \times DOC_F \times F \times 16/12$$

$$CH_{4\,RE\,(t)} = \sum_n (L_{on} * (e^{-k(t-(x-1)-1)} - e^{-k(t-(x-1))}))$$

$$CH4_{year\ emission\ (t)} = [CH4_{RE(t)} - R_{(t)}] \times (1 - OX)$$

where:
Lo – potential annual methane emission (Gg);
MSW_L - annual MSW landfilled (Gg);
MCF – CH4 correction factor, depend of waste disposal site type;
Managed sites – 1
Uncategorised – 0,6
DOC – degradable organic carbon (0,18);
DOC_F – fraction of DOC dissimilated (0,6);
F – fraction of CH_4 landfill gas (0,5);
R – recovered CH_4 (Gg);
$CH4_{RE}$ – methane real emission;
k- methane generation coefficient (1/y) (0,05);
x – calculation starting year;
n – number of years, when calculations are started;
t – inventory year.

All emissions factors are default factors from IPCC guidelines, because Latvia hasn't national emission factors.

Uncertainties

Emission factors uncertainty is estimated as 15 %. It is calculate from IPPC default uncertainties for many factors, which are used in methane emissions calculations.
Uncertainty for activity data is estimate as 20 %.

8.4 Wastewater Handling (CRF 6.B)

8.4.1 Description of source categories

LEGMA data show that 211 million m³ of wastewater in year 2004 was released, from which 133 million m³ were treated by different wastewater treatment plants, ~90% from which were biological plants.

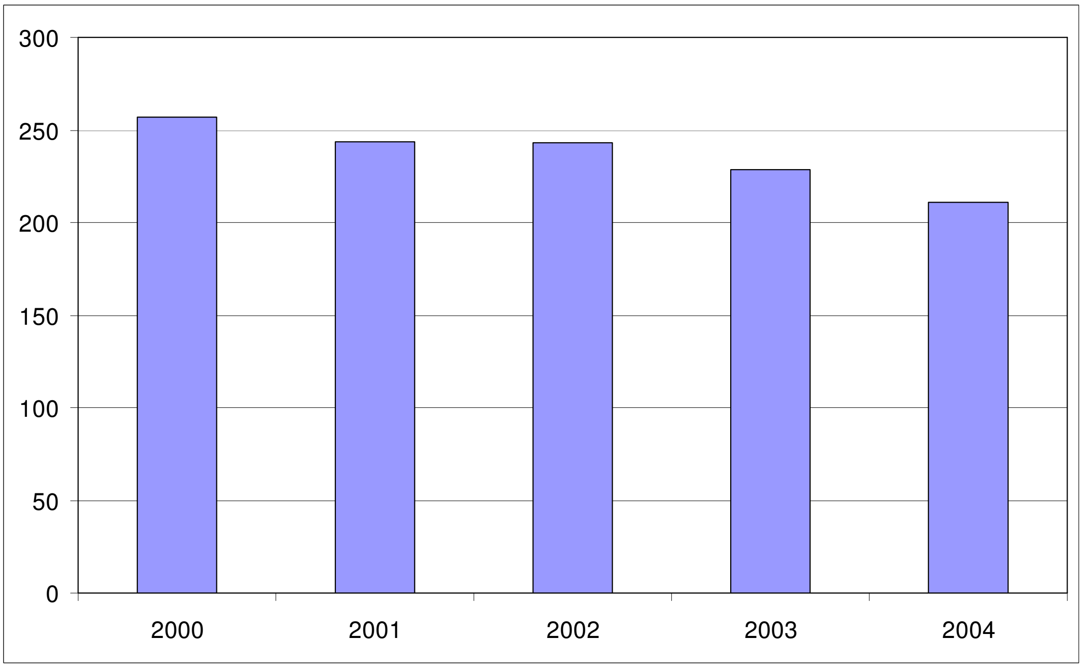


Figure 8.5 Amount of discharged wastewater in last five years (mio m^3)

In most cases municipal wastewaters are treated in aerobe systems in Latvia. Because of Latvia's climate sludge fields produce negligent amounts of methane (CH_4), therefore calculations of CH_4 emissions from municipal wastewater sludge were not carried out [13]. The only place in Latvia where sludge is treated anaerobically is in Riga wastewater treatment facilities UWWTP "Daugavgriva", where three methane tanks are in operation with the total volume of 12000 m^3. All biogas produced (~12000 m^3 per day) is burned in a cogeneration facility, producing heat and electricity.

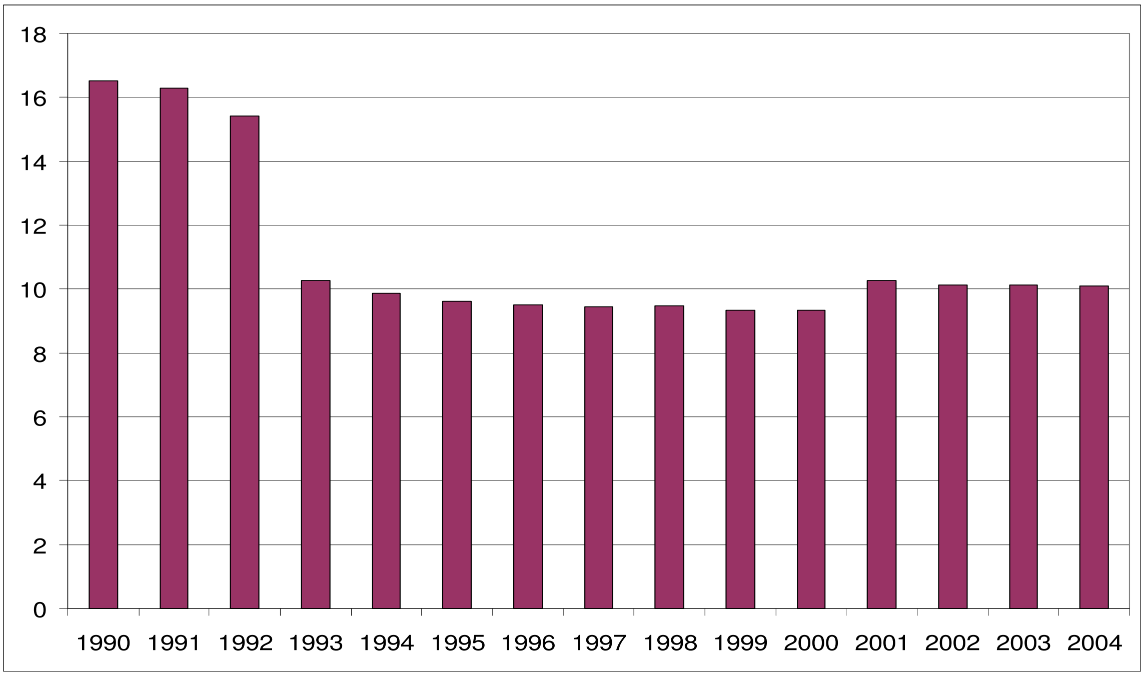


Figure 8.6 Emissions of methane from wastewater handling (total), Gg

The calculations regarding industrial wastewater in this report do not take into consideration the wastewater of facilities that release their wastewater into the municipal wastewater treatment plants. Only CH_4 emissions released from the industrial associations or company's local wastewater treatment was being calculated.

8.4.2 Methods, emission factors, activity data and uncertainties

Methods and emissions factors

To calculate CH_4 emissions from wastewater treatment, the control equation offered by IPCC was used:

$$WM = P \times D \times SBF \times EF \times EF \times FTA \times 365 \times 10^{-12},$$

where
WM – total CH_4 emissions from municipal wastewater in one year, Tg;
P – number of residents; P = 2.32 million;
D – organic load (BOD); D = 60 g BOD/person;
SBF –easily degradable part of BOD; SBF = 0.5;
EF – emission factor; EF = 0.6 g CH_4/g BOD;
FTA – anaerobically degradable part of BOD; FTA = 0.8.

$$WM = 2.32 \times 10^{6} \times 60 \times 0.5 \times 0.6 \times 0.8 \times 365 \times 10^{-12} = 0.0122 \text{ (Tg)}$$

Wastewater from Riga and partly from Jurmala is treated by UWWTP "Daugavgriva", and methane is collected as a biogas as mentioned above. Therefore emissions have to be decreased due to recovery of methane generated from waste water in Riga (with 0,65 mio inhabitants connected to treatment plant), and thus:

$$WM = 0.0122 - 0.65 \times 10^{6} \times 60 \times 0.5 \times 0.6 \times 0.8 \times 365 \times 10^{-12} = 0.0088 \text{ (Tg)}$$

A small amount of N_2O is emitted during the release from the sewage system. The calculations employ total protein use of 0.075 kg per resident per day, or 27.375 kg per resident per year. This number was acquired from expert data at the Latvian Food Centre.

Uncertainties

The following uncertainties were used for Wastewater Handling sector.

Table 8.2 Uncertainties for Wastewater handling sector

Emission	Activity data	Emission factor
CH_4	2%*	10%**
N_2O	2%*	10%**
CO_2	-	-

* 2% - frame uncertainty of CSB;
**10% - default uncertainty from guidelines.

8.5 Waste Incineration (CRF 6.C)

8.5.1 Description of source categories

Data on amount of waste incinerated in Latvia can be found in databases that are created and maintained by LEGMA. Data on hazardous waste incineration are available starting 1999. In the hazardous waste data base there is a separate entry for years 1997-2001 on the amount of incinerated waste. Starting 2002 the database also contains entries for recovery (R) and disposal (D) of waste, which is consistent with the EU legislation.

Currently there are no large amounts of waste being incinerated in Latvia. The main source of emissions is attributed to the hazardous and clinical waste incineration. The amounts of incinerated clinical waste are registered in the hazardous waste database (from year 2002 in "3-Waste" data base) as *Health service for humans and animals as well as related research waste*. All hospitals are reporting in this entry, so it is impossible to accurately separate medical waste from incinerated bodies and body parts burned locally in the hospital furnaces. There are approximate data available on Riga crematorium (see section 8.5.3), and calculations of its emissions are being made in accordance with the CORINAIR methodology. The rest of the incinerated waste from hazardous waste database is considered as hazardous (industrial) wastes. In year 2001 large increase of emissions are shown, because one enterprise reported huge amount of incinerated wastes, but aother year's amount is much smaller. CO_2 emissions from waste incineration are presented in Figure 8.7.

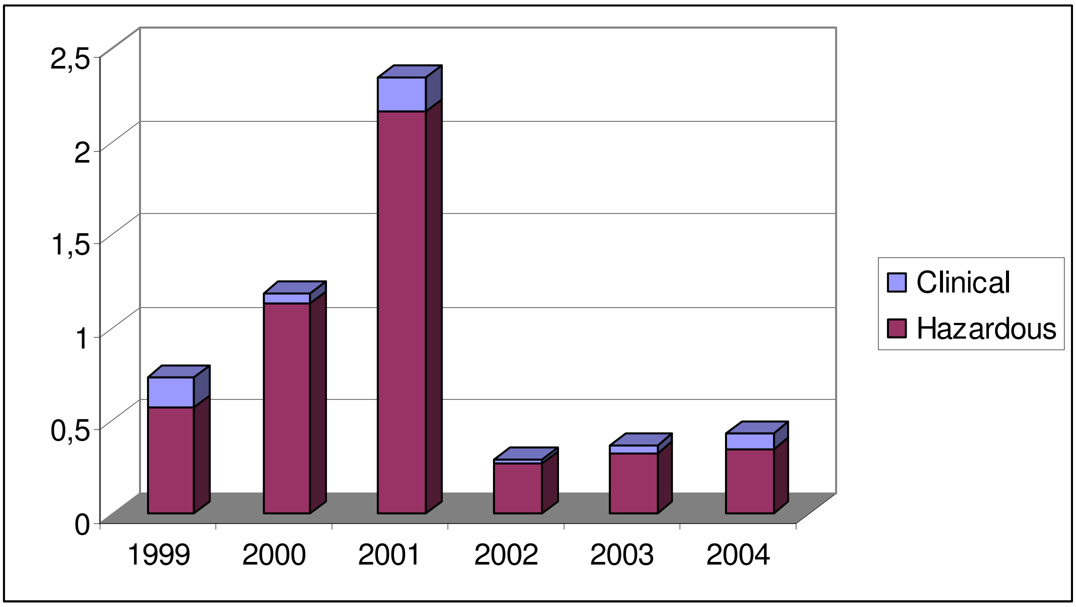


Figure 8.7 CO_2 emissions from waste incineration by waste type (Gg)

8.5.2 Methods, emission factors, activity data and uncertainties

Methods

According to the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* emissions of CO_2 and N_2O have to be calculated from the waste incineration. CH_4 emissions are negligible, and they are not calculated. Usually CO_2 emissions are substantially larger than emissions of N_2O. Emissions from waste incineration without energy production are considered under the Waste sector, while emissions from waste incineration with energy production are considered under the Energy sector. Waste amounts, which are incinerated with energy recovery, are much higher than incinerated without energy recovery. Emissions from waste incineration without energy recovery are very small.

CO_2 emissions were calculated using following IPCC equation:

$$\mathbf{CO_{2\,emissions} = \Sigma_i[\ IW_{ix} \times CCW_i \times FCF_i \times EF_i \times 44/12\ ]\ Gg/year,}$$

where:

i = solid municipal waste (hazardous waste, medical waste, wastewater sludge);
IW_i = amounts of type i waste incinerated. (Gg/year);
CCW_i = carbon contents in the type i waste;
FCF_i = fossil carbon contents in the type i waste;
EF_i = effectiveness of incineration of type i waste;
44/12 = conversion of C into CO_2.

Emission factors

There are no national factors for carbon and fossil carbon amounts in each type of waste, therefore default factors from the *IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories* were used (Table 8.3).

Table 8.3 Default factors for CO_2 emission calculation

	Solid household waste	Sewage sludge	Clinical waste	Hazardous waste
C contents in waste	33-50% of waste. (wet) default: 40%	10-40% of algae (dry) default:30%	50-70% of waste. (dry) default:60%	1-95% of waste. (wet) default:50%
Fossil C contents in waste	30-50% default:40%	0%	30-50% default:40%	90-100% default:90%
Incineration effectiveness	95-99% default: 95%	95%	50-99,5% default:95%	95-99.5% default:99.5%

N_2O emissions from waste incineration are not possible to estimate without direct measurements. In Latvia that kind of measurements in waste incineration facilities are not done. Some facilities are closed, which operated in past years. Incinerated wastes are defined like clinical and hazardous (industrial) wastes. IPCC GPG 2000 and EMEP/CORINAIR methodology do not provide useful factors for N_2O emission calculation.

Activity data

The calculations and results of calculations are given in table 8.4.

Table 8.4 CO_2 emissions from waste incineration

Year	Type of waste	Calculation of emission (Gg)
1999	Hazardous	CO_2 = 0.350 x 0.5 x 0.9 x 0.995 x 44/12 = **0.570** 0.350 – amount of incinerated hazardous waste
	Clinical	CO_2 = 0.201 x 0.6 x 0.4 x 0.95 x 44/12 = **0.168** 0.201 – amount of incinerated clinical waste
	Total in 1999	**0.738**
2000	Hazardous	CO_2 = 0.690 x 0.5 x 0.9 x 0.995 x 44/12 =**1.133** 0.690 – amount of incinerated hazardous waste
	Clinical	CO_2 = 0.056 x 0.6 x 0.4 x 0.95 x 44/12 = **0.047** 0.056 – amount of incinerated clinical waste
	Total in 2000	**1.180**
2001	Hazardous	CO_2 = 1.320 x 0.5 x 0.9 x 0.995 x 44/12 = **2.166** 1.320 – amount of incinerated hazardous waste
	Clinical	CO_2 = 0.213 x 0.6 x 0.4 x 0.95 x 44/12 = **0.178** 0.213 – amount of incinerated clinical waste
	Total in 2001	**2.344**
2002	Hazardous	CO_2 = 0.165 x 0.5 x 0.9 x 0.995 x 44/12 = **0.272** 0.165 – amount of incinerated hazardous waste
	Clinical	CO_2 = 0.032 x 0.6 x 0.4 x 0.95 x 44/12 = **0.027** 0.032 – amount of incinerated clinical waste
	Total in 2002	**0.299**
2003	Hazardous	CO_2 = 0.202 x 0.5 x 0.9 x 0.995 x 44/12 = **0.331** 0.202 – amount of incinerated hazardous waste
	Clinical	CO_2 = 0.040 x 0.6 x 0.4 x 0.95 x 44/12 = **0.034** 0.040 – amount of incinerated clinical waste
	Total 2003	**0,365**
2004	Hazardous	CO_2 = 0.210 x 0.5 x 0.9 x 0.995 x 44/12 = **0.345** 0.210 – amount of incinerated hazardous waste
	Clinical	CO_2 = 0.112 x 0.6 x 0.4 x 0.95 x 44/12 = **0.094** 0.112 – amount of incinerated clinical waste
	Total 2004	**0.439**

Uncertainties

Emission factors uncertainty is estimated as 50 %, because no correct information on carbon content in incinerated wastes is known. Uncertainty for activity data is estimate as 20 %.

8.5.3 Cremation

If data were available on amounts of bodies incinerated in crematoriums, it would be possible to calculate specific emissions using IPCC factors in the Cremation sub-sector. In Latvia the only working crematorium, as stated in the project *Inventory of Dioxin and Furan Releases in Latvia* (2002), is crematorium in Riga. The crematorium is being under operation since December 22nd, 1994, on average 1500 to 2000 bodies being incinerated every year. The main gases emitted during cremation are SO_x, NO_x, CO, and NMVOC, and all of them have to be reported in the IPCC inventory. These amounts are counted in incinerated Biogenic waste sector. Calculations were based on emission factors given by the EMEP/CORINAIR methodology.

GHG emissions from cremation were calculated by multiplying the number of bodies incinerated with the corresponding emission factor. Only the average number of bodies incinerated in the years 1995 - 2004 in Riga crematorium is available (assumed to be 1750), therefore emissions are identical for these years:

$$SO_{x\ emissions} = 1750 \times 6{,}364 \times 10^{-2} kg/body = 111{,}37\ kg \Rightarrow 0{,}000111\ Gg$$
$$NO_{x\ emissions} = 1750 \times 4{,}552 \times 10^{-1} kg/body = 796{,}6\ kg \Rightarrow 0{,}000797\ Gg$$
$$CO_{emissions} = 1750 \times 2{,}121 \times 10^{-1} kg/body = 371{,}175\ kg \Rightarrow 0{,}000371\ Gg$$
$$NMVOC_{emissions} = 1750 \times 1{,}30 \times 10^{-2} kg/body = 22{,}75\ kg \Rightarrow 0{,}000022\ Gg$$

8.6 Recalculations

Recalculations in activity data for waste disposal and incineration were made to the previous submissions.

In waste disposal sector landfill classification till year 1990 are changed from unmanaged sites to uncategorised and managed. Previous expert estimation was not correct, because biggest landfills were managed in that time. Other landfills are estimated like uncategorised, because inventory agency do not have feasible information about old small landfills profiles. Some corrections are done in disposed amounts for all inventory years (1990-2004). Now data about disposed amounts must be similar to data, which are reported to EUROSTAT and European Environment agency. First time First Order Decay (Tier2) method is used for methane calculation and emissions decrease in all years considerably.

In wastewater sector information about industrial wastewater output by branches and generation of domestic and commercial wastewater are added. Emissions from municipal waste water treatment of previous (starting from 2000 till 2004) years were recalculated due to concretisation of activity data on methane recovery in UWWTP "Daugavgriva".

In waste incineration sector all amounts are recalculated starting year 1999, because in previous submissions part of waste incineration with energy recovery was counted in waste sector. Incinerated amounts are decrease substantially.

8.7 Further improvements

The databases are becoming more complete with each year, thus improving the quality of data and consequently the precision of calculated emissions from incineration and disposing of waste. Data on waste incineration are only available starting 1999, since that is the year when incinerated amounts are registered in hazardous waste database. In the future database data will continue to be available, and starting 2002 the databases about wastes are combined in one waste database. Till year 2012 Latvia is planning to close or rebuild all old landfills and for waste disposing only 11 polygons will be used, then data collection and interpretation about wastes disposing became more easily.

Implementation of the *Waste Management Strategy* and plans related to this Strategy will be of great significance in further increase of reliability and quality of data.

9. RECALCULATIONS AND IMPROVEMENTS

The details of the recalculations can be found under the sectoral chapter. The latest recalculations were made on January – March 2006, because some advises were taken into account from Centralized review (2005/2006) as well due to, changing approach for emission calculation for some sectors, sub – sectors; some activity data in the some sectors and sub – sectors; emission factors, ratio or some assumptions.

Other general improvements made to the inventory

The latest centralised review (2004/2005) encouraged that Latvia need to provide more information about national emission factors and assumptions. In the current NIR this request has been taken into account for all sectors.

The planed improvements

Detailed information about planed improvements is described in the sectoral chapters. LEGMA will plan during 2006 implement QA/QC.

10. IDENTIFIED PROBLEMS OF PREPARING OF SUBMISSION IN THE CRF REPORTER

Main problems of working with CRF Reporter came up during import / export process and data exchange between Sector Experts and National Inventory Compiler.

During import process from Sector Expert computer to National Inventory Compiler computer software changed data in that sectors where data were not imported, for example, if data from Energy sector were imported data in Industrial Processes changed.

Biggest problems occurred in Industrial Processes sub-sector 2.F Consumption of Halocarbons and SF_6 where new gas is added in vertical structure of CRF Excel tables not in horizontal table structure as in other sectors. After new gas was added and all cells were filled sub-sector still were not marked as complete with green traffic light in bubble in navigation tree.

Also during data exchange between Sector Expert worked with Industrial Processes sector and National Inventory Compiler attention mark that some values had cyclic dependencies appeared. It was cleared up that this problem appeared with newly added gases in 2.F Consumption of Halocarbons and SF_6 sub-sector 2.IIA.F.1.2 Commercial Refrigeration. Attention mark that some unfilled cells are left appeared also during importing processes of data from Sector Expert to

National Inventory compiler. This problem concerned to newly added gases in 2.F Consumption of Halocarbons and SF_6 sub-sector 2.IIA.F.1.2 Commercial Refrigeration. But Completeness Check did not showed some unfilled cells. And careful view in this sub-sector data did not present mistakes. But it was not possible to finish importing process for this sector so Sector Expert had to make all changes in 2.F Consumption of Halocarbons and SF_6 sector straight to National Inventory Compiler computer.

Also some discrepancies in sectoral structure appeared in 2.F Consumption of Halocarbons and SF_6 sub-sector 2.F.1 Refrigeration and Air Conditioning equipment. There is some difference in Latvia reported data and data finds in CRF Reporter database – HFC-134a data of refrigeration and air conditioning equipment. Latvia reported 8.62 t HFC – 134a consumption, but 8.60 t of consumption is finding in CRF Reporter. As it was mentioned the CRF Reporter does not allow adding sub-categories under Domestic Refrigeration. This is why Ice cellar emissions do not exist in database.

There is no possibility to change unit of activity data for 3.D.5 Other (please specify) to "number of population". Emissions reported in this sub-sector are estimated in view of number of population. So activity data for this sub-sector were reported as "kt" although unit of activity data is other.

Submission in 15.04.2006 is done by the CRF Reporter updated version 2.30. XML file and CRF tables were generated with updated CRF Reporter software.

Problem of ghost categories appeared in Other sub-sector of Mineral industry sector (2.A.7). These ghost categories contained data that were taken account in calculation of total emissions so total emissions for years in time period 2000 – 2003 were calculated wrong for about 2 Gg too much. This problem is fixed in the CRF Reporter update 2.30.

During update and recalculation process of database some data and notation keys were lost so National Inventory Compiler had to check all sub-sectors again and correct all missing and lost data. Also some information about methods and emission factors used in estimations were changed from T1 to T2 for methods or CS to PS for emission factor. But empty cells of methods and emission factors used did not show up after running a completeness check so it was very hard to find empty values.

In sector Manure Management (CRF 4.B) software did not estimate implied emission factor for CH4 emissions although activity data and emissions data were input. For newest version of CRF Reporter – the CRF Reporter update 2.30, this problem is fixed.

Some sub-sectors missed in Cropland remaining Cropland sub-sector of LULUCF sector – Biomass burning sub-sector did not showed up in navigation tree and structure but this sector was included in formulas that calculated all emissions. So software presented that sub-sector is not completed because all cells of structure of formula were not filled. This problem also is fixed in the CRF Reporter update 2.30.

Total national emission table generated from CRF Reporter software shows one more mistake. Data from previous submission are given without LULUCF sector data but data of for the latest submission are given with LULUCF sector. So changes between these two submissions are much too large.

Attention window that object did not recognize this method or property showed up during preparing of official submission process so it was problematic to prepare submission.

One more mistake showed up in CRF Reporter Recalculation tables (Table 8) – data of total emissions in previous submissions did not match with data of submission 2005 sent to Secretariat of UNFCCC in April 2005. Discrepancy for about 0.35 – 6.75 Gg of CO_2 emissions occurred in sub-sector 2.A Mineral Products of Sector 2 Industrial Sector. This discrepancy occurred in all years in time series 1990 – 2003, except for year 1991 where these data match.

Data of Sector 5 Land Use, Land-Use Change and Forestry from CRF Reporter from submission 2006 and data from Excel tables from submission 2005 could not be compared due to changes in classification and sectoral structure of this sector.

ABBREVIATIONS

CRF – Common Reporting Format
CSB – Central Statistical Bureau of Latvia
UN – United Nations
FEWE – Polish Foundation for Energy Efficiency
EMEP/CORINAIR – Atmospheric emission inventory guidebook, Co-operative Programme for Monitoring and Evaluation od the Long Range Transmission of Air Pollutants in Europe, The Core inventory of air emissions in Europe
OECD - Organisation for Economic Co-operation and Development
IPCC – Intergovernmental Panel on Climate Change
LULUCF – Land Use, Land Use Change and Forestry
NIR – National inventory report
UNFCCC – United Nations Framework Convention on Climate Change
GHG – Greenhouse Gases
RTSD – Road Traffic Safety Department
MoE - Ministry of Environment
MoTC - Ministry of Transport and Communications
MoA - Ministry of Agriculture
SFS – State Forest Service
NCV – Net calorific value
LEGMA – Latvian Environment, Geology and Meteorology Agency
IPCC 1996 – Revised 1996 IPCC Guidelines for National Greenhouse gas Inventories (1996)
IPCC GPG 2000 - IPCC Good Practice Guidance and Uncertainty Management in National Greenhouse Gas Inventories (2000)
IPCC GPG LULUCF (2003) – IPCC Good Practice Guidance for land Use, Land – Use Change and Forestry
REB – Regional Environment Boards
LSIAE – Latvian State Institute of Agrarian Economics
SFRS – State Fire fighting & Rescue Service

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ANNEX 1

KEY SOURCE ANALYSES FOR 1990 WITH AND WITHOUT LULUCF AND FOR 2004 WITH LULUCF

Table 1 Key sources – Level assessment in 1990 without LULUCF

IPCC Source Categories	Direct GHG	Base year 1990, CO2-eqv.	% Level Assessment	% Cumulative Total
CO_2 Emissions from Stationary Combustion-oil	CO_2	7384,1	0,29	0,29
CO_2 Emissions from Stationary Combustion-gas	CO_2	5679,9	0,22	0,51
CO_2 Emissions from Stationary Combustion-coal	CO_2	2535,4	0,10	0,61
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	2057,2	0,08	0,69
Mobile Combustion: Road Vehicles	CO_2	1947,7	0,08	0,77
Emissions from Agricultural Soils	Direct-N_2O	1658,3	0,06	0,83
Emissions from Nitrogen Used in Agriculture	Indirect-N_2O	1033,9	0,04	0,87
Emissions from Manure Management	N_2O	551,6	0,02	0,89
Mobile Combustion: Railways	CO_2	525,6	0,02	0,91
Emissions from Wastewater Handling	CH_4	346,9	0,01	0,93
Emissions from Cement Production	CO_2	345,9	0,01	0,94
Emissions from Manure Management	CH_4	279,5	0,01	0,95

Table 2 Key sources – Level assessment in 1990 with LULUCF

IPCC Source Categories	Direct GHG	Base year 1990, CO2-eq	% Level Assessment	% Cumulative Total
Removals from Forest Land	CO_2	-20666,28	0,44	0,44
CO_2 Emissions from Stationary Combustion-oil	CO_2	7384,15	0,16	0,60
CO_2 Emissions from Stationary Combustion-gas	CO_2	5679,91	0,12	0,72
CO_2 Emissions from Stationary Combustion-coal	CO_2	2535,37	0,05	0,78
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	2057,23	0,04	0,82
Mobile Combustion: Road Vehicles	CO_2	1947,67	0,04	0,86
Emissions from Agricultural Soils	Direct-N_2O	1658,35	0,04	0,90
Emissions from Nitrogen Used in Agriculture	Indirect-N_2O	1033,87	0,02	0,92
Emissions from Manure Management	N_2O	551,63	0,01	0,93
Mobile Combustion: Railways	CO_2	525,64	0,01	0,94
Emissions from Wastewater Handling	CH_4	346,92	0,01	0,95

Table 5 Key sources –Level Assessment in 2004 without LULUCF

IPCC Source Categories	Direct GHG	2004, CO_2-eqv.	% Level Assessment	% Cumulative Total
CO_2 Emissions from Stationary Combustion-gas	CO_2	3090,88	0,29	0,29
Mobile Combustion: Road Vehicles	CO_2	2491,79	0,24	0,53
CO_2 Emissions from Stationary Combustion-oil	CO_2	1025,13	0,10	0,62
Emissions from Agricultural Soils	Direct-N_2O	681,70	0,06	0,69
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	561,78	0,0531	0,74
Emissions from Solid Waste Disposal Sites	CH_4	525,26	0,0496	0,79
Emissions from Nitrogen Used in Agriculture	Indirect-N_2O	281,21	0,03	0,82
Non-CO_2 Emissions from Stationary Combustion-biomass	CH_4	265,32	0,03	0,84
Mobile Combustion: Railways	CO_2	255,04	0,02	0,87
CO2 Emissions from Stationary Combustion-coal	CO_2	243,03	0,02	0,89
Emissions from Wastewater Handling	CH_4	212,10	0,02	0,91
Emissions from Manure Management	N_2O	152,12	0,01	0,92
Emissions from Cement Production	CO_2	144,38	0,01	0,94
Fugitive Emissions from Oil and Gas Operations	CH4	130,47	0,01	0,95

Table 7 Key source – Trend Assessment in 2004 without LULUCF

IPCC Source Categories	Direct GHG	Base year 1990	2004	Level Assessment	Trend Assessment	% Contribution to Trend	Cumulative Total
CO_2 Emissions from Stationary Combustion-oil	CO_2	7384,15	1025,13	0,10	0,46	0,29	0,29
Mobile Combustion: Road Vehicles	CO_2	1947,67	2491,79	0,24	0,39	0,25	0,54
CO_2 Emissions from Stationary Combustion-coal	CO_2	2535,37	243,03	0,02	0,18	0,12	0,66
CO_2 Emissions from Stationary Combustion-gas	CO_2	5679,91	3090,88	0,29	0,17	0,11	0,77
Emissions from Solid Waste Disposal Sites	CH_4	278,67	525,26	0,05	0,09	0,06	0,82
Emissions from Enteric fermentation in Domestic Livestock's	CH_4	2057,23	561,78	0,05	0,07	0,04	0,87
Non- CO_2 Emissions from Stationary Combustion-biomass	CH_4	161,93	265,32	0,03	0,05	0,03	0,90
Emissions from Nitrogen Used in Agriculture	Indirect-N_2O	1033,87	281,21	0,03	0,03	0,02	0,92
Emissions from Manure Management	N_2O	551,63	152,12	0,01	0,02	0,01	0,93
Emissions from Wastewater Handling	CH_4	346,92	212,10	0,02	0,02	0,01	0,94
Non- CO_2 Emissions from Stationary Combustion-biomass	N_2O	34,10	71,20	0,01	0,01	0,01	0,95
Mobile Combustion: Road Vehicles	N_2O	13,75	52,24	0,00	0,01	0,01	0,95

ANNEX 2

UNCERTAINTIES

Table 1 The uncertainties in CO_2 emissions

IPCC Source Categories (LULUCF not included)	Base Year (1990) Estimate,	Current Year (2004) Estimate,	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2004	Uncertainty in trend in national emissions introduced by emissions factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
	Gg CO_2-eq	Gg CO_2-eq	%	%	%	%	%	%	%
Emissions from Stationary Combustion-oil	7390,24	1025,76	2%	5%	5%	0,73%	-0,53%	0,16%	0,55%
Emissions from Stationary Combustion-coal	2701,76	242,74	2%	5%	5%	0,17%	-0,23%	0,04%	0,23%
Emissions from Stationary Combustion-gas	5433,73	3090,88	2%	5%	5%	2,21%	0,24%	0,47%	0,53%
Emissions from Stationary Combustion-other fuels	NO	38,16	2%	50%	50%	0,25%	0,10%	0,01%	0,10%
Mobile Combustion: Road Vehicles	1947,673	2591,795	10%	5%	11%	3,84%	0,48%	1,97%	2,03%
Mobile Combustion: Waterborne Navigation	17,459	44,161	50%	5%	50%	0,29%	0,01%	0,17%	0,17%
Mobile Combustion: Aircraft	0,066	2,333	2%	5%	5%	0,00%	0,00%	0,00%	0,00%
Mobile Combustion: Railways	525,636	255,042	2%	5%	5%	0,18%	0,01%	0,04%	0,04%
Emissions from Cement Production	345,91	144,38	2%	2%	3%	0,05%	0,00%	0,02%	0,02%
Emissions from Lime Production	125,17	3,04	2%	2%		0,00%			
Emissions from Asphalt Roofing	0,008	0,009	70%	70%	99%	0,00%	0,00%	0,00%	0,00%
Emissions from Road Paving with Asphalt	9,6	11,82	70%	70%	99%	0,16%	0,03%	0,06%	0,07%
Emissions from other mineral products	0,352	37,15	2%	10%	10%	0,05%	0,02%	0,01%	0,02%
Emissions from the Iron and Steel Industry	44,19	47,17	2%	2%	3%	0,02%	0,00%	0,01%	0,01%
Emissions from Solvent and other product use	55,69	49,12	25%	50%	56%	0,36%	0,07%	0,09%	0,12%
Emissions from Waste Incineration	0,74	0,44	20%	50%	54%	0,00%	0,00%	0,00%	0,00%

Table 2 The uncertainties in CH_4 emissions

IPCC Source Categories (LULUCF not included)	Base Year (1990) Estimate,	Current Year (2004) Estimate,	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2004	Uncertainty in trend in national emissions introduced by emissions factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
	Gg CO_2-eq	Gg CO_2-eq	%	%	%	%	%	%	%
Emissions from Stationary Combustion-oil	12,42	2,32	2%	50%	50%	0,06%	-0,06%	0,00%	0,06%
Emissions from Stationary Combustion-coal	55,39	5,81	2%	50%	50%	0,14%	-0,32%	0,00%	0,32%
Emissions from Stationary Combustion-gas	4,38	3,08	2%	50%	50%	0,08%	0,01%	0,00%	0,01%
Emissions from Stationary Combustion-biomass	161,93	265,32	15%	50%	52%	6,85%	2,38%	1,51%	2,82%
Emissions from Stationary Combustion-other fuels	0,00	0,02	2%	60%	60%	0,00%	0,00%	0,00%	0,00%
Mobile Combustion: Road Vehicles	13,976	14,589	10%	40%	41%	0,30%	0,08%	0,06%	0,09%
Mobile Combustion: Waterborne Navigation	0,038	0,079	50%	10%	51%	0,00%	0,00%	0,00%	0,00%
Mobile Combustion: Aircraft	0,000	0,000	2%	10%	10%	0,00%	0,00%	0,00%	0,00%
Mobile Combustion: Railways	0,626	0,305	2%	10%	10%	0,00%	0,00%	0,00%	0,00%
Fugitive Emissions from Oil and Gas Operations	274,05	130,473	2%	2%	3%	0,18%	-0,01%	0,10%	0,10%
Emissions from the Iron and Steel Industry	0,003	0,003	2%	10%	10%	0,00%	0,00%	0,00%	0,00%
Emissions from Enteric fermentation in Domestic Livestock	2057,23	561,78	2%	40%	40%	11,13%	-5,88%	0,43%	5,89%
Emissions from Manure Management	279,518	82,871	2%	30%	30%	1,23%	-0,55%	0,06%	0,55%
Emissions from Solid Waste Disposal Sites	278.88	579.18	20%	15%	25%	7.8%	1,9%	4,7%	5,1%
Emissions from Wastewater Handling	346,99	212,1	2%	10%	10%	1,07%	0,07%	0,16%	0,17%

Table 3 The uncertainties in N_2O emissions

IPCC Source Categories (LULUCF not included)	Base Year (1990) Estimate,	Current Year (2004) Estimate,	Activity data uncertainty	Emission factor uncertainty	Combined uncertainty	Combined uncertainty as % of total national emissions in year 2004	Uncertainty in trend in national emissions introduced by emissions factor uncertainty	Uncertainty in trend in national emissions introduced by activity data uncertainty	Uncertainty introduced into the trend in total national emissions
	Gg CO_2-eq	Gg CO_2-eq	%	%	%	%	%	%	%
Emissions from Stationary Combustion-oil	19,43	2,75	2%	50%	50%	0,10%	-0,07%	0,00%	0,07%
Emissions from Stationary Combustion-coal	14,93	1,20	2%	50%	50%	0,05%	-0,07%	0,00%	0,07%
Emissions from Stationary Combustion-gas	3,02	1,72	2%	50%	50%	0,06%	0,01%	0,00%	0,01%
Emissions from Stationary Combustion-biomass	34,10	71,20	15%	50%	52%	2,78%	0,84%	0,44%	0,95%
Emissions from Stationary Combustion-other fuels	0,00	0,01	2%	60%	60%	0,00%	0,00%	0,00%	0,00%
Mobile Combustion: Road Vehicles	13,749	52,241	10%	50%	51%	1,99%	0,68%	0,21%	0,71%
Mobile Combustion: Waterborne Navigation	1,990	5,237	50%	10%	51%	0,20%	0,01%	0,11%	0,11%
Mobile Combustion: Aircraft	0,001	0,020	2%	10%	10%	0,00%	0,00%	0,00%	0,00%
Mobile Combustion: Railways	63,674	30,876	2%	10%	10%	0,24%	0,02%	0,03%	0,03%
Emissions from Solvent and other product use	4,53	6,2	2%	2%	3%	0,01%	0,00%	0,01%	0,01%
Emissions from Manure Management	551,629	152,124	40%	30%	50%	5,69%	-0,53%	2,49%	2,55%
Emissions from Agricultural Soils	1658,35	681,70	40%	25%	47%	24,07%	0,29%	11,17%	11,18%
Emissions from Nitrogen Used in Agriculture	1033,87	281,21	30%	40%	50%	10,52%	-1,37%	3,46%	3,72%
Emissions from Wastewater Handling	56,978	49,6	2%	50%	50%	1,86%	0,40%	0,04%	0,40%

ANNEX 3

DIRECT GHG EMISSION TRENDS 1990-2004

Table 1 CO_2 emissions and sinks per sector (Gg)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
1. Energy	**18 016.57**	**15 962.14**	**12 991.12**	**11 742.00**	**9 735.95**	**8 594.06**	**8 855.61**	**8 287.41**	**7 904.06**	**7 256.89**	**6 667.69**	**7 151.82**	**7 060.01**	**7 198.20**	**7190.87**
A. Fuel Combustion (Sectoral Approach)	18 016.57	15 962.14	12 991.12	11 742.00	9 735.95	8 594.06	8 855.61	8 287.41	7 904.06	7 256.89	6 667.69	7 151.82	7 060.01	7 198.20	7 290.87
1. Energy Industries	8 591.32	7 653.01	5 706.79	5 347.61	3 648.00	3 302.18	3 452.85	3 240.85	3 317.23	2 912.29	2 452.88	2 406.38	2 321.71	2 267.09	2 088.20
2. Manufacturing Industries and Construction	3 710.82	2 872.40	2 270.43	1 698.65	2 200.19	2 068.97	2 028.55	1 882.85	1 567.60	1 412.15	1 186.04	1 109.17	1 120.24	1 110.17	1 066.12
3. Transport	2 490.83	1 739.44	1 628.47	2 024.11	1 799.93	1 897.49	2 062.45	2 047.91	2 023.50	1 991.48	2 201.48	2 591.34	2 586.49	2 704.68	2 793.33
4. Other Sectors	3 223.60	3 697.30	3 385.43	2 671.63	2 087.83	1 325.43	1 311.77	1 115.79	995.73	940.97	827.29	1 044.93	1 031.58	1 116.27	1 243.22
2. Industrial Processes	**525.23**	**359.16**	**161.22**	**61.82**	**202.20**	**166.69**	**182.36**	**204.10**	**208.22**	**246.95**	**192.23**	**209.28**	**223.04**	**229.86**	**244.82**
A. Mineral Products	481.04	348.17	155.66	41.84	169.56	139.58	156.72	159.72	160.91	201.18	147.92	165.75	180.25	187.00	197.64
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Production	44.19	10.99	5.56	19.98	32.65	27.11	25.64	44.38	47.31	45.78	45.49	44.49	44.52	44.16	47.18
3. Solvent and Other Product Use	**55.70**	**51.46**	**49.14**	**46.18**	**45.26**	**41.64**	**43.16**	**43.54**	**44.41**	**45.19**	**45.91**	**46.73**	**47.46**	**48.13**	**49.12**
5. Land Use, Land-Use Change and Forestry(2)	**-20 691.05**	**-21 260.49**	**-21 587.62**	**-20 746.86**	**-19 827.82**	**-17 688.29**	**-18 905.29**	**-16 660.74**	**-15 506.79**	**-14 685.67**	**-14 171.86**	**-14 225.39**	**-13 169.08**	**-13 676.12**	**-13 941.70**
6. Waste	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**0.74**	**1.18**	**2.34**	**0.30**	**0.37**	**0.44**
Total CO2 emissions including net CO2 from LULUCF (3)	**-2 093.54**	**-4 887.72**	**-8 386.14**	**-8 896.86**	**-9 844.40**	**-8 885.90**	**-9 824.16**	**-8 125.69**	**-7 350.09**	**-7 135.90**	**-7 263.66**	**-6 814.26**	**-5 836.55**	**-6 198.26**	**-6 357.17**
Total CO2 emissions excluding net CO2 from LULUCF (3)	**18 597.50**	**16 372.77**	**13 201.48**	**11 850.00**	**9 983.42**	**8 802.39**	**9 081.13**	**8 535.05**	**8 156.70**	**7 549.77**	**6 908.20**	**7 411.14**	**7 332.53**	**7 477.85**	**7 584.53**

Table 2 CH_4 emissions per sector (Gg)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total CH4 emissions	**166.87**	**164.27**	**139.51**	**100.82**	**97.76**	**97.31**	**95.50**	**93.18**	**90.71**	**86.61**	**85.61**	**89.02**	**89.61**	**85.02**	**87.50**
1. Energy	24.90	25.58	19.10	18.50	23.30	22.87	22.86	21.58	21.22	20.73	19.41	20.24	20.35	18.37	20.09
A. Fuel Combustion (Sectoral Approach)	11.85	13.01	7.64	7.54	12.59	12.44	12.81	12.20	12.22	12.15	11.47	12.54	12.32	12.09	13.88
1. Energy Industries	0.30	0.28	0.31	0.33	0.22	0.21	0.24	0.30	0.32	0.28	0.28	0.27	0.30	0.32	0.30
2. Manufacturing Industries and Construction	0.36	0.24	0.24	0.17	0.24	0.36	0.41	0.39	0.35	0.33	0.31	0.34	0.36	0.38	0.33
3. Transport	0.70	0.42	0.40	0.61	0.60	0.57	0.59	0.57	0.55	0.54	0.52	0.59	0.61	0.67	0.71
4. Other Sectors	10.49	12.07	6.68	6.43	11.54	11.31	11.57	10.94	11.00	11.00	10.36	11.34	11.06	10.72	12.53
B. Fugitive Emissions from Fuels	13.05	12.57	11.46	10.96	10.71	10.43	10.05	9.38	9.00	8.58	7.94	7.70	8.03	6.28	6.21
2. Oil and Natural Gas	13.05	12.57	11.46	10.96	10.71	10.43	10.05	9.38	9.00	8.58	7.94	7.70	8.03	6.28	6.21
2. Industrial Processes	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
4. Agriculture	**111.27**	**107.11**	**88.77**	**54.60**	**45.79**	**44.61**	**41.79**	**39.19**	**35.86**	**31.35**	**30.60**	**32.07**	**32.31**	**31.21**	**30.70**
A. Enteric Fermentation	97.96	94.64	79.27	48.88	40.61	39.31	37.02	34.72	31.67	27.52	26.88	28.08	28.20	27.20	26.75
B. Manure Management	13.31	12.47	9.50	5.72	5.17	5.30	4.77	4.47	4.19	3.83	3.73	3.99	4.11	4.01	3.95
5. Land Use, Land-Use Change and Forestry	**0.90**	**1.06**	**0.97**	**1.15**	**1.39**	**1.67**	**1.64**	**2.17**	**2.44**	**2.62**	**2.68**	**1.65**	**1.82**	**1.76**	**1.59**
6. Waste	**29.80**	**30.52**	**30.67**	**26.57**	**27.27**	**28.16**	**29.21**	**30.24**	**31.20**	**31.90**	**32.92**	**35.06**	**35.13**	**33.68**	**35.11**

Table 3 N_2O emissions per sectors (Gg)

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Total N_2O emissions	**12.30**	**11.43**	**8.90**	**6.46**	**5.68**	**4.44**	**4.55**	**4.59**	**4.41**	**4.07**	**4.12**	**4.54**	**4.50**	**4.73**	**4.64**
1. Energy	**0.49**	**0.47**	**0.37**	**0.35**	**0.37**	**0.39**	**0.43**	**0.44**	**0.44**	**0.42**	**0.42**	**0.48**	**0.48**	**0.50**	**0.53**
A. Fuel Combustion (Sectoral Approach)	0.49	0.47	0.37	0.35	0.37	0.39	0.43	0.44	0.44	0.42	0.42	0.48	0.48	0.50	0.53
1. Energy Industries	0.05	0.05	0.05	0.05	0.04	0.03	0.04	0.04	0.05	0.04	0.04	0.04	0.04	0.04	0.04
2. Manufacturing Industries and Construction	0.04	0.02	0.02	0.02	0.03	0.05	0.05	0.05	0.04	0.04	0.04	0.04	0.04	0.04	0.04
3. Transport	0.26	0.24	0.20	0.20	0.15	0.16	0.18	0.20	0.20	0.19	0.21	0.25	0.25	0.27	0.29
4. Other Sectors	0.14	0.16	0.10	0.08	0.15	0.15	0.16	0.15	0.15	0.15	0.14	0.15	0.15	0.15	0.17
3. Solvent and Other Product Use	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**NE,NO**	**0.01**	**0.02**	**0.02**	**0.01**	**0.01**	**0.01**	**0.03**	**0.02**	**0.02**	**0.02**
4. Agriculture	**11.62**	**10.78**	**8.34**	**5.93**	**5.13**	**3.85**	**3.92**	**3.95**	**3.77**	**3.45**	**3.50**	**3.86**	**3.83**	**4.04**	**3.92**
B. Manure Management	1.78	1.71	1.37	0.85	0.73	0.70	0.67	0.63	0.58	0.51	0.50	0.53	0.54	0.52	0.49
D. Agricultural Soils	9.84	9.07	6.98	5.07	4.40	3.14	3.25	3.32	3.19	2.93	3.00	3.33	3.29	3.52	3.43
5. Land Use, Land-Use Change and Forestry	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.02**	**0.02**	**0.02**	**0.01**	**0.01**	**0.01**	**0.01**
6. Waste	**0.18**	**0.18**	**0.18**	**0.18**	**0.18**	**0.17**	**0.17**	**0.17**	**0.17**	**0.17**	**0.16**	**0.16**	**0.16**	**0.16**	**0.16**
B. Waste-water Handling	0.18	0.18	0.18	0.18	0.18	0.17	0.17	0.17	0.17	0.17	0.16	0.16	0.16	0.16	0.16

Table 4 Actual HFCs and SF_6 emissions per sectors

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Emissions of HFCs - (Gg CO_2 equivalent)	**0.95**	**1.30**	**2.42**	**4.42**	**6.74**	**8.78**	**10.29**	**11.82**	**12.86**	**16.19**
HFC-23	NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0.00	0.00	0.00	0.00	NA,NO
HFC-32	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	0.00
HFC-125	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	0.00
HFC-134	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO	NA,NO
HFC-134a	0.00	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01
HFC-143a	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	0.00
HFC-227ea	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	NA,NE,NO	0.00	0.00	0.00	0.00
Emissions of SF_6 - (Gg CO_2 equivalent)	**0.25**	**0.29**	**0.51**	**0.71**	**0.98**	**1.28**	**1.98**	**3.38**	**4.41**	**4.82**
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

ANNEX 4

ACTIVITY DATA AND EMISSION FACTORE RELATED ENERGY SECTOR

TABLE 3 SO_2 emission factors per fuel type

Fuel	Sulphur content											EF (Gg/PJ)									
	1990-95	1996	1997	1998	1999	2000	2001	2002	2003	2004	NCV	1990-95	1996	1997	1998	1999	2000	2001	2002	2003	2004
Diesel	0.3	0.3	0.3	0.3	0.3	0.035	0.035	0.035	0.035	0.035	42.49	0.141	0.141	0.141	0.141	0.141	0.016	0.016	0.016	0.016	0.016
RFO	2.0	2.0	2.0	2.0	2.0	1.0	1.0	1.0	1.0	1.0	40.6	0.966	0.966	0.966	0.966	0.966	0.483	0.483	0.483	0.483	0.483
Gasoline	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	0.015	43.97	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007	0.007
Jet fuel	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	43.2	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023
Coal	1.8	1.8	1.20	1.19	1.18	1.12	1.12	0.82	0.68	0.66	26.22	1.236	1.236	0.825	0.820	0.807	0.770	0.769	0.564	0.467	0.454
Coke	1.8	1.8	1.20	1.19	1.18	1.12	1.12	0.82	0.68	0.66	26.79	1.209	1.209	0.808	0.802	0.790	0.753	0.753	0.552	0.457	0.444
Shale oil	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	39.35	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508	0.508
Peat	0.3	0.3	0.24	0.21	0.21	0.21	0.21	0.27	0.25	0.24	10.05	0.507	0.507	0.411	0.359	0.362	0.355	0.364	0.456	0.419	0.412

Notes:
Gasoline – due to legislation
Shale oil – average amount from database Nr. 2-Air
Peat – average amount from database Nr. 2-Air
Coal – average amount from database Nr. 2-Air and additional calculated average amount by periods
Diesel oil (transport) – due to legislation

TABLE 2 Fuel consumption by fuel type in Road transport sector in 1990 - 2004 (TJ)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004
Gasoline	24171	13452	12950	20014	19517	17984	17589	16181	15214	14687	13407	15260	15342	16289	17425
Diesel oil	2249	2700	3230	2497	1552	4237	6799	7861	8711	9093	11460	15935	14202	14961	14898
LPG	592	501	251	105	91	91	91	91	137	273	865	865	865	956	1047

ENERGOBALANCE 2004 (TJ)

sectors	**oil Products**	motor petrol	kerosene	jet fuel	diesel oil	residuel fuel oil	LPG	white spirit	paraffin waxes	used oils	petroleum coke	other oil products	oil bitumen	lubricants	**coal**	shale oil	used tires	**natural gas**	peat	coke oven coke	fuelwood	**heat energy**	**hydro energy***	**electricity**
NCV		44.00	43.20	43.20	42.49	40.60	45.54	41.86	41.86	29.23	32.98	40.60	41.86	41.86	**26.22**	39.35		**33.66**	10.05	26.37	6.70	**3.60**	**3.60**	**3.60**
Production of primary energy resources	42													42					130		77834		11369	
Recycled products	88									88							314							
Import	79168	18380	129	4753	32972	8445	2960	126	1046	409	989	126	2093	6740	2491	118		73042		161	60			9839
Export	14034	3342			2124	8120	364							84							20314			2290
Bunkering	8465				3187	5278																		
Interproduct transfer	-338		-129	-2636		8120								-5693										
Stock changes	448			-43	-85	568	-91		84		99		-84		78			-17066	-40	27	-215			
Statistical differences	690	308			382																			
Gross energy - total	**57599**	**15346**		**2074**	**27958**	**3735**	**2505**	**126**	**1130**	**497**	**1088**	**126**	**2009**	**1005**	**2569**	**118**	**314**	**55976**	**90**	**188**	**57365**		**11369**	**7549**
Transformation sector	2810				**43**	**2679**				**88**					**288**			**33896**	**60**		**12991**	**31093**		**5512**
Public CHP	1096					1096												21745			1420	14389		5224
Public heat plants	1633				43	1502				88					183			9863	60		6881	12917		
Autoproducers CHP																		741			47	428		288
Autoproducers heat plants	81					81									105			1548			4643	3359		
Energy sector**	415				212	203									26			875	10		268	1195		1789
Losses	46						46											538	10			5317		3186
Final consumption:	**54328**	**15346**		**2074**	**27703**	**853**	**2459**	**126**	**1130**	**409**	**1088**	**126**	**2009**	**1005**	**2255**	**118**	**314**	**20667**	**10**	**188**	**44106**	**24581**	**11369**	**19455**
Industry	**4029**	**44**			**850**	**366**	**91**	**126**	**1130**	**292**	**1088**	**42**			**184**	**118**	**314**	**11814**	**10**	**188**	**7437**	**558**		**5565**
Transport:	**40748**	**15038**		**2031**	**21627**		**1047**							**1005**				**68**						**501**
Air	2031			2031																				
Road	35233	15038			18143		1047							1005				**68**						281
Railways	3484				3484																			137
Pipelines																								83
Other sectors:	**9551**	**264**		**43**	**5226**	**487**	**1321**			**117**		**84**	**2009**		**2071**			**8785**			**36669**	**24023**		**13389**
Agriculture / forestry / fishery	2201	44			1954	203									52			909			657	119		583
Construction	2646	44			510	41						42	2009		26			135			375	50		317
Residential	2421	132			1105		1184								787			3972			29145	18119		5281
Other consumers	2283	44		43	1657	243	137			117		42			1206			3770			6492	5735		7208

* Including wind energy
** Energy sector includes consumption of electric energy in power stations, technological consumption in power lines, the consumption in energy sector

ANNEX 5

ACTIVITY DATA AND ASSUMPTION FOR AGRICULTURE SECTOR

Detailed information about AWMS:

In the Research (2005)[18] was reassessed AWMS due to:

- Previously submitted information about AWMS in the Latvia's National Inventory report submitted under the UNFCCC in April 2005;
- IPCC GPD (2003) Guidelines;
- Central Statistical bureau (CSB) data – real situation in the country.

Problems, which were listed in the Research, are following:

- For showing feasible situation was used CSB data base about agricultural structural survey which was made in 2003, but expert admit, that uncertainty could be 25-30%, but this is newest information which are available.

For AWMS determination was done calculations to classify AWMS according IPCC.

Calculation steps:

Step 1:

Amount of livestock was divided by size of farms and was calculated proportion of total amount/number of livestock in the each farm group (Table 1 – Table 4).

Table 1 Proportion of Dairy cows in different farm size

Type of farm	% from number of dairy cows
Farm with 1-2 cows	35,9
Farm with 3-9 cows	27,7
Farm with 10-19 cows	10,1
Farm with 20-49 cows	8,0
Farm with 50-99 cows	4,6
Farm with 100-399 cows	9,9
Farm with 400 and more	3,9
Total:	100,0

Source: CSP data and Latvian State Institute of Agrarian Economics calculations

Table 2 Proportion of Cattle in different farm size

Type of farm	% from number of cattle
Farm with 1-9 cattle	46,5
Farm with 10-49 cattle	27,2
Farm with 50-99 cattle	6,5
Farm with 100-399 cattle	8,8
Farm with 400 and more	11,1
Total:	100,0

Source: CSP data and Latvian State Institute of Agrarian Economics calculations

Table 3 Proportion of Swine in different farm size

Type of farm	% from number of Swine
Farm with 1-9 swine	25,5
Farm with 10-49 swine	14,3
Farm with 50-399 swine	14,6
Farm with 400-999 swine	5,2
Farm with 1000-4999 swine	10,1
Farm with 5000 and more	30,3
Total:	100,0

Source: CSP data and Latvian State Institute of Agrarian Economics calculations

Table 4 Proportion of Poultry in different farm size

Type of farm	% from number of poultry
Farm with 1-99 poultry	24,6
Farm with 100-999 poultry	0,6
Farm with 1000-49999 poultry	3,2
Farm with 50000 and more	71,6
Total:	100,0

Source: CSP data and Latvian State Institute of Agrarian Economics calculations

Step 2:

Was summarized data and different information about types of AWMS and AWMS distribution by group of farms as well as divided proportion when livestock are in the house and when in the pasture range and paddock (Table 5).

Table 5 housing and pasture range and paddock period for livestock, 1990 - 2004

Type of livestock	Amount of days of year	Number of days which is spends in the pasture range and paddock, 1990.-2003.	Pasture range and paddock, %	Housing, %	Number of Days which is spend in the pasture range and paddock,, 2004	Pasture range and paddock, %	Housing, %
Dairy cows	365	145	39,73	60,27	150	41,10	58,90
Other cattle	365	165	45,21	54,79	170	46,58	53,42
Horses	365	185	50,68	49,32	190	52,05	47,95
Sheep, goats	365	155	42,47	57,53	160	43,84	56,16

Source: CSP data and Latvian State Institute of Agrarian Economics calculations

Step 3:

Was calculated AWMS by type of livestock taken into account previously mentioned calculations as well as different available information (expert judgements, researches etc.). The results are shown under sub category Manure Management in the section 6.4. (Table 6.6. and Table 6.7).

Detailed information about calculated average N excretion per head of livestock:

Average N excretion per head of livestock was reassessed in the Research [18] which was made by Latvian State Institute of Agrarian Economics if compared previously submitted. For N excretion calculations was used newest published information of "Centre of Agrochemical researches" on different produced manure amount of livestock type in year and N amount in the manure, which was justly with results of manure analyses (Table 6). For reassessing values of N excretion per head of livestock was used in the Table 6 shown information, information from Research [14] previously submitted as well as IPCC Guidelines.

Table 6 Additional standards for manure of livestock type

Livestock and holding way	Type of manure	Extraction in year, t	N in natural manure, kg/t	N /year /from manure, kg
Dairy cows, milk yield, 3500-5000 kg, all-round floor	Solid storage ad dry lot	10,5	4,1	43,1
Dairy cows, milk yield, 5000-6000 kg, all-round floor	Solid storage ad dry lot	12,5	4,4	55,0
Dairy cows, milk yield, 6000 kg, all-round floor	Solid storage ad dry lot	13,7	3,3	45,2
Dairy cows, milk yield 7600 kg, rack floor	Partly liquid	18,2	3,1	56,4
Heifer (until 6 month), all-round floor	Solid storage ad dry lot	2,6	3,7	9,6
Heifer (6 month and older), all-round floor	Solid storage ad dry lot	8,0	3,4	27,2
Feedlot stock (heifer and bull), deep byre	Solid storage ad dry lot	11,1	3,8	42,2
Bulls for meet (feed with distiller's grain), all-round floor	liquid	16,0	3,7	59,2
Cows, calf for, all-round floor	Solid storage ad dry lot	12,0	3,4	40,8
Breeding bulls, all-round floor	Solid storage ad dry lot	13,0	4,3	55,9
Feedlot swine (30 –100 kg), all-round floor, rack floor (partial)	Solid storage ad dry lot	0,5	7,1	3,6
	liquid	1,0	4,9	4,9
Pregnant sow, all-round floor, rack floor (partial)	Solid storage ad dry lot	1,4	7,1	9,9
	liquid	2,8	4,6	12,9
Suckling sow, all-round floor, rack floor (partial)	Solid storage ad dry lot	1,5	5,4	8,1
	liquid	2,5	3,1	7,8
Weanling (7,5-30 kg), all-round floor, rack floor (partial)	Solid storage ad dry lot	0,06	6,4	0,4
	liquid	0,1	3,8	0,4
Boar, all-round floor	Solid storage ad dry lot	1,5	2,6	3,9
Goats with yeanling, all-round floor	Solid storage ad dry lot	1,5	6,3	9,5
Sheep with yeanling, deep farm	Solid storage ad dry lot	1,3	7,4	9,6
Horses, all-round floor	Solid storage ad dry lot	8,0	5,2	41,6
Broiler	Solid storage ad dry lot	0,02	21,7	0,43
Lying hen, cage		0,05	15,9	0,80
Lying hen, cage	liquid	0,10	6,4	0,64

Source: Timbare, 2002 and Latvian State Institute of Agrarian Economics calculations